COMPUTER • AUTOMOTIVE • RADIO • DISCO • TEST GEAR

ELECTRONICS

The Maplin Magazine

Britain's Best Selling Electronics Magazine

No. 100

FULL SOR

APRIL 1996 • £2.25

Printed in the United Kingdom

Maplin proudly present – the 100th issue!

Ni-Cd Battery Charger – prolongs the life of valuable batteries

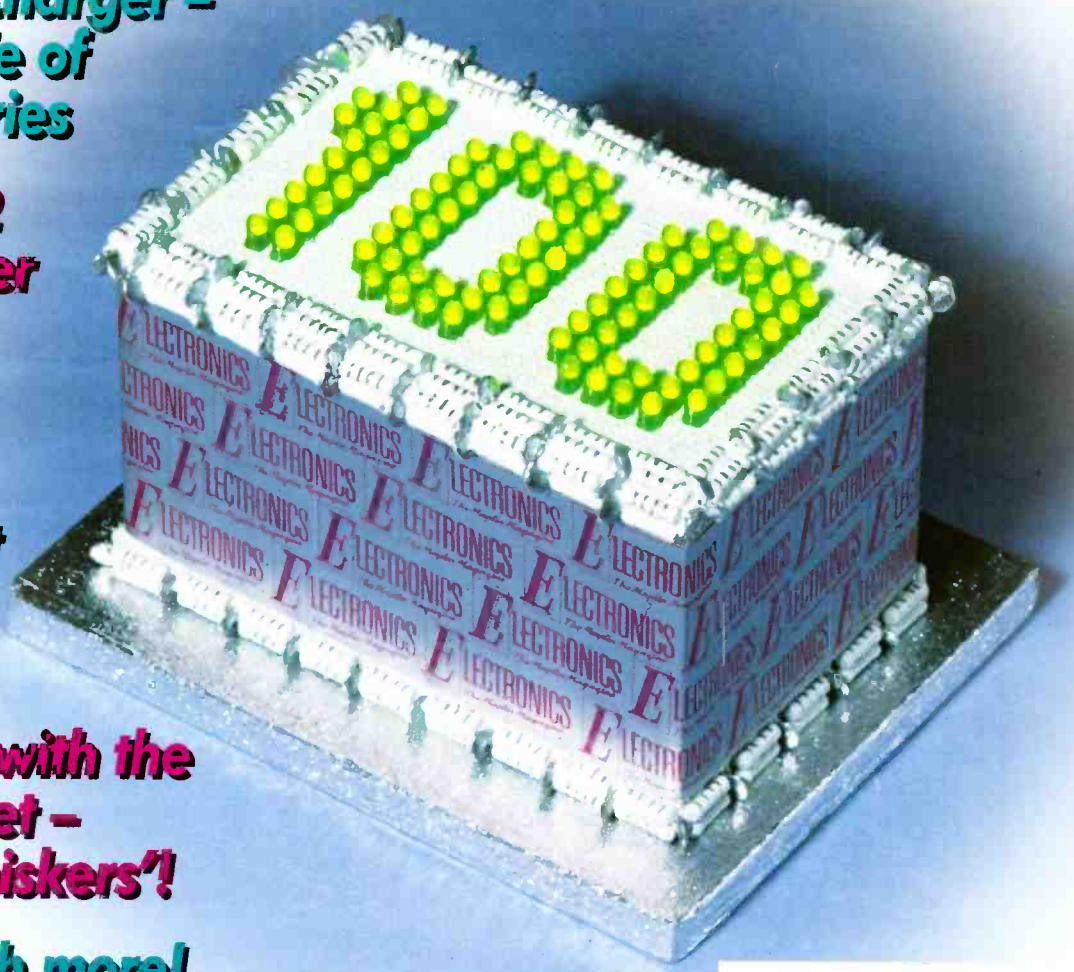
Versatile RS232 Serial Line Tester Update

Multi-Strobe Sequencer – for the flashiest lighting effects in town!

Back-to-basics with the Crystal Radio Set – its the 'cat's whiskers'!

and much, much more!

Plus – FREE Self-assembly Computer Guide!



9 770957 545084 04

AUDIBLE REALITY
for only £169.99

Experience the ambience and extra excitement of cinema style 'big film' sound in your own home, with the new Maplin Dolby Pro-Logic Surround Sound Processor. Enjoy the sensation of feeling that you're actually inside your TV! – on stage at a rock concert, or in the centre of the action with your favourite screen hero. Increase your enjoyment by bringing a new dimension to your home entertainment system that makes otherwise mediocre programmes good, and good programmes, out of this world.

Utilising your NICAM TV, satellite receiver or stereo video player, the Maplin Dolby Pro-Logic Surround Sound Processor unleashes the surround sound information which is digitally encoded on many TV programmes and modern prerecorded videos. An increasing number of programmes are broadcast in Dolby Stereo, including all premier league football matches broadcast on Sky. Built into the processor are two high quality 30 watt amplifiers which provide amplification for two of the additional audio channels. The processor has comprehensive inputs and outputs for connection to your existing Hi-Fi and TV, and is supplied complete with infra-red remote control, full operating instructions and suggested connection diagrams.

Buy now and save £££s

For a limited period we are offering the Maplin Dolby Pro-Logic Surround Sound Processor at the incredibly low price of

only £169.99 [H1]
(Catalogue price £229.99)
Plus UK Carriage £6

Save £60
Order Code 51245

Speaker Offer

Complement the performance of your Maplin Dolby Pro-Logic Surround Sound Processor with an ideally specified set of three superb quality speakers from Jamo. The set comprises a centre speaker and a pair of rear speakers which produce superb all-around-sound, plus cables and brackets. All at the special price of

Only £109.99 [E1]
Plus UK Carriage £4
Order Code 51246

Plus – Save a further £20!

Special Offer!

Buy the Surround Sound Processor and speakers at the same time and save a further £20 (and £4 carriage!)

Only £259.98 [H1]
Plus UK Carriage £6
Order Code 51247

Order now on 01702 554161
quoting these special order codes or call in at your local Maplin or Mondo Store.
Call 01702 552911 for details.
All prices include VAT. All items subject to availability. Offers end 30th April 1996. E&OE.

APRIL 1996
VOL 15. No. 100

IN THIS ISSUE...

PROJECTS *FOR YOU TO BUILD!*

COURTESY LIGHT CONTROLLER 6
An easily fitted 'luxury touch' add-on project for your vehicle, this extremely useful circuit provides intelligent control of the interior light, so that it remains on for a preset delay period after shutting a door (with instant-off facility), switches itself off if a door is left open for more than 10 minutes, and can be configured to operate in conjunction with central locking and alarm systems.

NI-CAD BATTERY CHARGER 22
Prolong the useful lifespan of your valuable nickel-cadmium (Ni-Cd) rechargeable batteries, by replenishing them using this high specification universal charger. Caters for practically any Ni-Cd battery configuration, with a very generous selection of charging voltages and capacities. Features include under- and over-voltage protection, temperature monitoring and slow and fast rate pulse-width modulation (PWM) charging.

PC WEATHER STATION SOFTWARE 44
This superb shareware software has been written specifically for use on any IBM-compatible PC used in conjunction with the PC Weather Station project. Enables your computer to display instantaneous wind speed and direction in analogue and digital format, with calculation and storage of average and maximum speeds, and graphical plotting of the results, plus built-in stand-alone emulation routine.

MULTI-STROBE SEQUENCER 48
The second part of the acclaimed Multi-Strobe project, the Serial Command Unit. When linked to the multi-strobe units, it will generate the flashiest lighting effects in town, with 8 channels and 100 strobe patterns stored in memory, plus many desirable features, including PC control provision, not provided in commercial designs. Ideal for creating the ultimate party atmosphere, and to bring your favourite sounds to life.

SERIAL LINE TESTER UPDATE 76
An improved version of the handy RS-232 Serial Line Tester, now with even more test routines built in, for the quick, convenient and comprehensive troubleshooting of equipment using the RS-232 data cabling standard. The component alterations can also be retrofitted to existing units, to update them to the new specification – full details are provided!

CRYSTAL SET 90
Return to a golden age of back-to-basics radio receivers – when tuning in to listen to your favourite broadcast was an occasion to be savoured. This project features a genuine galena crystal and cat's-whisker detector for tuning in, and is constructed on a wooden base with hand-wound coils, just like the now-treasured sets of yesteryear! And best of all, no batteries are required.

FEATURES *ESSENTIAL READING!*

SPECIAL EDITORIAL 3
A Brief History of *Electronics – The Maplin Magazine*. From an interview with Roger Allen – one of the founders of Maplin Electronics 1972.

EARTH RESOURCES SATELLITES 12
This article by Douglas Clarkson describes the development history and technology that went into making the European Remote Sensing satellite ERS, described as being the ultimate mapping machine. Capable of measuring the Earth's atmosphere and surface properties, including global warming and pollution levels, the satellite uses synthetic aperture radar (SAR) technology to allow accurate monitoring of our environment.

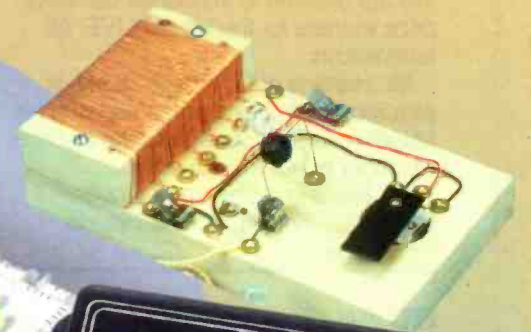
INTERNET CAFÉ 33
Our roving technology reporter, Alan Simpson, takes a look at the newly introduced Internet cafés. He checks out the frothiness of their cappuccino and jogs on to the World Wide Web all in the name of research for this article, which gently persuades you to try the experience for yourself, which you could do for free if you enter and win our great competition!

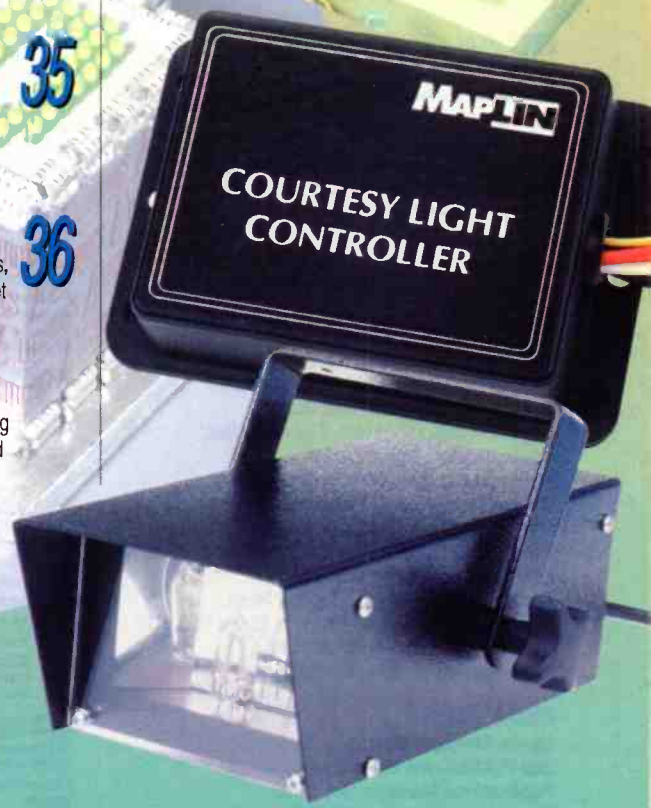
INTERNET CAFÉ COMPETITION 35
Enter our exciting contest for a chance to win a free Internet training course at the trendy Internet Café situated in Victoria, London, plus runners-up prizes!

THE INTERNET 36
In the final part of this information-packed series, Stephen Waddington describes how the Internet is developing, and in what directions its leading edges are heading. Ways in which the Internet will affect our lives in the future are forecast, including telephone services and virtual shopping. Also covered are methods of ensuring security of financial transactions and how to find what you are seeking within the 'net.

PRACTICAL GUIDE TO MODERN DIGITAL ICs 58
In the eighth part of this popular series, Ray Marston provides the essential information you need to know when designing circuits containing TTL and CMOS clocked flip-flop and counter ICs. Suggested practical applications are given for their use in building blocks such as ripple and walking ring counters, and divider chains.

EMC 85
The final part of John Woodgate's timely series is devoted to providing answers to frequently asked questions (FAQs) concerning the recently introduced ElectroMagnetic Compatibility (EMC) legislation. Find out where you stand in the stringent new market-place, whether you happen to be a designer, manufacturer, consumer or seller of electrical and electronic goods – essential reading for all!





REGULARS *NOT TO BE MISSED!*

FROM THE EDITOR...

Hello and Welcome to our 100th issue of *Electronics* with a fine collection of features and projects for you read and build! We present the second part of the long awaited Multi-Strobe: The Sequencer (Part 3 the Interface will be appearing soon), and as an added bonus, we bring you the updated Computer Assembly Guide.

Maplin LIVE '95 Competition

We are pleased to announce our lucky prize winners for the Maplin LIVE '95 competition:

Mr. Harding of Colnbrook, Berks is pictured above being presented with his Magellan GPS receiver by John Roberts, Manager of our Slough store.

Mr. Harding a Shipping Manager informs us that his hobbies include full-bore shooting, and entering competitions around the country. It has been suggested to him that his GPS could be used to locate shooting ranges which are often in the back-of-beyond locations.

Our other lucky prize winner is Mr. Timmins of Kingstanding, Birmingham who is pictured below, being presented with the Traffic*master* information system by Fitz Williams, Assistant Manager of our Birmingham store.

Mr. Timmins has been a regular customer at the Maplin store for the past twelve years, he currently works for Advance Technology Services and was ecstatic about his prize. He lists his hobbies as running a mobile disco, playing badminton and, of course, electronics.

Planetarium Competition

The six Prize winners of our Planetarium Competition are:

K. P. Scroggins, Canterbury, W. M. Stewart, Kirkintilloch, P. G. Full, Mid Glamorgan, G. Grey, Loughborough, R. Holderway, Crayford and H. Desai, Coventry.

Look out for further competitions and prizes from Maplin.

So until next month, from the rest of the team and myself, enjoy this bumper 100 page issue.

ABC
AUDIT BUREAU OF CIRCULATIONS
CONSUMER PRESS

Front Cover Picture:
©Copyright 1996 Maplin Electronics plc, All rights reserved.

EDITORIAL
Editor Robin Hall FBIS, G4DVJ
Technical Authors Maurice Hunt BSc (Hons), **Print Co-ordinators** John Craddock, Len Carpenter
News Editor Stephen Waddington BEng (Hons)
Drawing Office Ross Nisbet
Technical Illustrators Paul Evans, Kevin Kirwan Dip.Comp.
Project Development Chris Barlow, Dennis Butcher, Alan Williamson, Nigel Skeels

PRODUCTION
Art Director Peter Blackmore
Production Controller Jason Hyatt
Designers Jim Bowler, Matt Buhler
Layout Artists David Holt, Tracey Walker, Adrian Dulwich, Daniel Drake
Photography Co-ordinator Tracy Swann
Published by Maplin Electronics plc., P.O. Box 3, Rayleigh, Essex, SS6 8LR. Tel: (01702) 554155. Fax: (01702) 553935.
Lithographic Reproduction by Planagraphic Studios, 18 Sirdar Road, Brook Road Ind. Estate, Rayleigh, Essex SS6 7UY.
Printed by St Ives (Andover) Ltd., West Portway, Andover SP10 3SF.

MANAGEMENT
Senior Manager Design and Publications Steve Drake
Publications Manager Roy Smith
Development Manager Tony Bricknell

ADVERTISING
Jackson-Rudd & Associates Ltd., 2 Luke Street, London, EC21 4NT. Tel: (0171) 613 0717. Fax: (0171) 613 1108.
Advertisement Manager Eric Richardson.

UK NEWSTRADE DISTRIBUTION
Seymour, Windsor House, 1270 London Road, Norbury, London SW16 4DH. Tel: +44 (0)181 679 1899. Fax: +44 (0)181 679 8907.

©Copyright 1996 Maplin Electronics plc.

Copyright: All material is subject to worldwide copyright protection, and reproduction or imitation in whole or part is expressly forbidden. Permission to reproduce printed circuit board layouts commercially or marketing of kits must be sought from the publisher.

Advertisements: Whilst every reasonable precaution is undertaken to protect the interests of readers by ensuring, as far as possible, that advertisements appearing in the current issue of *Electronics* are bona fide, the publisher and staff of the magazine cannot give any undertakings in respect of statements or claims made by advertisers, whether on printed page or on loose insert. Readers who have reasonable grounds to believe that they have been misled are advised to contact their local Trading Standards Office.

Editorial: The views of individual contributors/authors are not necessarily those of either the publisher or the editor. Where errors occur corrections will be published as soon as possible afterwards.

Publisher's Statement: Maplin Electronics plc., take all reasonable care to prevent injury, loss or damage of any kind being caused by any matter published in *Electronics*. Save insofar as prohibited by English law, liability of every kind including negligence is disclaimed as regards any person in respect thereof.

Project Ratings

Projects presented in this issue are rated on a 1 to 5 for ease or difficulty of construction to help you decide whether it is within your construction capabilities before you undertake the project. The ratings are as follows:

1 Simple to build and understand and suitable for absolute beginners. Basic of tools required (e.g., soldering iron, side cutters, pliers, wire strippers and screwdriver). Test gear not required and no setting-up needed.

2 Easy to build, but not suitable for absolute beginners. Some test gear (e.g., multimeter) may be required, and may also need setting-up or testing.

3 Average. Some skill in construction or more extensive setting-up required.

4 Advanced. Fairly high level of skill in construction, specialised test gear or setting-up may be required.

5 Complex. High level of skill in construction, specialised test gear may be required. Construction may involve complex wiring. Recommended for skilled constructors only.

Ordering Information

Kits, components and products stocked by Maplin can be easily obtained in a number of ways:

Visit your local Maplin store, where you will find a wide range of electronic products.

If you do not know where your nearest store is, Tel: (01702) 552911. To avoid disappointment when intending to purchase products from a Maplin store, customers are advised to check availability before travelling any distance.

Write your order on the form printed in this issue and send it to Maplin Electronics, P.O. Box 3, Rayleigh, Essex, SS6 8LR. Payment can be made using Cheque, Postal Order, or Credit Card.

Telephone your order, call the Maplin Electronics Credit Card Hotline on (01702) 554161.

If you have a personal computer equipped with a MODEM, dial up Maplin's 24-hour on-line database and ordering service, CashTel. CashTel supports 300-, 1200- and 2400-baud MODEMs using CCITT tones. The format is 8 data bits, 1 stop bit, no parity, full duplex with Xon/Xoff handshaking. All existing customers with a Maplin customer number can access the system by simply dialling (01702) 552941. If you do not have a customer number Tel: (01702) 552911 and we will happily issue you with one. Payment can be made by credit card.

If you have a tone dial (DTMF) telephone or a pocket tone dialler, you can access our computer system and place orders directly onto the Maplin computer 24 hours a day by simply dialling (01702) 556751. You will need a Maplin customer number and a personal identification number (PIN) to access the system. If you do not have a customer number or a PIN Tel: (01702) 552911 and we will happily issue you with one.

Overseas customers can place orders through Maplin Export, P.O Box 3, Rayleigh, Essex, SS6 8LR, England; Tel: +44 1702 554000 Ext. 326, 327 or 351; Fax: +44 1702 553935.

Full details of all of the methods of ordering from Maplin can be found in the current Maplin Catalogue.

Subscriptions

Full details of how to subscribe may be found on the Subscription Coupon in this issue. UK Subscription Rate: £23.76/12 months, £11.88/6 months.

Prices

Prices of products and services available from Maplin, shown in this issue, include VAT at 17.5% (except items marked NV which are rated at 0%) and are valid between 7th February and 31st August 1996 errors and omissions excluded. Prices shown do not include mail order postage and handling charges, which are levied at the current rates indicated on the Order Coupon in this issue.

Technical Enquiries

If you have a technical enquiry relating to Maplin projects, components and products featured in *Electronics*, the Customer Technical Services Department may be able to help. You can obtain help in several ways; over the phone, Tel: (01702) 556001 between 9.00am and 5.30pm Monday to Friday, except public holidays; by sending a facsimile, Fax: (01702) 553935; or by writing to: Customer Technical Services, Maplin Electronics plc., P.O. Box 3, Rayleigh, Essex, SS6 8LR. Don't forget to include a stamped self-addressed envelope if you want a written reply! Customer Technical Services are unable to answer enquiries relating to third-party products or components which are not stocked by Maplin.

'Get You Working' Service

If you get completely stuck with your project and you are unable to get it working, take advantage of the Maplin 'Get You Working' Service. This service is available for all Maplin kits and projects with the exception of: 'Data Files'; projects not built on Maplin ready etched PCBs; projects built with the majority of components not supplied by Maplin; Circuit Maker ideas; Mini Circuits or other similar 'building block' and 'application' circuits. To take advantage of the service, return the complete kit to: Returns Department, Maplin Electronics plc., P.O. Box 3, Rayleigh, Essex, SS6 8LR. Enclose a cheque or Postal Order based on the price of the kit as shown in the table below (minimum £17). If the fault is due to any error on our part, the project will be repaired free of charge. If the fault is due to any error on your part, you will be charged the standard servicing cost plus parts.

Kit Retail Price	Standard Servicing Cost
up to £24.99	£17.00
£25.00 to £39.99	£24.00
£40.00 to £59.99	£30.00
£60.00 to £79.99	£40.00
£80.00 to £99.99	£50.00
£100.00 to £149.99	£60.00
Over £150.00	£60.00 minimum

Readers Letters

We very much regret that the editorial team are unable to answer technical queries of any kind, however, we are very pleased to receive your comments about *Electronics* and suggestions for projects, features, series, etc. Due to the sheer volume of letters received, we are unfortunately unable to reply to every letter, however, every letter is read – your time and opinion is greatly appreciated. Letters of particular interest and significance may be published at the Editors discretion. Any correspondence not intended for publication must be clearly marked as such.

Write to: The Editor, *Electronics – The Maplin Magazine*, P.O. Box 3, Rayleigh, Essex, SS6 8LR, or send an e-mail to AYV@maplin.demon.co.uk

SPECIAL EDITORIAL

A Brief History of ELECTRONICS– The Maplin Magazine

From an interview with Roger Allen – one of the founders of Maplin Electronics 1972.

THE origins of *Electronics – The Maplin Magazine* go back to April 1975, when Maplin introduced a price list known as *Maplin News*. This was produced on an ordinary typewriter, in a small office above the Westcliff shop and customers could subscribe to 6 copies a year for 30p.

Maplin began holding their prices for two month periods amid raging inflation, as prices up to then had been changed when necessary.

By June 1975, it had increased to an A3 sheet with more interesting items such as 'Special Offers'.

The August 1975 News Letter advertised the M252 Rhythm Kit, and an octopus playing the Rhythm Kit heralded the start of cartoons being incorporated into the newsletter. This became a regular feature as a series of very politically incorrect cartoons, as well as other elements which are still visible in *Electronics* today.

The newsletter became larger in December 1975 as more items were included in the price list, this reflected the bigger range of items available. Components for kits from a number of electronic magazines such as *Practical Electronics* and *ETI* were also included.

Early 1976, *Maplin News* advertised *ETI* and *PE* projects along with the start of some of the newly designed Maplin projects. By February 1976 Maplin were heavily into their own electronic organ series. A cartoon of Harold Wilson (the Labour Prime Minister at the time) was shown playing the Maplin Organ and tuning up his old 'pipes'. During 1976 many new items were introduced such as the *PE* Radio Controlled Project, Scopex Oscilloscopes, the original Michron Mk1 clock, and always plenty of new books.

1977 saw the launch of the main Maplin Catalogue (the one with a picture of Concorde taking off on the front cover). By this time video games such as 'Pong' appeared on the market, and this gave rise to a memorable cartoon.

The Maplin Mixer was introduced and again became the basis of a cartoon, this time showing Idi Amin (Big Daddy) at work on his mixer desk. By this time the price list had increased to 4 pages, and the video game acquired a rifle attachment, and Letters to the Editor started.

By August 1977, Maplin News contained a Graphic Equaliser, *ETI* balanced metal detector, New Books and Letters to the editor increased, and TV games were now reduced.

October 1977 saw the Drum kit turned into a complete system and the start of the five character Stock Code. Originally this related to the physical location of the product in the warehouse. A whole page on the Touch Sensitive Piano IC, and how to make a complete electronic piano also appeared.

In 1978, an early microprocessor evaluation kit (price £74) appeared, the price list expanded to four columns (still produced on a typewriter) over half a page of Letters to the Editor and more cartoons.

1979 saw the News Letter reduced to A4 size but containing more pages, with four columns of prices set to smaller type. In March 1979 Maplin did not have a computer, but shortly after that Maplin acquired its first mainframe computer.

By July 1979 a punched paper tape containing the prices was sent to a typesetter. VAT at this time was 15%, with a 30p handling charge for orders under the value of £4.00, but prices were now being held for 3 months. The 4600 synthsizer was redesigned with a digital keyboard and renamed the 5600.

June 1980 saw the introduction of the Atari Games Controller, Discount Vouchers, the Encoded IR LED System. By now there were five columns of prices, a whole page of New Books, and many Letters to the Editor. Project Leaflets were now being compiled, and the Matinee Organ was introduced.

Many of the staff at Maplin not only worked in electronics but were also involved with bands, groups and music generally – this is still true today. With such a background there became a point where it was felt that Maplin should have their own magazine which would include many of the elements of the newsletter but would be aimed at music/electronics, and so in February 1981 *Electronics & Music Maker* became Maplins first commercial venture to produce a magazine to be available to customers and readers through the news trade.

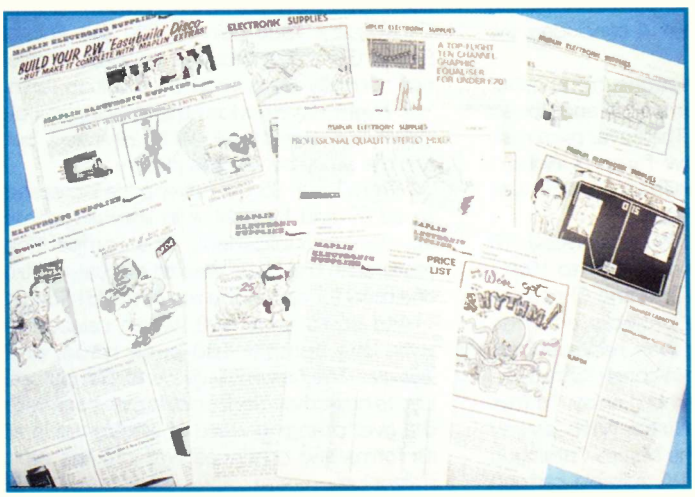
With a mixture of interesting articles on Pop Music, famous names like Rick Wakeman and front covers with Kate Bush, it had elements of electronics, but the kits had a bias towards music.

The Newsletter continued separately during this period.

Before the year was up though, it was felt that *Electronics & Music Maker* did not quite work for Maplin, it could not promote other kits and the economics dictated that Maplin had to encourage its competitors to advertise in the magazine at discounted rates. Maplin wanted its own magazine without other peoples' adverts. So rather than change the format of *Electronics & Music Maker* which had become by now extremely popular in its field, it was decided to sell off *E&MM* and introduce a new electronics magazine more representative of electronics and Maplin, and to run it more like a club, and so *Electronics – The Maplin Magazine* was thus born in December 1981, to be published every three months, (This might explain why the volume numbers change in December rather than January – Ed.).

The first issue of *Electronics – The Maplin Magazine* in December 1981 was priced at 60p. Its original format was 64 black and white pages with a colour cover. The launching editor was Mike Beecher, and Graham Daubney (now living in France with his wife and daughter) had the honour of appearing on the front cover.

Originally the issue numbers appeared inside the magazine and were printed on the



front cover much later. Regular items such as 'New Books' and 'Did You Miss?' were introduced. There was generally a mixture of computer, testgear and household projects, and it contained the same Maplin price list as printed in the Maplin News. Atari video/computer games were covered in the magazine as were Heathkit items. Many interesting articles supported the magazine, and generally all the advertisements were from Maplin.

By Issue 2, March-May 1982 the editor had changed to Doug Simmons as Mike Beecher was continuing as editor of *Electronics & Music Maker*, but the general style established in Issue 1 would be carried on and remain for many issues.

The mailing list was kept going for *Maplin News* but by November 1982 most people had changed over to *Electronics – The Maplin Magazine*, and so it was phased out.

Maplin at this time attended a number of shows such as the Daily Mail Ideal Home Exhibition. It was an opportunity to demonstrate the Maplin Organ and distribute several thousand leaflets for other products and kits.

Projects supporting popular computers of the day appeared from time to time, such as the ZX81 keyboard and informative technical articles on computers such as the VIC 20.

The first of the space theme covers appeared in Issue 4, along with the start of a series on satellites. On Special Offer were the Low Cost Multimeter, usual price £4.85 with a saving of £1, and a pack of 20 BC108Cs price £2.30 with a saving of 50p. By now copies of Issue 2 had sold out and so Maplin Projects Book Two was launched. This contained reprints of the projects from magazine Issue 2.

Issue 6 showed the Maplin version of the famous 'His Masters Voice' with the introduction of the Maplinised K9 from Doctor Who. As Issue 4 had now also sold out a reprint of the projects were now available in Maplin Projects Book Four. This was to set the pace for further Project Books.

CashTel Maplin's Computer-Aided Shopping by TELephone was launched in Issue 7. It also featured Hero the Heathkit robot which was to appear at many shows and exhibitions, including television chat shows.

For the front cover of Issue 9 the Chief Product Buyer was persuaded to pose as a burglar. Spectrum and Z80 projects abounded. Robert Penfold contributed many popular projects and articles. The price of the magazine was now 70p.

Generally the same mix and formula was kept for many issues, with only small price increases from time to time. Then by Issue 17 another landmark was reached when Roy Smith became the editor.

It just so happened that in Issue 19, the current editor Robin Hall appeared on the front cover. He had been persuaded to appear whilst home on leave from travelling around the world, the places he had visited were shown on the map in the background.

A memorable shot on the cover of Issue 24 was a silver-suited person using the Maplin Geiger Counter. The location was near to the nuclear power station at Bradwell. Legend has it that the photo shoot had to be concluded rather rapidly as the authorities from the power station were on their way over to see what was going on.

Another story behind the scenes was that during the testing phase of the Geiger

Counter project, the normal background radiation readings rose significantly, these were recorded for prosperity on a printout. We later learned of Chernobyl, the world's first major nuclear accident. It was detected here first at Maplin. The implication of this is that the radiation cloud passed over Britain, and not just contaminating the hillsides in Wales.

Issue 29 the magazine went bi-monthly and the price increased to £1.00. This issue contained the famous cover mounted Hobby Knife, which it seems most electronics enthusiasts still have – along with the original blades. A new look to the magazine was established with an increased number of pages. It was also the start of reader letters in the form as 'Air Your Views' (AYV).

Then in Issue 30, colour and spot pages were introduced to the magazine. It also heralded the start of the popular 'News Report'.

In magazine 34 the issue number was now placed on the front cover. The major article in that issue was an introduction to Digital Nicam Stereo Sound. Part Two in Issue 35 covered the Maplin Nicam Stereo Decoder designed by Chris Barlow, which by all accounts became the *de facto* standard around the world.

By Issue 40 the cover price had increased to £1.45. Included in this issue was D.I.G.E.S.T Volume 1 Part 1, this was a mini pullout catalogue full of products in a style quite different from the catalogue.

In issue 41 D.I.G.E.S.T Volume 1 Part 2 appeared. There was an 'Out and About' on P&O European Ferries, and the start of 'Stray Signals' by PC.

Issue 43 covered the London Planetarium and our first London Planetarium Contest. D.I.G.E.S.T Volume 1 Part 4 concluded the mini pullouts.

By Issue 46 the magazine hit another milestone when it went monthly and Robert Ball took over as editor. The cover price rose to £1.60, and the now famous Robert Penfold appeared on the front cover. It was also the start of 'Next Issue'.

Issue 48 December 1991 celebrated '10 Exciting Years of *Electronics* 1981 to 1991'. The Festive Christmas Tree and Christmas Star were among the projects on offer. Readers Circuit Maker was reintroduced. According to the tongue-in-cheek 'Christmas Xtra' on page 78 September entry, "a free trolley would be offered with every bumper-sized copy of the Maplin Catalogue sold at W. H. SMITH." A suitable cartoon also accompanied this news item. For December the cheeky Christmas Xtra announced "Maplin awarded an entry in *The Guinness Book of Records* for the world's largest catalogue" – by all accounts this record was only broken last year.

In Issue 61 'Technology Watch' and 'Life with Micro Chip' were started.

An interesting photograph of a surgeon on the front cover of Issue 66 was in fact the editor Robert Ball. According to Robert, the syringe was filled with a fluorescent liquid in order for it to be picked up on the photograph.

Issue 70 contained a questionnaire and also a free booklet on Making PCBs. The PCB booklet was so popular that it had to be reprinted separately.

With Internet becoming a powerful force for hobbyists and professionals alike, a new column was started in Issue 85 called @Internet. This was to cover both PC and AppleMac computers and offer areas to explore on the Internet.

Issue 90 featured the Ultrasonic Detector, this had many applications, but its main use was for detecting bats. As with many projects this had taken months to design and build with a fair degree of secrecy, and yet to our surprise our competitors managed to cover the same type of project before we did. Unfortunately for us our 'Bat Detector' could not detect moles.

Issue 92 heralded the start of new editor Robin Hall, and the Multi-Strobe Part One. No major changes to the format, apart from the Cavalry bugler blowing a raspberry on page 4.

The front cover of Issue 93 featured collision earth, which also became the Maplin Catalogue's 1996 front cover. The Animal Sound Generator included an extra animal not normally associated on a British farm. You might have noticed this, but if not look closely on page 16, all will be revealed, but not the story behind the picture.

From Issue 95 the cover price increased to £2.25 and brought it in line with other electronics publications. The competition featured in this issue was an exclusive prize of a meal for two at the top of the BT Tower.

And so to Issue 100, which celebrates with this bumper 100 page issue, and includes *The Assembly Guide to Computers*. Let us hope that *Electronics* keeps pace with the ever changing world of electronics in all its forms and continues well into the next millennium.

15 Good Reasons For Businesses To Open An MPS Account Today!

1. Credit Facility ✓
2. Reduced Delivery Charge ✓
3. Special Terms ✓
4. Dedicated Technical Support ✓
5. Free Catalogue Every 6 Months ✓
6. Schedule Order Facility ✓
7. Regular New Product Update Service ✓
8. 24-hour ordering and Guaranteed Same Day Despatch ✓
9. Courier Service ✓
10. Free Data Sheets ✓
11. Local Technical Support ✓
12. Volume Quotations ✓
13. Call and Collect at 34 Counters Nationwide ✓
14. Advance Notice of Retail Product Promotions ✓
15. Dedicated Personal Account Manager ✓

BSI REGISTERED FIRM
BS EN ISO 9002 (1994)
Level B: Quality Assurance RS12750

Apply now for the latest MPS catalogue

Business credit accounts can be set up and used straightaway– Apply for yours NOW – phone 01702 554171 or fax 01702 553935

MPS MAPLIN Professional

MPS, P.O. Box 777, Rayleigh, Essex SS6 8LU

Original design by Alan Williamson
Design update by Tony Bricknell

Revised text by Tony Bricknell
and Maurice Hunt

2nd Time Around

COURTESY LIGHT CONTROLLER

KIT AVAILABLE (95059) PRICE £14.99

* Easy to build
* Low power consumption
* Simple to fit

2 PROJECT RATING

This improved version of the Car Interior Light Controller project, previously featured in *Electronics* Issue 82, incorporates several modifications that result in superior operation and also a more compact housing. The unit is a very beneficial addition to many older, and base model vehicles, most of which do not have the courtesy light option of the latest upmarket models.

Fitting this easily installed project into your car, van, MPV or 4×4 will allow its courtesy light(s) to remain illuminated for approximately 30 seconds after the vehicle's doors have been closed, (unless the ignition is switched on, in which case, the light will be extinguished immediately). This provides sufficient interior lighting time to be able to easily locate the key in the ignition switch, and the seatbelt buckle into its slot.

The unit also adds a few extra features which many top models do not have – in the event of a door being inadvertently left open, the courtesy light will automatically turn off after approximately 10 minutes, to avoid draining the battery, and a quick open and shut of the door (for example, if you haven't quite latched it properly first time round) will also turn off the light. In addition, the unit may be linked to the central locking and/or alarm system (if applicable) so that the courtesy lights are also controlled by the activation and deactivation of these systems – many of which are operated by remote control. You will be surprised how detailed features such as these add to the sense of luxury in a vehicle, and installing this unit is a great way of personalising your pride and joy!

Circuit Description

The block diagram of the Car Interior Light Controller is shown in Figure 1. Refer to Figure 2, the circuit diagram; the door open/closed sensor comprises a slow charge/discharge R/C network (R3, R4, C1) to detect a definite

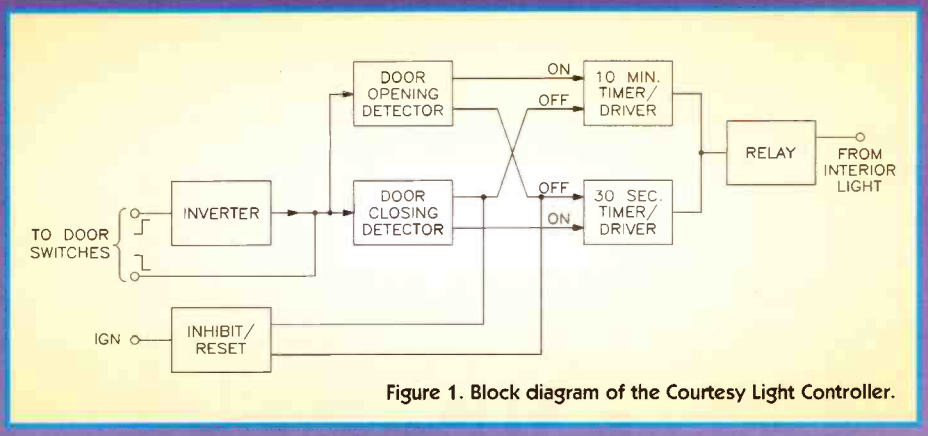


Figure 1. Block diagram of the Courtesy Light Controller.

IMPORTANT SAFETY WARNING

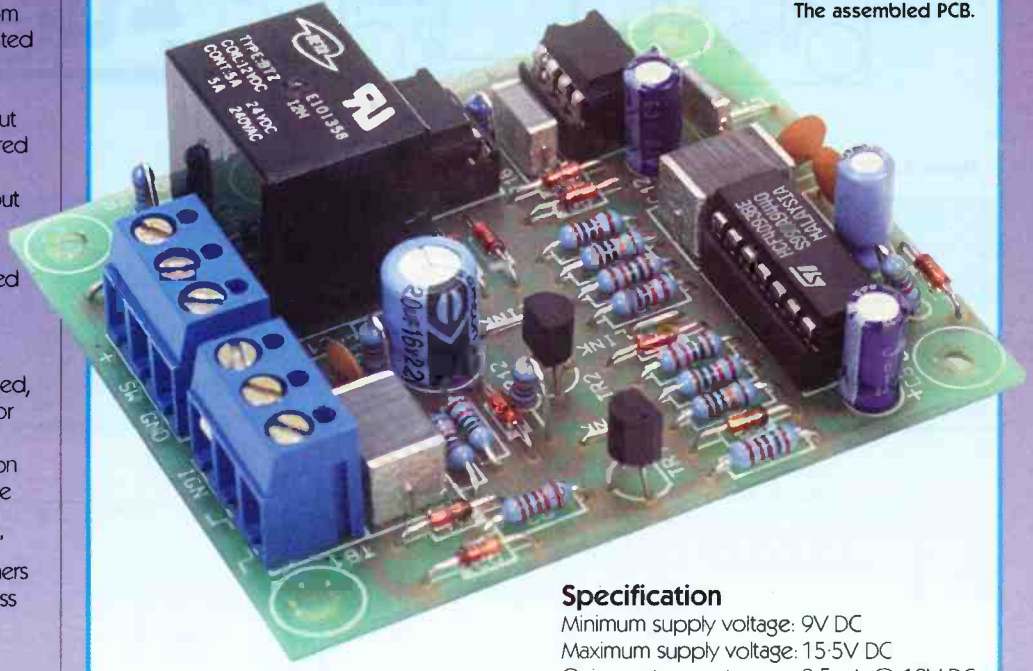
Before starting installation work, consult the vehicle's manual regarding any special precautions that apply. Take special care to avoid accidental short circuits occurring since a lead-acid battery is capable of delivering extremely high current. Remove all items of metal jewellery, watches, etc., before starting work. Disconnect the vehicle's battery before connecting the module to the vehicle's electrical system. Please note that some vehicles with electronic engine management systems will require reprogramming by a main dealer after disconnecting the battery. Assuming a negative earth vehicle, disconnect the battery by removing the (–) ground connection first; this will prevent accidental shorting of the (+) terminal to the bodywork or engine. It is essential to use a suitably rated (100mA) fuse in the supply to this project. For the electrical connections, use suitably rated wire capable of carrying the required current. If you are in any doubt as to the correct way to proceed, consult a qualified automotive electrician.

change in condition, and capacitors C2 & C3 to help prevent spurious operation from noise spikes; the transistor TR1 and associated components provide an inverted switch input.

Because of the slow change on the input of the NAND gate (IC1b), a Schmitt triggered variety was chosen (which has significant hysteresis) to prevent toggling of the output when the input is in between the two threshold levels.

The inverters IC1c & IC1d and associated components (C4 & R5 and C5 & R6) are positive edge detectors (i.e. detecting a change from '0' to '1'); the inverter IC1d produces a pulse when the door is opened, and IC1c produces a pulse when the door is closed.

IC2 and IC3 are interior light long duration timers, specifically designed for automotive applications. Each of the timers has 'ON', 'OFF' and 'TOGGLE' inputs – the 'TOGGLE' inputs are not used in this project. The timers also have a built-in 14V Zener diode across the supply pins, an oscillator, a frequency divider, input debounce circuits, and a (not quite) open collector transistor with protection (load dump) diode for switching reactive loads. IC2 is used as the 'courtesy



The assembled PCB.

Specification

Minimum supply voltage:	9V DC
Maximum supply voltage:	15·5V DC
Quiescent current:	2·5mA @ 12V DC
Operating current:	30mA @ 12V DC

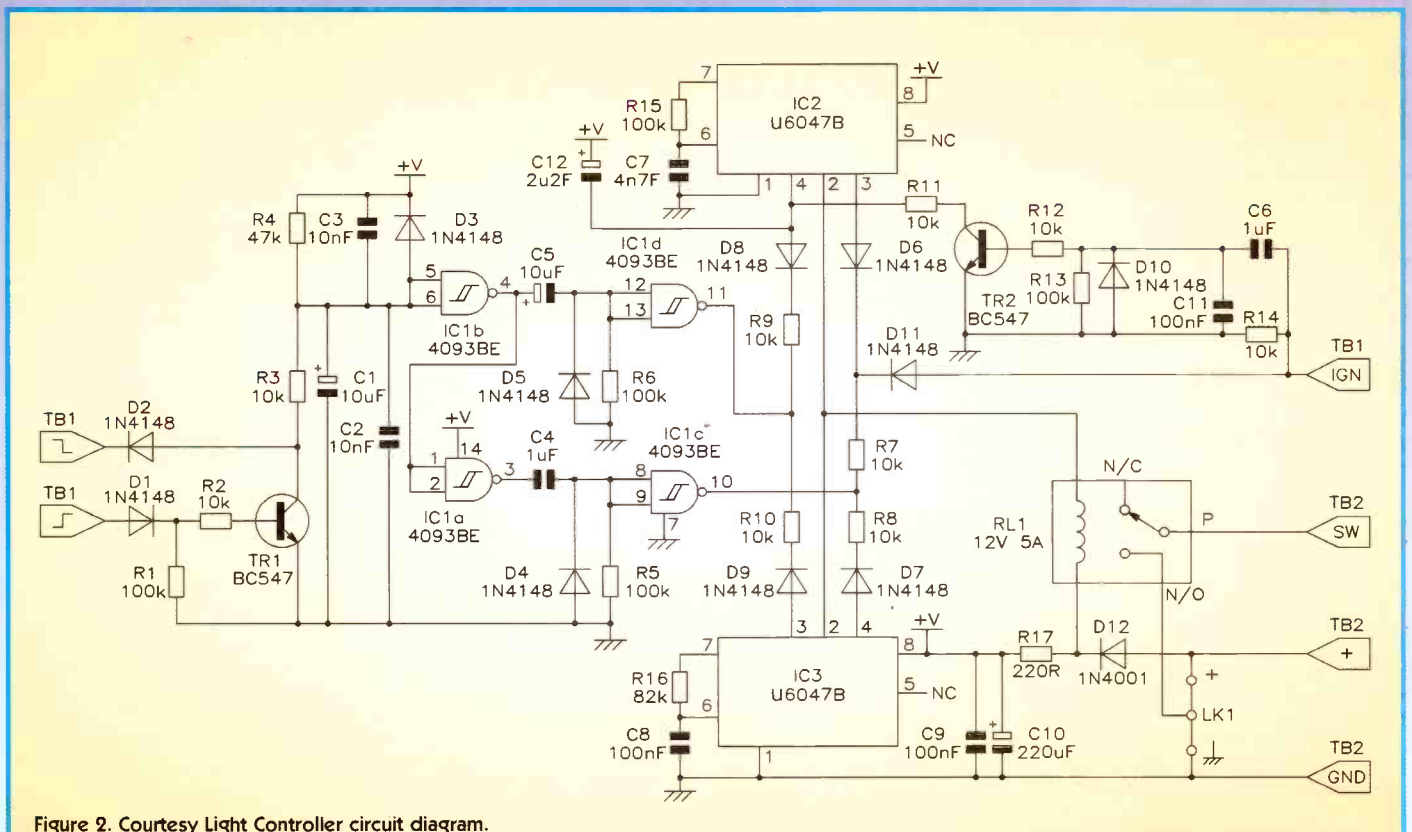
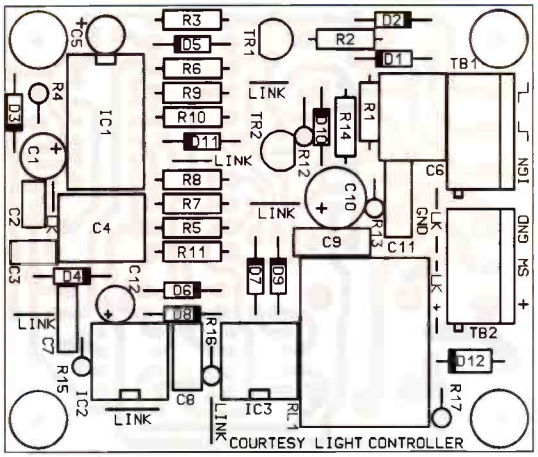


Figure 2. Courtesy Light Controller circuit diagram.



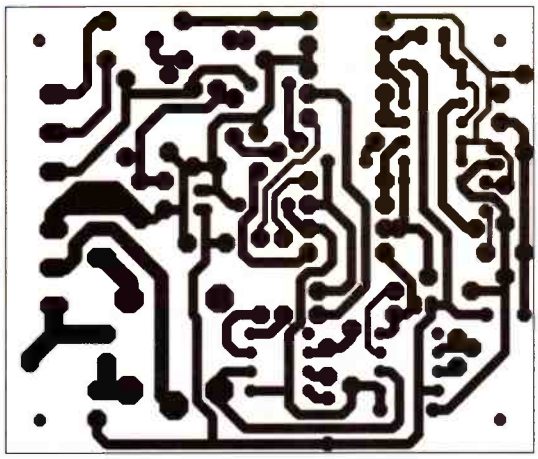


Figure 3. PCB legend and track.

light' timer, and IC3 is used as the 'door open' timer.

The components responsible for the time-out period are R15 and C7 for IC2, and R16 & C8 for IC3. The 'OFF' input of IC2 and the 'ON' input of IC3 are triggered by the door being opened, while the 'ON' input of IC2 and the 'OFF' input of IC3 are triggered by the door being closed.

The 'extra' components around the inputs of IC2 are the 'inhibit and reset' circuitry; when the door is closed and the engine is running, diode D11 feeds a jamming voltage to the 'ON' input of IC2, preventing it from being activated. However, if the courtesy light is ON and the engine is OFF, starting the engine will cause TR2 to generate a pulse which will reset IC2 and turn off the light.

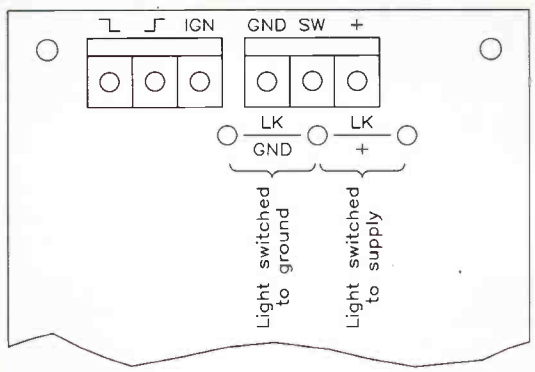


Figure 4. Link fitting (LK+ or LK GND).

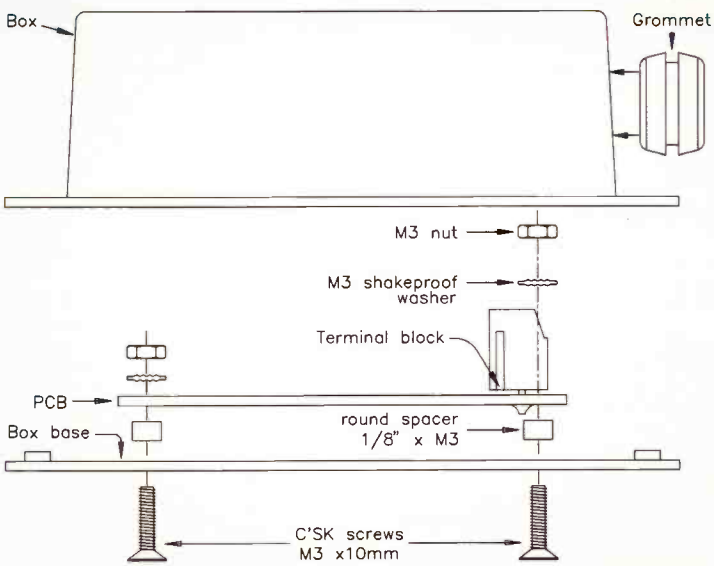


Figure 6. Exploded assembly diagram.

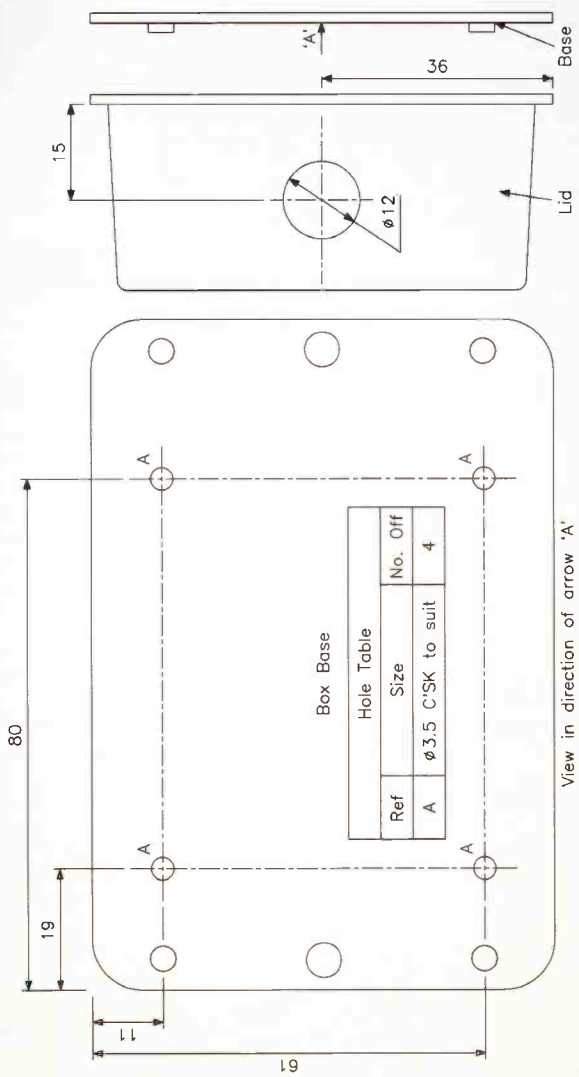


Figure 5. Box drilling details.

Diode D12 prevents damage to the circuit from accidental reverse polarity connections. Resistor R17 limits the current to the internal Zener diodes of IC2 and IC3. Capacitors C9 and C10 decouple the supply at high and low frequencies. The relay RL1 performs the light switching function; the coil of the relay is connected between the supply (after D12) and the open collector outputs of IC2 and IC3.

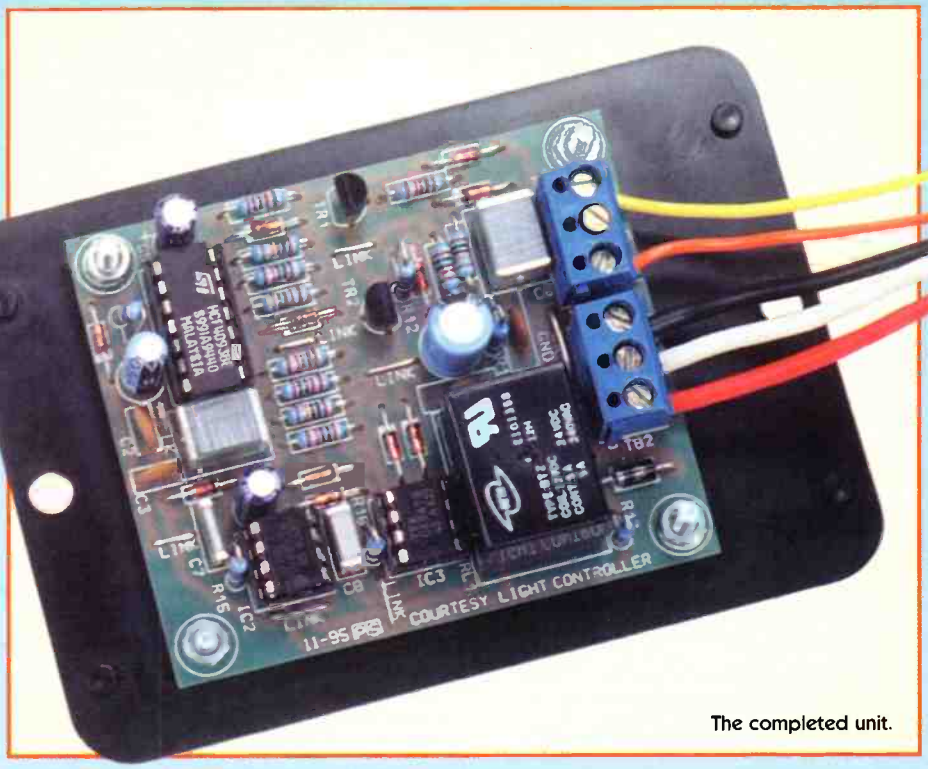
Changes made to the revised circuit consist of the addition of C12, and a larger value of C5. The addition of C12 placed between +V and pin 4 of IC2 improves the operation of the unit compared to the original design, by delaying the OFF pulse to the 30 second timer (IC2), long enough to let the 10 minute timer (IC3) activate and 'take over'. This prevents the courtesy light switching off and then back on quickly when a door is opened during the 30 second courtesy lighting period (which used to occur with the previous design). C11 is included to prevent spurious operation caused in some instances in the previous design by noise picked up from the vehicle's ignition wiring.

However, as a result of adding C12, a much longer-duration 'DOOR OPEN' pulse is required, to overcome the slowed-down operation of IC2 and the ON pulse debounce time of IC3. C5 is therefore increased in value from 1μF (unpolarized) of the previous version to 10μF (electrolytic), allowing a much longer pulse through the 'Door Opened' detection circuit stage formed around IC1d.

The changes made to the circuit have procured an additional 'spin off' benefit, in that during the 30 second time-out, if a door is opened and then immediately shut (within approximately 0·5s), then the 30 second time-out is bypassed. This is useful if, for some reason, you do not wish the interior lights to stay on for 30 seconds – simply open and shut the door quickly and the lights will be extinguished.

Construction Details

Construction of the module is fairly straightforward; the general rule being to begin with the smallest components first, working up in size to the largest. All the components are mounted on a single-sided PCB, the legend and track of which are shown in Figure 3.



The completed unit.

Firstly, the vehicle's electrical system needs to be examined. If you have a proper service manual (not the pamphlet supplied with the car), such as the popular *Haynes* series, then a quick glance at the electrical wiring diagram will tell you whether the interior lights are switched, via the door switches, to 'supply', or to 'ground' (if you cannot find this information, you will have to grab your multimeter and investigate!)

If the door switches connect the interior light to 'ground' (assuming negative earth), then the following components do not need to be fitted: R1, R2, D1, TR1, although they can be fitted if you wish – it won't affect the operation of the circuit. The link LK1 must be fitted in the 'GND' position.

If the interior light is switched to the 'supply', then the link LK1 must be fitted to the (+) position – see Figure 4. Diode D2 need not be fitted, although again, it won't affect the circuit operation if you do install it.

The recommended component assembly order is as follows: First, fit and solder the diodes D1 to D12. Care must be taken to fit the diodes the right way around; the cathode is indicated by a black band on the body of the diode, and this must face the thick white band on the PCB legend. Next, use any lead offcuts from the 1N4001 diode (D12) to make link LK1, which should then be soldered into place (shown in Figure 4).

Mount capacitors C2 to C3, C6 to C9 and C11 next, followed by the three IC DIL-sockets. Now, fit the transistors TR1 and TR2, taking care to ensure that the flat side of the device matches the straight edge on the PCB legend. Try not to keep the soldering iron in contact with the device leads for longer than two seconds or so.

Mount the polarized capacitors (C1, C5, C10 and C12) next, taking care to insert the devices correctly – the negative lead is identified by a black band and (–) symbols

Figure 7. Front panel label.

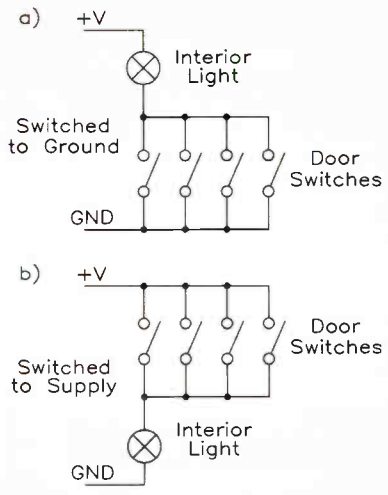


Figure 8. Wiring diagram for the existing basic courtesy light wiring on negative earth vehicles; (a) ground switched wiring; (b) supply switched wiring.

on the capacitor's body. Fit the two 3-way terminal blocks next. Finally, mount the relay, and build up the four 'wide' sections of tinned copper track with a thick layer of solder, since these have to withstand the current required to power the interior lamps.

Thoroughly check your work for errors, such as misplaced components, solder bridges, whiskers and dry joints, etc. Clean any flux off the PCB using a suitable solvent. The ICs can now be inserted into their sockets. Remember to observe the standard antistatic precautions before you handle the ICs – ensure that you touch an 'earthed' conductor (domestic metal water pipes, for example) to remove any static charge which you may have accumulated. The PCB is now ready for testing.

Testing

Connecting a 12V DC supply between the (+) and GND terminals should cause the relay to operate. The relay should take approximately 30 seconds to de-energize (i.e. simulating someone opening a car door, getting in, and closing the door).

Connect a lead between the appropriate input and supply terminal to trigger the module; the relay should take approximately 10 minutes to de-energize (i.e. someone has left a car door permanently open). Next, disconnect the lead from the input, the relay will energize once again; quickly reconnect the lead between (+) and 'IGN' (representing the car being started), and the relay should immediately de-energize (thus turning off the light). Leaving the lead connected to the IGN input, connect a second lead to the appropriate input to trigger the module (representing a door being opened, with the ignition switched on); the relay should energize (turning on the light).

Now that the module has been fully tested, it is ready for installation into a vehicle. If you wish to fit the module into the supplied box, follow the drilling instructions.

Box Preparation

The box drilling details are shown in Figure 5. Mark out, drill, cut and file all the holes as required. Fit a rubber grommet (included in the kit) into the large hole on the side of the box.

Assembly

See the photograph showing the way in which the assembled PCB is fitted into the box. Refer also to Figure 6, showing the box exploded assembly diagram. Fit spacers to the corners of the PCB, and fix the module onto the box base by means of the M3 screws, shakeproof washers and nuts, as shown. Finally, wipe the box clean, and apply the front panel label shown in Figure 7.

Installation

STOP! Before proceeding any further, make sure that you have read the warning at the beginning of this article. If you are, in any way, unsure about installation, consult a qualified automotive electrician.

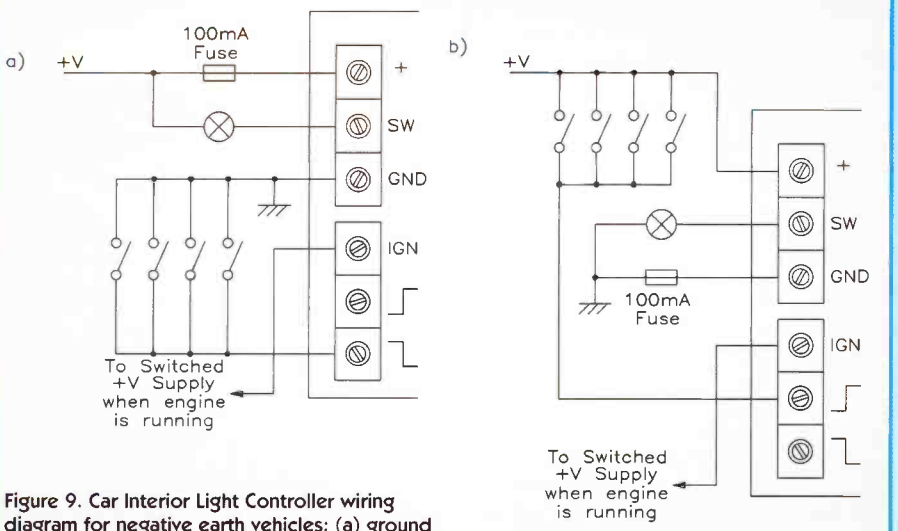


Figure 9. Car Interior Light Controller wiring diagram for negative earth vehicles; (a) ground switched wiring; (b) supply switched wiring.

Figures 8 and 9 show typical before and after wiring diagrams; (a) shows the wiring for ground switched courtesy light circuits, as found in most vehicles, while (b) shows the supply for the switched courtesy lights – study the circuit diagrams appropriate to your particular vehicle. Make sure that you use wiring capable of carrying currents of up to 5A, and be sure to fit a 100mA fuse in the appropriate supply line. Note that this should be fitted (into an in-line fuseholder) as close as possible to the vehicle's battery, so as to protect the connection leads and equipment beyond that point. Always use grommets at the point where the cables pass through the bulkhead or other panels, to prevent chafing and shorting out. The 'IGN' terminal should be connected to a terminal that provides a positive supply when the ignition is switched on – for example, the appropriate terminal on the ignition switch, or ignition switch-controlled radio power lead, etc. You are advised to consult your car manual for further information.

Figure 10 provides details on installing the unit so that it works in conjunction with the alarm and/or central locking system fitted to some vehicles. For 'positive' control central locking, the Courtesy Light Controller can be configured so that it turns the interior light on and off when the doors are centrally unlocked and locked, respectively. For 'negative' control central locking, the Courtesy Light Controller can only be configured to turn the interior light on when the doors are unlocked.

Note that additional 1N4148 diodes (not supplied with the kit) will be required. These should be connected as per the diagram, to the appropriate terminal block on the unit. However, they should be fitted with heat-

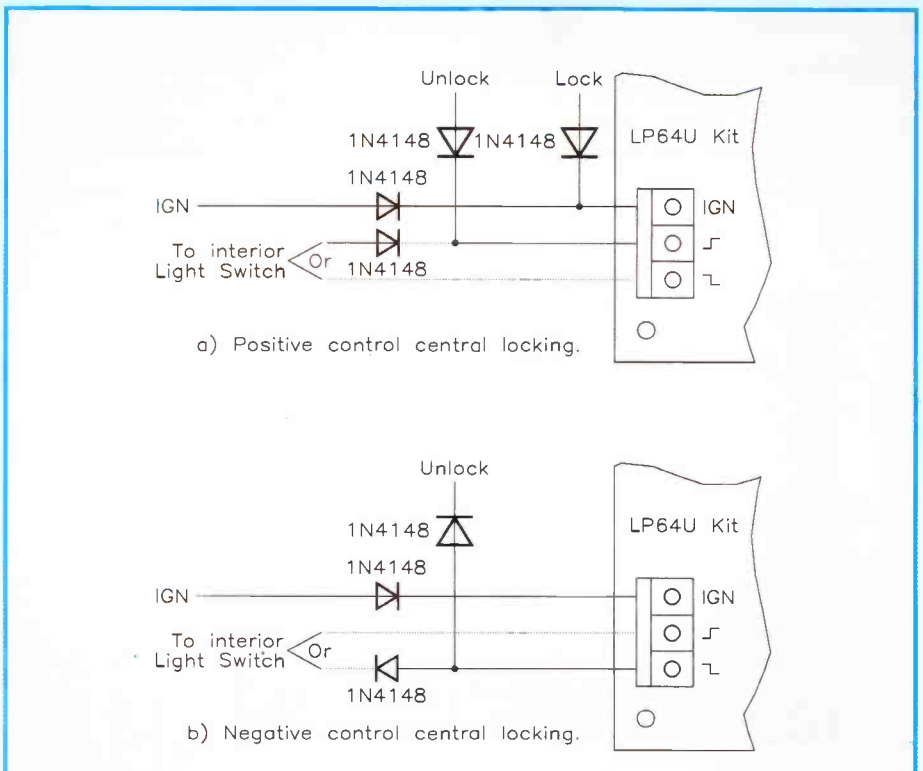


Figure 10. Wiring to car alarm/central locking system.

shrink sleeving or similar, so as to insulate them from contact with other parts of the circuit. The diodes are best fitted into the box (there is plenty of space for them), although they could be fitted at any suitable location within the lead's length, provided they are protected and well insulated. Wrapping them in electrical insulating tape is not advised, as this has a tendency to unwind after a period of time, as well as looking somewhat untidy.

The module may be positioned in any convenient location, but it is essential to ensure that the unit is not directly exposed to any source of high temperature, or in a position where there will be the possibility of moisture ingress – the specified box is not waterproof. A suitable location would be beneath the dashboard, or within a door pillar if there is sufficient space. This redesigned version of the project is fitted into a new type of box, with flanges for easy mounting to a panel by means of two suitable screws, or bolts.

Once the module has been installed, check and double-check the wiring before reconnecting the battery.

Final Testing and Use

Switch on your vehicle's courtesy light (so that it is activated when a door is opened), and open any one of the vehicle's doors, whereupon the light should turn on. Now close the door. The light should remain on for about 30 seconds, before being automatically extinguished.

Open the door again (the light should turn on) and wait for approximately 10 minutes. After this time, the light should be automatically extinguished. Having completed this test, close the door. Next, open and then immediately (within approximately 0·5s) shut the door – the light should briefly illuminate with the door open, and go out on shutting the door.

Finally, get into your vehicle and close the door (the light should remain on). Now, switch on the vehicle's ignition, whereupon the light should turn off immediately.

If you have linked the unit to operate in conjunction with the vehicle's alarm and/or central locking system, and having carried out the above tests, shut all the doors, and use either the key or the remote control (as applicable) to activate the alarm/locking – as a result, the interior light should be switched off, assuming the unit is used in conjunction with 'positive' control central locking (this will not occur with 'negative' control central locking systems). Now deactivate the alarm, and/or unlock the vehicle – the light should come on, and remain on for around 30 seconds, unless the ignition is turned on again before this period has elapsed.

The assembled unit.

COURTESY LIGHT CONTROLLER PARTS LIST

RESISTORS: All 0·6W 1% Metal Film			
R1,5,6,13,15	100kΩ	5	(M100K)
R2,3,7-12,14	10kΩ	9	(M10K)
R4	47kΩ	1	(M47K)
R16	82kΩ	1	(M82K)
R17	220Ω	1	(M220R)
CAPACITORS			
C1	10µF 50V Radial Electrolytic	1	(FF04E)
C2,3	10nF Ceramic Disc	2	(WX77J)
C4,6	1µF Polyester Layer	2	(WW53H)
C5	10µF 63V Radial Electrolytic	1	(AT77J)
C7	4n7F Polyester Layer	1	(WW26D)
C8	100nF Polyester Layer	1	(WW41U)
C9,11	100nF 16V Ceramic Disc	2	(YR75S)
C10	220µF 16V Radial Electrolytic	1	(FF13P)
C12	2µ2F 63V Radial Electrolytic	1	(AT75S)
SEMICONDUCTORS			
D1-11	1N4148	11	(QL80B)
D12	1N4001	1	(QL73Q)
TR1,2	BC547	2	(QQ14Q)
IC1	4093BE	1	(QW53H)
IC2,3	U6047B	2	(AH44X)
MISCELLANEOUS			
RL1	12V/5A Miniature Relay	1	(JM18U)
TB1,2	3-Way 5mm PCB Terminal Blocks	2	(JY94C)
	8-Pin DIL Socket	2	(BL17T)
	14-Pin DIL Socket	1	(BL18U)
	9·5mm Grommet	1 Pkt	(JX63T)
	M3×10mm Steel Screw	1 Pkt	(JY22Y)
	M3×⅛in. Spacer	1 Pkt	(FG32K)
	M3 Shakeproof Washer	1 Pkt	(BF44X)
	M3 Steel Nut	1 Pkt	(JD61R)
	Box and Base Type 2	1	(YN36P)
	PCB	1	(95060)
	Front Panel Label	1	(95061)
	Instruction Leaflet	1	(XV92A)
	Constructors' Guide	1	(XH79L)
OPTIONAL (Not in Kit)			
	In-line Fuseholder	1	(RX51F)
	1·25in. 100mA Fuse	1	(WR08J)
	Black Connection Wire (6A)	As Req.	(XR32K)
	White Connection Wire (6A)	As Req.	(XR37S)
	Red Connection Wire (6A)	As Req.	(XR36P)
	1N4148	As Req.	(QL80B)

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

The above items (excluding Optional) are available as a kit, which offers a saving over buying the parts separately.

Order As 95059 (Courtesy Light Controller) Price £14.99

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

The following new items (which are included in the kit) are also available separately, but are not shown in the 1996 Maplin Catalogue

Courtesy Light Controller PCB **Order As 95060 Price £3.99**

Courtesy Light Controller Front Panel Label **Order As 95061 Price £2.29**

by Douglas Clarkson

ERS: The Ultimate Mapping Machine

The concept of an Earth resources satellite without any conventional optical imaging systems may seem a paradox. ERS (European Remote-Sensing Satellite) was first conceived within the European Space Agency (ESA) during the late 1970s as an orbiting platform that would be able to measure the Earth's atmosphere and surface properties with new levels of accuracy. The use of Synthetic Aperture Radar (SAR) technology would allow such a craft to obtain images from the Earth's surface, independent of cloud cover and the level of surface daylight. This is in marked contrast to conventional satellites such as METEOSAT, which reveal topographic details only on occasions of clear sky conditions.

ERS is maintained in orbit at 780km above the Earth. When launched on the 17 July 1991 by an Ariane IV rocket from French Guyana, the ERS package weighed 1·0 tonne – one of the largest single payload launches up to that time. Photo 1 shows ERS undergoing final check procedures at ESTEC, Noordwijk in the Netherlands. Photo 2 shows the satellite as deployed in its sun-synchronous orbit. The main payload structure has a base some $2m^2$ and the unit is some 3m high. The main SAR antenna is 10m long and the solar panel array, capable of delivering 1kW of power, has a total area of $24m^2$ and comprises some 22,260 individual elements.

ERS experiences eclipse periods of some 34 minutes during its Earth orbit of 100 minutes. A series of four sets of Ni-Cd batteries with a total charge capacity of 96Ah provide power to the main craft so that it can continue its imaging function even when no power is derived from the solar panels. The management of the charge-discharge cycles is typically overseen by the onboard computer.

The orbit of ERS is sun-synchronous and highly inclined to the equator. This gives the satellite visibility of almost all areas of the Earth as the planet rotates beneath its orbit. An extensive array of ground receiving stations has been established specifically for the ERS mission. The orbit of ERS can be modified slightly to ensure that orbital paths are exactly repeated after 3, 35 and 176 days. This provides a means of detecting cyclic variations in ground features.

Two 6·5G-bit tape recorders are employed on board ERS to store data for relay to ground stations. Each recorder utilises 3,000 feet of ¼in. magnetic tape. In terms of onboard instruments, the main unit is the SAR system. Figure 1 shows the key SAR modes – image, wave mode and wind mode. For image data, the satellite scans along a swath 100km wide.

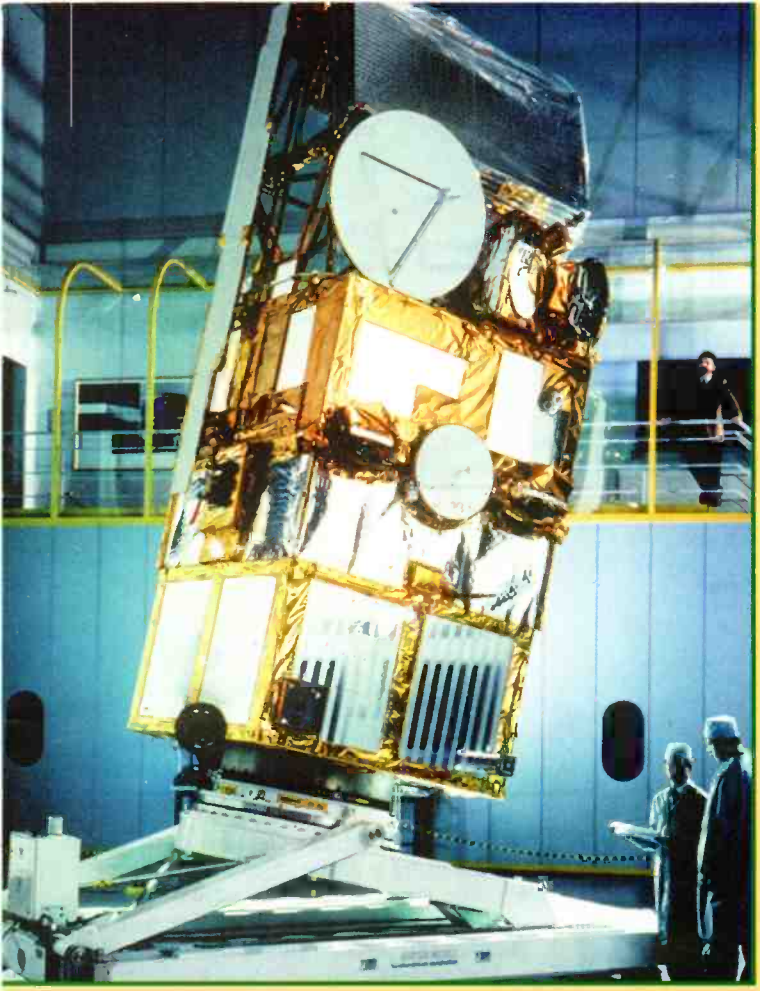
In image transmit mode, a pulse of 15·8MHz is linearly chirped and pulse shaped to be 37·2μs long. This signal is then up-converted to 5·3GHz and amplified to 250mW, prior to being fed into the High Power Amplifier (HPA) which outputs the final signal at around 5kW. The received signal can be compressed by a factor of about 590 by passing the received signal through an inverted dispersive delay line.

The high current drain of the imaging option of SAR and the large amount of data captured by the satellite when in this data capture mode requires that this option can only be operated for periods of approximately 10 minutes per orbit. In operation, the data rate communicated to ground is 105M-bit/s.

In wind mode, the satellite can scan along beams looking 45° forward, sideways and 45° backwards. These beams are continuously directed across a 500km swath of sub satellite track. Data is obtained within these coordinates on a 25km grid. The functional block of the Active Microwave Instrument is shown in Figure 2.

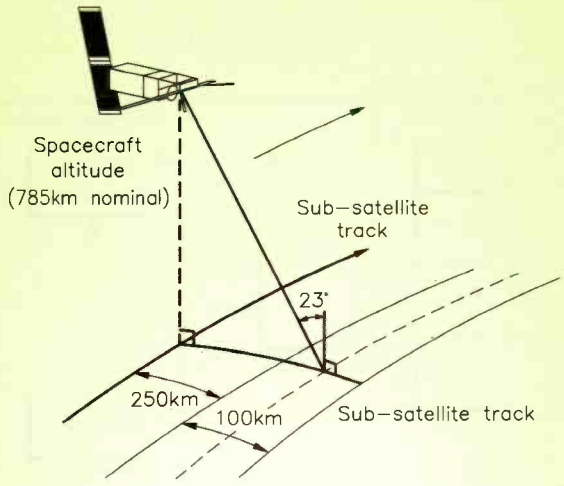
Radar Altimeter

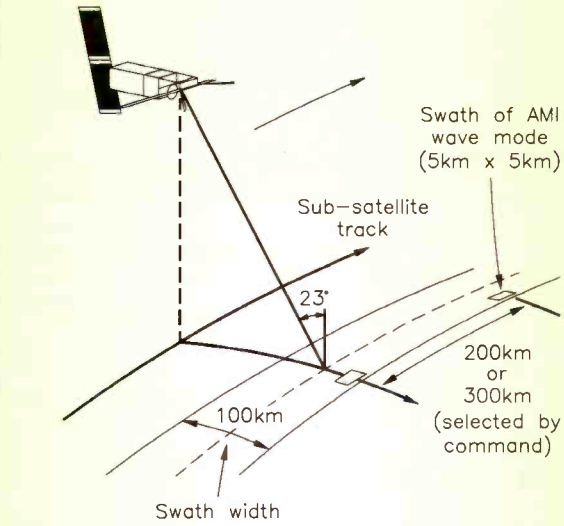
Precise measurement of the height of ERS above the surface of the Earth is provided by the Radar Altimeter. The data from the Radar Altimeter is interfaced to independent systems for tracking the satellite's precise orbit.

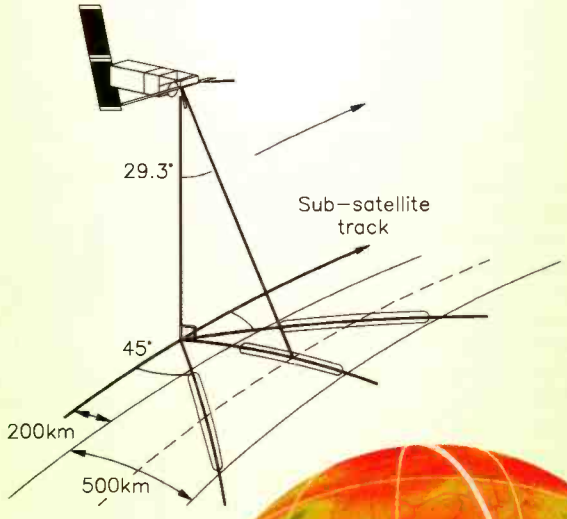


Above: Photo 1. Undergoing final check procedures at ESTEC. Noordwijk in the Netherlands. Key elements of systems check included ensuring satisfactory operation of sensitive electronic circuits in the close vicinity of high power microwave transmitters. (Courtesy: ESA ERS).

Photo 2. Diagram of the deployed satellite indicating the large SAR antennae and the extensive area of solar panel arrays. (Courtesy: ESA).







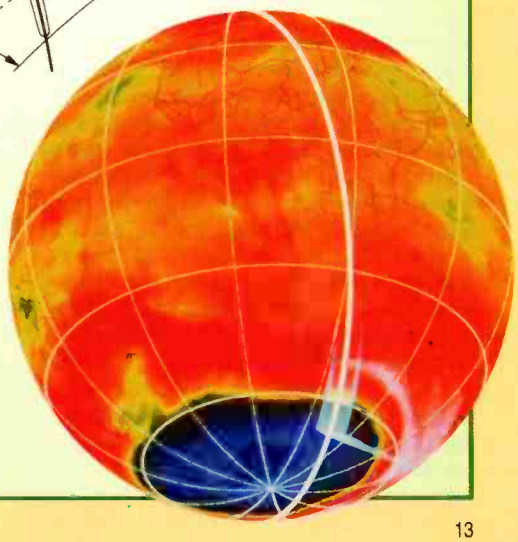


Figure 1. Scanning profile of the three main SAR modes, image, wave height and wind. (Courtesy: ESA).

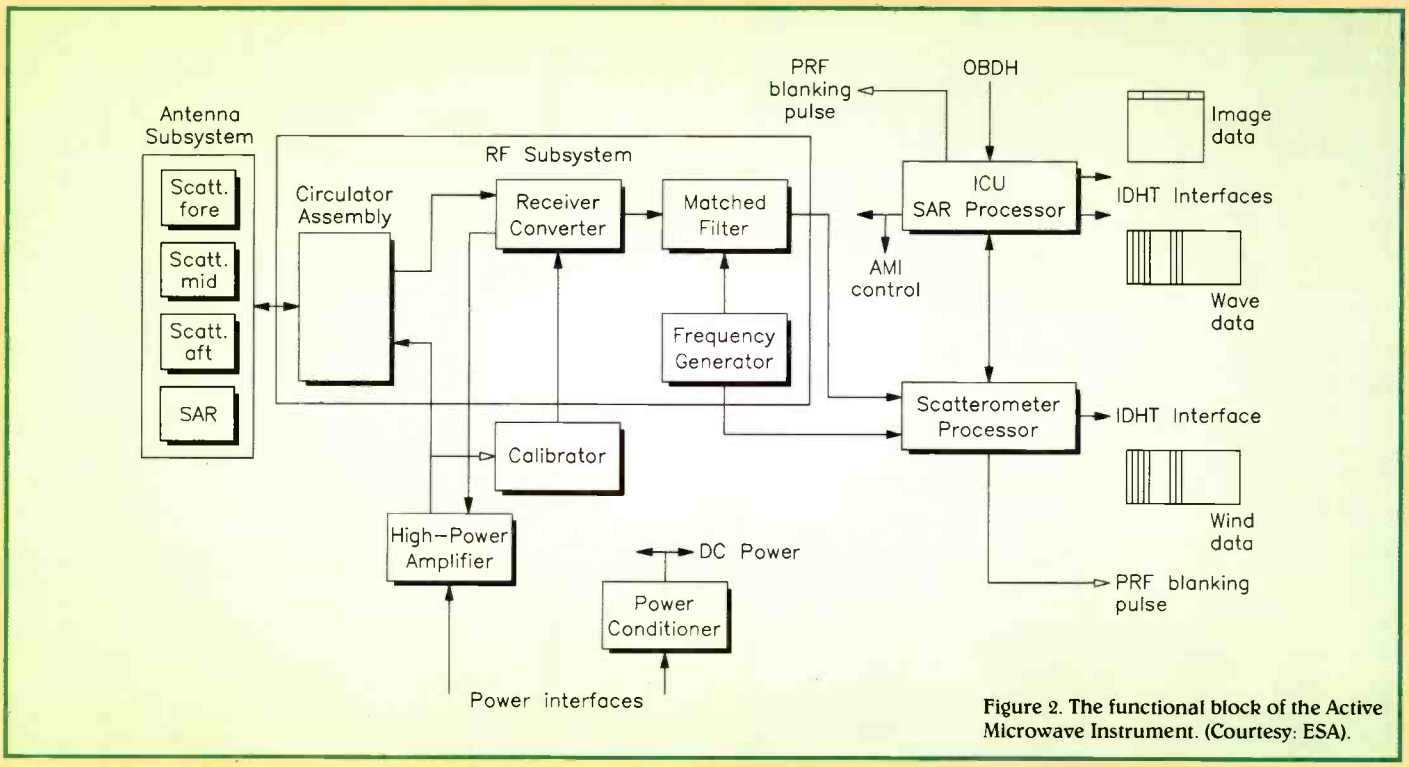


Figure 2. The functional block of the Active Microwave Instrument. (Courtesy: ESA).

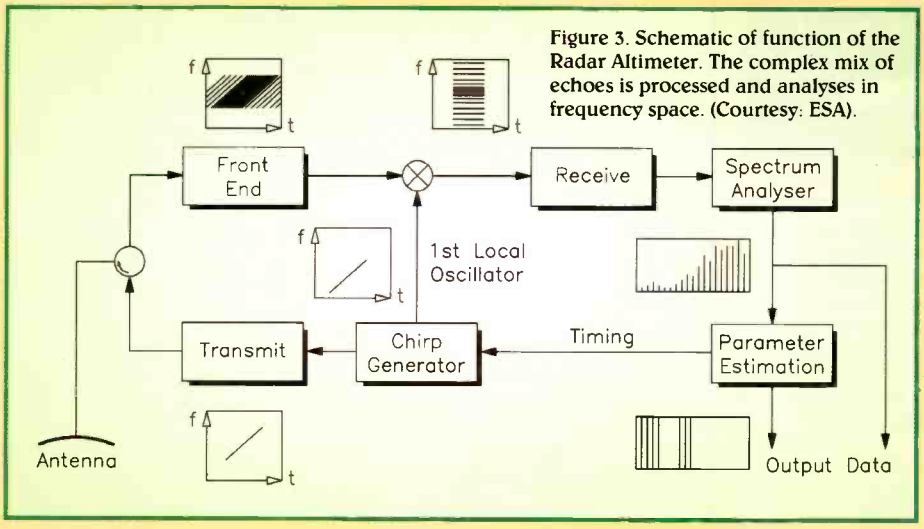


Figure 3. Schematic of function of the Radar Altimeter. The complex mix of echoes is processed and analyses in frequency space. (Courtesy: ESA).

One such system uses a passive reflecting device which is targeted by ground based satellite laser ranging systems. The PHARE instrument is an independent system which employs two-way micro-ranging systems in contact with ground stations.

The Radar Altimeter (RA) is primarily designed to make precise measurements of echoes from ocean and ice surfaces. The mechanism of the RA system is outlined in Figure 3. A chirp generator uses a surface acoustic wave (SAW) device driven at a pulse repetition frequency of 1.020Hz. The chirp comprises a frequency space as shown in the photograph. This signal is then up-converted to 13·8GHz and then on detection, down-converted and mixed with a fresh chirp signal. This results in a series of single frequencies in the time interval of the received pulse. From this is derived the spectrum of 64 points over a period of 3·03ns. A single value is derived as the average of fifty successive pulses. The full bandwidth of the spectrum is equivalent to a height window of about 30m in the ocean mode. The wave height can be interpreted from the distribution of the frequencies. The RA system operates at a power of 55W.

Due to different types of echoes from ice surfaces, a modified detection system is utilised using a lower chirp bandwidth of 82·5MHz. A range window of 115m is utilised – thus anticipating the more rough terrain of pack ice and glacier topography.

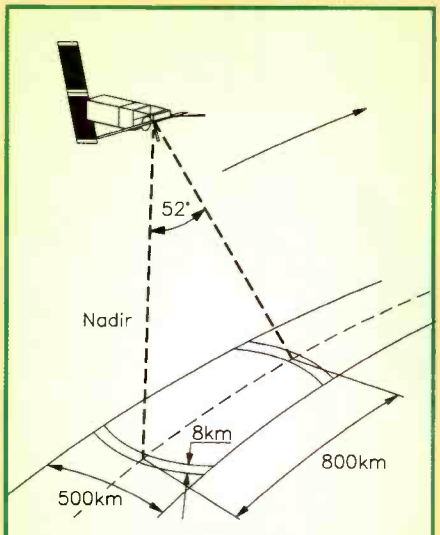


Figure 4. Scanning profile of the Along Track Scanning Radiometer (ATSR). Inside ATSR, a rotating mirror with a rotation period of 150ms operates over a swath of 500km and allows scanning in arcs directly under the satellite (Nadir view) and at a forward angle of 52°. (Courtesy: ESA).

The Along-track Scanning Radiometer and Microwave Sounder

The scanning radiometer is used to provide information on sea and land temperatures. For cloud-free operation, the accuracy of the unit is around 0·1K while for areas with up to 20% cloud cover, the accuracy is reduced to 0·5°C. The unit functions by measuring the level of infra red radiation at 1·6, 3·7, 11 and 12μm emitted by such surfaces. Calibration data is held on board in the form of one 'hot' and one 'cold' black body.

In terms of the area scanned by the system, a rotating mirror with a rotation period of 150ms operates over a swath of 500km, as shown in Figure 4. This allows scanning in arcs directly under the satellite (Nadir view) and at a forward angle of 52°.

As part of the data acquisition process, an initial series of 2,000 pixels are captured in a complete scan, including on board calibration sources. This is processed on board and returned to ground in the form of 555 Nadir view pixels, 371 forward-view pixels and 32 calibration pixels. This data, however, requires extensive ground processing to calculate the corresponding sea surface temperatures. The Along-track Scanning Radiometer was designed and developed by a team at the Rutherford Appleton Laboratory in the UK, and has performed exceptionably well.

The key role of the Microwave Sounder is to determine the amount of water vapour in the vertical column beneath the satellite. This information is, in turn, used by the Radar Altimeter to increase accuracy of its measurements. The Microwave Sounder uses channels at 23·8GHz and 36·5GHz, and has a constant 20km square view under the craft.

The Laser Retro-reflector

This unit is used to range find ERS using ground based laser systems. The corner cubes of the device are designed to reflect incident laser energy exactly along its incoming path. While sensitive in the optical spectrum between 350 to 800nm, its maximum sensitivity is at 532nm – the wavelength of red He-Ne lasers.

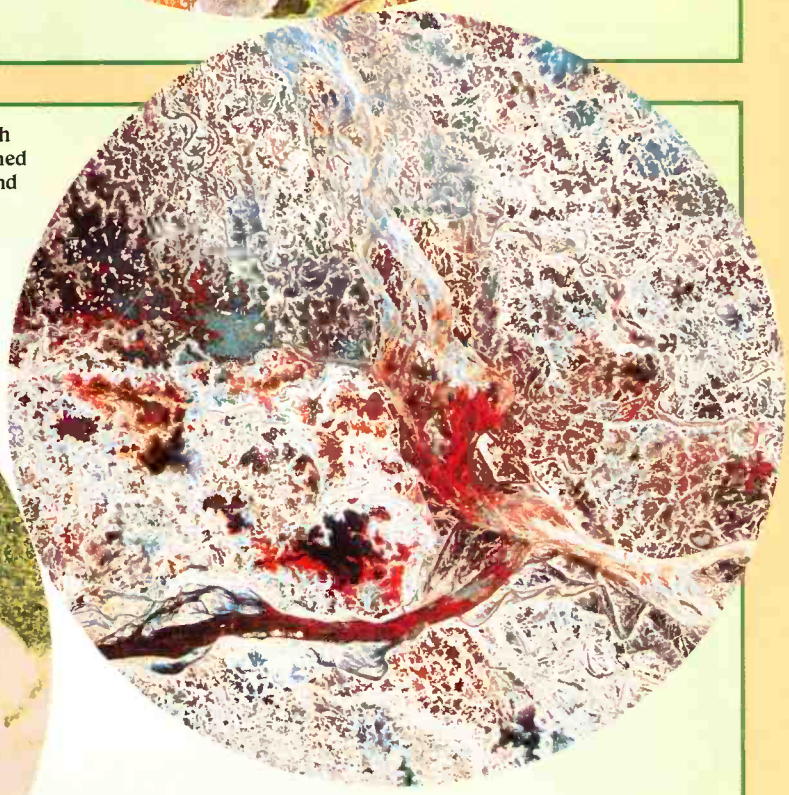
The Precise Range and Range-rate Equipment (PHARE)

A key element of the ERS mission is the ability to know the absolute position of the satellite with pinpoint accuracy. The PHARE system allows ranging of the ERS to be determined by about 5 to 10cm. The sequence of events is initiated by PHARE, with the emission of an S-band signal at 2·2GHz and one x-band signal at 8·5GHz. These signals will be detected by a ground station as time-resolved pulses due to ionospheric refraction. The ground station makes a coherent regenerated copy of the x-band transmission and this is detected by the PHARE unit on board ERS. Data is also computed on frequency shift of signals to provide range rate information. This system can be used by up to four ground stations simultaneously.

ERS in Action

The wealth of data relayed by ERS to Earth has been superb. As an instrument to monitor global climatic change, it provides frequent monitoring of key parameters such as

Above right: Photo 3. ERS image of the South Alligator River in North Australia and formed as a composite of three separate images obtained at intervals of several months. Changes due to flooding, bush fires and human activities can be readily inspected from the detailed image. (Courtesy: ESA ERS).



Above: Photo 4. Highly complex topography of confluence of the Brahmaputra and the Ganges is resolved in this ERS image. For images taken on the 24 July 1993 and 28 August 1993, red images indicate areas flooded at the earlier date and blue areas flooded in August. Black areas were flooded on both dates. (Courtesy: ESA ERS),

Left: Photo 5. Image of the Waterford region of Ireland. At the time the image was captured, the area was under extensive cloud cover. This highlights the considerable advantage of ERS as a weather/daylight independent scanning system. (Courtesy: ESA ERS).

the temperature of the oceans, distribution of currents and structure and distribution of ice. ERS's monitoring of sea surface winds and waves gives additional valuable information for weather forecasters. Safety at sea can be improved, especially in ice-infested regions. At an environmental level, oil spills can be readily detected.

In many ways, the images of ERS provide information keyed in radically different codes compared with simple optical images. In a precise geographical region, to some extent, the ERS images require to be investigated in the field in order to match up data sets to specific types of terrain. The ERS programme, therefore, is the focus for a very broad range of research activities worldwide. Also, a key part of the data processing of images obtained at different periods relates to highlighting areas which have changed significantly in data profile. The image shown in Photo 3 of the South Alligator River in North Australia indicates zones where significant changes have occurred in specific areas (Red: August 1992: Green: November 1992, and Blue: July 1993). Such changes relate, for example, to flooding, bush fires, change of vegetation or general land use.

ERS has been of particular value in casting a constant eagle eye at deforestation in the Amazon jungle, where monitoring can be undertaken more or less on a continual basis, whatever the level of cloud cover and daylight. Such studies have enabled a more accurate and speedy evaluation of rates of deforestation.

Even for areas of modest size, ERS images reveal as having a bewildering complexity. Photo 4 indicates a multi-temporal image, centred some 50km west of Dacca in Bangladesh. The main feature shown is the confluence of the Brahmaputra and Ganges rivers. The region is seen to be a maze of complex river courses linked to the main river channels. For images taken on 24 July 1993 and 28 August 1993, red images indicate areas flooded at the earlier date and blue areas flooded in August. Black areas were flooded on both dates. Occasional bright spots are identified as villages on slightly higher ground surrounded by permanently flooded rice fields. In the top right corner, a tropical rain forest is identified in light red colours.

Photo 5 shows the region of Waterford in Ireland, taken on 9 August 1991 – on a day which has almost complete cloud cover. The upper area (green) is the Suir Valley and the line of the coast is clearly delineated. For most areas of Europe, only one optical satellite image out of ten is cloud free – useful images are produced months apart. ERS, however, can produce meaningful images at intervals between 3 and 15 days. This also allows better co-ordination of ground studies following up satellite images when all of the scanned area is appropriate for ground study.

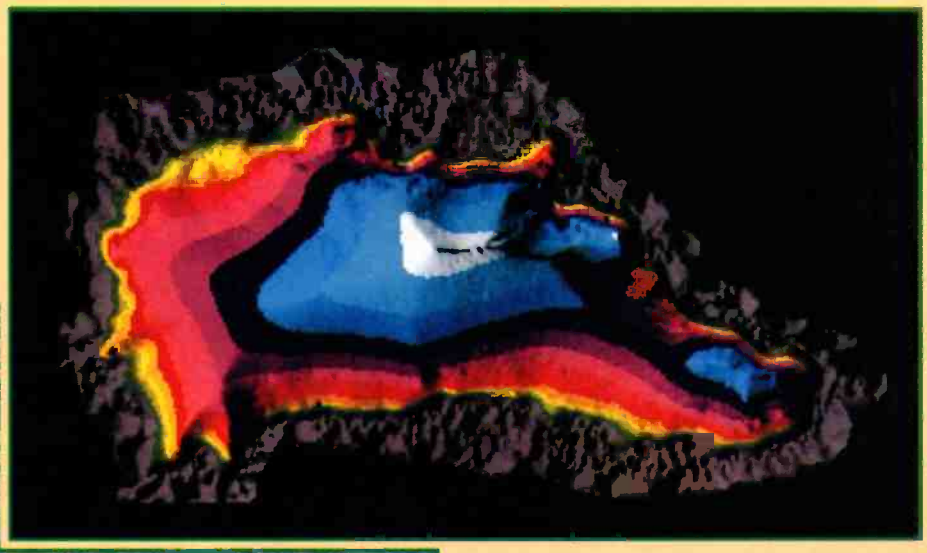
The ERS satellites are particularly useful for the study of oil pollution at sea. The presence of oil on water causes a change to the texture of the surface water, which is readily detected by the Synthetic Aperture Radar. Images were obtained, for example, of the oil spill during September 1991 off the French Riviera. ERS, in fact, detected the spill a day before aircraft of the French Navy observed the slick. ERS also returned images of the tanker Aegean Sea near La Coruna in Northern Spain during December 1992. Such images were able to provide precise details on the location of the areas of pollution, and would be essential for co-ordinating clean-up operations to disperse the slick at sea or lay booms to prevent contamination of bays and inlets.

Already, Norway is making use of ERS to monitor illegal discharges of oil from vessels in its territorial waters. This form of pollution typically arises from vessels cleaning their tanks, usually at night. Considerable work is being undertaken to improve the characterisation of oil slicks and other materials at sea. ERS is certainly able to identify the co-ordinates of vessels discharging oil at sea.

Recent events both in Europe and abroad have exposed the vulnerability of large areas of managed land to flooding. While such floods are caused by excessive and rapid rainfall, there are also contributing factors of river profile and the availability or not of natural flood plains for the rising rivers to spill out onto. Another key parameter is the level of water saturation of the soil. Data from ERS is being used to determine the degree of saturation of soils within zones of flooding and hence, help predict extents of flooding.

Right: Photo 6. Photomontage of the Camargue region of France which has been extensively studied by ERS in order to improve prediction of episodes of flooding. (Courtesy: ESA ERS).

Below: Photo 7. Topographic map produced by ERS's Radar Altimeter of Greenland. The highest point shown is at 3,277m above sea level. (Courtesy: MSSL-UCL/ESA).



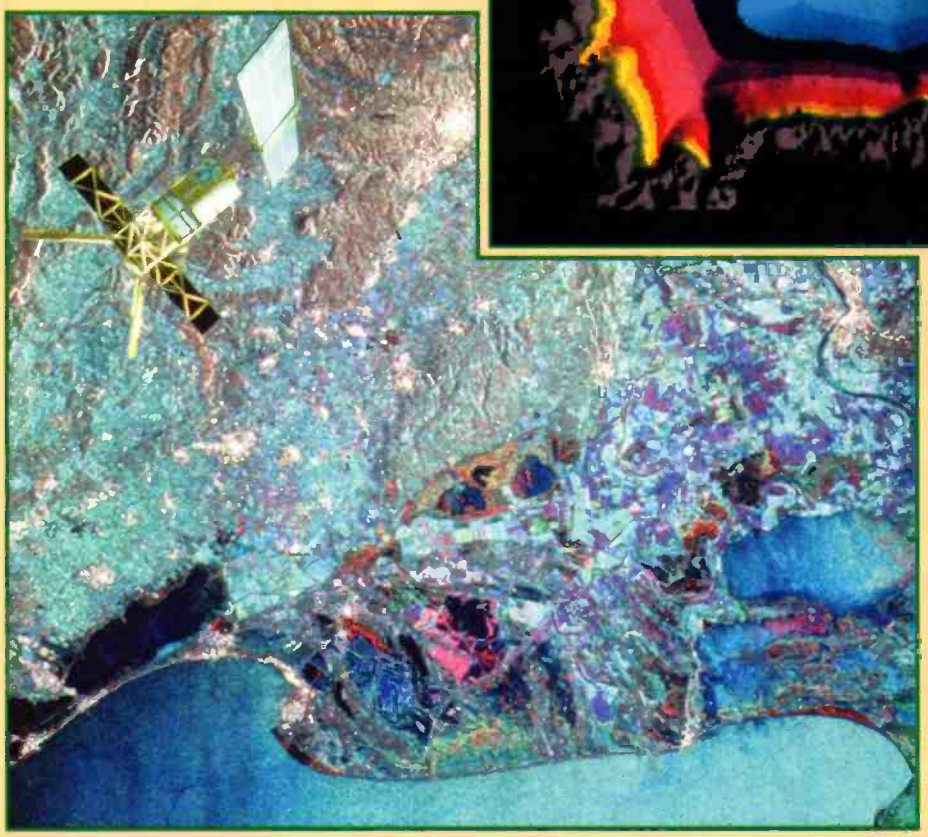


Photo 6 shows a photomontage of the Camargue region of France, where flooding frequently presents serious problems.

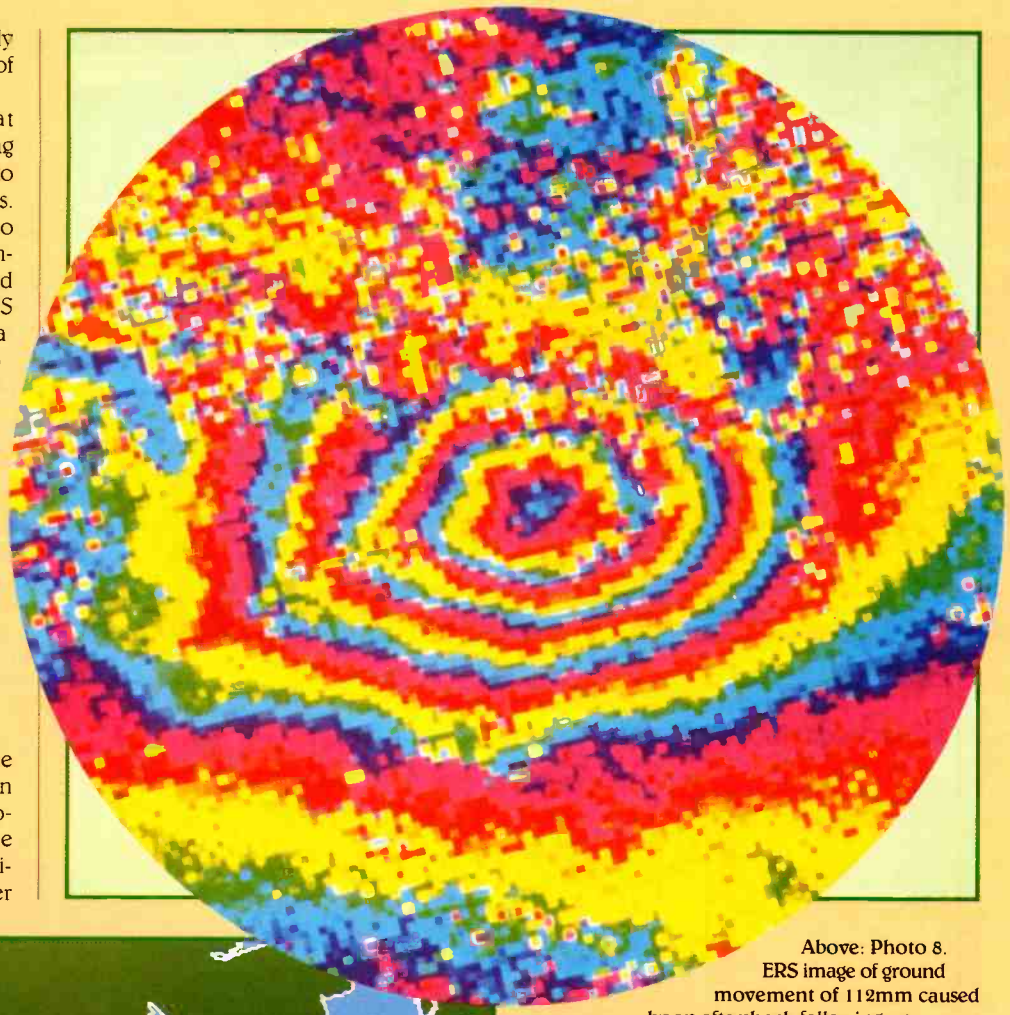
ERS is able to provide valuable information about the extent of ice cover over the Earth. These satellites have been able, for example, to produce a highly accurate topographical map of Greenland, from sea level to the highest point of ice cover at some 3,277m above sea level, as shown in Photo 7. This allows rapid and accurate monitoring of the mass balance of Greenland. A similar map has been produced for Antarctica, covering the latitude range +82°. Thus, the whole of Antarctica, except for a zone around the poles, can be readily scanned. This gives climatic researchers (for the very first time) highly accurate information regarding the ice mass of Antarctica and whether it is increasing or decreasing. With the ERS data acting as a form of baseline, cli-

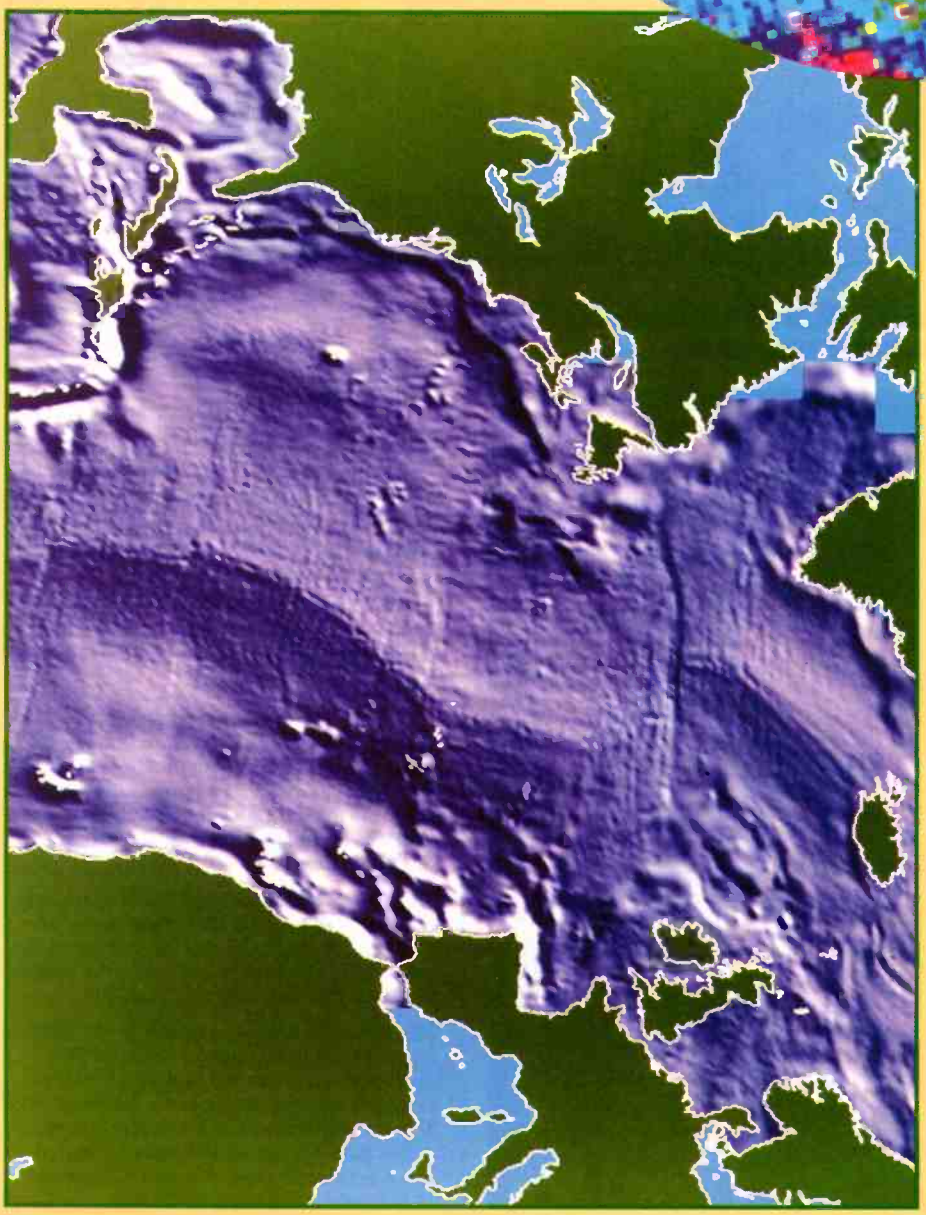
matic researchers will now be able to readily detect any significant changes in the mass of ice on this Southern continent.

With earthquakes still causing great destruction in the developed and developing world, technology is keenly being sought to help provide warning of such catastrophes. Images returned by ERS have been able to detect ground movements caused by earthquakes and aftershocks. One image obtained by a group of French researchers at CNES and shown in Photo 8, was able to detect a relative rising of ground of 112mm due to an aftershock that had taken place some months previously, during late 1992 in the Californian Mojave desert. This has indicated the great potential of SAR interferometry in measuring earth movements in millimetres over large areas and with a minimum of ground survey. There is, therefore, considerable activity underway in using SAR images to predict earthquakes by monitoring earth movements over a wide geographical area.

Mean Sea Surfaces

Strange as it may seem, the surface of the oceans are not uniformly 'flat'. Variations in the local gravity field caused by inhomogeneity in the crustal structure and also the effects of ocean currents, gives rise to variations in sea level from expected levels. Over





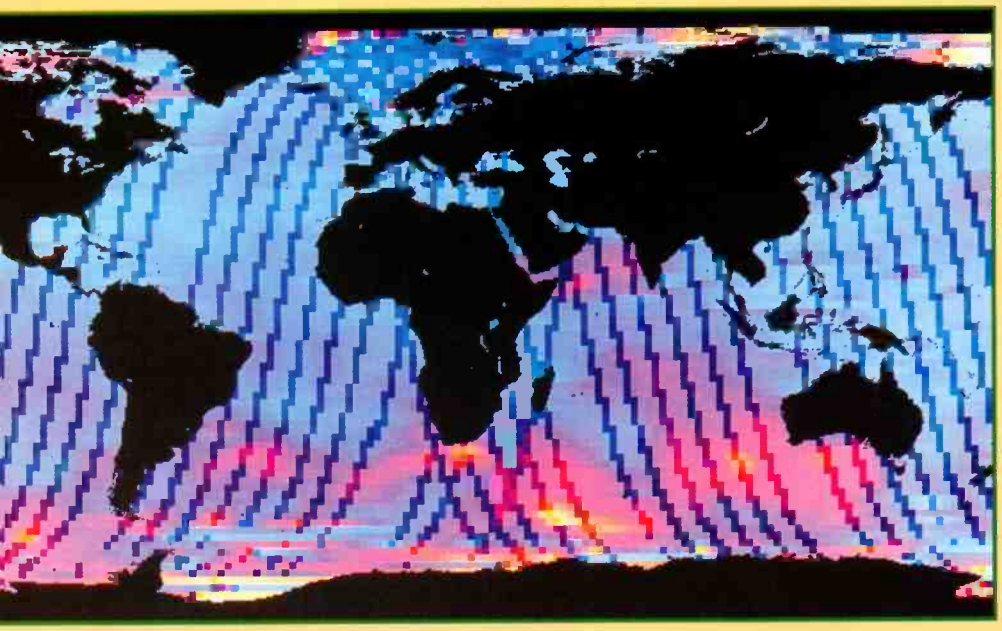
Above: Photo 8. ERS image of ground movement of 112mm caused by an aftershock following an earthquake of late 1992 in the Californian Mojave desert. The Synthetic Aperture Radar is thus able to remotely detect millimetre scale earth movements arising from crustal instability, and may hold the key to predicting earthquakes when such data is available over a large geographical area. (Courtesy: CNES/CNRS/ESA).

Left: Photo 9. Radar Altimeter image of surface of North Atlantic, showing how water collects over topographical features on the ocean floor. (Courtesy: ESA).

the world's oceans, the extreme range of deviation ranges from –105m south of India (a dip in the level) to +85m north of Australia. In many ways, the ocean surface mirrors the topography of the sea floor. The increased gravity around features such as the mid-Atlantic ridge tends to 'gather' water to the feature, which in turn, tends to raise up water levels over the feature. Such details are clearly visible in Photo 9. The Global Radar Altimeter has enabled highly accurate measurements to be made over almost the entire globe. With a precision of 2cm, ERS has allowed maps to be derived of unprecedented accuracy.

Global Wave Imaging

The Radar Altimeter of ERS can, in a three day full orbital cycle, undertake an almost complete mapping of the wave heights of the world's oceans. Photo 10 shows the data from the Radar Altimeter Significant Wave Height analysis during a three day orbital cycle during early August 1991. Blue colours correspond to waves of 1 to 2m, red values above 5m and yellow above 12m. The northern oceans are experiencing calm summer weather, though significant wave activity is

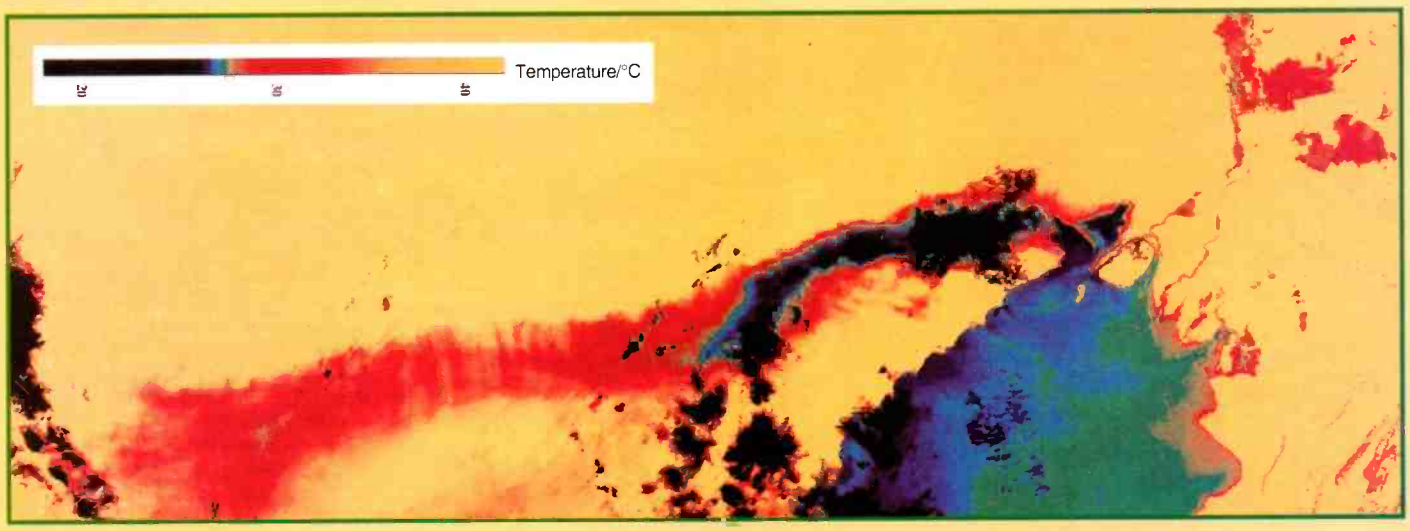


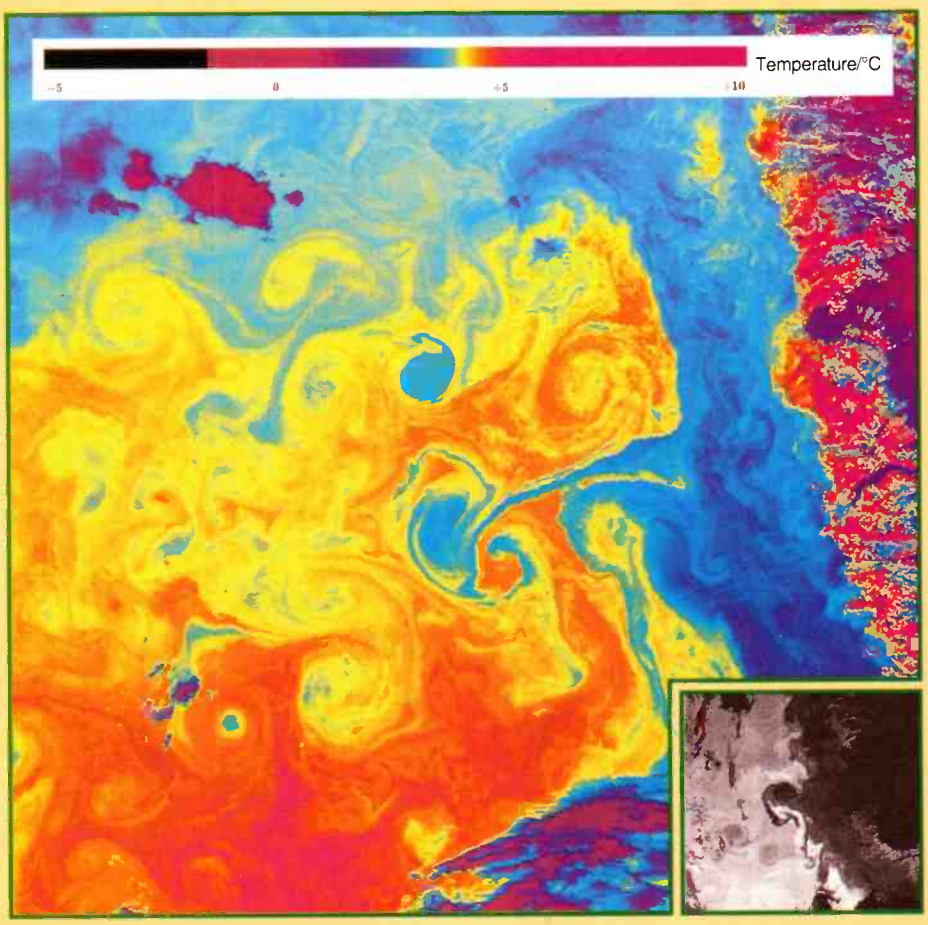
present in the southern oceans, with a severe storm off South Africa.

Systems are being developed using this and similar sets of data, to improve wave forecasting for shipping and generally improve safety at sea. There are obvious applications in the oil and gas industry, where accurate information of wave height is critical, both for exploration and supply and maintenance of oil installations. Also, on a more futuristic level, this set of information is of key value for developments planned to extract energy from the waves of the Earth's oceans and seas.

Temperature Studies

The Along Track Scanning Radiometer (ATSR) is a key equipment item on board ERS, used to monitor the Earth's temperature. The scanning at the nadir position, directly under the satellite and at the forward position, allows correction of data for atmos-





pheric absorption. In studies of climate change, the data from ocean temperature is a key contribution to the development of climate models.

The set of channels at 1·6, 3·7, 11 and 12μm provide slightly different sets of information. The scan at 1·6μm is closest to optical wavelengths, and gives an indication of surface reflectivity. The channel at 11μm provides the greatest signal relative to temperature profiles of land and sea surfaces.

The UK Meteorological Office has developed a model of Ocean-atmosphere General Circulation, which predicts the effects of 65

Top right: Photo 10. Global wave imaging of three day orbital period in August 1991 using the Radar Altimeter. The image shows areas of blue (waves of 1 to 2m), red (waves of above 5m) and yellow (waves of above 12m). (Courtesy: ESA).

Above: Photo 11. Effect of the setting alight of Kuwait Oil fields. This ERS image taken on 7 August 1991 indicates that there is significant lowering of air temperature under the regions of dense smoke. (Courtesy: ERC/ESA).

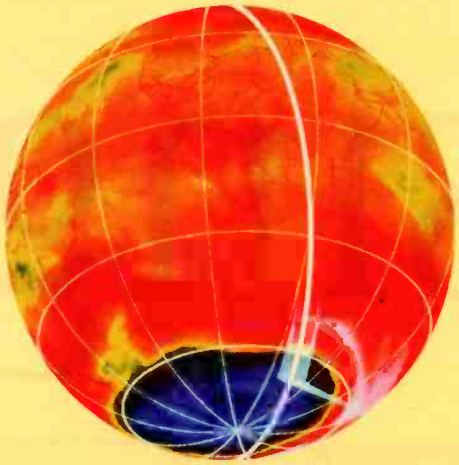
Left: Photo 12. Mixing of waters on the west coast of Greenland and the Labrador Sea. Spirals of cold water migrate west into the relatively warmer waters of the Labrador Sea. This circulation pattern is a typical feature of this area. The image indicates an area of 512 × 512km, and was acquired at 11μm on 10 July 1992. (Courtesy: NERC/ESA).

years of increases of 1% in CO_2 levels. Such a model predicts that the Northern Oceans will warm up more significantly than those near the tropics. Surprisingly enough, however, the North Atlantic just south of Greenland should cool slightly. Changes to the UK climate, however, on the basis of temperature, should only be slight. Significant increases, however, will take place on the major land continents.

Things Natural and Unnatural

Only a few weeks after ERS's launch, the Kuwait Oil fields were set alight by retreating Iraq troops. This image of Photo 11 shows how, in the area of 512×1,000km, the underlying air temperature was some 7° cooler than adjacent unaffected areas. While this was an exceptional event, satellite observations of gas flares have indicated that the routine flaring of gas from oil production sites is equivalent to 3% of all hydrocarbon burning worldwide.

Ocean currents influence significantly aspects of local climate. In Photo 12, the mixing of cold water along the west Greenland coast takes place with the warmer waters of the Labrador Sea. The pattern of strands of cold water projecting in a westerly direction is a typical characteristic of such current patterns. The inset (lower right) indicates a similar pattern obtained some three months previously.



Summary

The ERS mission has already operated for over 150% of its planned lifetime and in that time, has returned a vast wealth of highly relevant scientific images and data. The recent successful launch of the ERS-2 on 20 April 1995, almost a copy of ERS, has provided greater flexibility in image selectivity. ERS-2 is equipped with additional sensors for atmospheric ozone and three additional channels in the visible spectrum, to optimise vegetation monitoring. In many ways, the data of ERS and ERS-2 belongs to everyone. For its part, the European Space Agency will be only to pleased to provide information/images to inquirers (see Points of Contact). E

Points of Contact

Publications

Proceedings of the First ERS Pilot Project Workshop, 21-23 June 1994, Toledo, Spain.

CD-ROM Guide to ERS.
CD-ROM SAR Reference Coverage.
ERS User Handbook.
ERS Product Specifications.
From ERS to ERS-2: Destination Earth.
ERS: 500 days in orbit.

The above are available from:
ESA Publication Division,
ESA/ESTEC, Keplerlann 1,
NL-2200 AZ Noordwijk ZH,
Netherlands.
Fax: (+31) 1719-17400.

Media Material

ERS slide set.
ERS Photo CD.
What a Wonderful World: 24 minute video VHS-PAL/English.

The above are available from:
ESA Public Relations, Division,
8/10 rue Mario Nikis, F-75738 Paris cedex 15
France.
Fax: (+33) 1 4273 7690.

Along Track Scanning Radiometer Data
Press and Public Relations Section,
Rutherford Appleton Laboratory,
Rutherford Appleton Laboratory,
Chilton, Didcot, OX11 OQX.
Tel: (01235) 446482. Fax: (01235) 446665.

CLASSIFIED

Placing an advertisement in this section of *Electronics* is your chance to tell the readers of Britain's Best Selling Electronics Magazine what you want to buy or sell, or tell them about your club's activities – Absolutely Free of Charge! We will publish as many advertisements as we have space for. We will print the first 30 words free, but thereafter the charge is 10p per word for each added advert per reader.

Placing an advertisement is easy! Simply write your advertisement clearly in capital letters, on a postcard or sealed-down envelope. Then send it, with any necessary payment, to: Classifieds *Electronics – The Maplin Magazine*, P.O. Box 3, Rayleigh, Essex SS6 8LR. Advertisements will be published as soon as possible, space allowing. No responsibility is accepted for delayed publication or non-inclusion of advertisements.

Readers who have reasonable grounds to believe they have been misled as to the nature of an advertisement are advised to contact the Publisher and their local Trading Standards Office.

VARIOUS

ELECTRIC MOTOR BOOKS £10 each. *Rewinding AC Motors* 538pp, *Fractional H/P Motors* 372pp, *Rewinding Small Motors* 263pp, *Repair Shop Diagrams* 387pp, *Winding AC Motor Coils* 281pp. Tel: (01332) 738502.

OSCILLOSCOPE Telequipment model D61, double beam, 10MHz, excellent condition, with manual, £50. Quad valve FM tuner, good condition, with manual, £20. Tel: D. Moss (0181) 977 6649 (Teddington).

MAPLIN 3800/5600 SYNTH and Matinee organ construction manuals, with original demo cassette tapes. £5 the pair inc. postage o.b.o., will separate. Tel: (0191) 528 8664 (Sunderland).

MAPLIN NICAM DECODER. Full working order, complete with mains PSU. Cased, aligned by Maplin service dept., £50. NICAM compatible video recorder, Philips VHS VR6870/05. £250 or offers for both. Tel: (01245) 450050 (Chelmsford).

1·8 METRE SATELLITE DISH with polar mount, substantial ground stand, concrete blocks, motor arm, feed horn, Chapperal Twister O.M.T./polarizer 11GHz and 12GHz LNBs, £350 the lot! Tel: (01243) 431313.

20MHz DUAL-TRACE OSCILLOSCOPE Topward 7025, Maplin Stock Code (GL29G), cost new £300, 3 years old but used only once, hence immaculate condition. £200 or nearest offer. Tel: (01772) 315653.

WANTED

DATA FOR CONVERTING PHILIPS BSB STU902 unit to D2MAC. EPROM listing, etc. Contact: V. Stanley, 36 Meadow Court, Little Port, Ely CB6 1JW. Tel: (01353) 862076 (Answerphone).

SOMEBODY TO CONSTRUCT SIMPLE CIRCUIT for non-electronics hobbyist, on PCB, plan provided. Fee to be negotiated. Please write to: Peter R. Kirk, Le Court, Greatham, Liss, Hants GU33 6HJ.

MISCELLANEOUS

TOA POLYRECORDER EPR-3T, 2-channel chart recorder, X channels – 5mV to 100V FSD, chart speeds 20mm/hr to 180mm/min, chart width 165mm. Needs some attention, but only £25! Tel: (01582) 460531 (Herts).

CLUB CORNER

CRYSTAL PALACE & DISTRICT RADIO CLUB. Meets on the third Saturday of each month at All Saints Church Parish Rooms, Beulah Hill, London SE19. Details from Wilf Taylor, (G3DSC), Tel: (0181) 699 5732.

AARS (Aberdeen Amateur Radio Society) meets on Friday evenings in the RC Hall, 70 Cairngorm Crescent, Kincorth. For details contact: Martin, (CM0JCN), Tel (01569) 731177.

THE BRITISH AMATEUR ELECTRONICS CLUB (founded in 1966), for all interested in electronics. Four newsletters a year, help for members and more! UK subscription £8 a year (Junior members £4, overseas members £13.50). For further details send S.A.E. to: The Secretary, Mr. J. F. Davies, 70 Ash Road, Cuddington, Northwich, Cheshire CW8 2PB.

BURY ST. EDMUNDS AMATEUR RADIO SOCIETY. Meetings held at Culford School, 7.30pm for 8.00pm on the third Tuesday of each month, unless otherwise stated. Further details from Kevin Waterson, (G1GVI), 20 Cadogan Road, Bury St. Edmunds, Suffolk IP33 3QJ. Tel: (01284) 764804.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY meets every Wednesday at 7.30pm, at 119 Green Lane, Derby. Further details from: Richard Buckby, (G3VGW), 20 Eden Bank, Ambergate DE56 2GG. Tel: (01773) 852475.

ELECTRONIC ORGAN CONSTRUCTORS SOCIETY. For details of meetings, Tel: (0181) 902 3390 or write to 87 Oakington Manor Drive, Wembley, Middlesex HA9 6LX.

E.U.G. User group for all 8-bit Acorn Micros, since 1991. Still going strong. Programming, news, information, sales. Contact: E.U.G., 25 Bertie Road, Southsea, Hants. PO4 8JX. Tel: (01705) 781168.

THE LINCOLN SHORT WAVE CLUB meets every Wednesday night at the City Engineers' Club, Waterside South, Lincoln at 8pm. All welcome. For further details contact Pam, (G4STO) (Secretary). Tel: (01427) 788356.

MODEL RAILWAY ENTHUSIAST? How about joining 'MERG', the Model Electronic Railway Group. For more details contact: Paul King (Honorary Secretary), 25 Fir Tree Way, Hassocks, West Sussex BN6 8BU.

PRESTON AMATEUR RADIO SOCIETY meets every Thursday evening at The Lonsdale Sports and Social Club, Fulwood Hall Lane, Fulwood, (off Watling Street Road), Preston, Lancashire PR2 4DC. Tel: (01772) 794465. Secretary: Mr Eric Eastwood, (G1WCQ), 56 The Mede, Freckleton PR4 1JB, Tel: (01772) 686708.

SCIENCE AT YOUR FINGERTIPS, for 'hands-on' science experiences and experiments, *Science at Your Fingertips Science Review*, Membership £2.50. For further details, please contact Daniel and Caroline Gee, The S.A.Y.F., 37 South Road, Watchet, Somerset TA23 0HG.

SOUTHEND & DISTRICT RADIO SOCIETY meets at the Druid Venture Scout Centre, Southend, Essex every Thursday at 8pm. For further details, contact: P.O. Box 88, Rayleigh, Essex SS6 8NZ.

SUDBURY AND DISTRICT RADIO AMATEURS (SanDRA) meet in Gt. Cornard, Sudbury, Suffolk at 8.00pm. Visitors and new members are very welcome. Refreshments are available. For details please contact Tony, (G8LTY), Tel: (01787) 313212 before 10.00pm.

THANET ELECTRONICS CLUB. For school age Ham Radio and Electronics enthusiasts, enters its 16th Year. Meetings held every Monday evening from 7.30pm at The Quarterdeck, Zion Place, Margate, Kent. For further details contact: Dr. Ken L. Smith, (G3JIX), Tel: (01304) 812723.

SEEMUG (South East Essex Mac User Group), meet in Southend, every second Monday of each month. For details Tel: Michael Foy (01702) 468062, or e-mail to mac@mikefoy.demon.co.uk.

TESUG (The European Satellite User Group) for all satellite TV enthusiasts! Totally independent. TESUG provides the most up-to-date news available (through its monthly 'Footprint' newsletter, and a teletext service on the pan-European 'Super Channel'). It also provides a wide variety of help and information. Contact: Eric N. Wiltsher, TESUG, P.O. Box 576 Orpington, Kent BR6 9WY.

WAKEFIELD AND DISTRICT RADIO SOCIETY meet at 8.00pm on Tuesdays at the Community Centre, Prospect Road, Ossett, West Yorkshire. Contact Bob Firth, (G3WWF), (QTHR), Tel: (0113) 282 5519.

THE (WIGAN) DOUGLAS VALLEY AMATEUR RADIO SOCIETY meets on the first and third Thursdays of the month from 8.00pm at the Wigan Sea Cadet HQ, Training Ship Sceptre, Brookhouse Terrace, off Warrington Lane, Wigan. Contact: D. Snape, (G4GWG), Tel: (01942) 211397 (Wigan).

WINCHESTER AMATEUR RADIO CLUB meets on the third Friday of each month. For full programme contact: G4AXO, Tel: (01962) 860807.

WIRRAL AMATEUR RADIO SOCIETY meets at the Ivy Farm, Arrowe Park Road, Birkenhead every Tuesday evening, and formally on the the 1st and 3rd Wednesday of every month. Details: A. Seed, (G3FOO), 31 Withert Avenue, Bebington, Wirral L63 5NE.

WIRRAL AND DISTRICT AMATEUR RADIO SOCIETY meets at the Irby Cricket Club, Irby, Wirral. Organises visits, DF hunts, demonstrations and junk sales. For further details, please contact: Paul Robinson, (G0JZP) on (0151) 648 5892.

BBS CORNER

APPLE CRACKERS. FirstClass Client BBS, mainly for AppleMac and PC users. Baud rate 2·4K-bit/s to 28·8K-bit/s, 8 data bits, no parity, 1 stop bit. Tel: (01268) 781318/780724.

MACTEL METRO/ICONEX. FirstClass Client BBS, AppleMac and PC users. E-mail address on Internet for registered users. Baud rate 2·4K-bit/s to 28·8K-bit/s, 8 data bits, no parity, 1 stop bit. Tel: (0181) 543 8017 (Metro) or (0115) 9455417 (Iconex).

SPIDER! AMIGA BBS. The lighter alternative. Mainly Amiga and some PC files. Fidonet, Mercurynet and Mufonet. Online games. Speeds up to 19200. Tel: (01568) 613520.

All singing

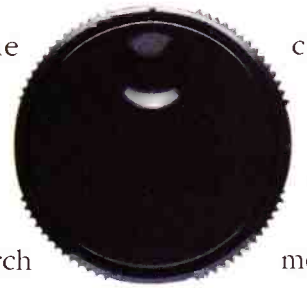
Sound LAB

That's the CDJ2600 from Soundlab. It's the twin CD for DJ's that does just about everything you could possibly ever need.

It comes as two 2U rack-mount units, finished in black enamel with clear legends and large, user-friendly controls, which are easy to find and use, even in the lowest light conditions.

The green LCD displays both track number and elapsed time to frame accuracy, while a 'time' button allows the track or CD time remaining to be displayed. It even gives a visual reminder should you leave one of the CD trays open.

When you're looking for a cue point, you can choose between two methods offered by a single concentric wheel. The outer ring gives shuttle search, while the inner portion allows Jog Search accurate to 5 frames (0.2 sec). Once you have found a cue point, it can be memorised then used instantly with a single 'cue' button.



An innovative joystick gives you total control over the comprehensive loop facilities: simply pushing the stick upwards memorises the loop start point and pulling it downwards marks the end point, giving a single repeat. Should you then pull the

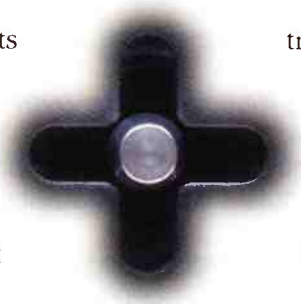
All dancing

reproduction is ensured by 16 bit, 8x over-sampling DAC technology, and ease of set-up is guaranteed by the unit's intelligent design.

The control panel connects to the transport via just two mini DIN leads which carry all power and control signals, while a single AC power lead means minimum mains requirements and virtually no spaghetti.

joystick down during the loop, it will repeat continuously.

Left/right movements of the joystick allow pitch bend for special effects and beat synchronisation when used together with the switchable pitch control.



And the CDJ2600 is as tough as it is talented. The robust twin transport has been designed to survive life on the road, while damped mechanisms offer a very high degree of mechanical isolation, to maximise playability in any conditions. High quality sound

All these features for only

£499.99 inc VAT

Order Code 51244

For more information call

01702 554161

MAPLIN

MONDO MAPLIN

2ND Time Around

Designed by Alan Williamson
Text by Alan Williamson
and Maurice Hunt

Intelligent Ni-Cd Battery Charger Mk II

3 PROJECT RATING

KIT AVAILABLE (95056) PRICE £69.99 C4

FEATURES

- 1 or 12-hour charge time with subsequent trickle charge
- Battery temperature and contact monitoring
- Charging interrupt for overvoltage or excessive temperature
- Constant current charge and discharge
- Charge pulse with modulation for battery capacity matching
- Automatic predischarge cycle
- Timer clock via internal oscillator
- LED status output for mode indication

APPLICATIONS

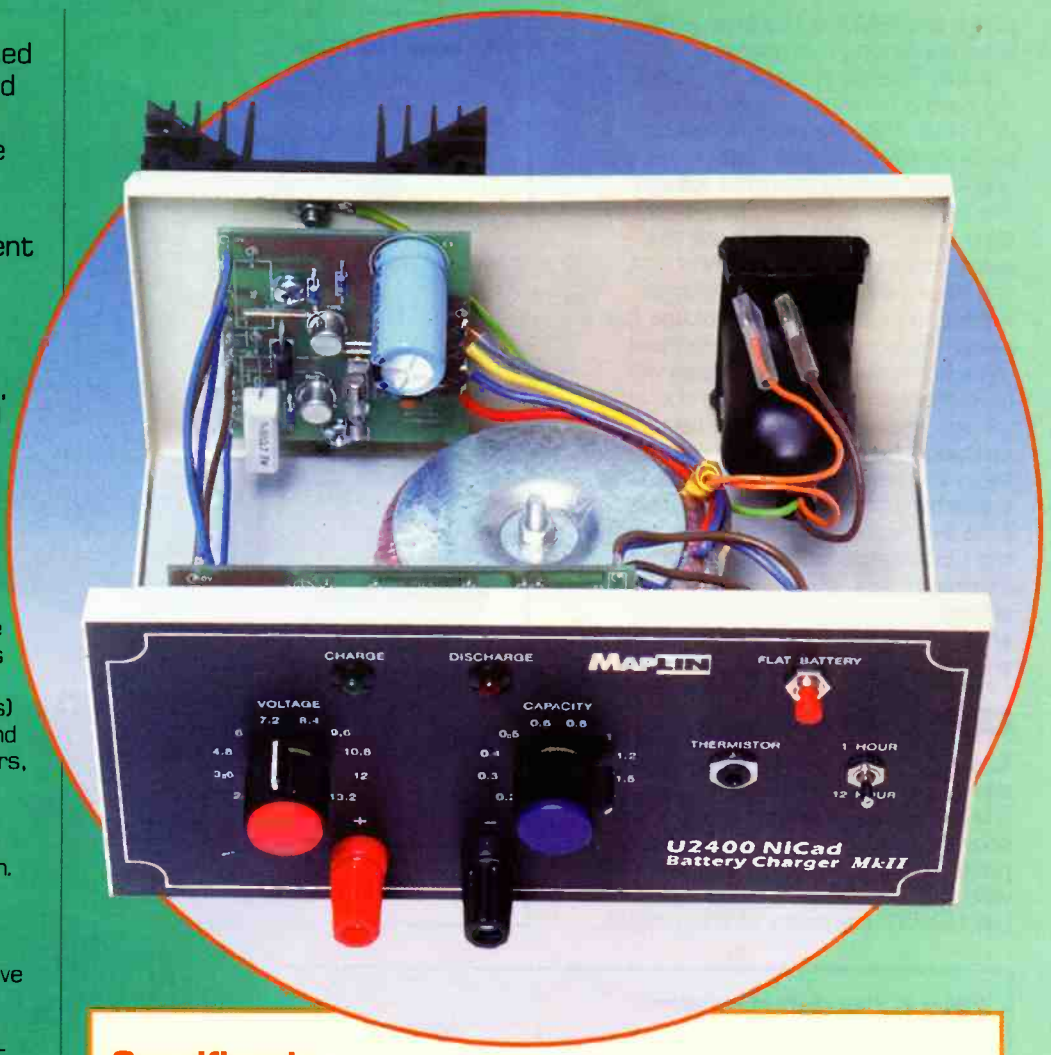
- Charging/discharging Ni-Cd cells
- Reviving damaged or misused cells

Due to numerous requests from customers for an updated version of the Intelligent Ni-Cd Battery Charger (previously described in *Electronics* Issue 79) catering for a wider selection of battery voltages and capacities, we now present the MkII version.

THIS revised and significantly improved design of 'intelligent' Ni-Cd battery charger is based, as with the previous version, around the U2400B IC, which has been specifically designed to handle the needs of Ni-Cd batteries. The new design offers, in addition more than double the number of voltage and capacity ranges, a beefier power supply stage using larger (power) transistors, to reduce temperature coefficient drift. The IC itself contains much of the electronics required, which include (amongst other things) a processor unit, battery voltage and temperature monitoring comparators, PWM comparator, open collector charge and discharge outputs, LED status output, an oscillator, voltage reference and mains synchronization. However, not all the features obtainable from the IC are used in this application.

The use of this charger can improve the performance of a cell or cells with 'reduced' capacity, by providing constant current discharge to a flat condition first before the constant current charging cycle commences. Once the charge cycle is completed (giving a 100% charge), the battery is then (by means of the Pulse Width Modulation (PWM) technique) 'trickle charged' for 100ms every 16·8s, which equates to a 'form factor' of 0·6%.

To enable different voltage and lower capacity batteries than 2Ah to match the charger, two rotary switches are provided. The voltage select switch divides the battery potential terminal voltage to provide the correct level for the voltage comparators, while the battery capacity selector switch



Specification

Power supply:	230V AC 50Hz
Power consumption:	45W maximum
Input connector:	IEC plug
Output connectors:	4mm terminal posts
Overall dimensions:	205 × 106 × 197mm (WHD)
Battery voltages:	Any combination of 1 to 12 cells
Battery capacity:	100, 200, 300, 400, 500, 600, 800mAh, 1, 1·2, 1·5, 1·7, 2Ah
Charge time:	1 or 12-hour
Over-temperature threshold:	45°C
Charge current:	2A, pulse width modulated (PWM)
Discharge current:	500mA
Minimum/maximum cell voltage:	0·8V/2V
Overload protection:	3·15mA Fuse

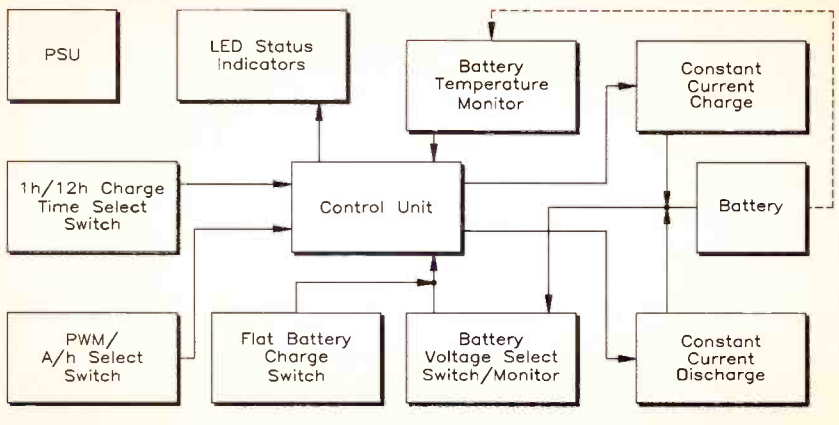


Figure 1. Overall block diagram of the Ni-Cd Battery Charger.

IMPORTANT SAFETY NOTE

It is important to note that mains voltage is potentially lethal. Full details of mains wiring connections are shown in this article.

Every possible precaution must be taken to avoid the risk of electric shock during maintenance and use of the final unit. Safe construction of the unit is entirely dependent on the skill of the constructor, and adherence to the instructions given in this article.

If in any doubt as to the correct way to proceed, seek advice from a qualified engineer.

alters the PWM of the charge circuit, thus preventing overcharging.

A fully functional single Ni-Cd cell will have a terminal charge voltage of 1·4 to 1·6V. However, a reduced capacity (or damaged) battery will rise above the nominal terminal voltage. The voltage monitoring comparator will then be active and increment the event counter. It will then interrupt the clock, and turn off the charge output, until the terminal voltage falls below the predetermined maximum voltage (an overheating battery will have the same effect). Once the voltage and/or temperature have dropped, the charger will then begin to charge the battery again. If another violation occurs (whether it be over-voltage or overtemperature), the LED status indicators will flash alternatel, see Table 1. Should this situation occur, the cell or battery should then be 'cycled', i.e. charged and discharged several times.

Circuit Description

To assist the reader in understanding the circuit description, first refer to the block diagram in Figure 1, which shows the overall concept of the project. Figure 2 shows the flow chart with the sequences and operation of the U2400, the heart of this project,

The assembled PCBs.

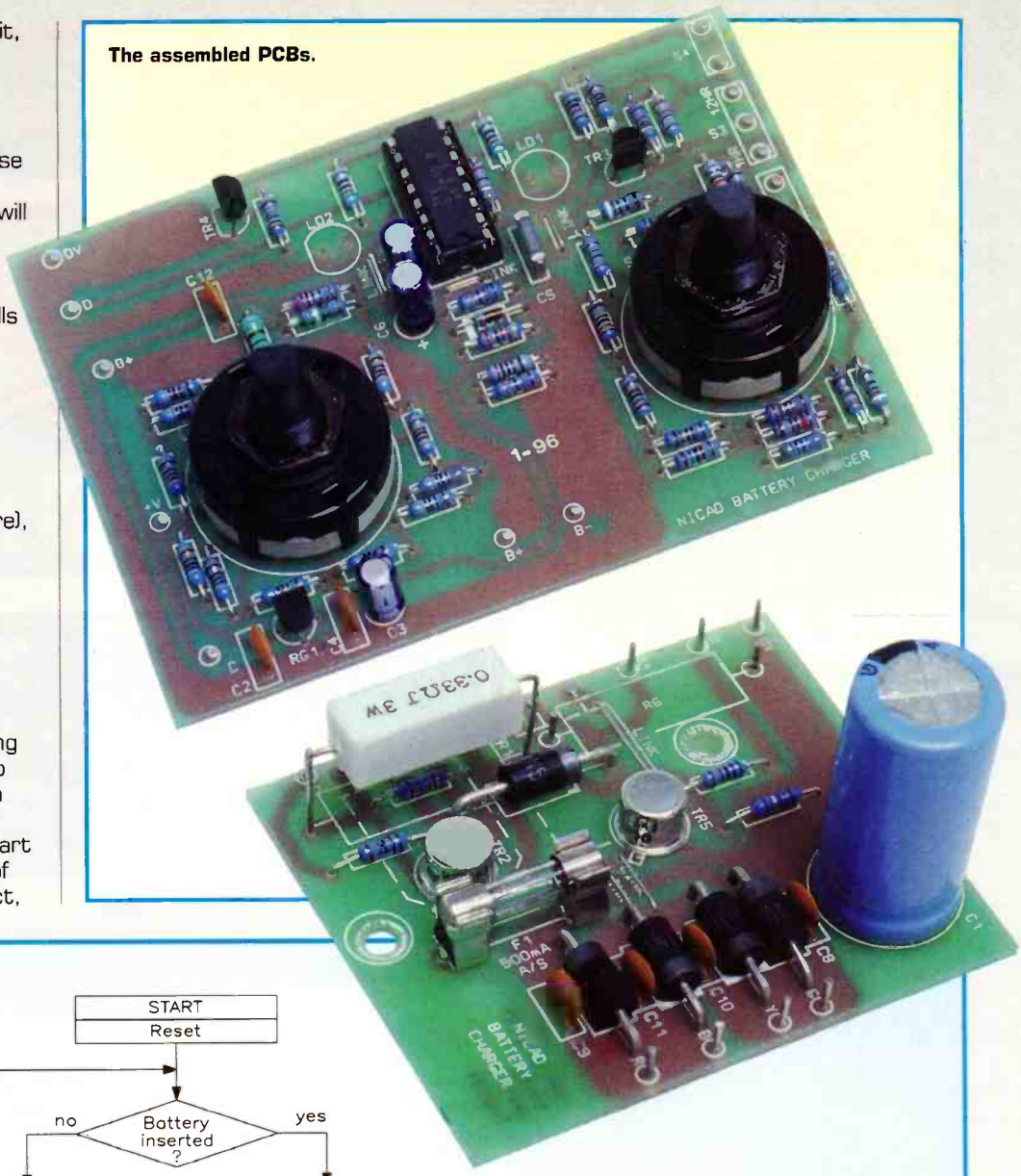
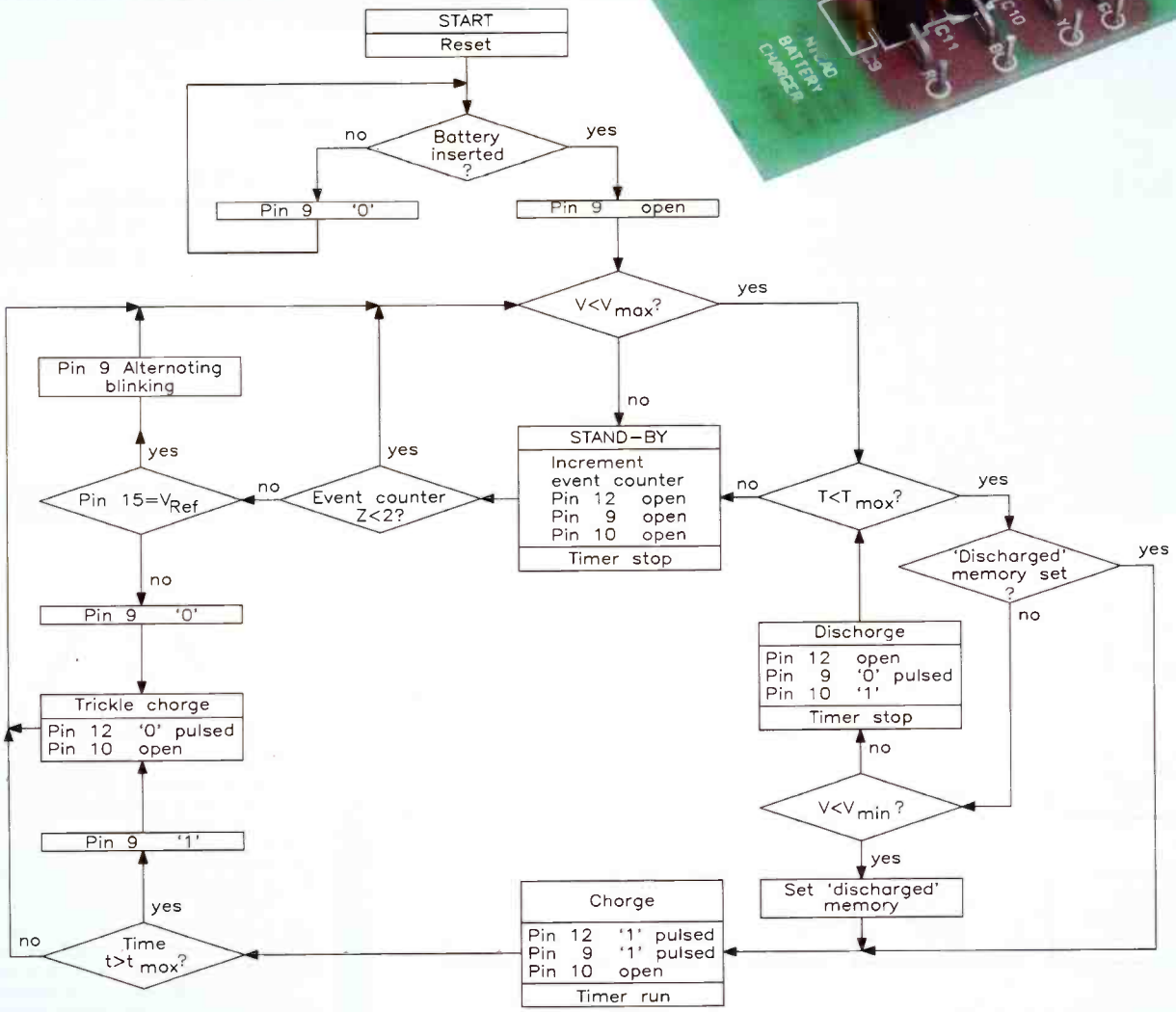


Figure 2. Flow chart of operation.



and Figure 3 shows in more detail the internal operation of the IC. The individual circuit stages are described in the following paragraphs.

Charge and Discharge Circuit

Refer to Figure 4, the circuit diagram of the Ni-Cd Battery charger. TR1 and TR2 combined with R1 and R2, form the 'constant current' charge circuit. TR5, TR6 and R5 (with the optional R6) form the 'constant current' discharge circuit, in each case, R1, R2 and R5 (and optional R6) set the current rate. With the values shown, the charge rate is set at 2A, and the discharge rate at 500mA. Note that a 1Ω5 0·6W resistor is supplied in the kit for R6, but this can be altered, if you wish, to set the required discharge rate; the resistor can be practically any value you want it to be, but must be of a suitable power rating, calculated as below:

$$\text{Power} = \frac{V^2}{R} = \frac{0{\cdot}36}{R6}$$

Use a resistor with a power rating of the next highest value to the calculated figure.

Diode D5 prevents discharge of the cell or battery via the constant current circuit, should the circuit be powered down.

Battery Voltage Selection

R22 to R27 determine the minimum and maximum voltage per cell. The values chosen set the minimum voltage to 0·8V and a maximum of 2V; the recommended current through the divider chain is ≥ 20μA.

Calculating Cell Minimum and Maximum Voltages

If alternative voltages are required, all the values will have to be altered. However, the total resistance *must*

LED STATUS	FUNCTION
Continuous red	Standby
Flashing red	Discharge cycle
Flashing green	Charge cycle
Continuous green	Trickle charge
Alternate flashing red/green	Overtemperature failure
Intermittent alternate flash red/green	Overvoltage charge failure
No LED illuminated	Under-voltage

Table 1. Functions indicated by LEDs.

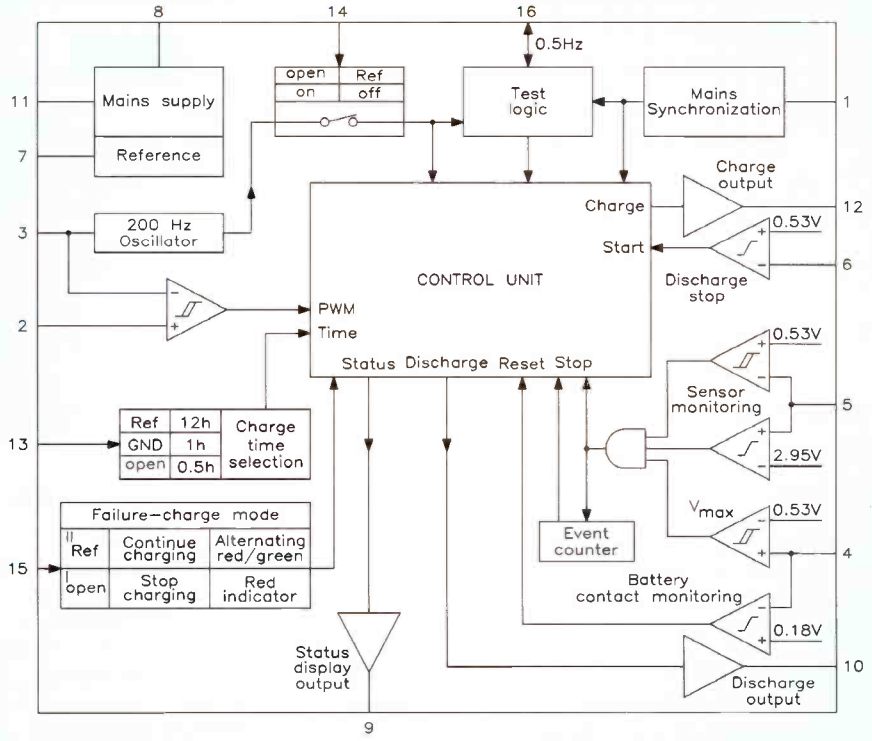
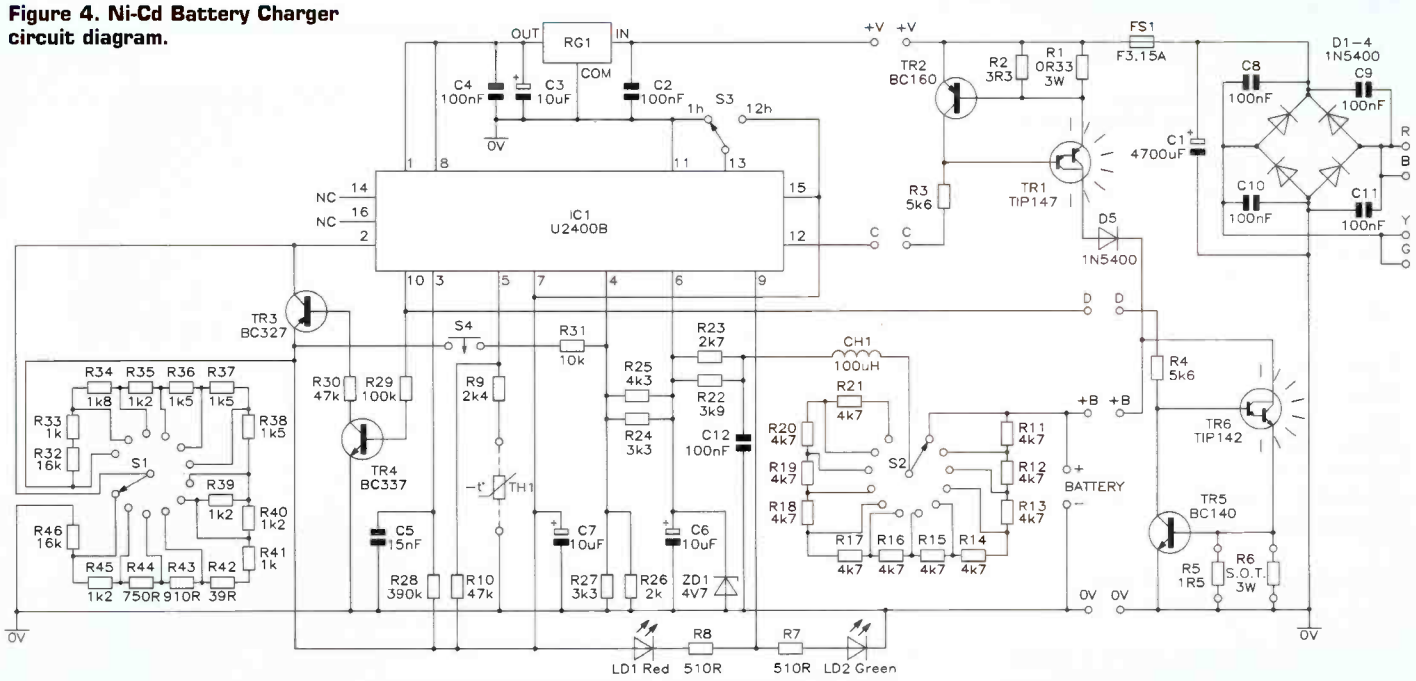


Figure 3. Block diagram of U2400B IC including pin-out.

Figure 4. Ni-Cd Battery Charger circuit diagram.



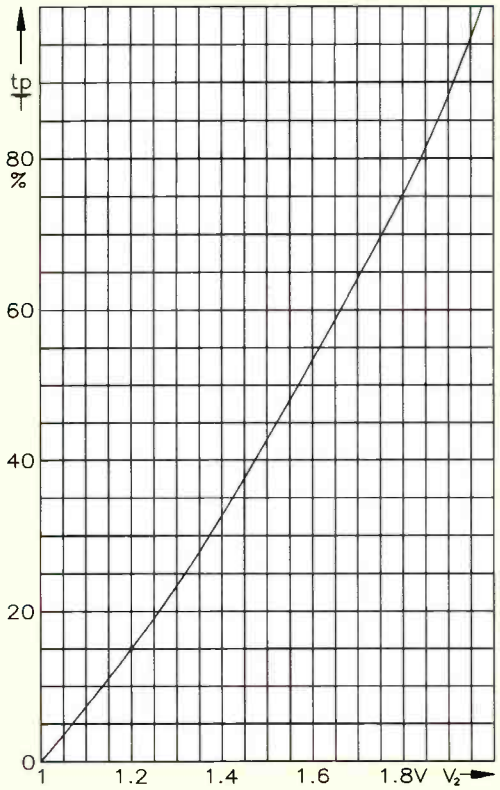
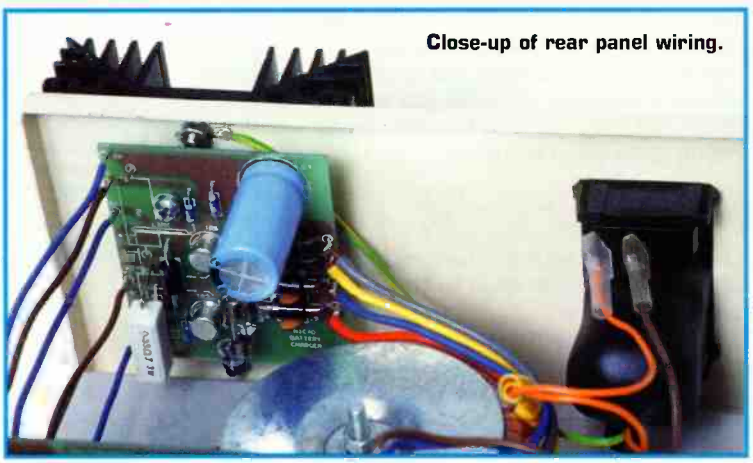


Figure 5. Pulse width versus input voltage graph.

Close-up of front panel wiring.



Close-up of rear panel wiring.

remain the same (assuming the voltage selector resistor chain (R11 to R21) remains unchanged).

To calculate new maximum and minimum voltages, some simple mathematics is required:

$$R_a = \frac{(0{\cdot}53 \times R_t)}{V_m}$$

$$R_c = R_t - \left(0{\cdot}53 \times \frac{R_t}{V_{min}}\right)$$

$$R_b = R_t - R_x$$

The values of R_a, R_b and R_c are found from the following equations:

$R_t = R_a + R_b + R_c$, 4k7Ω

$R_a = \frac{R26 \times R27}{R26 + R27}$ (or use reciprocal method)

$R_b = \frac{R24 \times R25}{R24 + R25}$

$R_c = \frac{R22 \times R23}{R22 + R23}$

$R_x = R_a + R_c$

If different battery voltages are required, i.e. a 24V pack (20 cells), the 'upper arm' impedance of the divider chain will need altering; simply add 4k7Ω per 'extra' cell on top of the S2 divider chain total impedance, or alternatively, use the formula below:

$R_t \times$ (Number of cells −1) = R11 upwards to R21

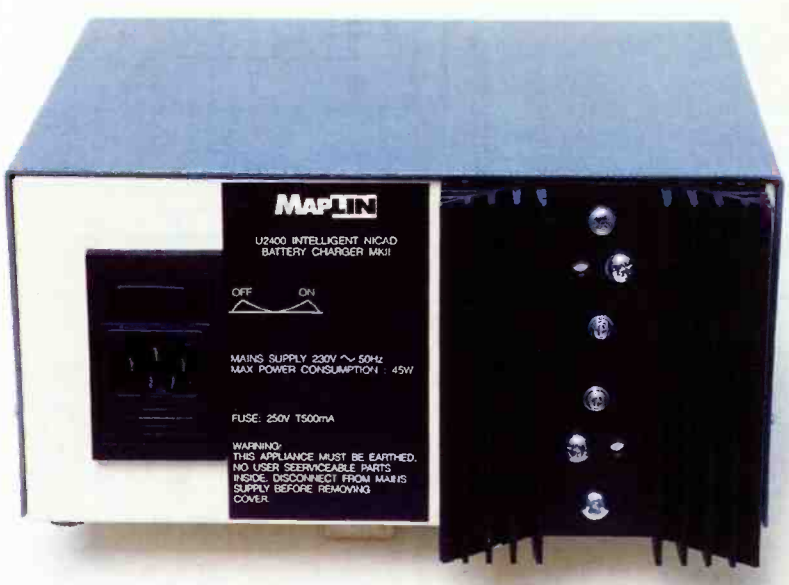
E.g., 24V = 20 cells, 20-1 × 4k7Ω = 89k3Ω = total impedance of R11 to R21.

Battery Contact Monitoring

The U24008 IC also includes a 'battery contact monitor' comparator to detect the presence of a cell or battery; the comparator requires a minimum input of 180mV, or a voltage of 500mV per cell for the resistor values in this circuit.

If a cell or battery is discharged below the minimum contact voltage, the charger will not recognise its presence and therefore, will not be charged. Switch S3 has been included to overcome the 'flat battery' problem. Pushing SW3 will connect the reference voltage (pin 7) through a 10kΩ resistor to the cell or battery maximum voltage comparator (pin 4). This will 'force' the charger into the charge mode while the switch (S4) is depressed, or until the cell or battery has sufficient charge to activate the 'battery contact monitoring' comparator.

A time lapse of 2s should be allowed between disconnection and reconnection to 'inform' the charger that a new cell or battery has been connected.



Shot of assembled rear panel from outside the box.

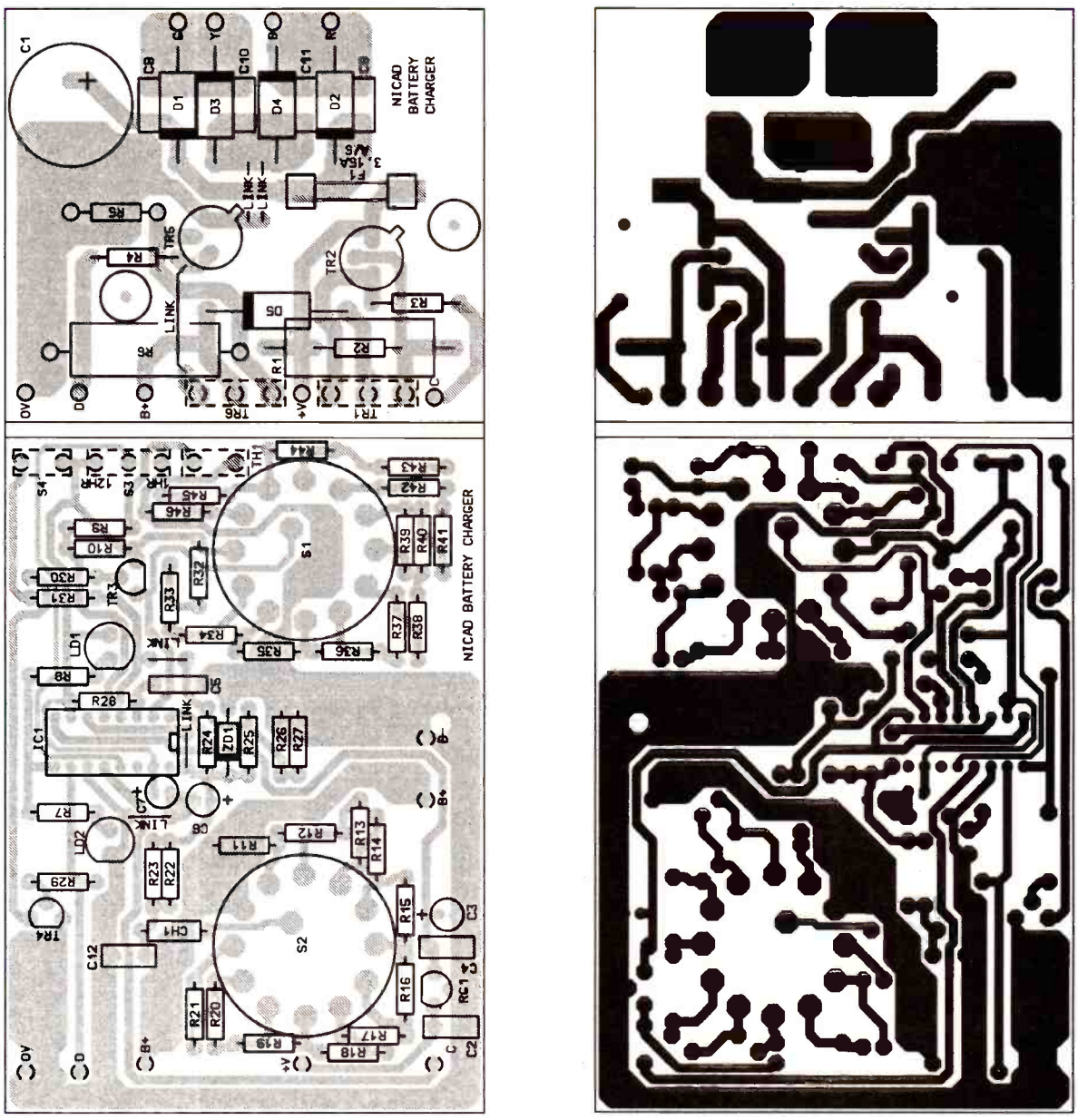


Figure 6. PCB legend and track.

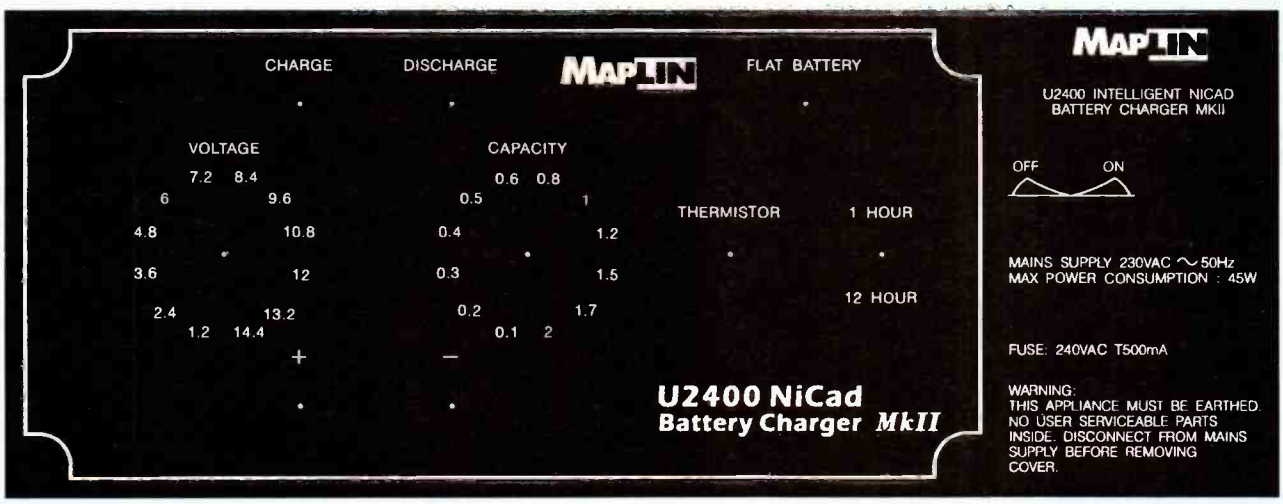


Figure 7. Front and rear panel labels, shown $^{2}/_{3}$ scale.

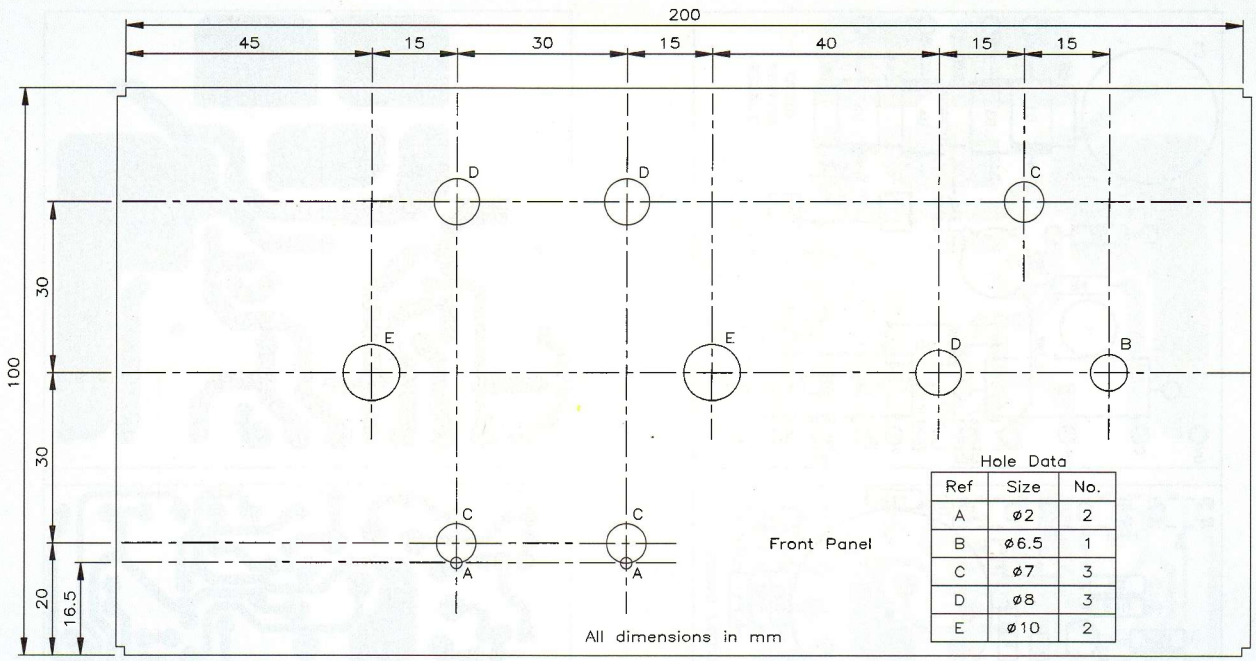


Figure 8a. Front panel drilling.

Figure 8b. Rear panel drilling.

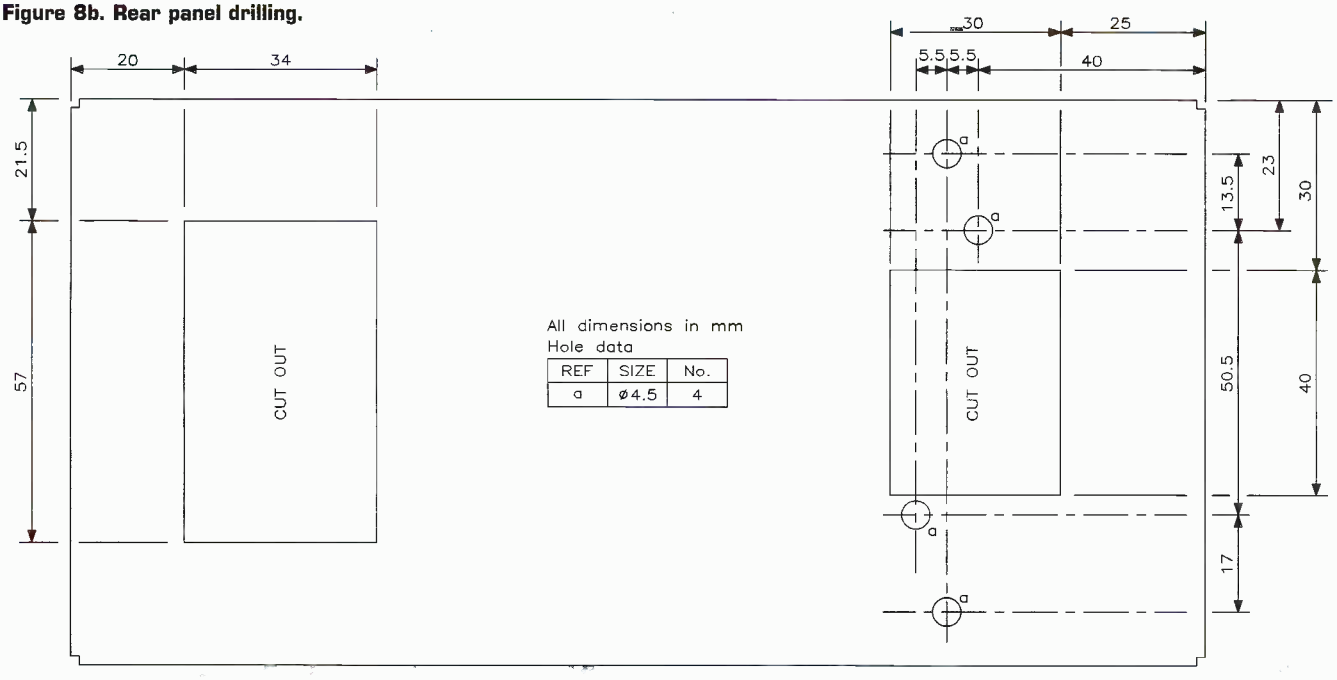
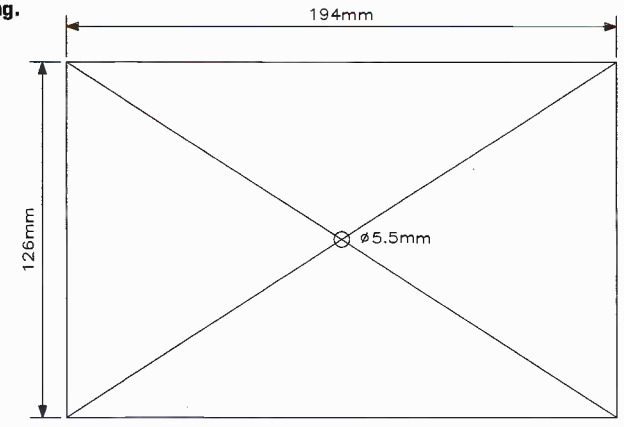


Figure 8c. Base drilling.



Pulse Width Modulation (PWM)

The resistor chain R32 to R46 determines the PWM characteristics of the charge circuit. An input voltage in the range of 0·9 to 2·1V will have a PWM ratio of 0 to 100%. Refer to Figure 5; the divider current should be in the range of 20 to 200µA.

During the discharge cycle, TR3 and TR4 connect the reference voltage to the PWM comparator input, therefore, different capacity cells or batteries are discharged at the same relatively low rate to ensure that a complete discharge is achieved.

Charge Time

The switch S3 selects between a 1-hour fast charge or a 12-hour slow

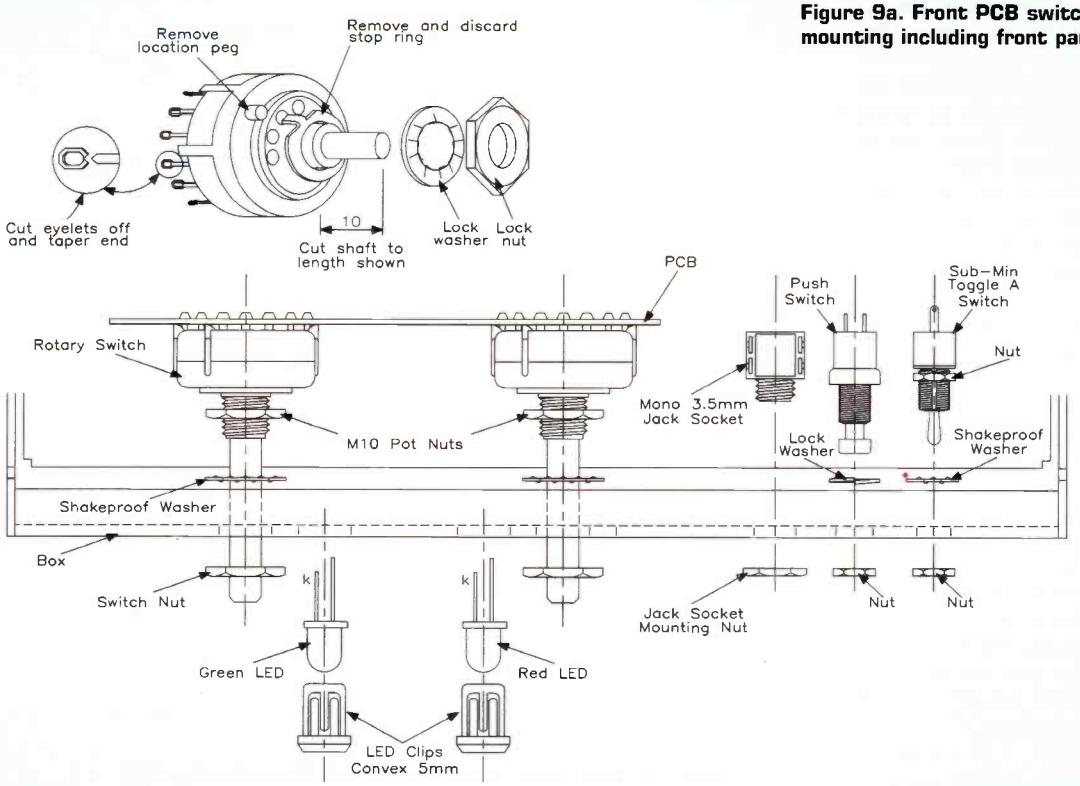


Figure 9a. Front PCB switch and LED mounting including front panel assembly.

charge. Selecting the 12 hour position will automatically pulse width modulate the charge circuit at a ratio of 1:11 (1 on, 11 off), which effectively, will give the same amount of charge to a cell as a 1-hour charge cycle. The 100ms charge pulse width will also be pulse width modulated if the cell or battery capacity switch (S2) is set lower than the maximum.

Temperature Monitoring

Another useful feature of the IC is that it has a 'battery temperature monitor' circuit which consists of R9, R10 and TH1. Should the cell or battery temperature rise above a preset point (with the chosen components, greater than 45°C), the temperature comparator will be activated, a second violation will turn off the charge and discharge outputs. The status indicator LEDs will then flash alternately. The battery temperature must then drop to approximately 30°C before the charger continues the cycle (the comparator has 15mV of hysteresis).

If you are wondering what the second comparator on the block diagram is for, its function is to determine whether the thermistor is connected or not; the charger will not function without it!

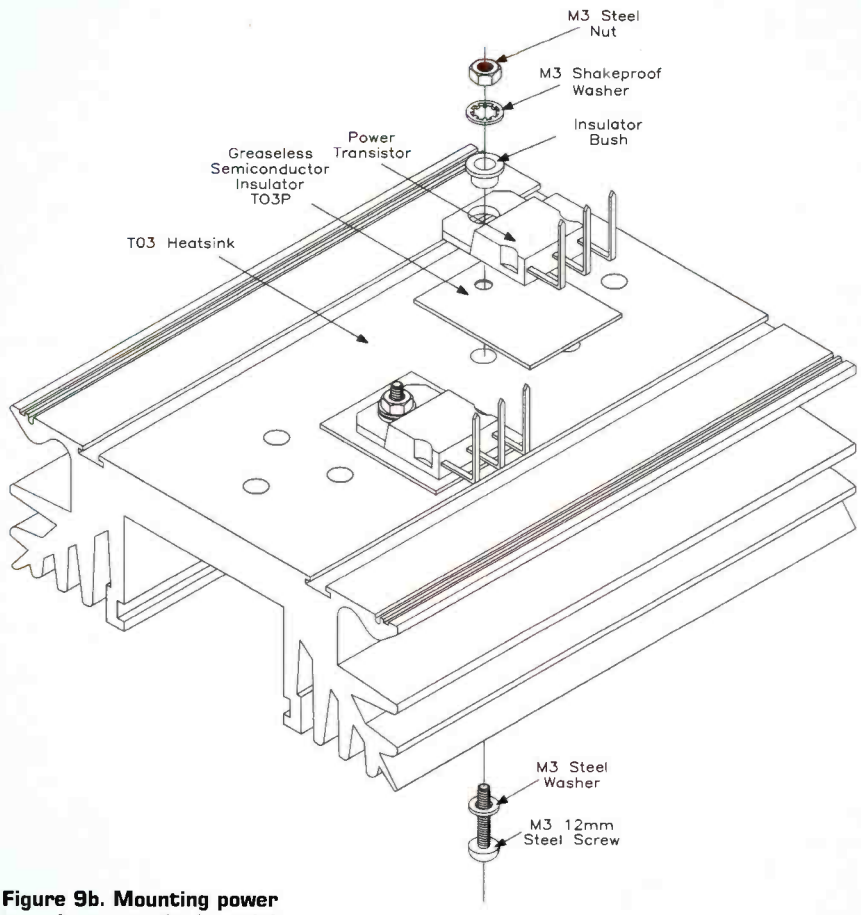


Figure 9b. Mounting power transistors to the heatsink.

Unused Features of the IC

A 0·5Hz frequency is available at pin 16, which can be useful for checking that the oscillator and divider circuits within the IC are functioning.

Connecting pin 14 of the IC to the reference voltage (pin 7) will disconnect the internal 200Hz oscillator from the internal control unit, allowing an external oscillator to be connected to pin 16 for alternative charge/discharge cycle timing periods.

Pin 1 of the IC is the 'mains synchronization' input (not direct mains), allowing the mains frequency to be used as the clock as well as turning on the charge output at the appropriate time.

Construction

Construction is fairly straightforward; fit all components except the LEDs and power transistors. The PCB legend and track are given in Figure 6.

The two rotary switches require slight modification – see Figure 9a for

details; trim down the switch shafts to 10mm, then remove the plastic location pins and finally, remove the eyelets.

Begin by inserting all the pins on the control PCB from the component side. The pins for the power supply transistors (TR1 and TR6), are inserted from the component side. All other pins for the power supply PCB are inserted from the track side. Note, R5 and the optional R6 are also mounted on PCB pins; this is to enable easy modification of the discharge current if so desired.

Populate the PCBs with the smallest components first, working up in size to the largest; use the component lead offcuts for the PCB links. Be careful to correctly orientate the polarized devices, i.e. electrolytic capacitors, diodes, transistors, regulator and IC. The IC should be inserted into the socket last of all.

Thoroughly check your work for any misplaced components, solder whiskers, bridges and dry joints. Finally, clean all the flux off the PCB using a suitable solvent.

Box Preparation

The front and rear panel labels for the box are shown in Figure 7; preprinted labels are included in the kit. Refer to Figure 8a for the front panel drilling. Mark out, then drill, cut and file all the holes as required. Do the same for the rear panel as shown in Figure 8b, note the two large cut outs. Included in the box is a chassis, which is where the transformer will be situated. Mark out the hole in the base, noting the easy way of marking the centre in Figure 8c. Remove the paint around the top fixing hole for the heatsink inside the box, since this is for the earth connection to the box.

The front and rear panel labels should now be fitted to the box; trim the label around all the front panel holes using a sharp craft knife.

Final Assembly

Carefully strip the insulation off the length of mains cable supplied in the

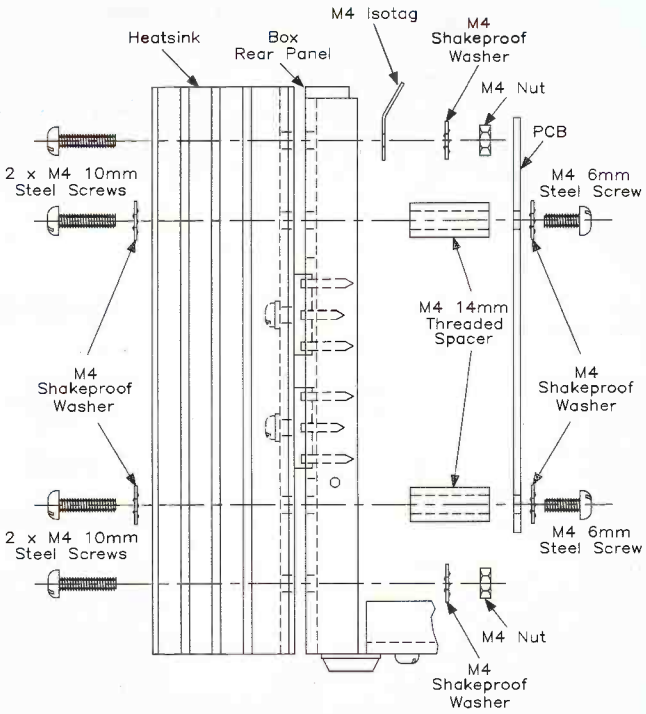


Figure 9c. Rear panel assembly showing heatsink mounting.

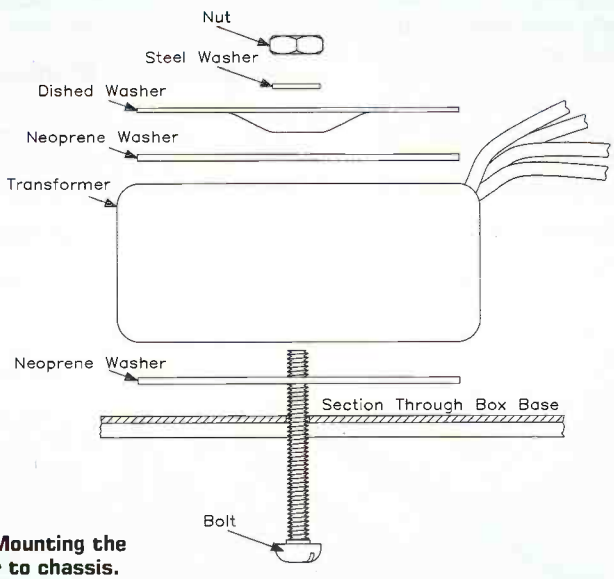


Figure 9d. Mounting the transformer to chassis.

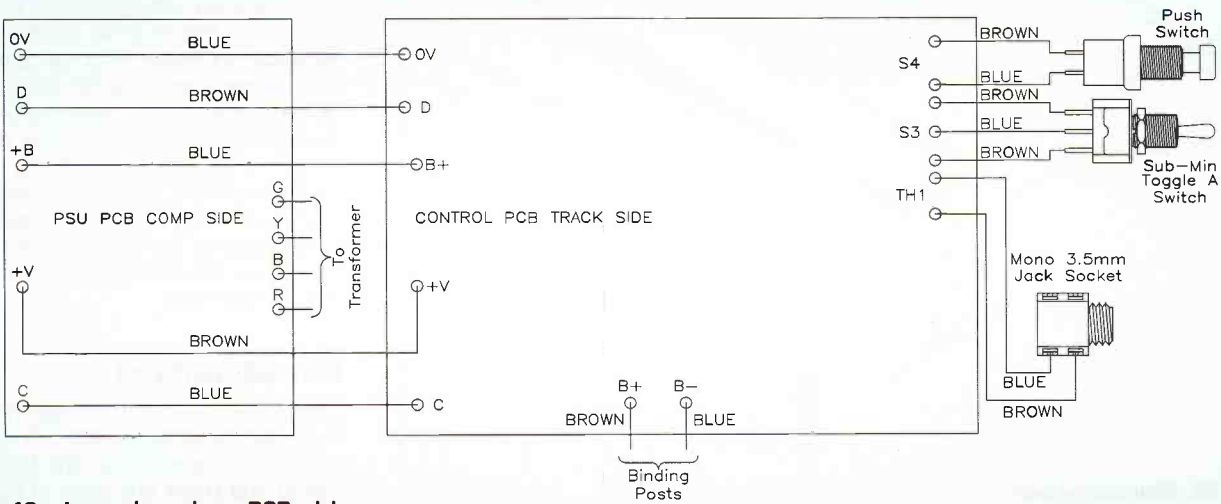
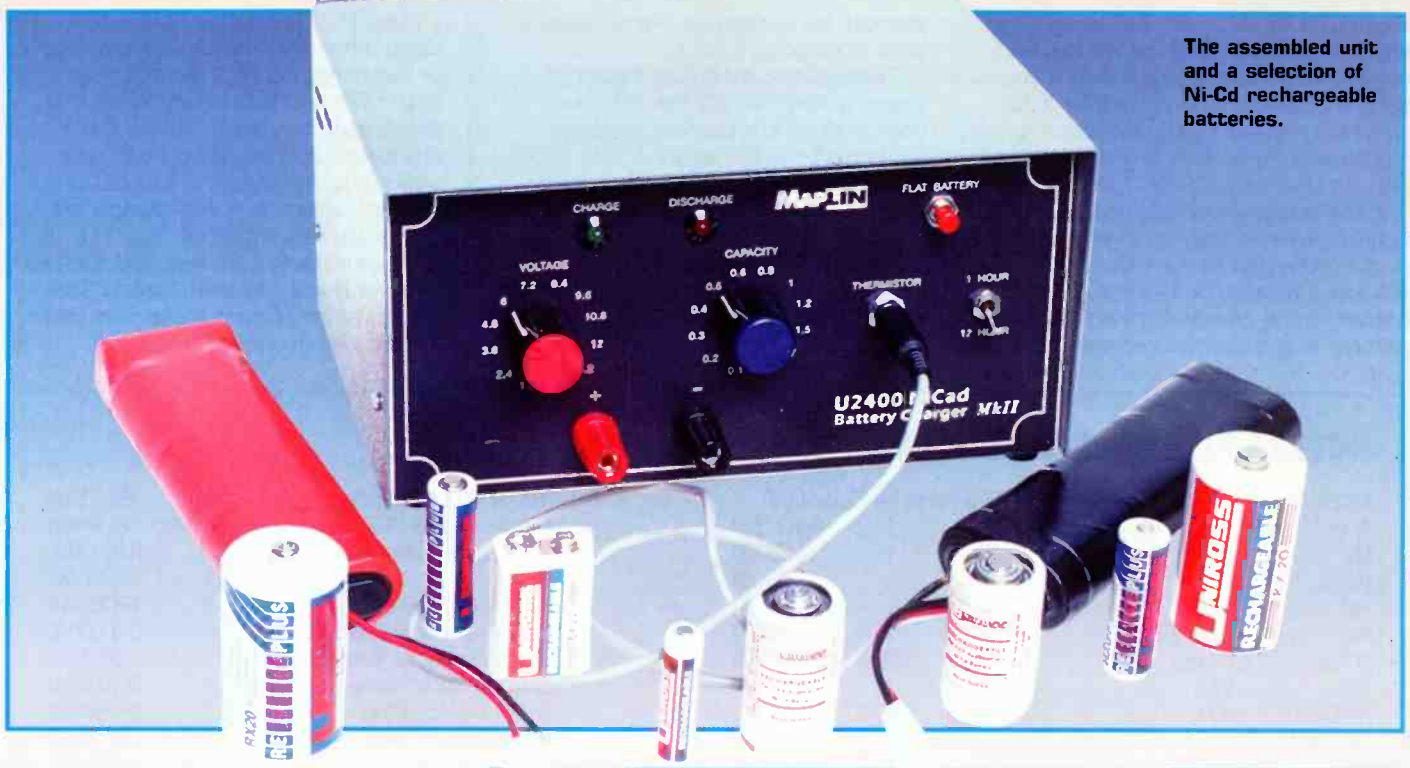


Figure 10a. Low voltage inter-PCB wiring.



The assembled unit and a selection of Ni-Cd rechargeable batteries.

kit, since the individual wires within will be required for connecting up parts of the unit. Fit the terminal (binding) posts into position; ensure that the solder tags are fitted horizontally, then attach short lengths of brown (+) and blue (–) wire, sourced from the length of mains cable.

Refer to Figure 9a. Insert the LED bezels into the box, then fit the LEDs into the appropriate bezels (keeping the shorter cathode lead aligned with the flat side of the PCB legend), fit the PCB, then solder the LED leads to the board. Fit the rest of the front panel hardware.

Assemble the power transistors onto the heatsink squarely (using a set square or similar), as shown in Figure 9b; note the heatsink orientation. Using a multimeter set on the highest resistance range, check the insulation between the transistor mounting tabs and the heatsink; an 'out of range' reading should be obtained.

Preform the power transistor leads, then bolt the heatsink assembly to the box (do not forget to fit the M4 solder tag). Solder the green/yellow lead from the mains cable to the solder tag; fit the switch-fuse-IEC socket assembly to the rear panel, then solder the free end of the green/yellow lead to the EARTH pin of the IEC socket; do not forget to fit the insulation boot BEFORE you solder up the leads.

Fit the M4 spacers to the PSU PCB shown in Figure 9c, then bolt the PSU assembly to the heatsink. Solder the power transistor leads to the PCB pins.

Next, assemble the transformer onto the chassis supplied with the box, referring to Figure 9d, and then place the chassis inside the box and fix in position.

Wire up the low voltage and inter-PCB wiring as shown in Figure 10a, noting the connections to the switches and the socket.

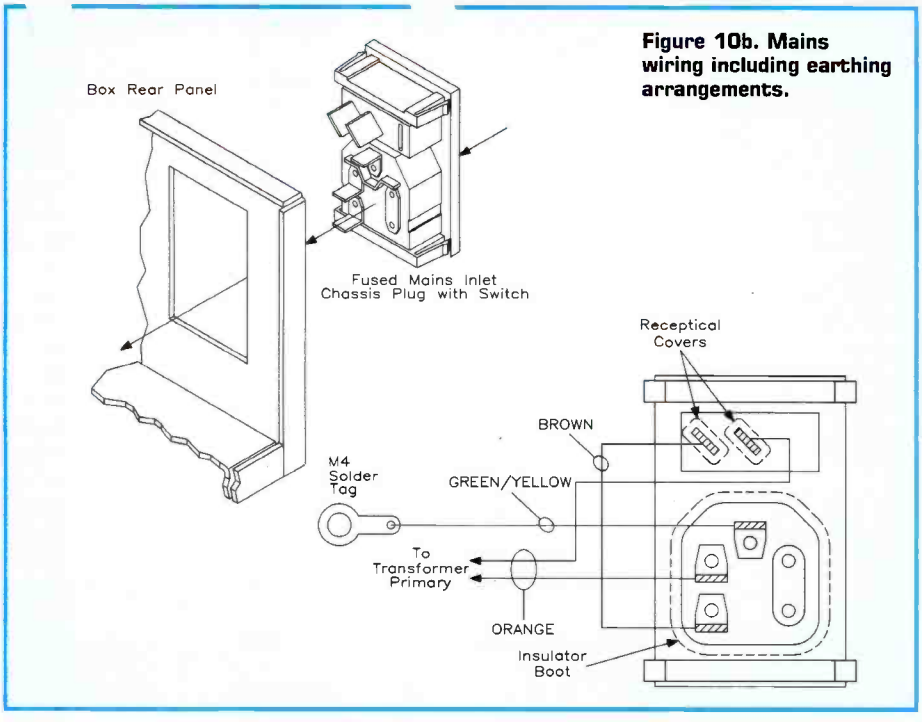


Figure 10b. Mains wiring including earthing arrangements.

Figure 10b shows the fitting of the fused mains inlet chassis plug with switch and the mains wiring, including the earthing arrangements. Thoroughly check all wiring before proceeding any further; once checked, the enclosure lid can then be fitted.

Complete the project by connecting the thermistor to the screened lead (insulate with the heat-shrink sleeving) and fitting the 3·5mm jack plug to the other end. Finish off by fitting the knobs to the rotary switches and inserting the fuse into the fuse drawer of the IEC socket.

Testing

To test the unit, a multimeter and a partially charged Ni-Cd battery are required. Make a suitable patch lead for your battery or battery pack to plug into the charger, but do not connect yet, and plug the thermistor into the charger.

Connect an IEC mains lead to the charger and plug into the mains supply. Switch on the mains and charger; the red LED should illuminate continuously. Select the appropriate charge voltage to match the battery or battery pack. Set the battery capacity switch to 2Ah, and set the charge time switch to 1-hour.

Connect the multimeter (set to its 5A DC or higher range) in series with the battery or pack, then connect to the charger. The charger should do one of three things, if the battery is partially charged, the red LED will start to flash, indicating that the battery is being discharged; a current reading of (approximately) 500mA should be obtained. If the green LED flashes, the battery is being charged; a current reading of (approximately)

2A should be obtained. Selecting a lower capacity (Ah) range will cause the ammeter reading to flicker; if you have an oscilloscope, you will be able to see the pulse width modulation of the charge current at the anode of D5 or collector of TR1.

If the battery is totally flat, the charger will not 'see' it; in which case, pushing the 'flat battery' switch for a few seconds at a time, will force the battery to be charged. When the battery is sufficiently charged, the charger will detect its presence, and begin to charge it.

Reselect the maximum battery capacity, then select the 12-hour charge time; the current reading will begin to flicker again.

Selecting a lower capacity setting will reduce the average current even further; if you are able to see the charge current, you will notice that the current pulses are pulse width modulated by the 12-hour charge setting.

Heat the thermistor above 45°C, using a hairdryer or similar; the charge or discharge current will stop and both LEDs will extinguish. When the thermistor has cooled down, the charge or discharge cycle will begin again, but on reheating, the LEDs will flash alternately, indicating that a violation has occurred.

Disconnect the battery and the red LED will illuminate continuously. The Ni-Cd Battery Charger has now been fully tested and is ready for use.

INTELLIGENT Ni-Cd BATTERY CHARGER PARTS LIST

RESISTORS: All 0·6W 1% Metal Film (Unless Specified)			
R1	0Ω33 Wirewound	1	(W0·33)
R2	3Ω3	1	(M3R3)
R3,4	5k6	2	(M5K6)
R5	1Ω5	1	(M1R5)
R6	* See Text *	1	(*SOT*)
R7,8	510Ω	2	(M510R)
R9	2k4	1	(M2K4)
R10,30	47k	2	(M47K)
R11-21	4k7	11	(M4K7)
R22	3k9	1	(M3K9)
R23	2k7	1	(M2K7)
R24,27	3k3	2	(M3K3)
R25	4k3	1	(M4K3)
R26	2k	1	(M2K)
R28	390k	1	(M390K)
R29	100k	1	(M100K)
R31	10k	1	(M10K)
R32,46	16k	2	(M16K)
R33,41	1k	2	(M1K)
R34	1k8	1	(M1K8)
R35,39, 40,45	1k2	4	(M1K2)
R36,37,38	1k5	3	(M1K5)
R42	39Ω	1	(M39R)
R43	910Ω	1	(M910R)
R44	750Ω	1	(M750R)
TH1	15k@25°C Thermistor B=3,740K	1	(FX22Y)
CAPACITORS			
C1	4,700µF 35V Radial Electrolytic	1	(JL30H)
C2,4,8,9, 10,11,12	100nF 50V Ceramic Disc	7	(BX03D)
C3,6,7	10µF 63V Radial Electrolytic	3	(AT77J)
C5	15nF Polyester layer	1	(WW31J)
SEMICONDUCTORS			
RG1	LM78L12ACZ	1	(WQ77J)
LD1	Red LED 5mm 2mA	1	(UK48C)
LD2	Green LED 5mm 2mA	1	(UK49D)
ZD1	BZX 4V7 Zener	1	(QF45Y)
TR1	TIP147	1	(UJ31J)
TR2	BC160	1	(QB48C)
TR3	BC327	1	(QB66W)
TR4	BC337	1	(QB68Y)
TR5	BC140	1	(QB37S)
TR6	TIP142	1	(UJ30H)
D1-5	1N5400	5	(QL81C)
IC1	U2400B	1	(AH40T)
MISCELLANEOUS			
S1,2	Rotary Switch SW12B	2	(FF73Q)
S3	Sub Miniature Toggle Type A	1	(FH00A)
S4	Push Type Switch	1	(FH59P)
F1	F3·15A Fuse	1 Pkt	(CZ80B)
	T500mA Fuse	1 Pkt	(CZ94C)
	Choke 10µH	1	(WH41U)
16-pin DIL IC Socket		1	(BL19V)
Single-ended PCB Pin 1mm		1 Pkt	(FL24B)
LED Bezel 5mm Convex		2	(UK14Q)
Knob RN18 Red		1	(FD67X)
Knob RN18 Blue		1	(FD65V)
Large Terminal Post Red		1	(HF07H)
Large Terminal Post Black		1	(HF02C)
3·5mm Jack Socket Chassis		1	(CX93B)
3·5mm Jack Plug		1	(HF80B)
Fuse/Switch Inlet		1	(JK71N)
Insulating Boot		1	(JK67X)
Push-on Receptical Cover		1 Pkt	(FE65V)
Transformer 18V 50VA		1	(DH59P)
Heatsink TO3 100mm Type X		1	(KW50E)
TO3 Insulator Kit		1	(WR24B)
TO3P Insulator		2	(UK86T)
Heat-shrink Sleeving CP32		1m	(BF88V)
Heat-shrink Sleeving CP24		1m	(BF87U)
M4 Solder Tag		1 Pkt	(LR63T)
M4 × 10mm Bolt		1 Pkt	(JY14Q)
M4 × 6mm Bolt		1 Pkt	(JY13P)
M4 Steel Nut		1 Pkt	(JD60Q)
M4 Shakeproof Washer		1 Pkt	(BF43W)
M4 × 14mm Threaded Spacer		1 Pkt	(FG39N)
M3 × 12mm Bolt		1 Pkt	(JY23A)
M3 Nut		1 Pkt	(JD61R)
M3 Shakeproof Washers		1 Pkt	(BF44X)
M3 Steel Washer		1 Pkt	(JD76H)
Miniature Black Mains Cable		1m	(XR01B)
Single Grey Cable		1 Pkt	(XR13P)
M10 Potentiometer Nut		1 Pkt	(FP06G)
Blue Case Type 237		1	(XY47B)
13A Euro Lead		1	(MK41U)
Front and Rear Panel Labels		1	(95058)
PCB		1	(95057)
Instruction Leaflet		1	(XV76H)
Constructors' Guide		1	(XH79L)

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

The above items are available as a kit, which offers a saving over buying the parts separately.

Order As 95056 (Ni-Cd Battery Charger)
Price £69.99 C4

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

The following new items (which are included in the kit) are also available separately, but are not shown in the 1996 Maplin Catalogue.

Ni-Cd Battery Charger PCB
Order As 95057 Price £3.99

Ni-Cd Battery Charger Panel Labels
Order As 95058 Price £2.49

POP IN for a BYTE at the Internet Café

The Café Internet, opposite Victoria station in London.

The way things are going, every high street will soon boast a cyber café, alongside newsagents, multiple building societies and charity shops. Apart from the famed cafés on America's West Coast, there is the Cyberia Café in London's Soho and the more recent Café Internet in Victoria. In fact, there are already some 32 Internet cafés in the UK – all opened in the past two years, with The Café Internet group planning a further 5 openings in the UK shortly. Also up and running is Germany's first Internet café in the centre of Berlin, while no visit to Southern France would be complete without soaking up the culture and surfing the Internet in a Nice café.

by Alan Simpson

A café visit will soon dispel the comment of one industry pundit, "The Internet is an academic tool and not a plaything for bad technies in anoraks". In fact, cyber cafés attract a wide audience, who come in all shapes and sizes, suits and anoraks, males and females. Five minutes after the doors open at the Cyberia Café, the place is bulging with Internet terminal operators and cappuccino drinkers in full swing.

I Heard it on the Cyber Grapevine

Also in full swing, was heavy levels of The Beach Boys surfing away to their heart's content. Meanwhile, closer to home, surfers were busy learning the Web, accessing FBI data files, flirting, chatting and generally hanging out. It is an environment where you would expect to be reading *The Hitchhikers Guide to the Galaxy* or just taking a stroll into the next millennium. It is a club where you don't need a degree to join, frequented in the main by people who don't have their own computers or just want to be social – 'just like the net'.

Certainly, for computer professionals, being positively encouraged to have their coffee at the keyboard is a novelty in itself.

Left: Café Cyberia in Soho, London. Below left: Motorola's Internet Solution package delivers everything you need to access the Internet in a single box (with exception of the computer itself, of course!)

Café Internet attracts not just business and student customers but tourists (the café is opposite Victoria Station) and the general public. Many customers it seems, have become regulars because they cannot justify the price of over £1,000 for the hardware plus the ongoing cost of direct connection to the Internet.

Back to the Future

Meanwhile, the Cyberia Café has attracted over 100,000 visitors in just a few short months, and ages range from teenagers to OAPs. For business users, special pre-opening breakfast sessions are held, but whether you are a computer professional or an absolute beginner, all are catered for. While waiting your turn on the terminal, you can browse through the community notice board (non electronic), and view the regular exhibitions of drawings and paintings by up-and-coming art types.

There is also no shortage of strange-sounding Internet magazines, with *The Net* being in greatest demand. In fact, the Internet itself is rather like the Foyles bookshop of old. The item or information is there somewhere, if only you can find it, in what seems deliberately haphazard and disorganised archiving. No-one doubts that there is a lot of information lurking in the Net, but finding it is the challenge. However, it is a challenge which increasing numbers relish. The information superhighway allows us all to communicate via computers on a truly global scale at the cost of a local 'phone call.

You Are Never Alone on the Net

You won't be lonesome if you are operating from a cybercafé. Punters apart, at London's Cyberia Café, there are some 15 staff (sorry, Cyberhosts) helping the uninitiated through the NetMaze or serving breakfast.

In contrast, the Café Internet, which claims to be London's biggest and best-equipped Internet venue, serves a range of hot and cold foods from 8.00am to 11.00pm. There is even a wine bar area, nicknamed The Boozers Browser. Here, the café atmosphere appears to take precedence over the Internet.

For co-owner Gavin Sheppard, a seasoned computer professional, the café design is based on updating the coffee house of the 1700s, but replacing quill pens and ink with the Internet for communication. "It is not a meeting place for 'technies'. Our aim is to demystify the Internet and show people how easy it is to access and surf the mind-blowing databases of information that are available."

Both of London's Internet cafés provide a range of courses, seminars and workshops, ranging from beginners to full training and web page development, seminars and workshops. Not surprisingly, the Cafés are also the venue for launching Internet-related products and Web sites, and are not short of film and TV crews using the site for location shots.

The need for Internet hands-on centres is great. Often a visit will help you to surf rather than drown in the Net. Maybe the best-selling hi-tech author David Ambrose should pay a visit. His *Mother of God* block-buster seems to confuse the Internet with Artificial Intelligence – so much for virtual thinking. Similarly, sound-bite commentators and broadcasters appear to think that most WWW members are busy hacking into The White House, the Bank of England or the National Lottery database.

It is a Cyberspace World

A visit to Cyberia will soon put the record straight. The most popular service is Rencounter (dubbed love-byte), an electronic dating agency for anyone seeking a virtual relationship. Other highlights include a Rainforest Action Network, The Wall Street Journal, and MTV. Wells Fargo, who claim to be the first in online banking and the US CIA ('Your peace dividend at work') compete with such electronic diversions as NetNoose – 'hang more than ten with this cool cybertwist on an old game'.

Cool seems to be the operative word. CNN reads the Cool News Network and the index page listings highlight what's new, what's cool. So cool is surfing, that every 10 seconds, someone joins the Internet. A recent BBC broadcast suggested that there are now between 30 and 50 million users (what is 20 million between Internet friends) and that the numbers keep growing by leaps and bauds every day. The figures are backed by such network services companies as CompuServe, who have just claimed 40,000 new subscribers in one week alone. The world of Cyberspace is currently served by some 30 million computers worldwide connected to the Internet, a figure which will, so the pundits tell us, have doubled by the end of the decade. However, all pundits are agreed that the market for Internet services is still vastly untapped.

Helping guide users at the Café Internet are 12 of the latest Intel-based Fujitsu ICL Indiana PCs shortly to be joined by a further 20 units. Also on hand are 8 Internet 'cyberhosts' to guide surfers through the available options. With not a little assistance from Windows NT, you too can surf the World Wide Web, discover the secrets of the Net, do some shopping, find a partner, organise your holiday, read online magazines and books or even access the new Porsche Club pages. If all else fails, you can order some wine from the Tesco files.

The café systems support your own private e-mail address and exchange message service, or you can rent an e-mail box from about £1 a week. Many users just drop in to pick up their mail, hang around for a coffee or if queues permit, browse the Net for a while. For the record, John Major does not have an e-mail address, but those who do include Sinead O'Connor, Michael Jackson and Madonna.

Home, Home on the Web

The world is rapidly falling into two camps: those who believe that the world wide web is being created by a superbreed of Amazon spiders, and those (such as the BBC) who believe it is the most exciting electronic development ever created. It is, in fact, the rapidly expanding multimedia of the Internet. Sites on the WEB known as home pages can incorporate animation, graphics, video and audio. Popular WWW sites include the Vatican Library, world weather library (including weather on Mars) and naturally, estate agencies.

So just how do you get aboard the Internet? Well for a start, there is no shortage of starter packs. Motorola has recently announced The Internet Solution, a pack which provides everything required to access the Internet straight away in a single box. Contents of the box include a V.34 standard high-speed 28·8K-bits data/fax modem, cabling, software including a World Wide Web browser, one month's free access to CompuServe's online service, and an Internet service provider membership option for instant Internet access, at a cost of about £200 (details on 01293 404343).

Not unexpectedly, it has been left to the UK government to put a dampener on the Internet proceedings. DTI Minister Ian Taylor is concerned that the system in not misused. The Minister prefers to highlight the potential exploitation of international databases and the lack of security of transactions and scope for fraud or publishing illegal or undesirable material. No comment about the vast possibilities for learning, teaching and business. Stand by for some heavy government Internet legislation.

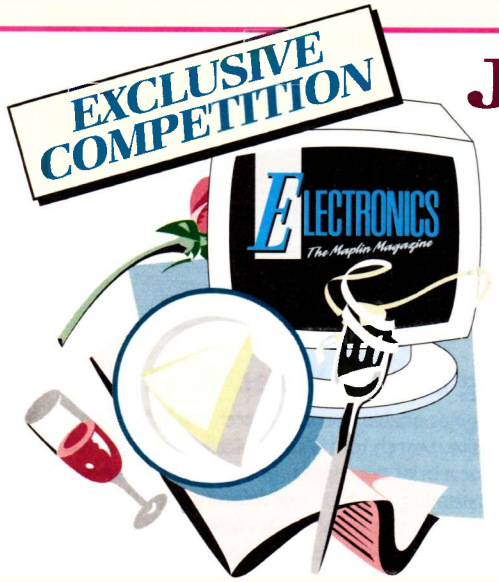
Watch this Cyberspace

One noted industry journal is forecasting that at the current rates of growth, every PC and terminal in the world will be attached to the Internet, or the Internet will be piped to your home, rather like a public utility. Presumably, the editor of the journal hopes to be the first 'Netel' chairman, and is already negotiating his salary. What is true, is that the Internet will become the cutting edge of modern society, and at the same time, cyber-culture could divide generations as no other activity has. Already, cable operator Videotron is taking the Internet onto the streets by means of a bus touring London schools. Don't miss the CyberBus!

Contacts

Cybercafé Ltd., Tel: (0171) 209 0982,
cyberia@easynet.co.uk

Café Internet, Tel: (0171) 233 5786,
gavin.sheppard@caféinternet.co.uk



JOIN THE CYBER SET!

Want to know more about the Internet? Interested but not hooked up? Why not get tuned in and consult *Electronics* regular update section, @Internet, or pay a visit to your local Internet café. You can do the latter by entering our competition. The prizes (courtesy of the Café Internet) are: two places on its 2-hour Introductory Training Course, value £25 each, and six ½-hour sessions on the Internet worth £3 each, for the runners-up.

Send your entry to: **Internet Competition, The Editor, *Electronics – The Maplin Magazine* P.O. Box 3, Rayleigh, Essex SS6 8LR.**
Entries must be received by 31st May 1996. Good luck and happy surfing!

How to enter

All you have to do to enter, is complete the coupon (right), correctly answering the four questions, or send your answers on a postcard or back of a sealed-down envelope.

Please note that employees of Maplin Electronics, associated companies and family members are not eligible to enter. In addition, multiple entries will be disqualified. The prizes will be awarded to the first all-correct entries drawn. The Editor's decision will be final.

Internet Competition Entry

ELECTRONICS The Maplin Magazine

Answer all the questions below, ticking one box for each question:

1. To surf the Internet you need:
- ☐ A surf board.
- ☐ A cappuccino.
- ☐ A WWW home page number.

2. Spot the odd one out:
- ☐ Mischief.
- ☐ Yahoo!
- ☐ Demon.

3. What is a main use of the Internet?
- ☐ Watching *Tomorrow's World*.
- ☐ Buying a National Lottery Ticket.
- ☐ E-mail.

4. What is an Internet Provider?
- ☐ The network interface between user and database.
- ☐ The local fishing tackle supplier.
- ☐ A 007 adversary.

Name _____ Daytime Tel. _____

Address _____

_____ Postcode _____

The INTERNET

PART 5

The Future of the Internet

At the moment it looks like the Internet is here to stay. Growth rates are impressive (whichever statistics you choose to consult) but will this growth continue, or will the Internet remain no more than a business tool for technologists? In this final part of the series, Stephen Waddington outlines his personal view of how the Internet will develop as we head towards the next century.

My first taste of the Internet came in 1990, when I was introduced to e-mail at university, as a means of communicating with academic campuses across the world. Of course, at the time, I never imagined the growth and commercialisation of the Internet to the extent which we see today. Equally, six years on, I do not intend to forecast what might happen in the next ten years. It would be completely arrogant for me as an individual to predict how the Internet may develop. I am no psychic. What I can, and what I intend to do, is examine developments at the leading edge of the Internet, and discuss the impact these might have on our lives in the future.

While the Internet is popular, it has not yet reached critical mass, and as such, cannot be considered a consumer item. True, the Internet is growing at a phenomenal rate, but then in the early stages of mobile telephony, similar growth rates were experienced among the business community. My mother has yet to open an e-mail account, and my bank is not online. By comparison, both my mother and my bank have fax machines. Once the Internet reaches the same critical mass as faxes have done, then I believe it will be here to stay. The major barrier to this level of growth among individuals is technical complexity and confusion over suppliers and services, while the major concern of business is security.

Tools

The Internet, in the form of newsgroups and the world wide web (WWW), brings a massive amount of data to the desktop of every PC user. It is like having access to a massive international library. However, not only does that library allow free access to archive databases, but users can also access dynamic information such as news, wire services and weather data, as shown in Table 1. New dynamic Internet programming languages, such as Sun Microsystems' Hot Java, allow WWW pages to be constantly updated, enabling Internet users to access rolling news services.

Search agent	WWW address
NetMall	http://www.ais.net:80/netmall
Spry Internet Wizardhttp	://www.compuserve.com/wizard/wizard.html
World Wide Web Worm	http://www.cs.colorado.edu/home/mcbryan/wwww.html
Yahoo	http://www.yahoo.com

Table 1. Internet search agents.

However, the problem at the moment is that users cannot directly access the information that they need. Instead, they must trawl through massive amounts of information to reach material of interest. Structured databases use indexing techniques to create ordered data patterns that enable single records to be retrieved from databases consisting of gigabytes of data, within fractions of a second, but one of the virtues of the Internet is the fact that it is anarchic and without formal structure. This means that conventional data manipulation tools are unable to deal with this new method of information delivery.

Over the next two years, Internet mining tools will become a key area of development, in response to the individual's need to search, access and exploit information located within Internet newsgroups and the WWW. We took a brief look at a selection of already established Internet tools or agents in Part 3 of this series. This included search mechanisms such as the World Wide Web Worm, as shown in Figure 1, and NetMall. Additional search engines are outlined in Table 2.

Information Source	WWW address
BBC	http://www.bbc.co.uk
Business Wire	http://www.hnt.com/bizwire
CNN	http://www.cnn.com
Daily Telegraph	http://www.telegraph.co.uk/
Information Age	http://www.techweb.wais.com/techweb/ia/current/
Metrological Office	http://www.metr.govt.uk
NBC	http://www.nbc.com
PC Week	http://www.ziff.com/~pcweek/
Press Association	http://www.pa.press.net
Yearling Interactive TV Guide	http://www.yearling.com

Table 2. Dynamic information sources available on the Internet.

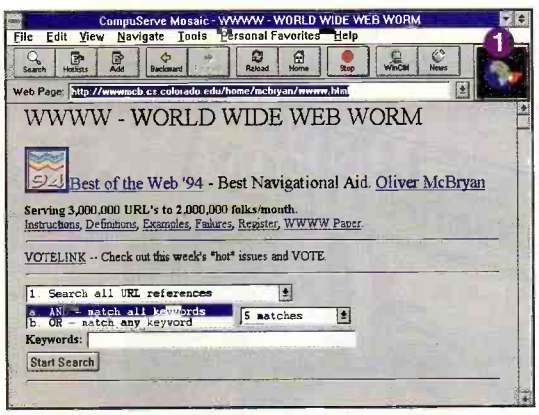
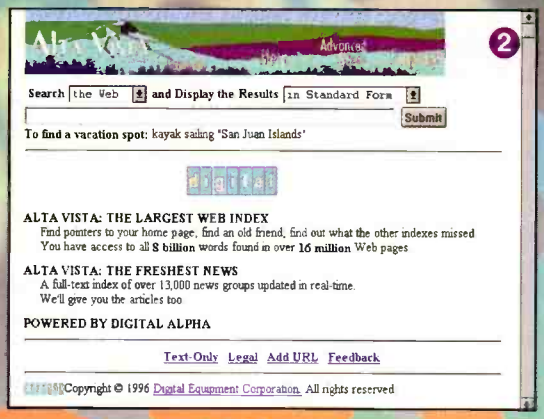


Figure 1. The World Wide Web Worm Internet search agent.

Finding Exactly What You Want

Search engines enable users to search the WWW for a particular site. Search terms are typically limited to the site URL, or a brief description of contents. However, Digital is extending the terms of reference for WWW search tools with a new software engine. The company claims its Super Spider engine, as shown in Figure 2, will be able to conduct the most comprehensive text-based search of the entire WWW, unlike the majority of search engines currently available, which undertake searches based on their own lists of WWW sites. If a WWW site is not registered with the search engine, it will not be returned in response to a search request.

Digital's technology has huge implications for the online community. Once the final version of the software is released, it will become possible to determine the exact number of WWW sites in existence around the world. In addition to this, it will become possible to undertake text services



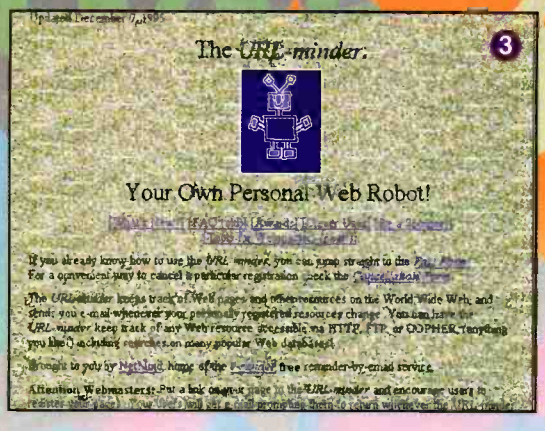


Figure 2. Digital Super Spider search engine capable of searching the entire WWW on a key word.

Figure 3. URL-minder Internet robot monitors WWW pages and reports changes back to the user via e-mail.

across any site in existence, so for example, users will for the first time be able to pinpoint the exact number of 'hot-links' or references to their home page from other WWW sites.

Under development at Digital's Corporate Research Group, the 'Super Spider' technology promises to surpass the limitations of current information services by delivering the most complete, precise, and up-to-date information of the WWW's entire text. Users can test the super spider's WWW index and provide feedback through Digital's Internet address at **http://www.altavista.digital.com.**

Internet Robotics

Internet agents are set to extend far beyond the functionality of mere search engines. In Part 3, we took a look at a WWW browsing robot which will notify you every time a WWW page of interest to you has been updated. By accessing the NetMind's URL-minder WWW site at **http://www.netmind.com/url-minder**, as shown in Figure 3, Internet users can register pages of interest. A WWW Robot will monitor registered pages and e-mail you every time something new is added to the page.

A number of companies are working to develop commercial software in this area. Combined with an Internet shopping mall, an agent could search electronic stores for the lowest price products, such as a book or CD. An example of the latter is BargainFinder, an agent developed by Andersen Consulting, that searches eight Compact Disc stores on the Internet. Here, the user types in the name of an album and BargainFinder searches for the best price available. BargainFinder can be accessed at **http://bf.cstar.ac.com/bf/**.

While the functionality of BargainFinder is currently limited, the application demonstrates the potential power of agents. In the future, these tools will increase in processing power, literally allowing the user to define a task which the agent will then process before returning a response.

We have already seen that agents such as URL-minder can also perform functions such as checking WWW pages to see if any changes have been made since a previous visit. WebWatch, a shareware program as shown in Figure 4, is an extension of this theme. Here, a user can specify pages for the agent to monitor. WebWatch will then display a list of the pages and tell the user when they were last modified. WebWatch also notifies the user if pages are no longer in existence or have changed URLs. This can be useful for businesses that wish to monitor competitors' information. WebWatch can be downloaded from **http://www.specter.com/products.html.**

News on Demand

One of the most impressive examples of an Internet agent is the personalised news service. At the moment, CompuServe's Executive News Service (ENS), as shown in Figure 5, is the most impressive. ENS takes feeds from 25 news wires around the world, from the German Press Agency to The Washington Post. The service continually scans each wire service for keywords or phrases which the subscriber selects and is able to update at any occasion. Any wire story which contains the selected keyword or phrase is downloaded and stored in a folder for the subscriber to access.

Unfortunately, CompuServe's ENS service is restricted to CompuServe users. However, similar concepts are beginning to be applied to the WWW, with companies such as Quarterdeck and Yahoo working on mechanisms which will pull news information from user-specified WWW pages.

Jeff Boulter, a student at Bucknell University in the USA, has created a WWW service that lets you put together your own online newspaper, as shown in Figure 6. CRAYON consists of an online form that allows you to select from a variety of free news and information services available on the WWW, such as daily newspapers and industry newsletters. You choose the types of news and sources you want, then CRAYON creates a personalised WWW document that can be saved locally for subsequent access. CRAYON can be accessed at **http://sun.bucknell.edu/~boulter/crayon/**.

Personalised news services such as CompuServe's ENS and Jeff Boulter's CRAYON are already plotting the future of Internet agents. These will continue to become increasingly sophisticated with time, providing the Internet user with powerful information on demand. Paul Youlton (an Internet specialist with consultants PYA) claims that in the future, the model

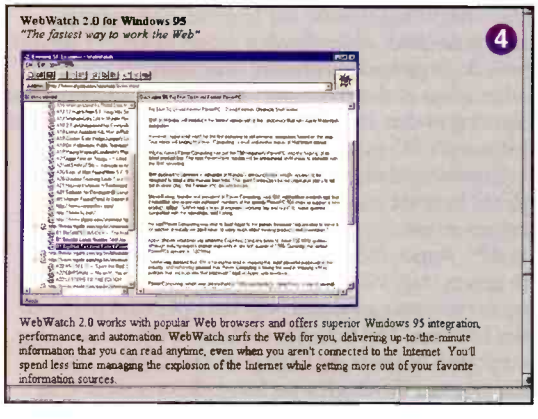


Figure 4. WebWatch sits on a local machine, and monitors WWW site for changes.

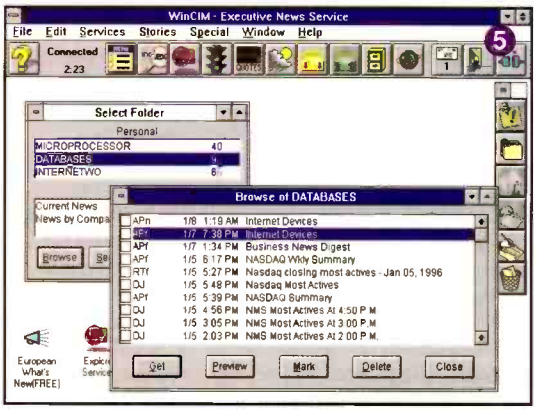


Figure 5. CompuServe's Executive News Services (ENS) retrieves information on keywords.

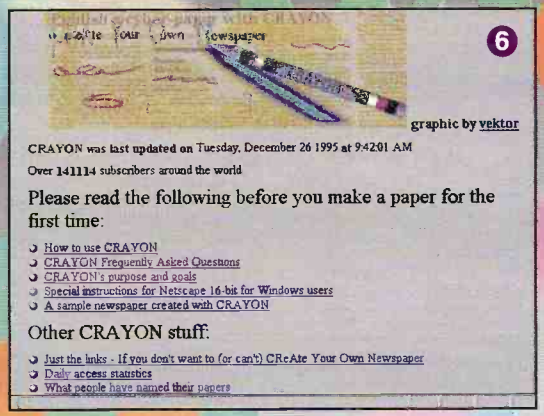


Figure 6. CRAYON allows the WWW user to compile a personalised WWW-based newspaper.

of the Internet personalised news services will be extended to radio and television. Instead of receiving news reports electronically, users will be able to receive television and radio programmes that have been edited electronically, according to a user-defined algorithm.

Internet Telephone Service

One of the most interesting Internet applications is the ability to make long-distance telephone calls over the Internet. Service provider Global intends to launch a full-blown Internet telephone service, despite confusion over the legality of using the Internet for two-way voice conversations. Currently this is a not a concern, since it is not technically possible to conduct a two-way conversation.

Manufacturer VocalTec claims that Global users, equipped with its new Iphone software, will be able to make international calls for the price of a local call. This obviously has huge implications for PTTs such as BT. To date, BT has been wary in its responses to voice over the Internet, questioning the quality of such services. VocalTec insists the audio quality which its software enables is excellent. According to industry analysts, both OFTEL and Vodaphone are keeping the situation under review. A 60 second downloadable sample of Iphone is available free at **http://www.vocaltec.com**.

Internet Insecurity

Security is currently the barrier to the growth of commercial business on the Internet. The concern here is twofold: while allowing access to WWW servers, how do organisations prevent unauthorised access to other areas of the computer network and secondly, the securing of data such as credit card details between the individual's PC and WWW server and beyond?

Commercial organisations with servers connected to the Internet must separate areas of their IT infrastructure. While large computer companies such as IBM, Apple, Motorola and Intel want Internet users to access their WWW sites, they do not want to allow access to data connected with the operation of day-to-day business. And here lies a dilemma for modern day corporate business. If IT systems are connected to the Internet via a local area network, or a wide area network, without adequate protection, a hacker may be able to vandalise the system, or steal confidential data.

The second area of Internet security which perhaps most concerns the consumer, is the securing of financial transactions over the Internet. Analysts are correct in claiming that the Internet will not mature as a commercial entity until individuals are confident that they can conduct secure credit card transactions.

Consider a scenario which combines both elements of Internet security. A catalogue company opens up a shop on the Internet. A team of university students, for example, log on to the virtual catalogue shop via its WWW page. As a result, they are able to locate the host server. Using client/server protocol analysis software, the student hackers log on to the host server, and by deciphering passwords, access financial files containing the credit card details of customers who have ordered goods from the virtual catalogue service. Using this information, the students were able to go on a virtual shopping frenzy.

While the virtual catalogue example may seem extreme, it is real. Indeed, examples of poor Internet security even exist in the US government. Last year, the US Defence Department enlisted a team of hackers to attempt to break into its computer network, which is connected to the Internet via an e-mail server. The hackers succeeded in poking holes into the main server 88% of the time. Of even more concern, is the fact that 96% of all illegal accesses went undetected.

Computer hacking is a growing sport, keeping pace well in line with the explosion of the Internet. A recent Rand Corporation study revealed that there were three times as many detected hacking incidents in the first six months of last year as there were in the entire previous year.

Firewalls

Firewalls can be thought of as a security guard monitoring all traffic in and out of your network. A firewall allows a business to specify the level of access that will be afforded to network users. An example of this is anonymous FTP. An Internet site can set up an FTP site that allows any outside user to access files at the site. This FTP site will allow users to access files, but only at the lowest level of security. Anonymous FTP is very useful to companies that wish to place documentation in the public domain. It also can be used to allow users to download software.

Securing Financial Transactions

The way in which information flows through the Internet makes it extremely susceptible to security problems. The TCP/IP packets flow through many different nodes on the way to their intended destination. The bad news is that any of these mid-points can be the source of a security breach.

MasterCard and Visa, as well as many other large corporations, have endorsed Secure Sockets Layer (SSL) for financial transactions. SSL uses a three-part process. First, information is encrypted, which prevents unauthorised access. Second, the information is authenticated, which makes sure that the information is being sent and received by the correct computers. Finally, SSL provides message integrity, which prevents the information from being altered during interchanges between the two computers.

SSL is based on a two-key encryption system. A customer submits a request to purchase merchandise over the Internet. The company responds with a public key that the customer's computer uses to encrypt sensitive information. The information is sent to the company, which then uses a private key to decrypt the information. The process is invisible to the customer, so it is very easy to use. Imagine a locked chest that contains a mailbox; customers are asked to place cheques in the mailbox, but are not able to remove other customer's cheques. A business would give customers a public key that could open the chest so that they could deposit their checks. The company would have the only key that could open the mailbox inside the chest, using the private key.

Netscape has developed an application called Secure Courier, which uses SSL to allow financial data to be transmitted in a secure digital envelope. Information is encrypted from the time it leaves the user's computer until it reaches the financial institution. This ensures that only the financial institution will have access to the inputted financial information. Secure Courier can also verify the authenticity of inputted financial account information.

Secure Courier appears to be a potential solution to the issue of credit card security. Netscape must now convince commercial organisations of its potential

in eradicating fraud. For the Internet to become a commercial success, companies such as Netscape and network hardware providers, such as 3-Com and Cisco must resolve the security problem. For the successful company, the potential revenues could be enormous.

Internet Shopping

With security concerns resolved, shopping is due to change out of all recognition as we move towards the new millennium, according to the research group, INTECO. 'Virtual' will have the kind of impact on our shopping habits and retailing in the High Street that supermarkets have had in the recent past. "Some people will find virtual shopping more convenient and at least as enjoyable as going out to the shops", said Graham Taylor, manager of the INTECO survey.

Direct online links to suppliers will allow home shoppers to order off the screen at any time of day or night. Products such as video, news, books, or music, and services such as banking, travel planning, or medical advice will be piped into the home in digital form.

"Barclaysquare – the basic online shopping services launched recently by Barclays Bank, Dixons, Tesco, Sainsburys and other leading UK retailers, don't yet deliver the full benefits of virtual shopping to the consumer. At present, they charge full retail prices, add extra charges for home delivery and are vague about when they will deliver", said Taylor. Barclaysquare, as shown in Figure 7, and billed as the UK's premier online shopping centre, features high street names such as Argos, Toys 'R' Us, Interflora, Eurostar and Victoria Wine, and can be accessed at **http://www.itl.net/barclaysquare**.

"New home-shopping service operators, not encumbered by the cost of retail premises and telesales staff, will start a war on price and delivery, moving competition between retail and direct selling into a whole new phase", he added.

Virtual High Streets

A wide range of products will eventually be affected in some way by changes in the shopping process. Methods of shopping change slowly, but there is a progressive shift towards those where prices benefit from low distribution costs and where the shopper feels less exposed to overt sales pressure. During the '60s and '70s, off-the-shelf buying from self-service retail stores replaced the service of a shopkeeper, or sales person, and telephone ordering from printed mailshots and magazine advertisements is already changing the face of industries such as insurance.

INTECO's research found that the banking, finance, insurance, travel, housing, utility and public service sectors face the most significant changes over the next decade. Most stages of selling a new contract could be performed on-screen at home, although the legal and security aspects of verifying and approving a contract before it is issued and the dispensing of secure media, such as tickets and cheques, cannot. Tickets and documents will be mailed, or be made available from kiosks at convenient, 24-hour locations.

There are clear potential cost savings achievable through on-line services for non-sales transactions such as payments, queries and changes. Leading suppliers in all service industries will be tempted to offer online services as soon as they think that their client base is equipped to use them. According to INTECO, the implications of home shopping and digital delivery on employment in retail and white-collar service industries could be viewed as potentially catastrophic. Digital delivery poses a threat to large blocks of workers in businesses such as banks, travel agencies, utilities and public services.

Non-digital Goods

Home shopping for non-digital goods will not necessarily be in the interests of major companies in retailing and distribution. Large investments in land, parking, physical distribution and staff employment are based on the current model of shopping and known trends. A rapid drift away from visiting shopping facilities would not suit the current market leaders.

The actions of the major retailers in the UK, therefore, will have a major effect on the growth of new forms of home shopping for non-digital goods. For example, home shopping for non-perishable groceries could be easily implemented as a service to home PC users. INTECO believes that if Sainsbury or Tesco do nothing, the market could grow slowly. However, it points out that there is room for a challenge by smaller supermarket chains, who could use the service to differentiate themselves.

Matching the Real Shopping Experience

The new virtual-shopping processes will only succeed if they match or improve upon the real retail or catalogue shopping experience they seek to replace. Unfortunately, INTECO concludes, brand owners and channel-owners will not invest in multimedia as a technical novelty. They want to see demonstrable links to subsequent purchases, ideally off the screen, to justify the cost of developing new technology.

One important marketing benefit that may justify the cost is feedback about which products are browsed by each type of shopper, in addition to off-the-screen buying rates. The ability to adjust prices and then measure changes in browse-buy ratios, or generate browsing statistics by product class, will enable new approaches to marketing and promotion to be developed.

Despite the attention they are attracting, online services are used by less than 2% of UK households in the current year, and only 200,000 have the 28,800-bit/s modems needed to make virtual shopping an enjoyable experience. By 1998, this number will rise to 4·6 million households, 2·1 million having high spending power and the skill to navigate online networks.

Technological Shift

Ultimately, the Internet could challenge the conventional Windows-based Intel PC model. According to Oracle Chief Executive Larry Ellison, WWW servers based on stripped-down PCs are the way forward. Instead of carrying their own software on hard disks and huge amounts of memory, the terminals would dial up the Internet and grab software and data remotely. They are expected to be priced similarly to video recorders, at around £200.

Internet appliances could, in theory, change ground rules in more fundamental ways. While Oracle's Ellison is quick to note PCs won't die out, he says the appliances will create an explosive new category, because of their simplicity and ease of use. Oracle, which doesn't plan to make a WWW server itself, is sharing hardware designs with a number of partners. Ellison expects prototypes of these and other systems from Koreans, Japanese and Europeans by the end of

Figure 7. Barclaysquare is probably the most impressive online shopping service.

the first quarter of 1996 (i.e. by the time that you are reading this Ed.)

Meanwhile, Philips Electronics and Sega Enterprises are trying to build Internet capability into TV sets, video game machines and other consumer-electronics devices. Japan's Bandai is using an Apple hardware design called Pippin to build a game player that connects players over an online service. Apple, Toshiba and others are also designing portable devices for connecting to the Internet.

As we have seen, cost is the major hurdle to the consumer market. Online Media will ship a NetSurfer product next year using a microprocessor from Advanced RISC Machines (ARM). The £200 device will come with a keyboard for sending e-mail and for viewing WWW pages on a TV screen, and will cost £600 more when sold with a PC-type monitor.

Internet Predictions

- Technical complexity, and confusion over supplies are the Internet's main barriers to growth in the consumer market.
- Tools which empower the user will become a key issue over the next two years. Search agents are the beginning of this trend.
- The Internet could kill newspapers as a publishing medium. Personalised news services will become the vogue.
- Long distance telephony over low-cost Internet connections could provide a major challenge for companies such as BT. Ironically much of the Internet in the UK is run over BT lines.
- Until recently, security has been a barrier to the growth of business on the Internet. This is still seen as a major concern to corporate organisations.
- Banking and Insurance are two service industries which would adapt naturally to the Internet model.
- The Internet could ultimately challenge the Windows/Intel PC model. The web-server of the future consists of a stripped down PC, which downloads software remotely.
- The Internet has the potential to become a completely new sales channel, augmenting retail stores and catalogue services.

MAPLIN

SOUTH AFRICA

Calling all customers in Southern Africa...

R39,95 from any branch of CNA or by Mail Order from Maplin South Africa

. . . your new 1996 Maplin Catalogue is now available.

Maplin South Africa (Pty) Ltd.
P.O. Box 1846, Somerset West, 7129, RSA
Telephone: (024) 515124 Fax: (024) 515127

CORRIGENDA

ISSUE 99/MARCH 1996.

@Internet, page 76. Please note that the CompuServe telephone number, as given in @Internet (CompuServe Gets Personal) was incorrect, and any queries should be directed to: CompuServe Sales, Tel: 0800 000 200; CompuServe Technical Support, Tel 0800 000 400.

TECHNICAL INFORMATION SERVICES

76 Church Street, Larkhall, Lanarks, ML9 1HE
Tel: (01698) 883334 Fax: (01698) 884825
Technical Help Line (01698) 884585

We have the World's Largest Selection of:

SERVICE MANUALS
CIRCUIT DIAGRAMS

We also have 100s of Titles on TVs, VCRs, Satellites, Midi Systems, Computers, Test Equipment, etc....
Please Phone or Send an SAE for FREE QUOTE & CATALOGUE of Publications

ORDER COUPON

MAPLIN ELECTRONICS AND BEYOND

P.O. Box 3, Rayleigh, Essex SS6 8LR.
Telephone, Credit Card Sales (01702) 554161; Enquiries (01702) 552911.
Overseas Customers, Telephone +44 1702 554000 Ext. 326, 327 or 351.

A different postal code is correctly shown on the reply paid envelopes.

Please make cheques payable to 'Maplin Electronics plc'.
On occasion Maplin Electronics may permit other reputable companies to make offers of products or services which we believe will be of interest to our customers. If you do not wish to receive this information please write no in the box. ☐

In any correspondence please quote your customer number. *Date* ....

Customer No. ....

Name ....

Address ....

....

Postcode .... *Phone No* ....

IT IS MOST IMPORTANT THAT YOU INCLUDE YOUR POSTCODE

Block capital letters please. ***Keep a copy of your order.***

*Please enter catalogue page no. where item appears. If not in catalogue, write Mag for Magazine or SO for Special Offers etc. If not using 1996 catalogue, enter date of catalogue here: 19............

Description (for your information only)	**Page***	**Order Code**					**Quantity**	**Price Each**	**£ Total**	**p**	**£ Carriage Charge**	**p**
Price Change Leaflet (Please write 1 in quantity, if required)		C	A	9	9	H		FREE	0	00	0	00
1996 Maplin Catalogue		C	A	1	3	P		£3.45 *NV*			0	00
Electronics – The Maplin Magazine Subscription (UK 6 Issues)		X	A	0	0	A		£11.88 *NV*			0	00
Electronics – The Maplin Magazine Subscription (UK 12 Issues)		X	A	0	0	A		£23.76 *NV*			0	00
Electronics – The Maplin Magazine Index	467	X	U	8	7	U		80p *NV*			0	00
Electronics – The Maplin Magazine Binder	467	X	H	9	9	H		£6.99			0	00

Form ME94 Issue 1

Access | VISA | AMERICAN EXPRESS

PHONE BEFORE 5pm FOR SAME DAY DESPATCH

Overseas Customers including Channel Isles and Eire, please deduct VAT where applicable and tick box.
Export Order ☐

Office Use Only			
DOR	CQ	CA	PO
CNC	Total		
CNM			

I authorise you to debit my credit card account for the cost of goods despatched.

Credit Card Number ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Access/American Express/Visa...Delete as required.

Note: Goods will be despatched only if the address above is the cardholder's address. If ordering by credit card please sign:

....

Expiry date of Credit Card ....

	£	p	£	p
Total this sheet £				
Total other sheet(s) £				
Total for goods £				
Carriage charges for large, fragile, or heavy items as shown in catalogue. If total in this box exceeds £6.00 you need only pay £6.00 (Max. Carr. Charge per order £6.00).			←	
Deduct value of Credit Note No. Enclose the numbered Credit Note with this order.				
Deduct value of Gift Token No. (Enclose Gift Token with order.)				
Please add £1.55 Handling Charge. This amount must be added to each order placed.*	1	55		
*Except if only ordering a Catalogue or Magazine Subscription **Total £**				

Carriage Charges	
A	£1.60
B	£2.30
C	£2.90
D	£3.40
E	£4.00
F	£4.70
G	£5.50
H	£6.00

SUBSCRIBE TO

✻ BRITAIN'S BEST SELLING ✻ ELECTRONICS MAGAZINE!

ELECTRONICS
The Maplin Magazine

- ✻ **2 FREE ISSUES** if you agree to subscribe by Direct Debit or Continuous Credit Card, saving you £6.12!
- ✻ **FREE DELIVERY TO YOUR DOOR,** and there are no additional carriage charges.
- ✻ **YES, SAVE MONEY** by taking a subscription, it's cheaper than buying each individual copy.
- ✻ **REGULAR SUBSCRIBERS' SPECIAL OFFERS** Super savings on selected products!
- ✻ ***PLUS*** – News, reviews, readers letters, competitions and lots, lots more besides!

To subscribe just send a cheque/postal order for £11.88 made payable to Maplin Electronics, P.O. Box 3, Rayleigh, Essex SS6 8LR. **OR** you can take advantage of our offer of two free issues by completing the coupon below and agreeing to pay by Credit Card or Direct Debit. The two free issues offer only applies if you use one of these two methods of payment. Simply fill in the 'Payment by Credit' or 'Payment by Direct Debiting Mandate' and return it to Maplin. Every time, about 1 month before your subscription is due, we will send you a letter giving details of the subscription rate and telling you the date on which we will charge your Credit Card or debit your bank account. If you do not wish to continue your subscription, you have until that date to let us know, and we will then cancel your authority to bill your Credit Card or cancel your mandate. Otherwise, if you do nothing, your subscription will continue. The authority or mandate you give us does not allow us to charge anything other than the Maplin Magazine subscription. The benefit to you is that you no longer need to remember to renew your subscription or send off any more cheques or postal orders. Payment is made automatically.

OVERSEAS READERS – *SUBSCRIBE NOW!* – Phone Maplin Export: +44 1702 554155 Ext. 326, 327 or 351. Full details on request.
Subscription rates for 6 issues are: £16.20 (or 40 IRCs) in Eire, Europe and surface mail outside Europe; £24.24 (or 60 IRCs) Air Mail outside Europe.
Subscription rates for 12 issues are: £32.40 (or 80 IRCs) in Eire, Europe and surface mail outside Europe; £48.48 (or 119 IRCs) Air Mail outside Europe.
AFRICAN READERS – SUBSCRIBE NOW! – Phone Maplin South Africa: +27 24 51 5124.
Subscription rate for 6 issues is: R114,00; Subscription rate for 12 issues is: R215,00.

TAKE THE NEXT 2 ISSUES OF THIS MAGAZINE FREE!!

Because we're so certain that now you've seen the Maplin Magazine you'll want to receive it regularly, we're offering to send you the next two issues free of charge with absolutely no obligation to continue. Just fill in the details below and if after receiving two issues you do not wish to continue, just let us know at least one month before the next issue is due and we will cancel your subscription. The two free issues will be yours to keep whatever you decide. If you already have a subscription, fill in the details below and we'll add two issues free of charge to your current subscription. SEND NO MONEY NOW. About 2 weeks before the third issue is due, we will charge you £11.88 for the next six issues, unless you have cancelled. This offer is not available to those already paying by Direct Debit or Continuous Credit Card or those who have stopped payment by either method within the last year. **THIS OFFER IS OPEN TO RESIDENTS WITH U.K. ADDRESSES ONLY.**

PLEASE START MY SUBSCRIPTION WITH ISSUE ☐ (If left blank subscription will start from next issue.)

EITHER

★ PLEASE ADD YOUR ADDRESS, SEE BOTTOM RIGHT ★

PAYMENT BY CREDIT CARD. Please charge my Credit Card Account

Customer Number (if known) .....

Access ☐ Visa ☐ American Express ☐ Expiry Date of Card ☐☐/☐☐

I authorise you until further notice in writing to debit my CREDIT CARD account by £11.88 and in future, with any amounts which, after notification, MAPLIN ELECTRONICS plc may debit thereto in respect of my subscription to the Maplin Magazine.
Overseas subscribers see above.

Account No.

Signature | Date

OR

PAYMENT BY DIRECT DEBITING MANDATE in favour of Maplin Electronics plc, P.O. Box 3, Rayleigh, Essex SS6 8LR.
Direct Debit payment option is only open to customers with bank accounts in the U.K. including Channel Isles, Isle of Man and N. Ireland.
Please note: Instructions cannot be accepted to charge Direct Debits to a Deposit or Savings Account.

DIRECT Debit

Bank Sort Code | Bank Account Number

Name of account to be debited

Bank Address

I authorise you until further notice in writing to charge my account, with you, any amounts which MAPLIN ELECTRONICS plc may debit thereto by Direct Debit in respect of my subscription to the Maplin Magazine.

I will inform the bank in writing if I wish to cancel this instruction.

I understand that if any direct debit is paid which breaks the terms of this instruction, the bank will make a refund.

Signature | Date

Enter your address and Maplin customer number, if known.

Postcode

Put this form in an envelope and address it to: Maplin Electronics, Freepost, P.O. Box 3, Rayleigh, Essex, SS6 2BR.

TECHNOLOGY WATCH!

with Keith Brindley

Look Who's Tracking Now

Safeway, the supermarket chain operator, is fitting complex mobile data communications systems to its fleet of 550 delivery trucks to help it maintain maximum usage of vehicles. Three main advantages are expected, based on the technologies of the systems. First, data terminals are to be fitted which will monitor engine efficiency and tacograph details. Second, a satellite global positioning system will detect each truck's exact location at any given time. Third, the system will provide direct two-way communications between drivers and Safeway's central headquarters in Warrington with messaging capabilities.

It is not that any part of this system is new or original, of course, but it's the combination of the various parts which makes this an interesting item of news. Quite how the drivers view the intrusion of technology into the cab is, I suppose, another matter.

Putting Out the Fire

In an attempt to stop computer suppliers up-rating processor speeds to get higher revenues (to the point where devices become overhot and eventually burn-out in some instances) Intel is to include governor circuits inside its microprocessors which prevent devices from being run at a speed higher than intended. Chips will be tested in the manufacturing stage, and encoded with data which specifies the speed they should be run at. An on-chip phase-locked loop circuit will then limit the device to run only at that speed. If a higher clock speed is attempted the device will not run at all.

The Secret, Secret Service

Home Secretary Michael Howard has recently widened MI5's powers to encompass the right to be able to search computer databases. This means that, technically, they can now access databases of information which may hold personal information previously classed as confidential.

Of course, MI5 cannot do this without a warrant, but the warrant is one signed by a relevant Government minister, unlike the offical and judicial warrants needed by police when searching premises. Obviously I don't for one minute suggest that the Home Secretary or any of his representative signatories would undermine a citizen's rights of privacy by allowing MI5 to access any particular database, but the whole situation is surely cause for a certain amount of alarm (and one which, incidentally, the Data Protection Registrar hopes to pursue as a matter of course). After all, while no-one could argue that a criminal's database records should not be accessed by MI5, there may be *other* records on the database, belonging to hundreds or thousands of non-criminals, which MI5 should simply *not* be allowed to access.

Have You Seen the Streets of London?

Making a useful utility out of a good idea is not the easiest thing to do with a computer but London Access is a good attempt. It is a streetfinder for central London rolled into a computer program, with extra advice on finding restaurants, attractions, tube stations as well as boring old streets. An interesting perspective and new dimension on an old idea.

Particular area maps can be saved or printed and several restaurant coupons (to the value of £400) are included. At £15.99 from most large high street shops the only drawback (I'm being flippant here) appears to be the weight of the computer you have to carry around town with you.

ARM Goes from Strength to . . .

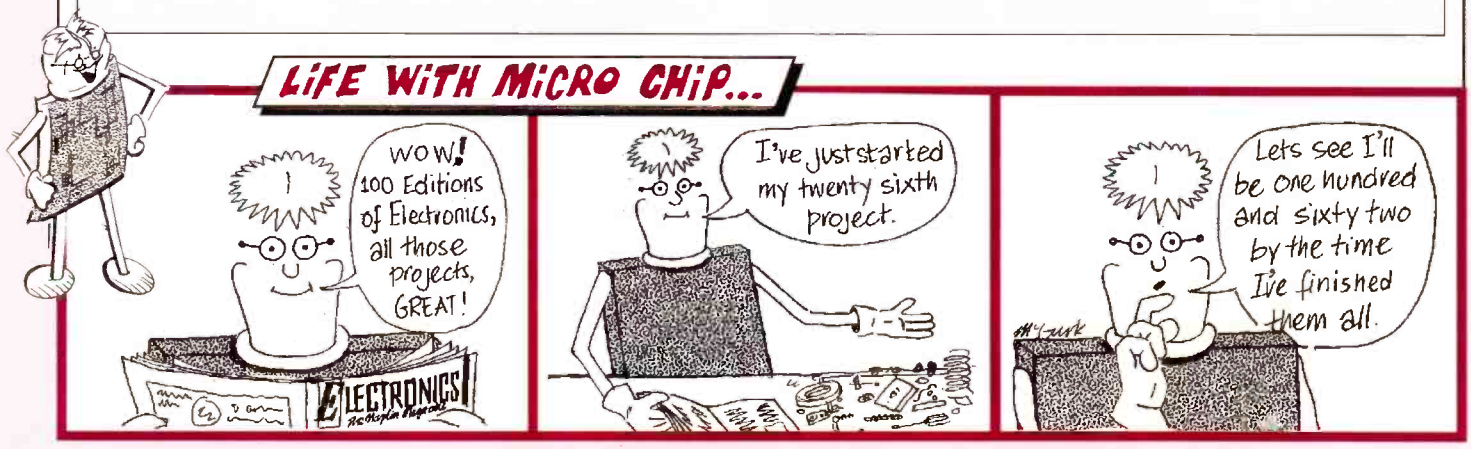
A recent deal between the UK's Acorn Computers and Oracle, the US megacompany looks set to mean that a new operating system will be used with an Advanced RISC Machines (ARM) microprocessor and find placement in several products planned for the near future. Everything from personal digital assistants (PDAs) to videophones, encompassing Oracle's long-dreamed of consumerised Internet Web browser, could result. Oracle's cheap network computer (NC – where *network* really means Internet) which is to be priced from around £330, is the first product to use the ARM processor and the new operating system (called NC-OS). It was prototyped in Japan in January, and is due to be launched in time for Christmas.

The potential of Oracle's NC is huge. It is, in fact, the Holy Grail which many computer manufacturers have been touting for many years now, in which the consumer entertainment and communications system becomes integrated with the computer, to the extent that it's not really possible to accurately define where one starts and the other finishes. I'm still not holding my breath, though.

However, couple the NC with Psion's aim to produce a PDA using an ARM chip, together with other similar projects planned for the near future and it looks as though ARM, at least, has got a big winner in its technology.

Fighting from the more conventional Intel side, on the other hand, Microsoft is rumoured to be readying its *Simply Interactive* PC. This is planned as a cheap personal computer to compete directly with Oracle's, running an optimised version of Windows and selling as a complete multimedia system capable of (among other things) Web browsing. Computer hardware, of course, would mark a significant change in Microsoft's business which, to date, has been all software-based. However, nothing's been seen of such a device, the idea of which therefore might be misconstrued as sour grapes on Microsoft's behalf. I may be wrong (prove it to me Mr Gates!) but I'm breathing normally here, too.

The opinions expressed by the author are not necessarily those of the publisher or the editor.



1 PROJECT RATING

PC Weather Station Software Update

The software described in this article has been developed specifically for use with the PC Weather Station project, as featured in *Electronics* Issue 70 (October 1993), and will run on any IBM-compatible PC operating under Windows™ 3.x or Windows™ '95. The software incorporates a Weather Station emulation routine, so that the program may be put to the test without having to actually have any project hardware connected to the PC. It is supplied in the form of a shareware 3·5in. floppy disk, for which the charge is for the postage and handling costs only, making it exceptional value!

FEATURES

- ★ Analogue and digital display
- ★ Selectable graphical display
- ★ Adjustable logging rate
- ★ Average and maximum wind speed display
- ★ Real-time clock and elapsed logging time displays

APPLICATIONS

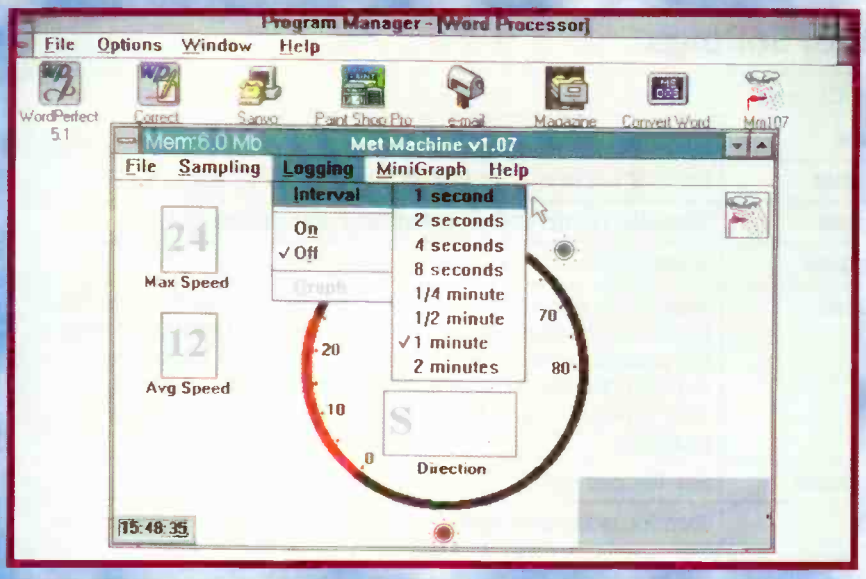
- ★ PC Weather Station
- ★ Trial PC Weather Station emulation software

DISKETTE AVAILABLE (95069) PRICE £4.99

Software written by Paul Blackmore

Technical support by Tony Bricknell

Text by Paul Blackmore and Maurice Hunt



Above: Screen shot of new menu.

Far left: Anemometer and weather vane.

Left: Weather station window icon.

ALTHOUGH four test programs were included in the original article, these gave only individual functions, for example, wind speed and wind direction. However, this easy to use software enables the simultaneous analogue and digital displaying of these functions, within an attractive window on your PC's monitor – see the screen shots pictured. Additionally, the software computes and displays a real-time clock, elapsed monitoring time, average and maximum wind speeds, and both instantaneous and selectable graphical representation of the variables being measured by the PC Weather Station hardware, with features including adjustable monitoring (logging) rate.

MetMachine Display

The purpose of the main display is to show current wind speed and wind direction values in both digital and analogue format.

Wind speed is displayed both within a box (digital display) within the circle, and as a red line overlaying the main circle (analogue display). Current average wind speed is displayed in a box to the left of the display, as is the maximum wind speed recorded since execution of the current recording session.

Wind direction is displayed in compass point form within the box, and as a series of coloured beacon symbols around the outside of the main circle. The current wind direction is displayed as a red beacon, while the current average wind direction is displayed as a grey beacon. If the current wind direction and average coincide, then the beacon is displayed as purple.

Average Values

The average wind speed is displayed as the average over a number of readings, as indicated by the .ini parameter 'RollValue'. The maximum value permitted is 100 readings, but you may reduce this number by editing the .ini file and changing the value. Be careful when changing this setting, however, as no validation is carried out as to the maximum value. If you choose a number greater than 100, the program will terminate. In a later release of MetMachine, this will be made more robust, but to be fair to the software author, the option was only allowed in order to tune the average wind speed algorithm without having to recompile the program.

Average wind direction works in a similar way to wind speed, but the algorithm is a little more complicated. Values received from the interface board vary between 0 (for North) and 15 (for North North West). A wind speed varying between NNE and NNW equally should produce a value representing North, but simply averaging the number returned from the interface board will not produce this result.

The algorithm works by examining an array of the last *n* wind direction values where *n* equates to the .ini RollValue parameter. The array is examined and the number of times each individual direction is logged is accumulated. Then, each direction has the number of hits one direction either side of it is accumulated and added in. If a single direction comes out highest on its own, then that is the new average direction. If no single number comes out on top then the set is examined to see if one of the values is the same as the last average direction, if this is so then the average direction is left unchanged. If an average still has not been determined then the first value in the array is taken.

Installing the Software (MetMachine v1.07)

The installation disk should contain the following files:

MM107.EXE
VBRUN300.DLL
INOUT.DLL
THREED.VBX
GRAPH.VBX
GSWDLL.DLL
GSW.EXE
MM107RC.CSV
READ.ME

For the purposes of these notes, an assumption is made that your hard drive is designated as your C: drive. Create a directory called **C:\MM107** on your hard disk and copy all of the above files to this directory. The only file that must stay in C:\MM107 directory is **MM107.EXE**, all of the others can be copied to your **C:\WINDOWS\SYSTEM** directory, if so desired. Before you do so, however, check whether you have any of these files in C:\WINDOWS\SYSTEM already. If you don't want to clutter up C:\WINDOWS\SYSTEM then leave them

in C:\MM107. You now need to set up an icon for MetMachine.

In Windows 3.x, select FILE from the menu bar, then NEW, then program item, then browse and select C:\MM107. Look for MM107.EXE and select it. Ensure that the working directory is also set to C:\MM107.

In Windows '95, click your right mouse button over START on the task bar and choose EXPLORE. Select the MM107 folder and click your right mouse button over MM107.EXE and create a SHORTCUT. Drag this shortcut onto your desktop.

Starting MetMachine

Double click the MetMachine icon. When MetMachine starts, it will look for an initialisation file called MM107.INI in the current working directory. If it cannot find one, it will create one with default values as follows:

```
(MM107)
Mode=Dsbl
Base Address=0768
Sampling Interval=1/2
Logging Interval=015
Graph=1
GraphValue=WS
Graph Interval=001
RollValue=100
```

All of the above values, with the exception of RollValue, are maintained within MetMachine, although in an emergency, you can modify the settings manually. If you accidentally corrupt the .ini file, simply delete it and MetMachine will create the default one again when it is next run.

Setting the Base Address

When MetMachine first starts, the default mode is set to disable. This is to allow you to set the base address of your interface board. MetMachine assumes a default of Hex 300, the prototype board setting. To change this setting, select SAMPLING, then BASE ADDRESS and you will be presented with a selection. A tick will indicate the current setting. Choose the setting you require by left clicking with the mouse.

Setting the Mode

Now that you have selected the base address of your board, you need to activate MetMachine. Select FILE, then MODE and you will be presented with a selection. From this selection, choose ENABLE, and MetMachine should start sampling from your interface board.

If it appears to freeze at this point, then you may have set the address incorrectly. Break out using Ctrl/Alt/Del and once back at Windows, go to C:\MM107, delete MM107.INI and start again. When you exit MetMachine, the current settings will be written back to MM107.INI. See Table 1 for other settings.

Other Settings

FILE Options	
Mode	
Disable	Default value at installation. Freezes application.
Enable	Samples board at Sampling interval (see later).
Emulate	A test mode.
Record	This mode records the readings sampled from the interface board and writes them to a file called MM107RC.CSV. This file is used by the PLAYBACK option and can be used to playback the last session. This option was originally developed to allow the code to be developed using a portable PC. You may find it useful, so it is left in.
Playback	See Record option.
Exit	Terminate MetMachine and write any changes to the .ini file.
SAMPLING Options	
Base Address	Allows the base address of the interface board to be set A list is provided of the ones thought to be most useful.
Interval	How often MetMachine will go to the interface board to extract readings. The shortest interval provided is ¼ second, but with any logging or graphing options enabled, it is unlikely this frequency will be achieved.
LOGGING Options	
Interval	If logging is on (see below), this setting indicates how frequently a logging record should be written to the file MM107LG.CSV. This file is used by the Graph option (see below) but can also be analysed via any spreadsheet application that supports Comma Separated Value (CSV) files.
On	Switches logging on.
Off	Switches logging off.
Graph	Displays a graph of average wind speed over the complete logging period. This option will remain 'greyed out' until at least two records have been written to the logging file.
MINIGRAPH Options	
Interval	The interval at which the Minigraph is refreshed at the bottom right of the screen.
On	Switches Minigraph logging on.
Off	Switches Minigraph logging off.
Use Windspeed	Causes the Minigraph to plot windspeed.
Use Average	Causes the Minigraph to plot average windspeed.

Table 1.

Future Enhancements

MetMachine will be compiled under Visual Basic 4.0 to provide a fully compliant Windows '95 version.

The graphing option will be expanded to include wind direction. If you examine the logging file (**MM107LG.CSV**), you will see that wind direction data is already being recorded. The author had problems visualising how he could graphically represent a wind direction, but having examined a book on Meteorology to see how manual wind direction loggers do it, he now knows how.

Known Bugs

Currently, if playback mode is selected, it is possible to select it again, at which point, the program announces that the playback file is already open. It then terminates and returns to Windows. This was only spotted recently, and will be fixed in a later release.

No validation is carried out on values in the .ini file apart from the name of each parameter. This is not a problem unless the .ini file is edited manually, but the next release will address this by detecting that the .ini file is corrupt and recreating the default.

Suggestions

The author of this software is open to suggestions about the current version and any ideas for possible inclusion in future releases. The discovery of any bugs will be of

particular interest. See the contact address below.

MetMachine for DOS

The user interface was originally developed in QuickBasic to run under DOS has now been redeveloped to run under Windows. Most, but not all, of the features built into MetMachine for Windows are in the DOS version. If anyone would like a copy, please contact the software author at the address below.

Paul Blackmore
Bearware Computer Consultancy,
16 Lyme Park, West Bridgford,
Nottingham NG2 7TR.
e-mail:
pasatt@bearware.demon.co.uk

PC WEATHER STATION SOFTWARE UPDATE PARTS LIST

MISCELLANEOUS		
PC Weather Station Software 3·5in. Disk	1	(95069)
OPTIONAL		
PC Weather Station Card	1	(LT28F)
Wind Direction Kit	1	(LM88V)
Wind Speed Kit	1	(LM87U)
Maplin Magazine Issue 31	1	(XA31J)
Maplin Magazine Issue 70	1	(XA70M)

Order As 95069 (PC Weather Station Software) Price £4.99

NEXT issue

In the May 1996 issue (No. 101) of *Electronics – The Maplin Magazine*, there is another appealing assortment of terrific projects and features heading your way – don't miss it!

PROJECTS

HIGH-LEVEL BRAKE LIGHT FLASHER

Designed as an enhancement to safety for vehicles fitted with a high-level brake light, this project is used in emergency situations, to flash the high-level brake light in antiphase to the hazard warning indicators, without affecting the normal operation of the conventional brake lights. Very useful for warning following drivers of danger ahead on the motorways, or during breakdowns.

KOJAK SIREN

Create or imitate a variety of different siren sounds with this project, which is ideal for use in alarms, or to bring toys and models to life. Widely adjustable, having three presets, and incorporating a loud 2W on board amplifier, it cannot be ignored!

GUITAR PHANTOM PSU

This mains-powered project acts as a battery eliminator for use with guitars having active pickups, and as an enhancer for guitars fitted with passive pick ups. Avoids the risk of the battery running flat mid-session in guitars with active pickups, the project supplies the required DC power via the conventional guitar lead, and contains a buffer amplifier to improve the drive signal from passive pickups.

NURSE CALL SYSTEM

This project is a potential life-saver for vulnerable elderly or infirm people, or those suffering from illness. It comprises of a pendant radio transmitter worn around the neck, which is triggered in the event of the wearer requiring assistance. This transmits a coded radio signal to a receiver, which has an open-ended relay output to activate alarms, an auto-dialler or similar, so that essential help can be summoned quickly.

FEATURES

Positive Thinking by Stephen Waddington, demonstrates techniques for achieving split rail voltage supplies, and provides details on building inverters that can be used to increase a battery's voltage. The Use of Lasers in Ophthalmology by Douglas Clarkson provides a sharp insight into how accurately-controlled lasers can be used to correct eye defects such as glaucoma and poor focusing. Part 9 of Ray Marston's series, A Practical Guide to Modern Digital ICs, covers practical up/down and programmable counter ICs, and ways of using them as frequency dividers. The Vision of Arthur C. Clarke by Ruth Ling, records the accurate predictions this world-renowned science fiction writer made on the satellite revolution – 50 years ago! Digital Video by Reg Miles, investigates the latest video recording technology and how it may be combined with the still-to-be-developed interactive television. High Bandwidth Memory, by Frank Booty, describes the development of extremely rapid memory, capable of supporting and keeping pace with the most powerful of modern processors. Finally, Value Added Internet Services by Keith Brindley shows how to go about getting the most out of Internet access, and choosing the right Internet provider to best suit your requirements.

Don't miss out on your FREE AOL COVER DISK with the May 1996 issue, featuring the new Internet service, American On-Line Service (AOL). Using this disk, you can try out this new service totally free of charge for up to 10 hours!

ALSO!

Enter our Science Museum and Hard Target Competitions – exclusive to *Electronics*.

ELECTRONICS – THE MAPLIN MAGAZINE
BRITAIN'S BEST SELLING ELECTRONICS MAGAZINE

MAPLIN
NATIONWIDE STORES

Telephone 01702 552911 for details of your nearest store.

FOR BARGAINS AND MORE, VISIT YOUR LOCAL STORE!

For personal service, visit our stores at:

Belfast 357-359 Lisburn Road.
Birmingham Sutton New Road, Erdington.
Bradford 28 Valley Road, Ham Strasse.
Brighton 65 London Road.
Bristol 302 Gloucester Road, Horfield.
Cardiff 29-31 City Road, Roath.
Chatham 2 Luton Road.
Cheetham Hill 169 Cheetham Hill Road, Cheetham Hill.
Coventry 12 Bishop Street.
Dudley Unit 7, Sterling Park, Pedmore Road, Brierley Hill.
Edgware 146-148 Burnt Oak, Broadway.
Edinburgh 126 Dalry Road, Dalry.
Forest Hill 107-113 Stanstead Road.
Glasgow 264-266 Great Western Road.
Hammersmith 120-122 King Street.
Ilford 302-304 Green Lane.
Leeds Carpet World Building, 3 Regent Street.
Leicester Office World Building, Burton Street.
Liverpool Edge Lane, Fairfield.
Manchester 8 Oxford Road.
Middlesbrough Unit 1, The Forbes Building, 309-321 Linthorpe Road.
Milton Keynes Unit 2, Office World Building, Snowdon Drive, Winterhill.
Newcastle-upon-Tyne Unit 4, Allison Court, (The Metro Centre) Gateshead.
Northampton 139 St. James Road.
Nottingham 86-88 Lower Parliament Street.
Portsmouth 98-100 Kingston Road.
Preston Unit 1, Corporation Street.
Reading 129-131 Oxford Road.
Sheffield 413 Langsett Road, Hillsborough.
Slough 216-218 Farnham Road.
Southampton 46-48 Bevois Valley Road.
Southend-on-Sea 282-284 London Road.
Stockport 259-261 Wellington Road South.
Stoke-on-Trent 39-45 London Road.

This project complements the Multi-Strobe project published in *Electronics* Issue 92. The Multi-Strobe Sequencer contains 100 preset pattern programs, and is able to control one or more groups of up to eight Multi-Strobes simultaneously; as many strobes as you wish may be connected to and controlled by the unit. The system enables the easy creation of captivating and spectacular lighting effects to really liven up discos, parties and other fun events!

MULTI-STROBE

Part Two:

The Sequencer

Design by Chris Barlow and Alan Williamson

Strobe patterns created by Nigel Skeels

Text by Alan Williamson, Chris Barlow and Maurice Hunt

FEATURES

- ★ 100 preprogrammed strobe patterns
- ★ 8 channels ★ Line level input
- ★ Digital display of pattern selected
- ★ LED display of pattern sequence
- ★ 8-bit TTL level input and output
- ★ Built-in microphone
- ★ External microphone input
- ★ 25-way D-type I/O connector

FOR EASY CREATION OF SPECTACULAR LIGHTING EFFECTS!

APPLICATIONS

- ★ Entertainment, discos, etc. ★ Parties
- ★ Promotional events

3 PROJECT RATING

IMPORTANT SAFETY NOTE:
It is important to note that mains voltage is potentially lethal. Full details of mains wiring connections are shown in this article, and every possible precaution must be take to avoid the risk of electric shock during maintenance and use of the final unit, which should never be operated with the box lid removed. Because the unit is housed in a metal case with integral mains supply, Class 1 construction techniques must be employed; the case and metalwork of the mains transformer must be earthed. Connection to the mains supply must be via a 3-core mains lead and conventional 3-pin plug. Every possible precaution must be taken to avoid the risk of electric shock during maintenance and use of the final unit. Safe construction of the unit is entirely dependent on the skill of the constructor, and adherence to the instructions given in this article. For *your* safety, it is important that insulation is applied to all the exposed mains connectors. If you are in any doubt as to the correct way to proceed, consult a suitable qualified engineer.

Specification

Operating voltage:	230V AC 50Hz Mains
Power consumption:	4W Maximum
Flash rate:	0·5 to 20Hz
Microphone input:	5mV rms
Line level input:	250mV rms
VOGAD output level:	80mV rms
Variable gain audio amplifier output:	1V rms
Low pass audio filter output:	1V rms
Low pass audio filter frequency:	–3dB @ 125Hz
Low pass audio filter type:	4 pole Chebyshev
Audio trigger output:	TTL
Run input:	TTL
Stop input:	TTL
8 Bit data input:	TTL
8 Bit data output:	TTL
Serial clock/data output:	RS-232
Serial clock/data test loop input:	RS-232
Overload protection:	50mA Fuse
PCB dimensions (before separation):	357 × 193mm
Case dimensions (WHD):	435·5 × 40 × 198mm (19in. Rack Case)
Front panel dimensions (WH):	482 × 43·5 (standard 1U dimensions)

NOTE. Electrical statistics above are valid with the 'AUDIO LEVEL' control set to maximum.

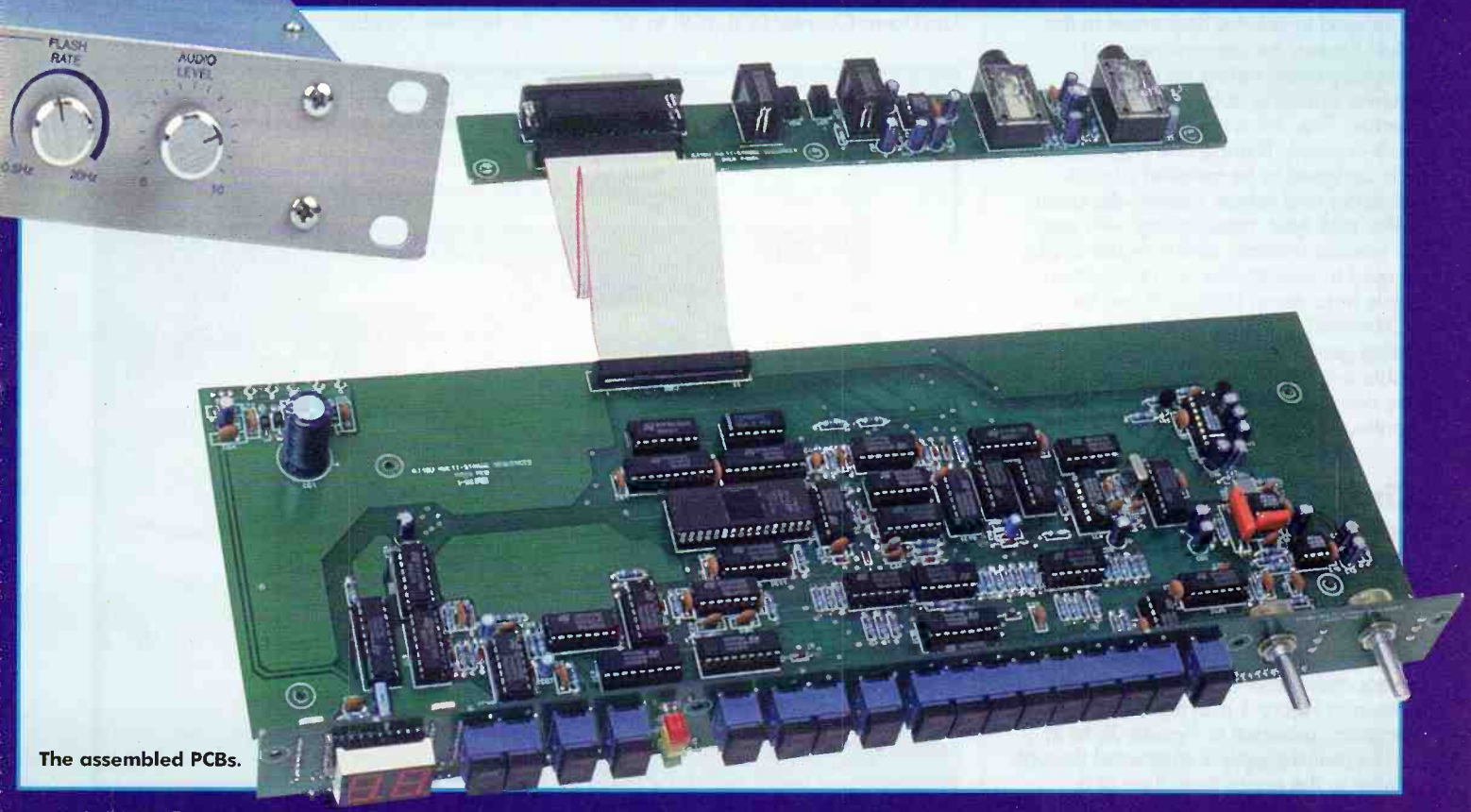
KIT AVAILABLE (90040) PRICE £199.99 H1 Includes Case

The completed unit.

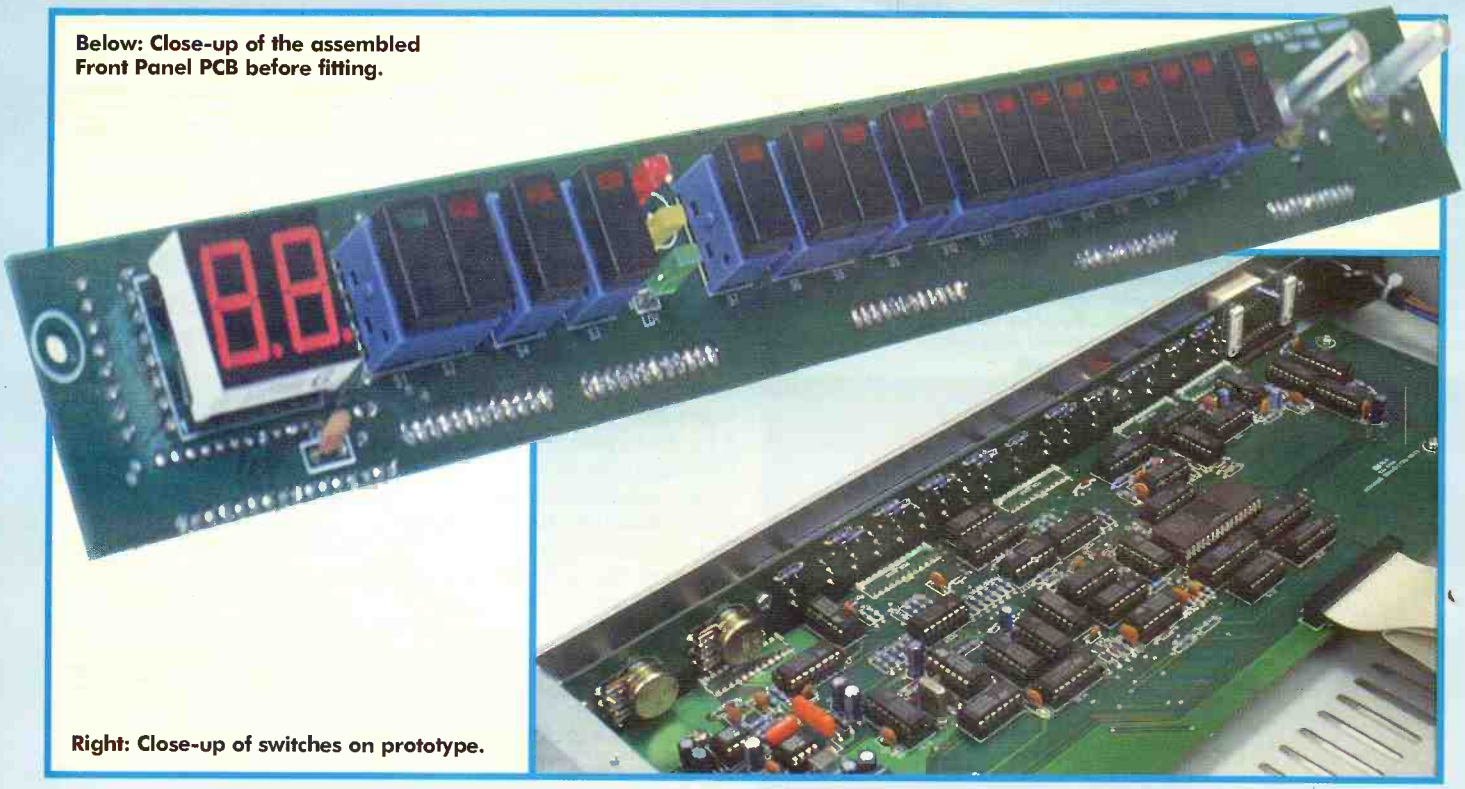
THE Sequencer offers many highly desirable functions, many of which are not available on more expensive commercial designs. In particular, the unit provides an exceptionally wide number of possible input and output permutations. In addition to the built-in pattern control system, the patterns may be controlled via an 8-bit parallel TTL-level input obtained from virtually any suitably programmed computer via a 25-way D-type connector, which enables several I/O options. These consist of strobe firing trigger inputs, an RS-232 compatible serial data input, audio outputs for transmission to other pieces of equipment if required, and digital output of the pattern being generated at any given moment.

In addition, the lighting pattern change rate may be controlled either manually, via the front panel controls, or automatically, by means of the built-in crystal-controlled master clock, or an audio signal. The latter can be picked up by either the built-in microphone, an external microphone, or via a line level input. The sensitivity to the sound is widely adjustable, with VOGAD circuitry to cater for all levels of music.

The 100 preprogrammed patterns, as detailed in Table 1, are stored in a



The assembled PCBs.



Below: Close-up of the assembled Front Panel PCB before fitting.

Right: Close-up of switches on prototype.

master clock-controlled EPROM, which can be selected to output single or continuous-loop sequences, and your own patterns can be entered using the front panel buttons. The unit allows differing configurations of strobes to be controlled; 2 strobes connected allow 10 patterns, 4 strobes allow 20 patterns, 6 strobes allow 30 patterns, while 8 strobes allow the full 100 patterns – including the 2, 4 and 6 strobe patterns. However, you can also use the 8-strobe patterns on 2-strobe setups, though obviously, the full effect will not be obtainable. You can connect as many groups of up to 8 strobes each to the unit as you wish.

Cables terminated with American telephone-style FCC68 connectors are employed to link the Sequencer to the Multi-Strobes for convenience and simplicity when setting up a lighting system, enabling daisy-chaining of the strobes. The unit is mains powered with built-in supply filtering and regulation. It is designed to be installed into an attractive and robust, custom-designed 19in. rack type metal casing, with easy to operate controls, and a digital display is used to indicate the selected pattern while front panel LEDs built into the 'CHANNEL' switches show the sequence being generated. Additionally, an RS-232 cable loop tester is incorporated into the design, with LEDs to confirm the continuity of the interconnecting lead.

Circuit Description

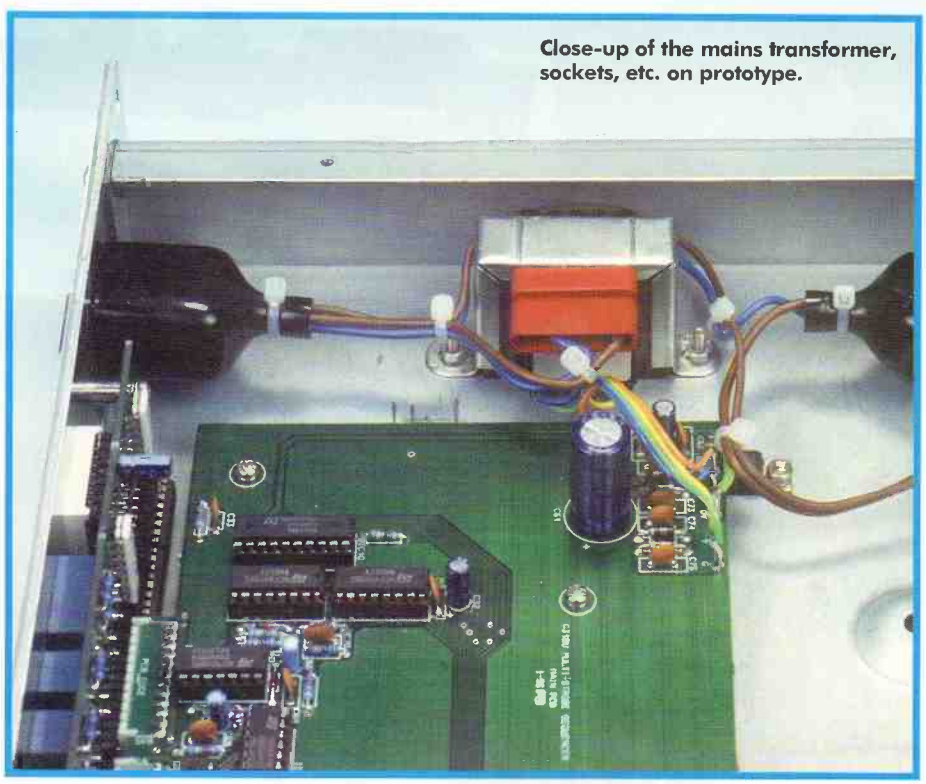
Although on first glance, the circuit appears rather complicated, with 39 ICs in total, it consists of relatively straightforward sections, although it requires an admittedly lengthy description to describe its overall operation adequately. Refer to the block diagram, shown in Figure 1 and the circuit diagram, provided in Figures 2a to 2f.

The mains supply is connected through a filter to the mains fuse, then to a double-pole switch followed by a standard linear PSU consisting of the usual transformer, full-wave bridge rectifier, reservoir, regulator and output decoupling combination.

A power on reset (Reset 1) is performed by IC19b; this resets a number of circuits to set certain conditions upon switching the unit on; this includes setting the 'Pattern Timing Selector' (IC5) to 'MEMORY'; the 'Single/Flash' (IC22b) to 'SINGLE'; the 'Strobe Data Output Latch' (IC22a) to 'OFF'; the 'One Run Latch' (IC21b) to 'OFF'; the 'Pattern Stop OR Gate'(IC20b) to 'STOP'; the 'Pattern Data Address Counter Reset Generator' (IC20a) to 'FIRST ADDRESS'; and finally, the 'Pattern Number Up/Down Counter (IC8, IC9) to '0'.

The Pattern Number Up/Down Scan Buttons, S1 and S2, are the DOWN (▼) and UP (▲) controls, respectively; pushing switch S2 will start the ring oscillator formed by IC39a to c. The first cycle from the oscillator will be longer than the following cycles. This is because capacitor C66 starts off fully discharged on the first cycle and will only be partially discharged on subsequent cycles. The output clock pulses are delayed by R49 & C70 to allow IC8 & IC9 to change to the up counting mode before being clocked. IC39d to f form the down oscillator.

The output of the Pattern Up/Down Counter, IC8 & IC9 are connected to BCD to 7-segment display drivers (IC37 & IC38) and viewed on the Pattern Number Display.



Close-up of the mains transformer, sockets, etc. on prototype.

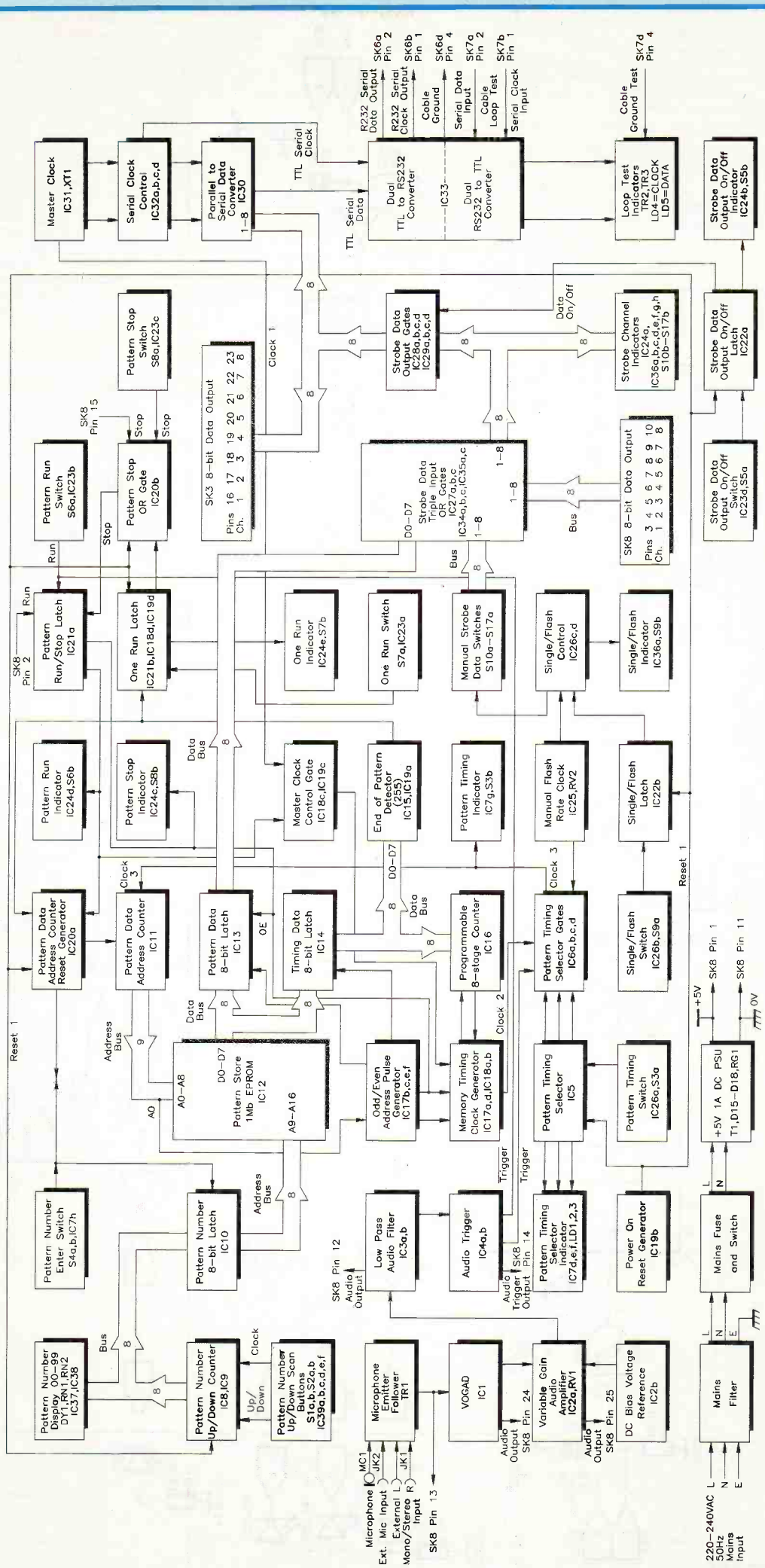
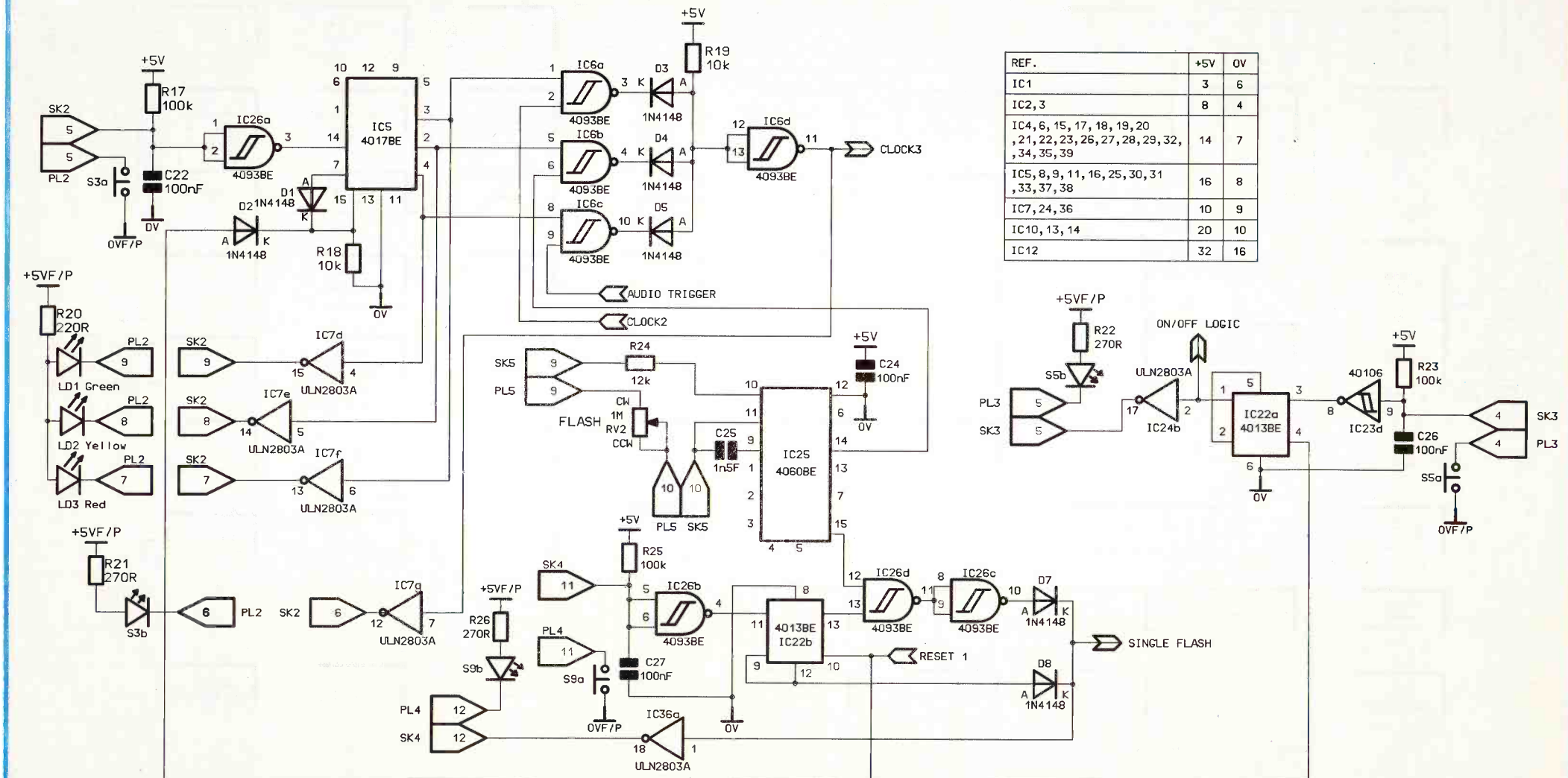


Figure 1. Block diagram of the Multi-Strobe Sequencer.



REF.	+5V	0V
IC1	3	6
IC2,3	8	4
IC4,6,15,17,18,19,20,21,22,23,26,27,28,29,32,34,35,39	14	7
IC5,8,9,11,16,25,30,31,33,37,38	16	8
IC7,24,36	10	9
IC10,13,14	20	10
IC12	32	16

Figure 2a.

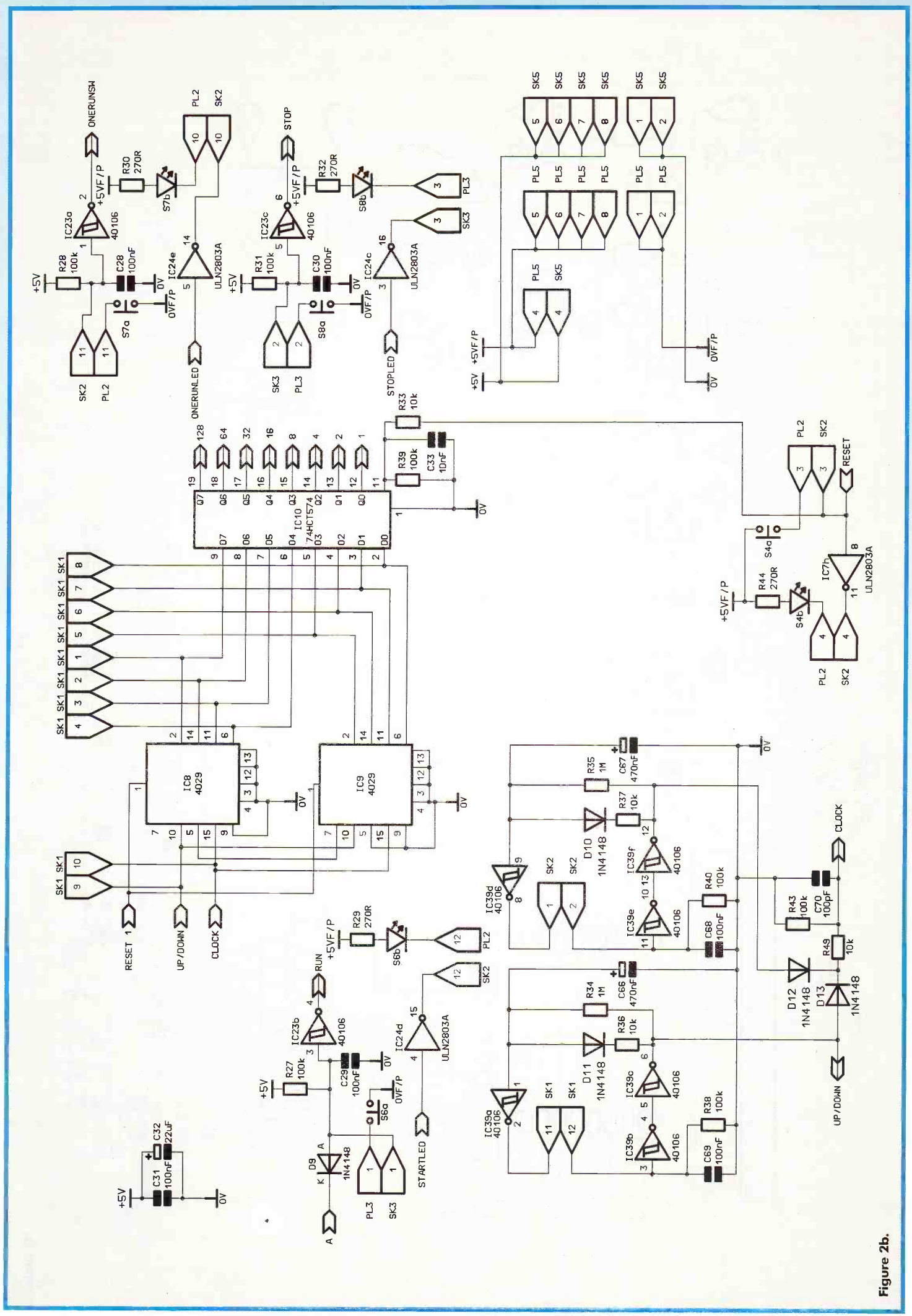

ONERUNSW
STOP
+5V/P
R30 270R
R32 270R
S7b
S8b
PL2
SK2
PL3
SK3
IC23a 40106
IC23c 40106
R28 100k
C28 100nF
R31 100k
C30 100nF
IC24e ULN2803A
IC24c ULN2803A
S7a
S8a
0VF/P
0V
+5V
ONERUNLED
STOPLED
SK5
PL5
R33 10k
R39 100k
C33 10nF
IC10 74HCT574
IC8 4029
IC9 4029
SK1
RESET
UP/DOWN
CLOCK
S4a
S4b
R44 270R
IC7b ULN2803A
R29 270R
S6b
RUN
IC23b 40106
IC24d ULN2803A
R27 100k
C29 100nF
S6a
C32 22uF
C31 100nF
D9 1N4148
STARTLED
R35 1M
C67 470nF
R37 10k
D10 1N4148
IC39f 40106
IC39d 40106
IC39e 40106
R40 100k
C68 100nF
R34 1M
C66 470nF
R36 10k
D11 1N4148
IC39c 40106
IC39a 40106
IC39b 40106
R38 100k
C69 100nF
R43 100k
C70 100pF
R49 10k
D12 1N4148
D13 1N4148

Figure 2b.

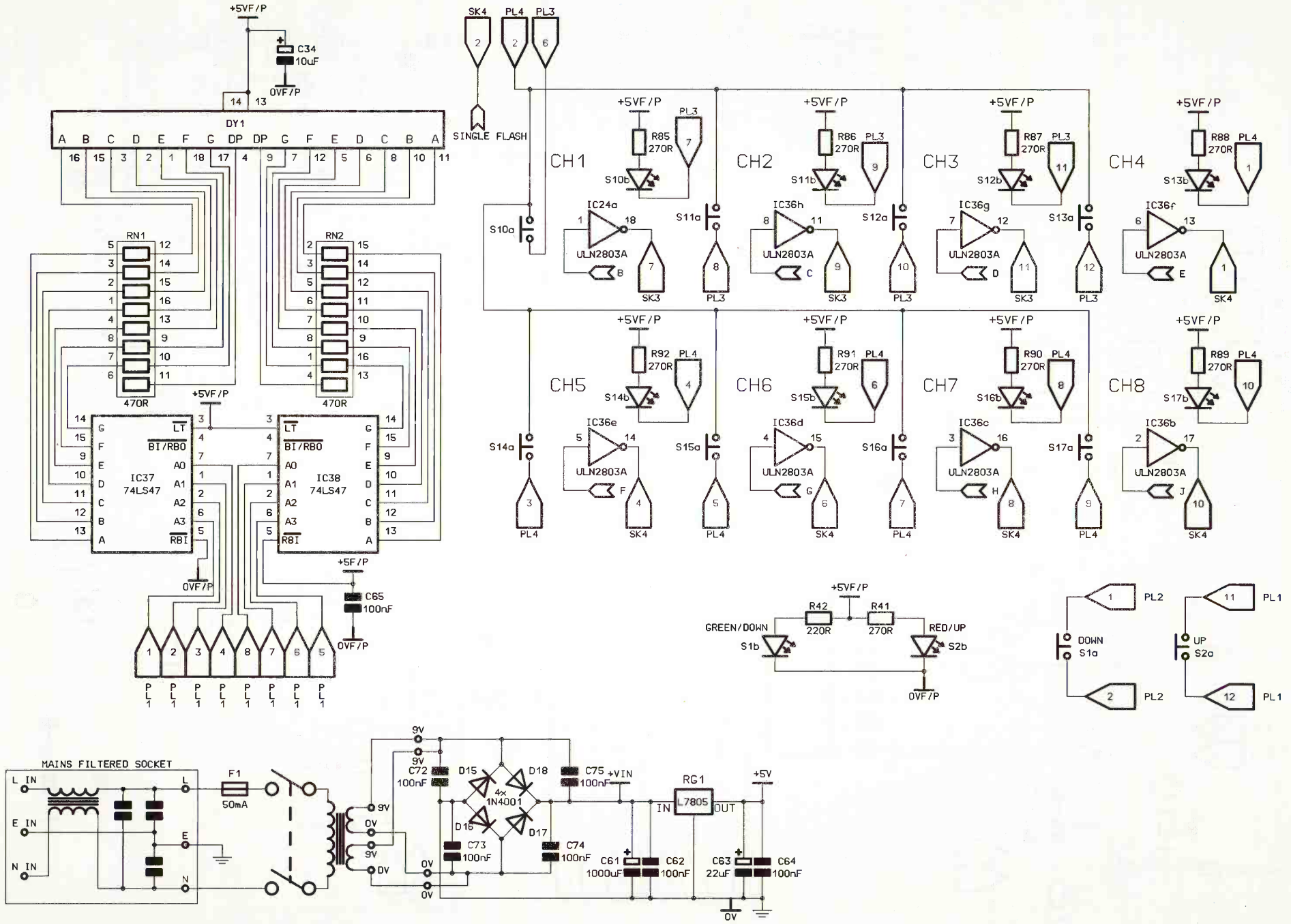

+5VF/P
C34
10uF
0VF/P
DY1
A B C D E F G DP DP G F E D C B A
RN1
RN2
470R
IC37
74LS47
IC38
74LS47
LT
BI/RBO
RBI
A0
A1
A2
A3
C65
100nF
SK4
PL4
PL3
SINGLE FLASH
CH1
CH2
CH3
CH4
CH5
CH6
CH7
CH8
R85 270R
R86 270R
R87 270R
R88 270R
R92 270R
R91 270R
R90 270R
R89 270R
S10a
S10b
S11a
S11b
S12a
S12b
S13a
S13b
S14a
S14b
S15a
S15b
S16a
S16b
S17a
S17b
IC24a
IC36h
IC36g
IC36f
IC36e
IC36d
IC36c
IC36b
ULN2803A
SK3
SK4
PL3
PL4
R42 220R
R41 270R
GREEN/DOWN
RED/UP
S1b
S2b
DOWN
S1a
UP
S2a
PL1
PL2
MAINS FILTERED SOCKET
L IN
E IN
N IN
F1
50mA
9V
0V
C72 100nF
D15
D16
D17
D18
4x 1N4001
C73 100nF
C74 100nF
C75 100nF
+VIN
RG1
L7805
IN
OUT
+5V
C61 1000uF
C62 100nF
C63 22uF
C64 100nF

Figure 2c.

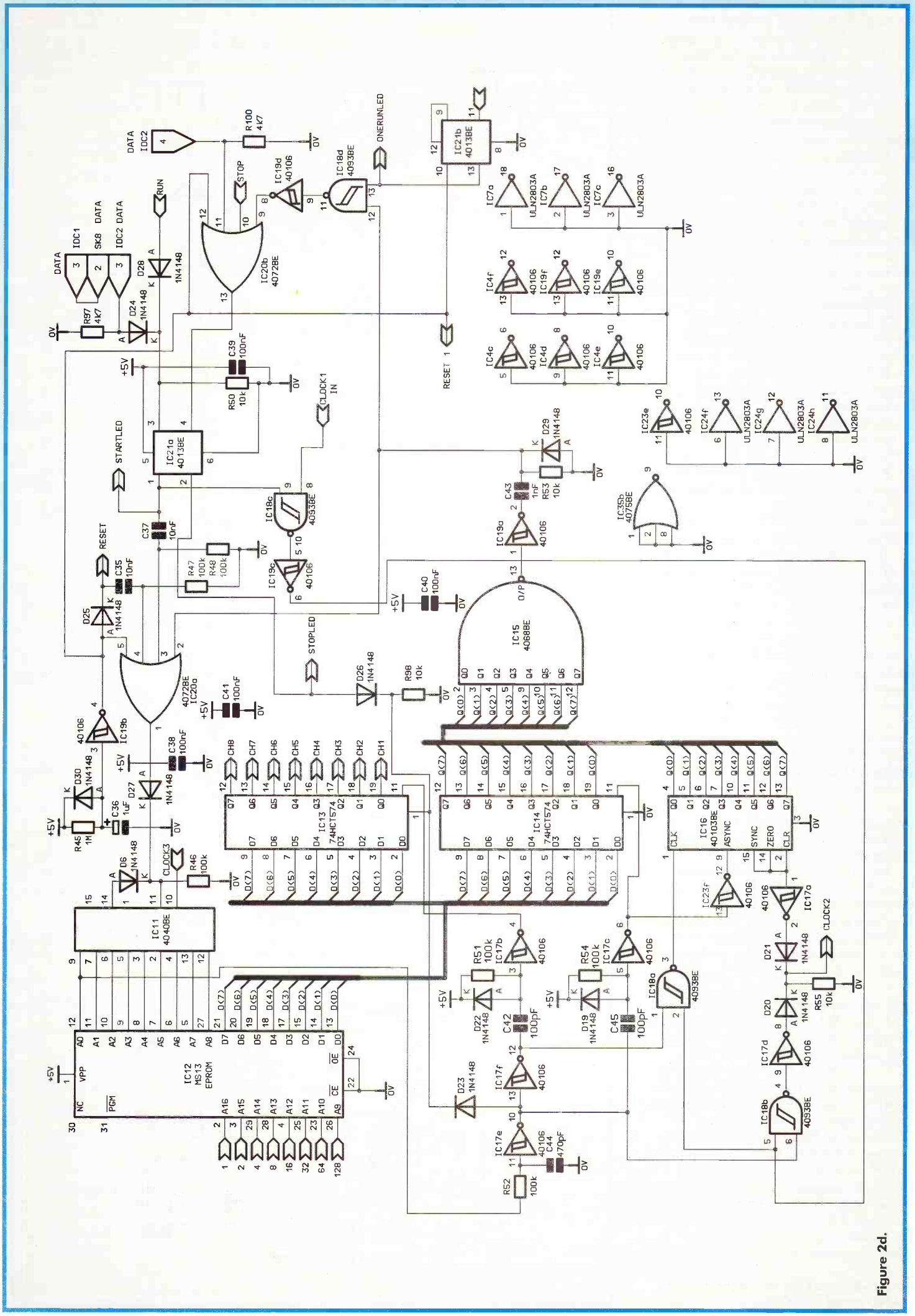

IC12 MS13 EPROM
IC11 4040BE
IC13 74HCT574
IC14 74HCT574
IC15 4068BE
IC16 40103BE
IC20a 4072BE
IC20b 40728BE
IC21a 4013BE
IC21b 4013BE
IC35b 4075BE
IC18a 4093BE
IC18b 4093BE
IC18c 4093BE
IC18d 4093BE
IC19a 40106
IC19b 40106
IC19c 40106
IC19d 40106
IC19e 40106
IC19f 40106
IC4c 40106
IC4d 40106
IC4e 40106
IC4f 40106
IC17a 40106
IC17b 40106
IC17c 40106
IC17d 40106
IC17e 40106
IC17f 40106
IC23e 40106
IC23f 40106
IC24f ULN2803A
IC24g ULN2803A
IC24h ULN2803A
IC7a ULN2803A
IC7b ULN2803A
IC7c ULN2803A
R100 4k7
R97 4k7
R50 10k
R53 10k
R98 10k
R55 10k
R51 100k
R52 100k
R54 100k
R45 1M
R46 100k
R47 100k
R48 100k
C36 1uF
C37 10nF
C38 100nF
C39 100nF
C40 100nF
C41 100nF
C42 100pF
C43 1nF
C44 470pF
C45 100pF
D6 1N4148
D19 1N4148
D20 1N4148
D21 1N4148
D22 1N4148
D23 1N4148
D24 1N4148
D25 1N4148
D26 1N4148
D27 1N4148
D28 1N4148
D29 1N4148
D30 1N4148
DATA IDC2
RUN
STOP
ONERUNLED
DATA IDC1
SK8 DATA
IDC2 DATA
RESET
CLOCK1 IN
STARTLED
STOPLED
CLOCK3
CLOCK2
+5V
0V

Figure 2d.

The output of the Pattern Up/Down Counter is also fed to an 8-bit Latch (IC10). Pushing S4 will store the pattern number in IC10 and reset the Pattern Data Address Counter (IC11), via IC20.

IC12, the EPROM, is the heart of the Sequencer, where all the pattern data is stored; a binary number is applied to the address pins A_9-A_{16}, to access a block of data starting at the number corresponding to that shown on the double-digit LED display. See Table 1 (on pages 66 and 67) for details of the EPROM memory allocations.

The EPROM not only contains the pattern data as to which strobe or strobes are to be fired, it also contains the timing data; Pattern Data is held in EVEN addresses and Timing Data is held in ODD addresses.

IC11 is the Pattern Data Address Counter which is advanced on each pulse by Clock 3; the counter is reset by the EPROM by producing an 'end of pattern marker' (Timing Data=255), at the end of each pattern, to stop the counting sequence. Diode D6 is used as a 'belt and braces' fail-safe reset.

The outputs of IC11 are connected to the A_0 to A_8 addresses of the EPROM, to access the Pattern and Timing data held within the data block.

The Least Significant Bit (LSB) from the EPROM data input (A0) is used by IC17b, c, e & f to generate pulses on the positive and negative transitions, latching the data in either IC13 (Pattern Data) or IC14 (Timing Data). An EVEN number input (A_0=0) switches the Output Enable (OE) of IC13 ON via D46.

In the default 'MEMORY' (EPROM) pattern timing setting, Clock 3 is derived (eventually) from Clock 1, which is produced by the Master Clock, IC31. This is a 2MHz crystal controlled oscillator/divider with three outputs; pin 4 (Q6, ÷64), pin 15 (Q10, ÷1,024), and pin 2 (Q13, ÷8,192 – Clock 1). The ratios are Q10:Q13=8:1, and Q6:Q10=16:1; for the moment, we are only interested in the Q13 output, Clock 1 (pin 2); the function of the other two will be described later.

Clock 1 is connected to the Master Clock Control Gate (IC18c). Pushing the Run Switch S6, will set the Pattern Run/Stop Latch (IC21a) to 'Run' via the switch debounce inverter, IC23b. This sets a number of conditions; it allows the Clock 1 pulses to be passed through the Master Clock Control Gate (IC18c); it also switches the Pattern Stop Indicator 'OFF' (the LED in S8) and the Pattern Run Indicator 'ON' (S6). The Output Enable (OE) of the Pattern Data 8 Bit Latch (IC13) is switched 'ON' via D47. IC21a also generates a pulse through C37, this resets IC11 via the Pattern Data/Address Counter Reset Generator IC20a.

Pushing the Pattern Stop Switch (S8), will reset the Pattern Run/Stop latch to the 'STOP' condition, illuminate the Stop LED, and extinguish the 'RUN' indicator.

The Master Clock Control Gate (IC18c, IC19c) output (Clock 1) is manipulated by the Memory Timing Clock Generator (IC17a & d, and IC18a & b).

An EVEN input (A_0=0) to the EPROM is AND gated (via IC17e) with a Clock 1

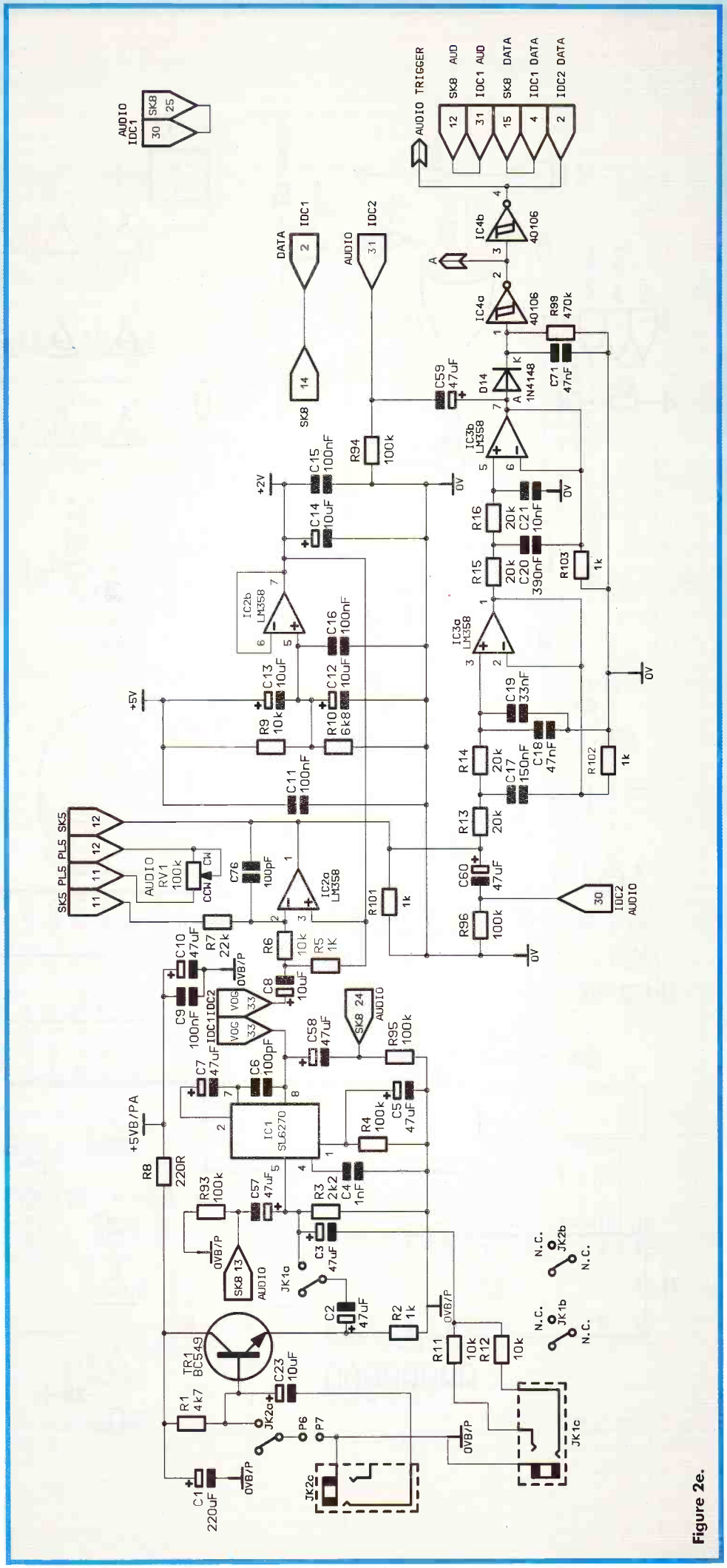


Figure 2e.

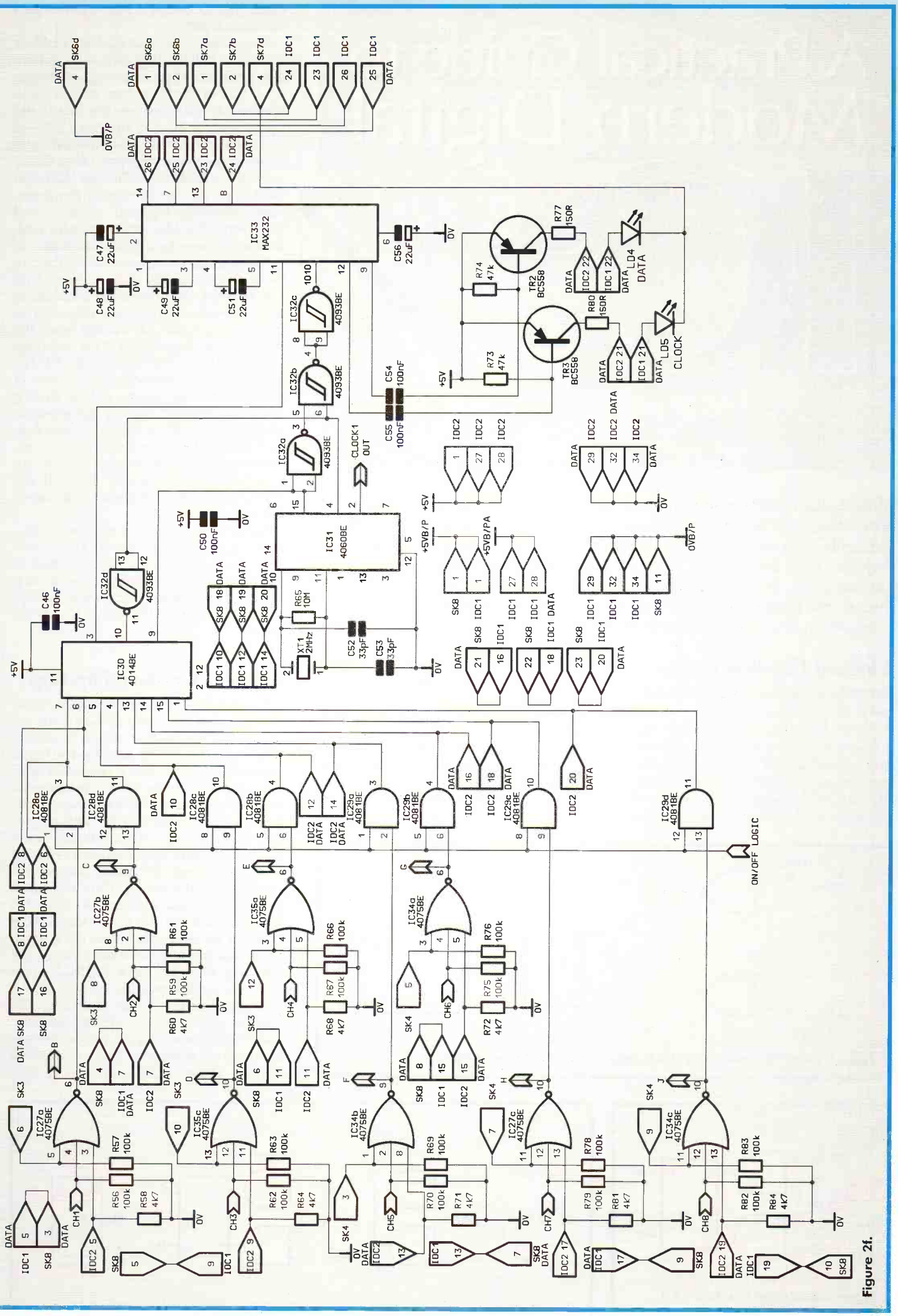


Figure 2f.

Continued on page 65.

A Practical Guide to Modern Digital ICs

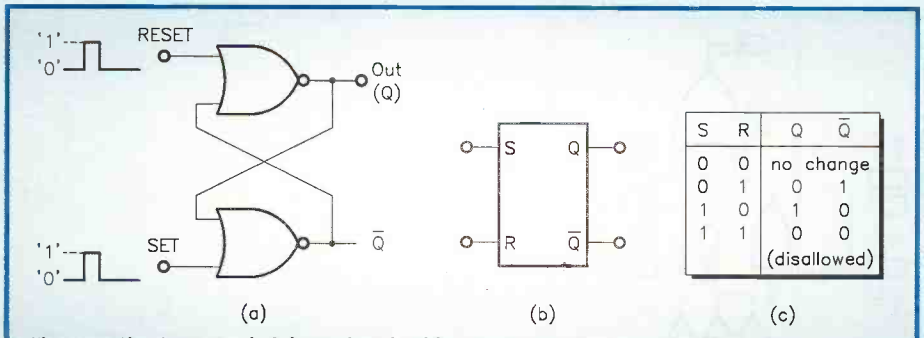
by Ray Marston

Part 8

Most digital ICs are based on either simple logic gate networks of the types described in Part 6 of this series, or on clocked bistable or flip-flop elements. This second type includes simple counter/divider ICs, shift registers, data latches, and complex ICs such as presettable up/down counters, etc. This part takes a detailed look at clocked flip-flop basics, and presents practical user information on some popular clocked flip-flop and counter/divider ICs.

Clocked Flip-flop Basics

One of the simplest types of digital flip-flop circuit is the cross-coupled NOR-type bistable, which was briefly described last month. Figure 1 shows the basic circuit, standard symbol and truth table of this type of flip-flop. The circuit's basic action is such that its Q output latches high (and NOT Q latches low) when the SET terminal is briefly driven high, and remains in that state until the RESET terminal is briefly driven high, at which point, the Q output latches low (and the NOT Q output latches high). The basic SET-RESET (S-R, or R-S) flip-flop thus acts as a simple memory element that remembers which of the two inputs last went high. Note that if both inputs go high simultaneously, both outputs go low, but if both inputs then simultaneously switch low, the output states can not be predicted; the 'both inputs high' condition is thus regarded as a 'disallowed' state.



S	R	Q	$\overline{Q}$
0	0	no change	
0	1	0	1
1	0	1	0
1	1	0	0
		(disallowed)	

Figure 1. Circuit (a), symbol (b), and truth table (c) of the NOR-type S-R flip-flop.

Note at this point, that the S-R bistable is actually a voltage-triggered regenerative switch; the NOR-type circuit triggers when its input (SET or RESET) voltage *rises* to some intermediate value between the logic-0 and logic-1 levels, at which its input stage is biased into its linear amplifying mode; a NAND-type circuit triggers when the input voltage *falls* to some intermediate value. Thus, all NOR-type bistable circuits are intrinsically 'level-sensitive, rising-edge triggered' elements, and NAND-type bistables are intrinsically 'level-sensitive, falling-edge triggered' elements.

The versatility of the basic S-R flip-flop can be greatly enhanced by wiring a 2-input AND gate in series with each input terminal, as shown in Figure 2, so that logic-1 input signals can only reach the S-R flip-flop when the clock signal is also at logic-1. Thus, when the clock signal is low, both inputs of the S-R flip-flop are held low, irrespective of the states of the SET and RESET inputs, and the flip-flop acts as a permanent memory, but when the clock signal is high, the circuit acts as a standard S-R flip-flop. Consequently, data is not automatically latched into the flip-flop, but must be clocked in via the clock (CLK) terminal; this circuit is thus known as a clocked S-R (or R-S) flip-flop.

Figure 3 shows how two clocked S-R flip-flops can be cascaded and clocked in anti-phase (via an inverter in the clock line) to make one of the most important of all flip-flop elements, the clocked master-slave flip-flop. The basic action of this circuit is outlined below.

The Master-slave Flip-flop

When the clock input terminal of the Figure 3 circuit is low, the master flip-flop inputs are enabled via the inverter, so the SET-RESET data is accepted, but the slave flip-flop inputs are disabled and this data is not passed on to the output. When the clock input terminal goes high, the master flip-flop inputs are disabled (via the inverter) and it thus outputs only the remembered input data, and simultaneously the slave flip-flop inputs are enabled and the remembered data is latched and passed on to the output. Thus, the circuit accepts input data when the clock signal is low, and passes that data to the output on the arrival of the rising-edge of the clock signal, i.e. its data-shifting action is synchronous with the timing of the clock signal. This flip-flop uses the circuit symbol shown in the diagram.

The clocked master-slave flip-flop can be made to give a clocked toggle or divide-by-two action by cross-coupling its input and output terminals as shown in Figure 4(a), so that SET and Q (and RESET and NOT Q) logic

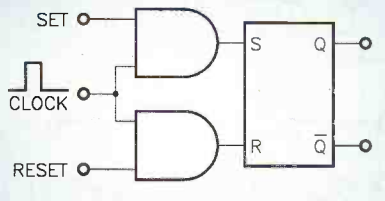


Figure 2. Basic circuit of a clocked R-S flip-flop.

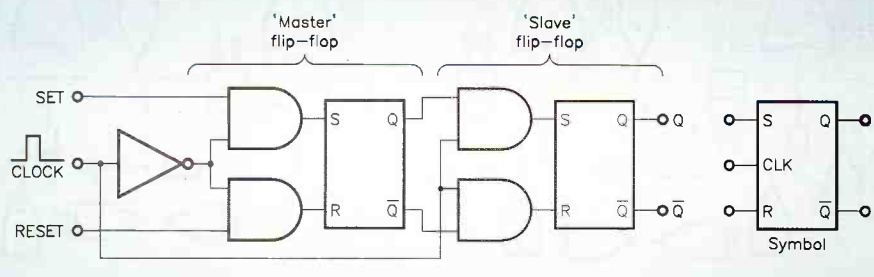


Figure 3. Clocked master-slave flip-flop basic circuit and symbol.

levels are always opposite. Consequently, when the clock signal is low, the master flip-flop receives the instruction 'change state', and when the clock goes high, the slave flip-flop executes the instruction; the output thus changes state on the arrival of the rising-edge of each new clock pulse, and two clock pulses are needed to complete a full switching cycle; the output switching frequency is thus half that of the clock frequency, and this circuit, which is known as a 'toggle' or 'T-type' flip-flop, thus acts as a binary divide-by-two counter.

Figure 4(b) shows the basic circuit symbol of the clocked T-type flip-flop; note that the sharp-edged 'notch' symbol on the CLK input indicates that the element (the flip-flop) is triggered by the rising-edge of a clock signal (falling-edge triggering can be notated by adding a 'little circle' symbol to the CLK line).

D and JK Flip-flops

The T-type flip-flop acts purely as a counter/divider. A far more versatile device is the 'data' or D-type flip-flop, which is made by connecting the clocked master-slave flip-flop as shown in Figure 5(a). Here, the inverter wired between the flip-flop's S and R terminals ensure that the input data is applied to these pins in antiphase. Figures 5(b) and 5(c) show the symbol and truth table of the D-type flip-flop, which can be used as a data latch by using the connections shown in Figure 6(a), or as a binary counter/divider by shorting D and not-Q together as shown in 6(b).

Note in the Figure 5 truth table, that the 'rising step' symbol used in the CLK (clock) column indicates that the circuit element triggers or changes state on the arrival of the clock signal's rising-edge; a 'falling step' symbol can be used to indicate that an element triggers in the arrival of a clock signal's falling-edge.

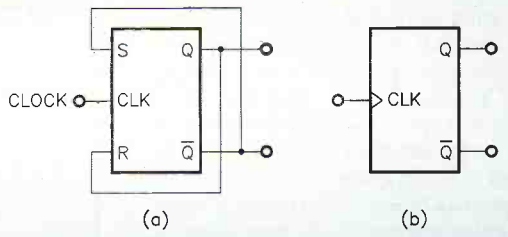
Figure 7 shows the basic circuit (a), symbol (b) and action table (c) of the most important and versatile of all clocked flip-flops, the JK type, which can be 'programmed' to act as either a data latch, a counter/divider, or a do-nothing element, by suitably connecting the J and K terminals as indicated in the table. In essence, the JK flip-flop acts like a T-type when the J and K terminals are both high, or as a D-type when the J and K terminals are at different logic levels. When the J and K terminals are both low, the flip-flop states remain unchanged on the arrival of a clock pulse. Note that clocked T-type, D-type, and JK flip-flops all give a synchronous (clock-synchronized) switching action.

Practical Flip-flop ICs

Figure 8 lists basic details of twelve popular flip-flop ICs. Of these, the 74LS73, 74LS76, and the 4027B are all Dual JK flip-flops; each 74LS73 element is falling-edge-triggered and has a RESET input terminal, each 74LS76 element is falling-edge-triggered and has SET (or PReset) and RESET (or CLeaR) inputs, and each 4027B element is rising-edge-triggered and has SET and RESET inputs.

All other ICs listed in Figure 8 house D-type flip-flops that are triggered on the rising-edge of the clock signal. In the 74LS74, 74HC74 and 4013B 'dual' types, each element is fully independent and has its own SET (or PReset) and RESET (or CLeaR) inputs, but in all Quad, Hex, and Octal types, the elements are effectively connected in parallel and share common CLOCK and RESET (or CLeaR) inputs.

Figure 4. A clocked 'toggle' or 'T-type' flip-flop is constructed as shown in (a), and uses the standard symbol of (b).



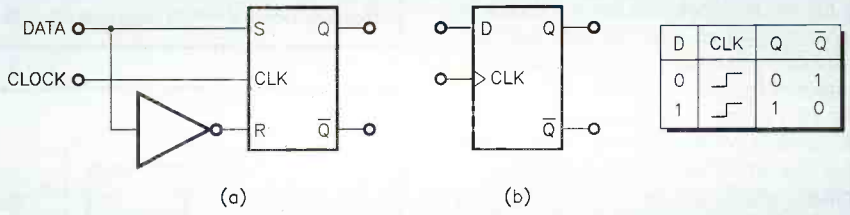


Figure 5. Basic circuit (a), symbol (b), and truth table of the D-type flip-flop.

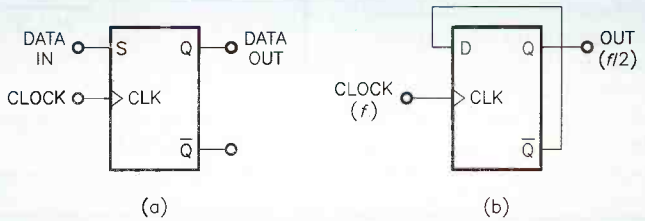
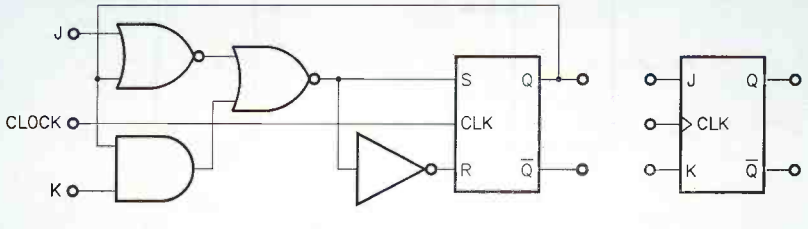


Figure 6. A D-type flip-flop can be used as (a) a data latch or (b) as a divide-by-2 (binary counter/divider) circuit.



J	K	Clocking Action
0	0	Does nothing (inhibits)
0	1	Sets Q output low
1	0	Sets Q output high
1	1	Changes output state

(c)

Figure 7. Basic circuit (a), symbol (b), and action table (c) of the JK flip-flop.

Device	Type	Description
74LS73	LS TTL	Dual J–K flip–flop
74LS74	LS TTL	Dual D–type flip–flop
74HC74	CMOS	Dual D–type flip–flop
74LS76	LS TTL	Dual J–K flip–flop
4013B	CMOS	Dual D–type flip–flop
4027B	CMOS	Dual J–K flip–flop
74LS175	LS TTL	Quad D–type flip–flop
74HC175	CMOS	Quad D–type flip–flop
40174B	CMOS	Hex D–type flip–flop
74LS273	LS TTL	Octal D–type flip–flop
74HC273	CMOS	Octal D–type flip–flop
74LS374	LS TTL	Octal D–type flip–flop

Figure 8. Twelve popular D-type and JK flip-flop ICs.

Note at this point, that all D-type flip-flops have D and CLK input and Q and NOT Q output terminals, and all JK types have J, K, and CLK inputs and Q and NOT Q outputs, so the basic ways of using *any* D-type or JK flip-flop in the divide-by-two mode can be presented as in the general or 'universal' circuit diagrams of Figure 9. If an engineer wants to build either of these circuits from a specific IC of the appropriate type, he or she can do so by simply looking up that IC data sheet or truth table to find the appropriate connections for any terminals that are not shown in the general diagram, and then add that data to a 'specific' circuit diagram, as shown in the examples of Figures 10 and 11.

The two Figure 10 circuits are based on 4000-series CMOS ICs; the 4013B Dual D-type has active-high SET (S) and RESET (R) terminals, which can be disabled by tying them directly to ground, as in (a). The 4027B Dual JK type has active-high SET and RESET terminals that can be disabled by grounding them, and has J and K terminals that can by put into the logic-1 state by tying them directly to the V+ line, as shown in (b). The Figure 11 circuits are based on 74LS-series TTL ICs; the circuit shown in (a) uses a 74LS74 Dual D-type IC, which has active-low PR and CLR inputs that can be disabled by tying them high via a 1kΩ resistor; the design shown in (b) uses

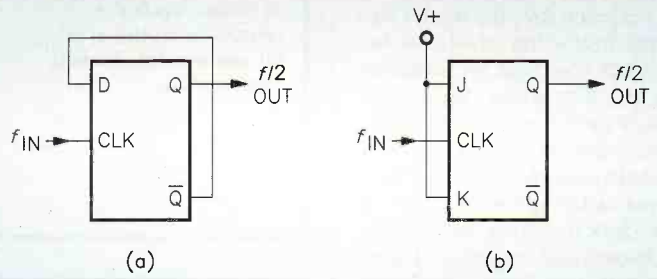


Figure 9. General circuit diagrams of (a) D-type and (b) JK divide-by-2 stages.

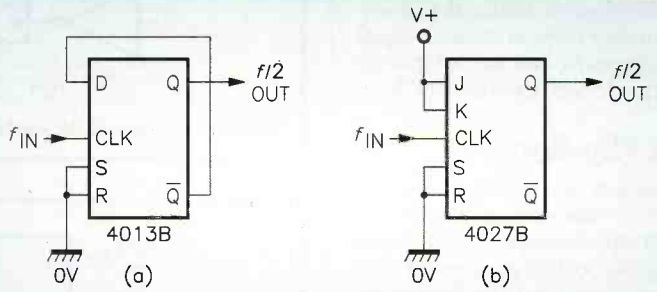


Figure 10. Specific circuit diagrams for 4000-series CMOS (a) D-type and (b) JK-type divide-by-2 stages.

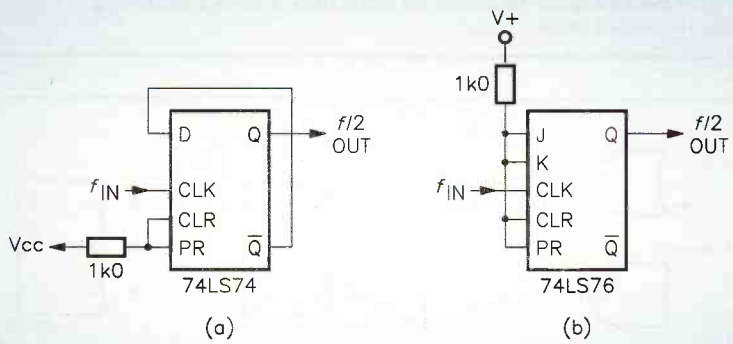


Figure 11. Specific circuit diagrams for 74LS-series (a) D-type and (b) JK-type divide-by-2 stages.

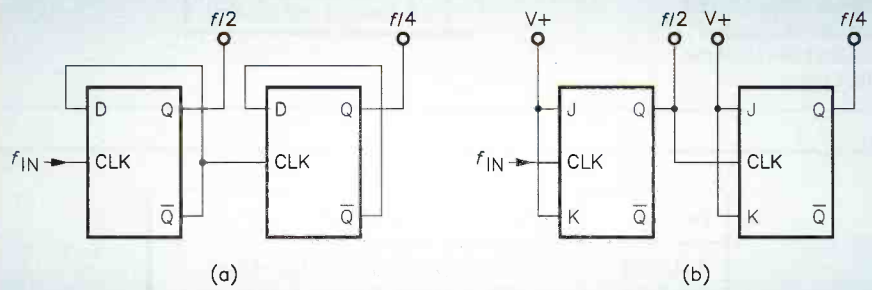


Figure 12. General circuit diagrams of (a) D-type and (b) JK divide-by-4 ripple counters.

a 74LS76 Dual JK-type IC, which has active-low CLR and PR terminals that are disabled by tying then to the V+ line via a shared 1kΩ resistor.

Thus, 'general' logic-circuit diagrams are a useful way of presenting valuable design information, and can easily be translated into 'specific' circuit diagram form. Several 'general' logic-circuit diagrams are used in the remaining sections of this article.

Ripple Counters

The most popular application of the clocked flip-flop is as a binary counter, which can be made from individual D-type or JK elements by using the basic connections shown in Figure 9. These circuits give a divide-by-two action, and if clocked by a fixed-frequency waveform, give a symmetrical squarewave output at half of the clock frequency.

Numbers of basic divide-by-two stages can be cascaded to give multiple binary division by simply clocking each new stage from the appropriate output of the preceding stage. Thus, Figure 12 shows (in 'general' form) two D or JK stages cascaded to give an overall division ratio of four (2^2), and Figure 13 shows three stages cascaded to give a division ratio of eight (2^3). Figure 14 shows how D-type stages can be cascaded to make a divide-by-2^N counter, where N is the number of counter

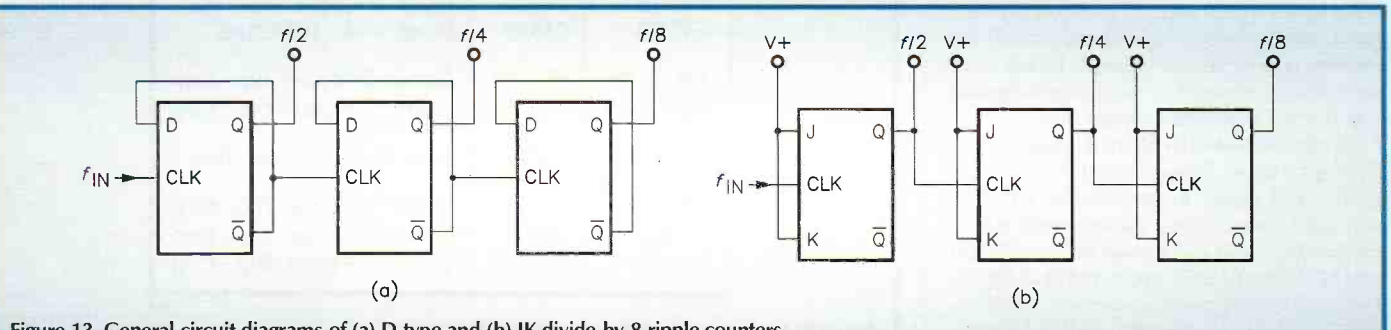


Figure 13. General circuit diagrams of (a) D-type and (b) JK divide-by-8 ripple counters.

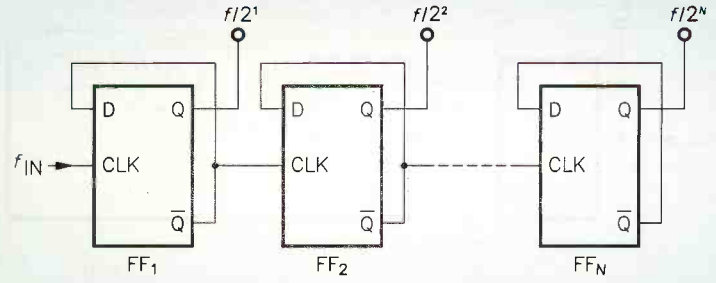


Figure 14. General circuit diagram of a D-type divide-by-*N* ripple counter.

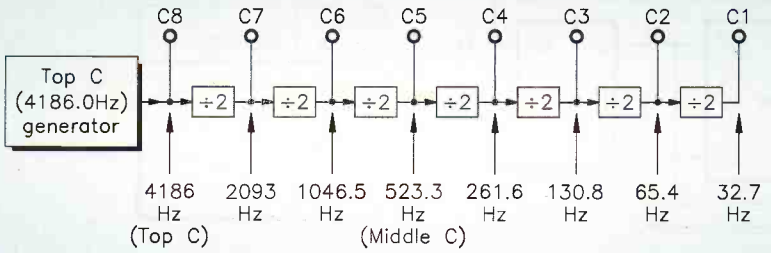


Figure 15. A 7-bit ripple divider used to make an 8-octave 'C'-note generator.

stages. Thus, four stages give a ratio of 16 (2^4), five stages give 32 (2^5), six give 64 (2^6), and so on. In modern flip-flip jargon, the number of stages in a multi-stage binary divider are often referred to as its 'bit' size; thus, a four stage counter may be called a '4-bit' counter, etc.

The Figure 12 to 14 circuits are known as ripple dividers (or counters), because each stage is clocked by a preceding stage (rather than directly by the input clock signal), and the clock signal thus seems to ripple through the dividers. Inevitably, the propagation delays of the individual dividers all add together to give a summed delay at the end of the chain, and counter stages other than the first thus do not clock in precise synchrony with the original clock signal; such counters are thus described as 'asynchronous' in action.

If the multibit outputs of a ripple divider are decoded via gate networks, the propagation delays of the asynchronous dividers can result in unwanted output 'glitches'. Ripple dividers are thus best used in simple frequency-divider applications where no decoding is needed. These applications may range in complexity from 2-bit 'divide-by-four' types, to ones using 22 or more divider stages. Figures 15 to 17 show some common applications of large-bit ripple dividers.

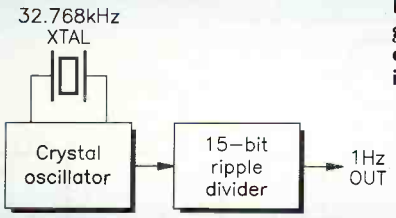


Figure 16. Timing generator circuit commonly used in digital watches.

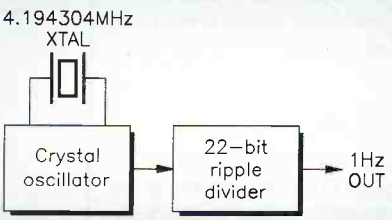


Figure 17. Timing generator circuit using a commonly available crystal reference.

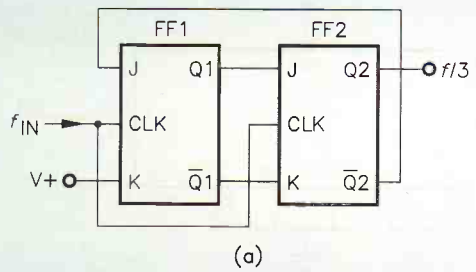
Device	Type	Description
74LS93	LS TTL	4–bit (3+1) binary divider
74LS393	LS TTL	8–bit (4+4) binary divider
74HC393	CMOS	8–bit (4+4) binary divider
4520B	CMOS	8–bit (4+4) binary divider
4020B	CMOS	14–bit binary divider
4024B	CMOS	7–bit binary divider
74HC4024	CMOS	7–bit binary divider
4040B	CMOS	12–bit binary divider
74HC4040	CMOS	12–bit binary divider
4060B	CMOS	14–bit binary divider
74HC4060	CMOS	14–bit binary divider

Figure 18. Some popular large-bit ripple counter ICs.

In Figure 15, a 'top-C' (4186·0Hz) generator is used in conjunction with a 7-bit ripple divider to make an 8-octave 'C' note generator that produces symmetrical squarewave outputs on terminals C1 to C7; this basic type of circuit is widely used in electronic pianos, etc. Figure 16 shows a 15-bit ripple divider and a 32·768kHz crystal oscillator used to made a precision 1Hz timing generator of the type that is commonly used in digital watches, and Figure 17 uses a 22-bit ripple divider and a commonly available 4·194304MHz crystal reference, etc., to make another precision 1Hz generator.

Large-bit Ripple Divider ICs

74LS73, 74LS74, and similar 'dual' flip-flop ICs can be cascaded to give any desired number of binary ripple stages, but where more than four stages are needed, it is more econ-



(a)

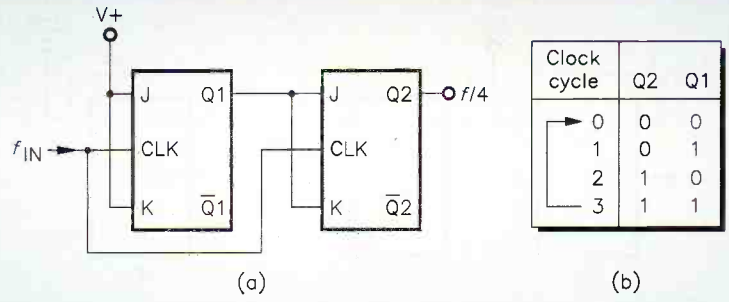
Clock cycle	Q2	Q1
0	0	0
1	0	1
0		
1	1	0
0		
1	0	0

FF2 JK code	FF2 Instruction	FF1 JK code	FF1 Instruction
0 1	Set Q2 low	1 1	change state
1 0	Set Q2 high	1 1	change state
0 1	Set Q2 low	0 1	Set Q1 low

(b)

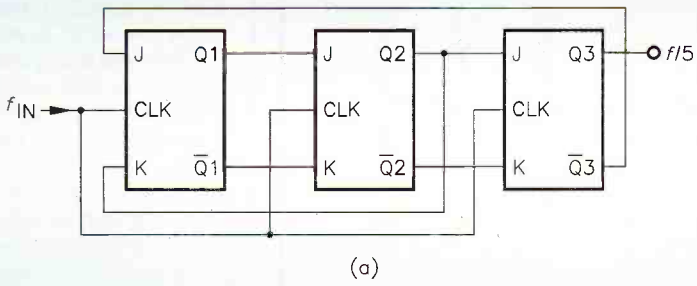
Figure 19. Circuit (a) and truth tables (b) of a synchronous divide-by-3 counter.

omic to use special medium-scale integration (MSI) ripple-counter ICs, such as those listed in Figure 18. Of these, the 74LS93 is a 4-bit JK ripple divider arranged in 1-bit plus 3-bit style, and the 74LS393, 74HC393 and 4520B are dual 4-bit binary ripple dividers. The 4020B 14-bit counter has the outputs of all but stages 2 and 3 externally available. The 4024B and 74HC4024 are 7-bit binary dividers with the 'Q' outputs of all stages externally available. The 4040B and 74HC4040 12-bit counters have the 'Q' outputs of all stages externally available. The 4060B and 74HC4060 14-bit counters have all 'Q' outputs except those of stages 1, 2, 3 and 11 externally available, and have a built-in oscillator or clock generator circuit.



Clock cycle	Q2	Q1
0	0	0
1	0	1
2	1	0
3	1	1

Figure 20. Circuit (a) and truth tables (b) of a synchronous divide-by-4 counter.



Clock cycle	Q3	Q2	Q1
0	0	0	0
1	0	0	1
2	0	1	1
3	1	1	0
4	1	0	0

Figure 21. Circuit (a) and truth table (b) of a synchronous divide-by-5 counter.

Walking-ring Counters

Ripple counters are asynchronous in action, and thus generate glitch problems that debar them from use in some decoded-counting applications. Fortunately, a synchronous binary division technique is also available and does not create glitch problems; it is known as the walking-ring technique. In this technique, numbers of flip-flops (usually JK types) are clocked in parallel and thus operate in synchrony with the input clock signal, and

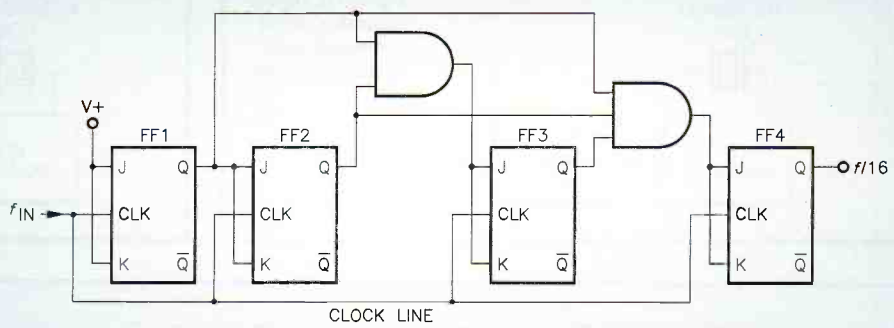
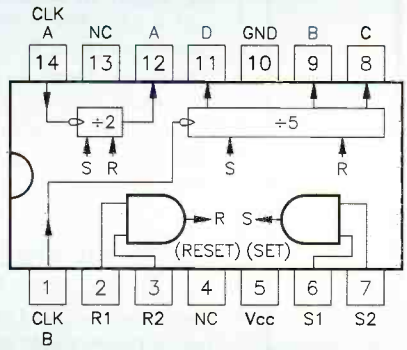


Figure 22. Circuit of a synchronous divide-by-16 counter.



R/S INPUTS				OUTPUTS				
R1	R2	S1	S2	D	C	B	A	
1	X	0	X	0	0	0	0	= BCD '0'
1	0	X	0	0	0	0	0	
X	1	1	1	1	0	0	1	= BCD '9'
0	X	0	X	COUNTING				
X	0	X	0					
0	X	X	0					
X	0	0	X					

X = DON'T CARE

Figure 23. Functional diagram and R-S truth table of the 74LS90 decade counter IC with BCD outputs.

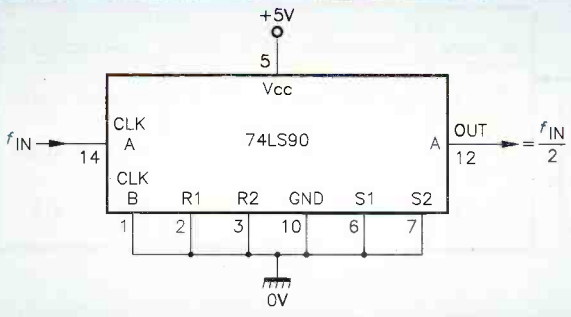


Figure 24. The 74LS90 used as a divide-by-2 counter.

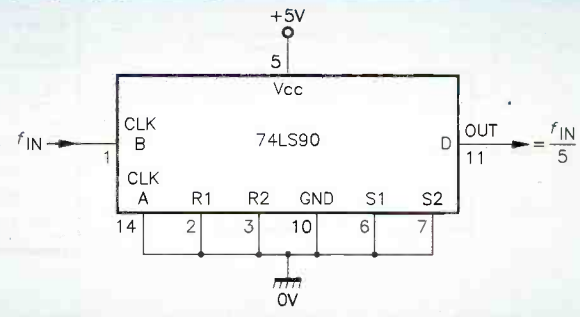


Figure 25. The 74LS90 used as a divide-by-5 counter.

digital feedback determines how each stage will react to individual clock pulses.

The JK version of the walking-ring technique depends on the fact that any JK flip-flop can be 'programmed' via its J and K terminals to act as either a SET or RESET latch, a binary divider, or as a do-nothing device. A detailed example of the basic walking-ring technique is given in Figure 19, which shows the circuit and truth tables of a synchronous divide-by-three counter. Note that the truth table shows the action state of each flip-flop at each stage of the counting cycle; remember that when the clock is low, the action instruction is loaded (via the JK terminals) into the flip-flop, and the instruction is then carried out as the clock signal transitions high.

Thus at the start of the cycle (clock low), when Q2 and Q1 are both low the binary instruction 'change state' (11) is loaded into FF1 via its J and K terminals, and the instruction 'set Q2 low' (01) is loaded into FF2. On the arrival of the first clock pulse this instruction is executed, and Q1 goes high and Q2 stays low. When the clock goes low again, new program information is fed to the flip-flops. FF1 is instructed to 'change state' (11) and FF2 is instructed 'set Q2 high' (10); these instructions are executed on the rising-edge of the second clock pulse, causing Q2 to go high and Q1 to go low.

When the clock goes low again, new program information is again fed to the flip-flops from the outputs of their partners. FF1 is instructed 'set Q1 low' (01) and FF2 is instructed 'set Q2 low' (01); these instructions are executed on the rising-edge of the next clock pulse, driving Q1 and Q2 back to their original '0' states. The counting sequence then repeats *add infinitum*.

Thus, in the walking-ring counter, all flip-flops are clocked in parallel, but are cross-coupled so that the clocking response of any one stage depends on the states of the other stages. Walking-ring counters can be configured to give any desired count ratio, and Figures 20 and 21 show the circuits and truth tables of divide-by-4 and divide-by-5 counters, respectively. In some cases, circuit operation relies on cross-coupling via AND gates, etc., and an example of this is shown in the four-stage divide-by-16 counter of Figure 22. In walking-ring counters based on D-type flip-flops, cross-coupling may be made to the SET or RESET terminals of individual flip-flop stages, etc.

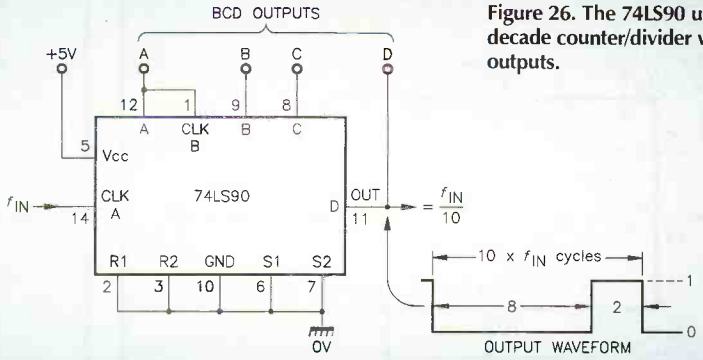


Figure 26. The 74LS90 used as a decade counter/divider with BCD outputs.

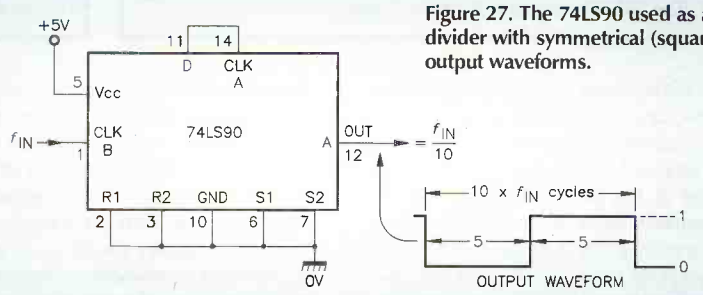


Figure 27. The 74LS90 used as a decade divider with symmetrical (squarewave) output waveforms.

COUNT	OUTPUT D	C	B
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0

Figure 28. Truth table of the 74LS90's divide-by-5 (quinary) counter.

The 74LS90 Decade Divider

One of the best-known TTL 'divider' ICs is the 74LS90, which is popularly called a decade divider but actually houses an independent

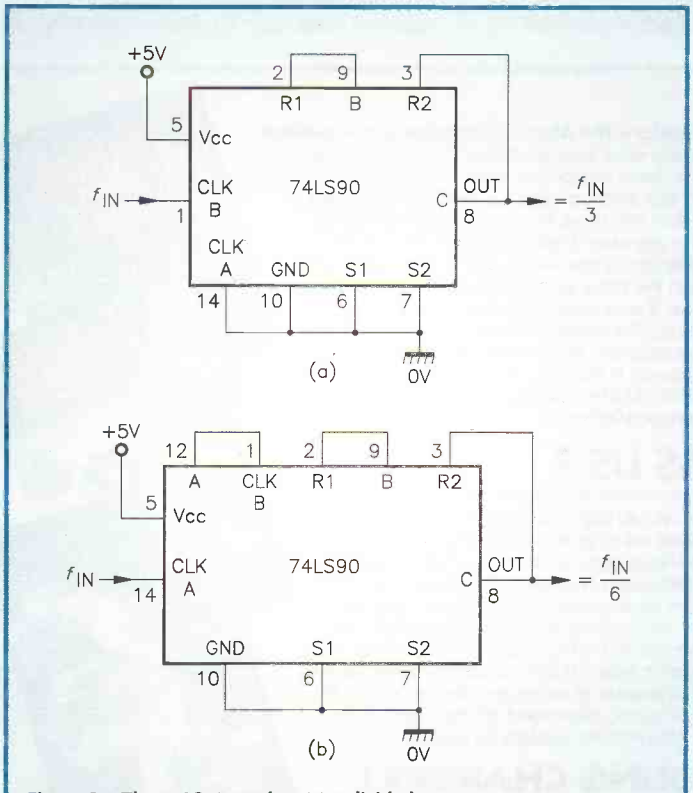


Figure 29. The 74LS90 used as (a) a divide-by-3 or (b) a divide-by-6 counter.

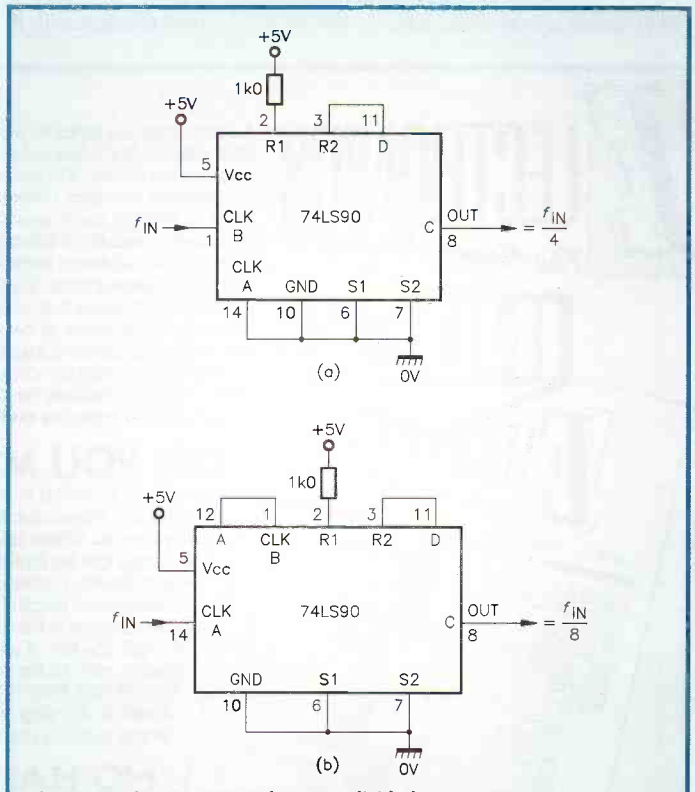


Figure 30. The 74LS90 used as (a) a divide-by-4 or (b) a divide-by-8 counter.

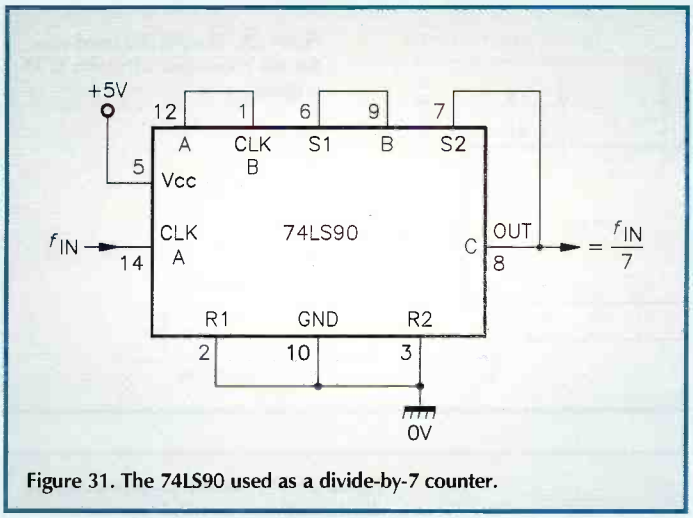


Figure 31. The 74LS90 used as a divide-by-7 counter.

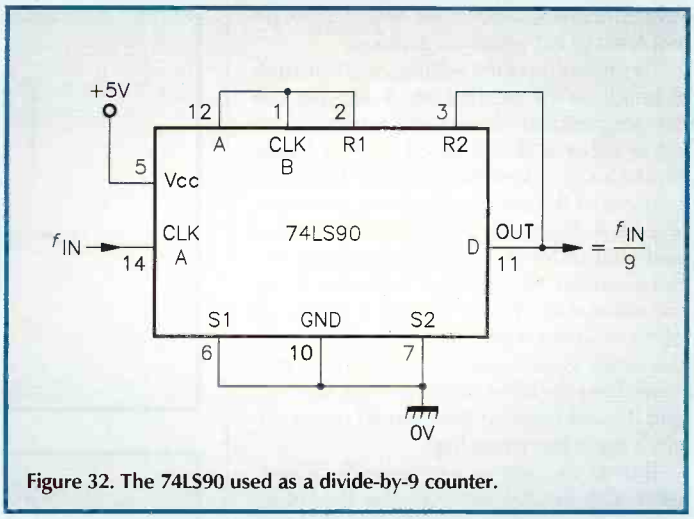


Figure 32. The 74LS90 used as a divide-by-9 counter.

divide-by-2 counter and a walking-ring divide-by-5 counter, and can be configured to give any whole-number division value from 2 to 10 inclusive. Figure 23 shows the IC's functional diagram and its R-S (RESET/SET) truth table. The two counters share SET and RESET lines that are controlled via 2-input AND gates; normally, each of these AND gates are disabled by tying at least one input low, and are active only when both inputs (R1 and R2 for RESET, S1 and S2 for SET) are driven high; when RESET is active, the DCBA outputs are driven to '0000' (= BCD '0'); when SET is active, the DCBA are driven to '1001' (= BCD '9'); the SET control has priority over RESET.

Figures 24 and 25 show two very basic ways of using the 74LS90's counting ability. In Figure 24, only the internal divide-by-2 counter is used; the divide-by-5 counter and SET/RESET gates are disabled, and the IC thus functions as a simple divide-by-2 (binary) counter. In Figure 25, only the internal divide-by-5 counter is used; the divide-by-2 counter and SET/RESET gates are disabled, and the IC thus acts as a simple divide-by-5 (quinary) counter.

Figure 26 shows the IC used as a decade counter with BCD outputs. Here, both internal counters are used; f_{IN} is fed to the input of the divide-by-2 counter, and the output (A) of this drives the input of the divide-by-5 counter; in this configuration, the IC functions as a divide-by-10 counter with BCD outputs. Note that the final (pin-11) output waveform is asymmetrical, with a 1:4 mark-space ratio.

Figure 27 shows the IC used as a decade counter with a symmetrical (squarewave) output. Here, f_{IN} is fed to the input of the divide-by-5 counter, and the output (D) of this drives the input of the divide-by-2 counter, which provides the final output; in this 'biquinary' configuration, the IC functions as a divide-by-10 counter with a perfectly symmetrical (1:1 mark-space ratio) output, and the outputs are not BCD coded.

The 74LS90 can be made to divide by any whole-number value from 3 to 9 inclusive by feeding appropriate outputs back to the IC's RESET or SET line, so that the counter automatically resets each time the desired count number is reached. For divide values of 3, 4, 6 and 8, these feedback connections can be taken directly from the divide-by-5 counter's DCB outputs; Figure 28 shows this counter's truth table. Thus, the IC can be configured as a divide-by-3 counter by using only its divide-by-5 counter, with RESET action provided via the B and C output so that it resets to '000' on the arrival of every count-3 pulse, and with the output taken from the C terminal, as shown in Figure 29(a). The IC can be made to give divide-by-6 action by using these same basic connections, but with the input applied via the divide-by-2 counter stage, as in Figure 29(b). These two circuits can be modified to give divide-by-4 or divide-by-8 action by tying the R1 input to logic-1 and taking the R2 input to output D, as shown in Figures 30(a) and 30(b).

For divide-by values of 7 and 9, both internal counters must be used, with the divide-by-2 counter driving the divide-by-5 counter; Figures 31 and 32 show the practical IC connections. For divide-by-7 action, both RESET terminals are grounded, but outputs B and C are coupled to the SET line via the S1 and S2 terminals, so that both counters set to the BCD-'9' state on the arrival of the 6th clock pulse, and then reset to zero when the next (7th) clock pulse arrives. For divide-by-9 action, the counters are RESET via the A and D outputs, which both go high on the 8+1 count.

Next month Part 9 of this series will describe special 'Down' and 'Up/Down' counters. E

ELECTRONICS
The Maplin Magazine

INDEX

A comprehensive index to ***Electronics – The Maplin Magazine*** is now available from Maplin. The index covers every issue from December 1981 to October 1995. Included are details of every article, series and project published during that period. Conveniently arranged, sectionally and alphabetically, it'll take minutes instead of hours to find the exact issue number and page you need. You'll be able to rediscover a wealth of information you never knew you had! A list of all the ***Corrigenda*** published is also included, so you will be able to find details of changes or amendments. You'll find the index an invaluable addition to the issues of ***Electronics*** that you have. If your collection is incomplete, many issues are still available as back issues. The Magazine index costs just 80p *NV* and can be obtained (subject to availability) from Maplin Stores countrywide; by Mail Order, using the Order Coupon in this issue, or by calling the Credit Card Hotline, Tel: (01702) 554161, Order As XU87U. You'll wonder how you ever managed without it!

DID YOU MISS US ?

If you've ever wanted to lay your hands on an elusive issue of ***Electronics – The Maplin Magazine***, then we can help! Many editions are still available, as back issues. Where issues are out of print, details of projects that are still current can be found in Maplin Projects Books and Best of Maplin Projects Books. Copies of back issues (subject to availability) can be obtained from Maplin Stores countrywide; by Mail Order, using the Order Coupon in this issue, or by calling the Credit Card Hotline, Tel: (01702) 554161. If you are not sure which issue or Projects Book you require, refer to the Magazine Index (XU87U) or call Customer Services, Tel: (01702) 552911. Photocopies of out of print feature articles are available; a charge will be made, dependent on the length of the article to be copied – call Customer Services for details.

NO HANDLING CHARGES !

If you are *only* ordering a copy of ***Electronics – The Maplin Magazine*** Index or back issues of the magazine, the normal £1.50 Mail Order handling charge does not apply!

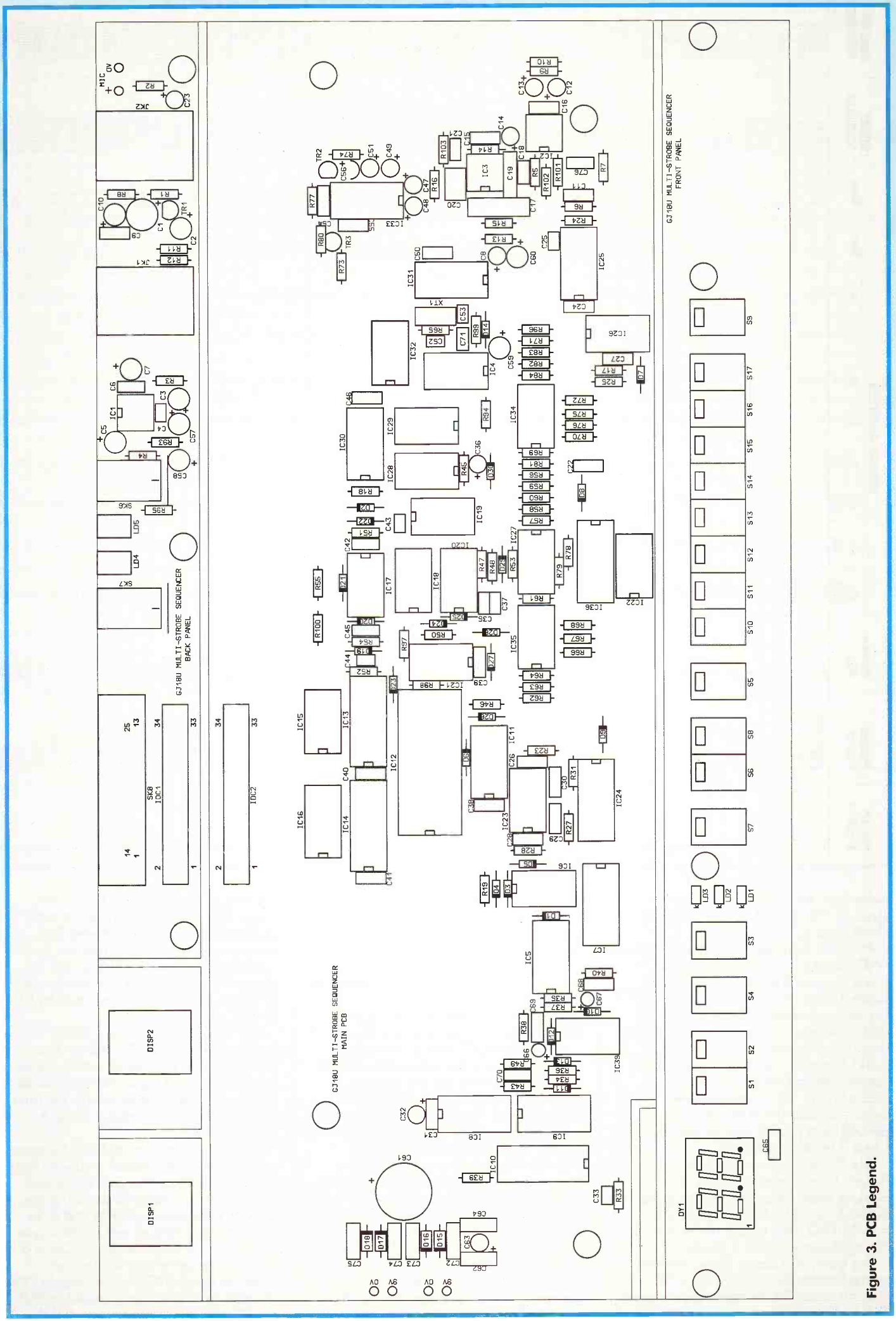


Figure 3. PCB Legend.

No. of Strobes	Pattern Name	Pattern No.	EPROM ADDRESS								Dec	Hex	START ADDRESS	FINISH ADDRESS
			A_7 128	A_6 64	A_5 32	A_4 16	A_3 8	A_2 4	A_1 2	A_0 1				
2	Night Rider	0	0	0	0	0	0	0	0	0	0	0	00000	001F0
2	Star burst	1	0	0	0	0	0	0	0	1	1	1	00200	003F0
2	Wave	2	0	0	0	0	0	0	1	0	2	2	00400	005F0
2	Yo Yo	3	0	0	0	0	0	0	1	1	3	3	00600	007F0
2	Space	4	0	0	0	0	0	1	0	4	4	4	00800	009F0
2	Tandem	5	0	0	0	0	0	1	0	1	5	5	00A00	00BF0
2	Syncopate	6	0	0	0	0	0	1	1	0	6	6	00C00	00DF0
2	Hypnotise	7	0	0	0	0	0	1	1	1	7	7	00E00	00FF0
2	Hard-core	8	0	0	0	0	1	0	0	0	8	8	01000	011F0
2	Random	9	0	0	0	0	1	0	0	1	9	9	01200	013F0
4	Night Rider	10	0	0	0	1	0	0	0	0	16	10	02000	021F0
4	Starburst	11	0	0	0	1	0	0	0	1	17	11	02200	023F0
4	Wave	12	0	0	0	1	0	0	1	0	18	12	02400	025F0
4	Yo Yo	13	0	0	0	1	0	0	1	1	19	13	02600	027F0
4	Space	14	0	0	0	1	0	1	0	0	20	14	02800	029F0
4	Split	15	0	0	0	1	0	1	0	1	21	15	02A00	02BF0
4	Syncopate	16	0	0	0	1	0	1	1	0	22	16	02C00	02DF0
4	Hypnotise	17	0	0	0	1	0	1	1	1	23	17	02E00	02FF0
4	Hard-core	18	0	0	0	1	1	0	0	0	24	18	03000	031F0
4	Random	19	0	0	0	1	1	0	0	1	25	19	03200	033F0
4	UFO	20	0	0	1	0	0	0	0	0	32	20	04000	041F0
4	Butterfly	21	0	0	1	0	0	0	0	1	33	21	04200	043F0
4	Invader	22	0	0	1	0	0	0	1	0	34	22	04400	045F0
4	Bounce	23	0	0	1	0	0	0	1	1	35	23	04600	047F0
4	Cradle	24	0	0	1	0	0	1	0	0	36	24	04800	049F0
4	Wasp	25	0	0	1	0	0	1	0	1	37	25	04A00	04BF0
4	Pop	26	0	0	1	0	0	1	1	0	38	26	04C00	04DF0
4	Jazz	27	0	0	1	0	0	1	1	1	39	27	04E00	04FF0
4	Crescendo	28	0	0	1	0	1	0	0	0	40	28	05000	051F0
4	Train	29	0	0	1	0	1	0	0	1	41	29	05200	053F0
6	Night Rider	30	0	0	1	1	0	0	0	0	48	30	06000	061F0
6	Star burst	31	0	0	1	1	0	0	0	1	49	31	06200	063F0
6	Wave	32	0	0	1	1	0	0	1	0	50	32	06400	065F0
6	Yo Yo	33	0	0	1	1	0	0	1	1	51	33	06600	067F0
6	Space	34	0	0	1	1	0	1	0	0	52	34	06800	069F0
6	Split	35	0	0	1	1	0	1	0	1	53	35	06A00	06BF0
6	Syncopate	36	0	0	1	1	0	1	1	0	54	36	06C00	06DF0
6	Hypnotise	37	0	0	1	1	0	1	1	1	55	37	06E00	06FF0
6	Hard-core	38	0	0	1	1	1	0	0	0	56	38	07000	071F0
6	Random	39	0	0	1	1	1	0	0	1	57	39	07200	073F0
6	UFO	40	0	1	0	0	0	0	0	0	64	40	08000	081F0
6	Butterfly	41	0	1	0	0	0	0	0	1	65	41	08200	083F0
6	Invader	42	0	1	0	0	0	0	1	0	66	42	08400	085F0
6	Bounce	43	0	1	0	0	0	0	1	1	67	43	08600	087F0
6	Cradle	44	0	1	0	0	0	1	0	0	68	44	08800	089F0
6	Wasp	45	0	1	0	0	0	1	0	1	69	45	08A00	08BF0
6	Pop	46	0	1	0	0	0	1	1	0	70	46	08C00	08DF0
6	Jazz	47	0	1	0	0	0	1	1	1	71	47	08E00	08FF0
6	Crescendo	48	0	1	0	0	1	0	0	0	72	48	09000	091F0
6	Train	49	0	1	0	0	1	0	0	1	73	49	09200	093F0

pulse from the Master Clock Control Gate (IC18c, IC19c), and emerges as Clock 2 via IC17d & D43.

An ODD input (A_0=1) to the EPROM is AND gated (via IC17e & f) with the Clock 1 signal from the Master Clock Control Gate (IC18c, IC19c), to clock the Programmable 8-Stage Counter (IC16). After a number of clock cycles, determined by the Timing Data held in IC14 (which is used to produce the Pattern Timing Delay between each strobe firing), the Programmable Divider outputs a pulse (for a single Clock 1 period) from pin 14, and emerges as Clock 2 via IC17a & D44.

The Clock 2 pulse is applied to the Pattern Timing Selector Gates (IC6a to d), to select the preferred triggering method, i.e., 'MEMORY', 'MANUAL' and 'AUDIO'. The output of the Pattern Timing Selector Gates is Clock 3.

The gates of IC6a to c are controlled by the Pattern Timing Selector (IC5). Pushing switch S3 will clock The Pattern Timing Selector (via IC26a), advancing the output to select 'MANUAL', and illuminating the 'MANUAL' LED; depressing the switch again will select 'AUDIO', and illuminate the 'AUDIO' LED. The third press will return to the default 'MEMORY' setting, and illuminate the MEMORY LED.

The 'MANUAL' and 'AUDIO' pattern timing signals are derived as follows:

In the 'MANUAL' setting, the pulses are derived from the Manual Flash Rate Clock IC25, which has two outputs; one output to the Pattern Timing Selector Gates at twice the frequency to the other output connected to the Single Flash control. This is because the EPROM requires two pulses, one to load the Pattern Data and one to load the Timing Data. The clock frequency (marked 'FLASH RATE' on the front panel) can be adjusted by RV2. The frequency to the Single Flash Control will be between 0·5Hz and 20Hz.

The AUDIO trigger pulses can be derived from one of three sources; the on board electret microphone, or an external microphone, via JK2, a ¼in. mono jack socket, both of which are buffered by the emitter follower TR1. Alternatively, the audio signal can be applied to the Line level input, JK1, a stereo ¼in. jack socket; the stereo input of JK1 is mixed to a mono signal by R11 & R12.

IC1 is a Voltage Operated Gain Adjusted Device, or VOGAD for short; the device has a constant output signal level for an input signal with a dynamic range of 60dB. In other words, the gain (amplification factor) of the device is self-adjusting.

With a low input signal level, the gain of the device is increased; and with high input signal levels, the gain is reduced. The VOGAD is output to pin 24 of the 25-way D-type socket (SK8) and IC2a, an inverting amplifier with variable gain (×2·2 to ×12·2), set by RV1. IC2b is a bias voltage generator for the non-inverting input of IC2a. The output of the variable gain amplifier is output to SK8 pin 25 and applied to the input of the

6	Cyclone	50	0	1	0	1	0	0	0	0	0	80	50	0A000	0A1F0
6	Interleave	51	0	1	0	1	0	0	0	0	1	81	51	0A200	0A3F0
6	Tremulous	52	0	1	0	1	0	0	0	1	0	82	52	0A400	0A5F0
6	Pendulum	53	0	1	0	1	0	0	0	1	1	83	53	0A600	0A7F0
6	Dancer	54	0	1	0	1	0	1	0	0	0	84	54	0A800	0A9F0
6	Pizzicato	55	0	1	0	1	0	1	0	1	0	85	55	0AA00	0ABF0
6	Vivid	56	0	1	0	1	0	1	0	1	0	86	56	0AC00	0ADF0
6	Tension	57	0	1	0	1	0	1	1	1	1	87	57	0AE00	0AFF0
6	Explosion	58	0	1	0	1	1	0	0	0	0	88	58	0B000	0B1F0
6	Morph	59	0	1	0	1	1	0	0	0	1	89	59	0B200	0B3F0
8	Night Rider	60	0	1	1	0	0	0	0	0	0	96	60	0C000	0C1F0
8	Start burst	61	0	1	1	0	0	0	0	0	1	97	61	0C200	0C3F0
8	Wave	62	0	1	1	0	0	0	0	1	0	98	62	0C400	0C5F0
8	Yo Yo	63	0	1	1	0	0	0	0	1	1	99	63	0C600	0C7F0
8	Space	64	0	1	1	0	0	0	1	0	0	100	64	0C800	0C9F0
8	Split	65	0	1	1	0	0	0	1	0	1	101	65	0CA00	0CBF0
8	Syncopate	66	0	1	1	0	0	0	1	1	0	102	66	0CC00	0CDF0
8	Hypnotise	67	0	1	1	0	0	0	1	1	1	103	67	0CE00	0CFF0
8	Hard-core	68	0	1	1	0	1	0	0	0	0	104	68	0D000	0D1F0
8	Random	69	0	1	1	0	1	0	0	0	1	105	69	0D200	0D3F0
8	UFO	70	0	1	1	1	0	0	0	0	0	112	70	0E000	0E1F0
8	Butterfly	71	0	1	1	1	0	0	0	0	1	113	71	0E200	0E3F0
8	Invader	72	0	1	1	1	0	0	0	1	0	114	72	0E400	0E5F0
8	Bounce	73	0	1	1	1	0	0	0	1	1	115	73	0E600	0E7F0
8	Cradle	74	0	1	1	1	0	1	0	0	0	116	74	0E800	0E9F0
8	Wasp	75	0	1	1	1	0	1	0	1	0	117	75	0EA00	0EBF0
8	Pop	76	0	1	1	1	0	1	1	0	1	118	76	0EC00	0EDF0
8	Jazz	77	0	1	1	1	0	1	1	1	1	119	77	0EE00	0EFF0
8	Crescendo	78	0	1	1	1	1	0	0	0	0	120	78	0F000	0F1F0
8	Train	79	0	1	1	1	1	0	0	0	1	121	79	0F200	0F3F0
8	Cyclone	80	1	0	0	0	0	0	0	0	0	128	80	10000	101F0
8	Interleave	81	1	0	0	0	0	0	0	0	1	129	81	10200	103F0
8	Tremulous	82	1	0	0	0	0	0	0	1	0	130	82	10400	105F0
8	Pendulum	83	1	0	0	0	0	0	0	1	1	131	83	10600	107F0
8	Dancer	84	1	0	0	0	0	0	1	0	0	132	84	10800	109F0
8	Pizzicato	85	1	0	0	0	0	0	1	0	1	133	85	10A00	10BF0
8	Vivid	86	1	0	0	0	0	0	1	1	0	134	86	10C00	10DF0
8	Tension	87	1	0	0	0	0	0	1	1	1	135	87	10E00	10FF0
8	Explosion	88	1	0	0	0	0	1	0	0	0	136	88	11000	111F0
8	Morph	89	1	0	0	0	1	0	0	0	1	137	89	11200	113F0
8	Blue Monday	90	1	0	0	1	0	0	0	0	0	144	90	12000	121F0
8	Accelerator	91	1	0	0	1	0	0	0	0	1	145	91	12200	123F0
8	Photon	92	1	0	0	1	0	0	0	1	0	146	92	12400	125F0
8	Mutant	93	1	0	0	1	0	0	0	1	1	147	93	12600	127F0
8	Flow	94	1	0	0	1	0	1	0	0	0	148	94	12800	129F0
8	Killer	95	1	0	0	1	0	1	0	1	1	149	95	12A00	12BF0
8	Lightning	96	1	0	0	1	0	1	1	1	0	150	96	12C00	12DF0
8	Whizzer	97	1	0	0	1	0	1	1	1	1	151	97	12E00	12FF0
8	Trance	98	1	0	0	1	1	0	0	0	0	152	98	13000	131F0
8	Jungle	99	1	0	0	1	1	0	0	0	1	153	99	13200	133F0

Table 1. Bit pattern and memory location of the 100 patterns.

fourth order 125Hz low-pass Chebyshev filter, formed around IC3a & b. The filtered signal is output to SK8 pin 12 and to the Audio Trigger circuit comprising IC4a & b; IC3b quickly charges C71 via D14 but the capacitor is slowly discharged by R99. The Audio Trigger circuit has two outputs, one trigger line automatically sets the Pattern Run/Stop Latch (IC21a) to RUN; the other output is applied to pin 14 of SK8 and to IC6c of the Pattern Timing Selector Gates.

As previously mentioned, the selected output from the Pattern timing selector gates is Clock 3; which is used to clock the Pattern Data/Address Counter IC11. The clock timing signal can be seen on the Pattern Timing Indicator LED in S3.

The following is an overview of the timing sequence, assuming the circuit to be in the default power up reset condition. During power up, a pulse is produced from C42 to latch the Pattern Data from the EPROM into IC13.

Setting the Pattern Run Latch 'ON' allows a Clock 1 pulse from the Master Clock to be connected through the Master Clock Control Gate, Memory Timing Clock Generator, then delayed by the 8-stage Programmable Generator (to produce the Pattern Timing). It is then regated by the Memory Timing Clock Generator to become Clock 2, which is then gated through the Pattern Timing Selector Gates to become Clock 3. This clocks the Pattern Data Address Counter which addresses the EPROM; the EPROM output data is then latched into the Timing Data 8-Bit Latch.

A second Clock 1 pulse generated by the Master Clock is gated through the Master Clock Control Gate, Memory Timing Clock Generator, to become Clock 2. This is then gated through the Pattern Timing Selector Gates, to become Clock 3; this clocks the Pattern Data Address Counter, which re-addresses the EPROM. The EPROM output data is then latched into the Pattern Data 8-bit Latch.

The third Clock 1 pulse loads the second lot of Timing Data into the IC14 register, the fourth pulse loads third lot of the Pattern Data, etc.

The end of the EPROM Pattern Block is detected by IC15, an 8 input NAND gate; when the Timing Data value is 255 (IC14, D_0 to D_7=1). A pulse is produced from C43 to reset the Pattern Data/Address Counter (IC11) via IC20a; the Pattern Block is addressed at the beginning, and the whole sequence is repeated over again.

Pushing the 'One Run' switch (S7), will set the One Run Latch IC21b to 'RUN'. When an 'end of pattern marker' pulse is produced from C43, it will be gated by the NAND gate IC18d, and this will reset the Run/Stop Latch (via IC19d & IC20b) to 'STOP'.

Pushing the 'Single/Flash' switch (S9), will set (via IC26b) the Single/Flash Latch IC22b to 'FLASH'; this allows the pulses from the Manual Flash Rate Clock to be gated through the Single Flash Control (IC26c & d), to the Manual Strobe Data Switches S10-17. Pushing any one of the switches will feed the pulses into the

appropriate Strobe Data Triple Input OR gate; the Strobe Data Pattern output of the OR gates can be viewed on the LEDs within the Manual Strobe Data Switches (S10-17).

The Strobe Data Triple Input OR gates (IC27a to c, IC34a to c, and IC35a & c) receive Pattern Data from one of three sources; from the already mentioned Manual Flash Rate Clock, from the EPROM via the Pattern Data 8-Bit Latch (also previously mentioned), or from an external source (e.g., a computer, sequencer, etc.) via the 25-way D-type socket (SK8) pins 3 to 10, (Strobe 1 to 8).

Pushing S5, the Strobe Data Output On/Off Switch, will set the Strobe Data On/Off Latch to 'ON'; this will illuminate the LED within S5 and allow the output data of the Strobe Data Triple Input OR gates to be connected to the Parallel To Serial Data Converter (IC30), via the Strobe Data Output gates (IC28a to d, IC29a to d).

The Q6 & Q10 outputs (pins 4 & 15, respectively) of the Master Clock (IC31) are used to drive the Parallel To Serial Converter; the Q6 output of the Master Clock is used to convert the parallel data input to serial by clocking the shift register, while the Q10 output is used to set the output frame rate.

The serial data output from the shift register (IC30) is applied to one input of IC33, a dual TTL to RS-232 converter (and vice-versa), while the gated clock output of IC32a is applied to the other input. The RS-232 level clock and serial data is then output to SK6, an American style (FCC68) telephone socket. The clock and data signals are then connected by a 'flying lead' to the strobes. Note that the connectors differ to BT style telephone connectors, which are NOT compatible with this unit.

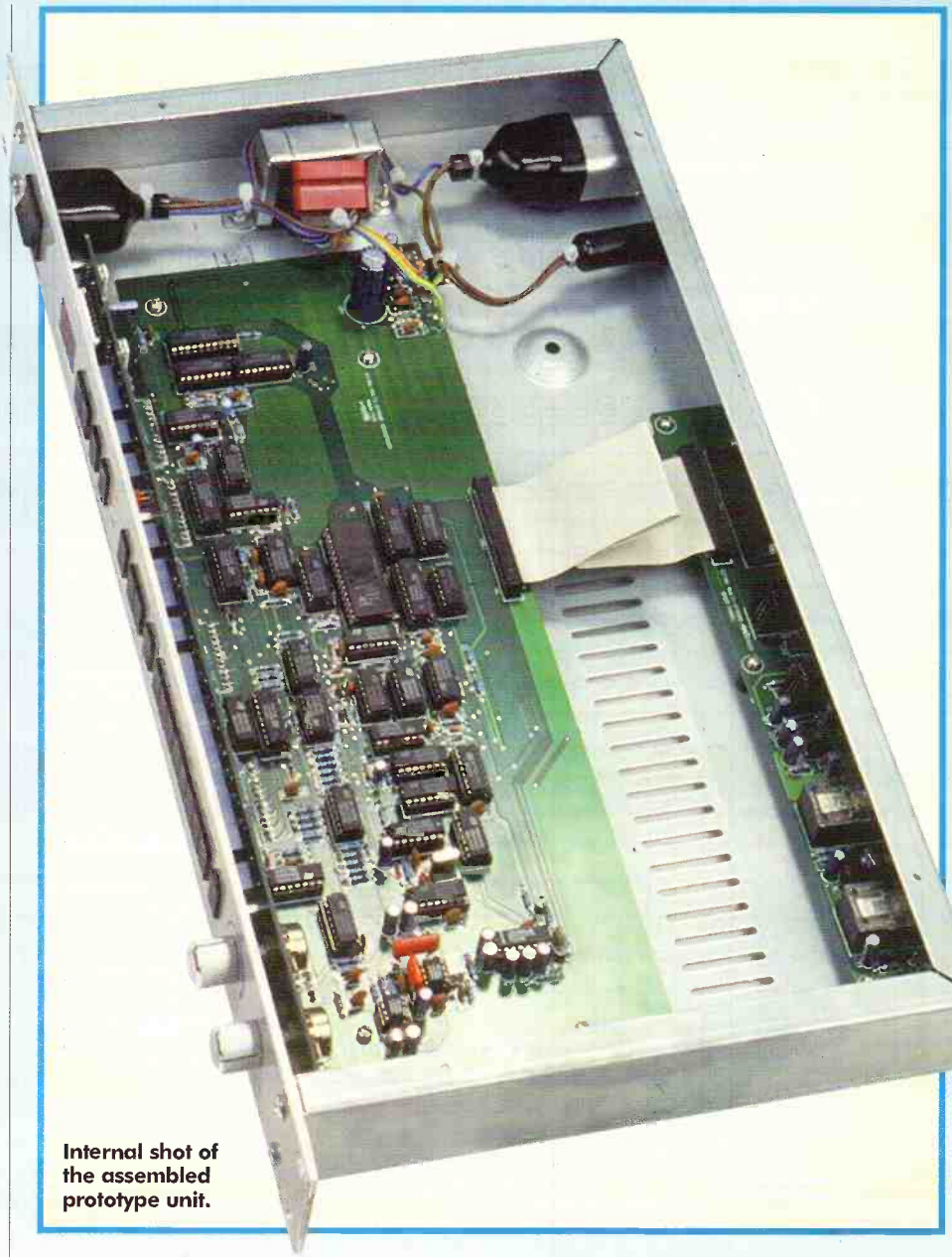
Because IC33 is a dual TTL to RS-232 and dual RS-232 to TTL converter, the second half of the IC (RS-232 to TTL) has been used as a 'flying lead' cable tester. By simply connecting a 'flying lead' to SK6 and SK7, the RS-232 clock and data will be converted back to TTL; the signals are then applied to TR1 & TR2, which illuminate LD4 & LD5.

If both LEDs fail to illuminate, it is likely that a fault in the cable 0V lead exists.

Construction

The PCB is a high quality glassfibre, double-sided, Plated Through Hole (PTH) type, complete with solder resist and silk screen legend on both sides to aid construction – see Figure 3. Note that the PCB is supplied in one piece, which needs to be divided into separate snap-off sections – front, rear, main and two display template sections, and an unused area, which can be discarded. Clean up the board edges after snapping, to remove any sharp projections.

Construction is fairly straightforward; begin by cleaning the tarnish off the component leads (especially the front panel mounted push switches), this will make soldering much easier. Assemble the PCB in order of ascending component size (smallest to largest), i.e., diodes, resistors, IC sockets, capacitors and semiconductors. However, it is advisable to install the DIL IC holders before fitting the taller components, as it is then easier to ensure that they are fitted squarely onto the board.



Internal shot of the assembled prototype unit.

Check, double-check and check again the components are the correct value and orientation before soldering, as it will be difficult to remove components without damaging the PCB.

Note, the PCBs have components fitted on BOTH sides; fit the components to the same side as their respective legends.

The rows of switches interlock, fit to the PCB then solder. Be careful to correctly orientate the polarized devices, i.e. electrolytic capacitors, LEDs, diodes, transistors and ICs; the ICs should be inserted into the sockets last of all whilst observing the usual antistatic precautions, since most are CMOS devices. The resistor networks RN1 & RN2 are fitted directly to the PCB (no sockets required).

Front Panel PCB

The front panel PCB has a number of components fitted from the solder side; these include PL1 to PL4, C34, IC38 & IC39, all the 0·6W resistors, RV1 & RV2 (see Figure 4 for RV1 & RV2 leg modification before fitting), and RN1 & RN2. All other components are mounted from the usual component (top) side, including the pins for RV1 & RV2. The LEDs LD1-3 are mounted at a height of 12mm from the PCB, as shown in Figure 5.

Cut the 0·1in. socket strip into two 9-way pieces for the 7-segment display, then fit to the front panel PCB. The 7-segment LED display legs need to be trimmed down to the correct size before fitting them into the 0·1in. socket strip – see Figure 6.

Main PCB

The main PCB sockets SK1 to SK5 and the regulator RG1 are mounted from the solder side; see Figure 7 for the regulator mounting details. However, DO NOT fit the regulator until final construction. Insert the PCB pins from the track side.

Last of all, thoroughly check your work for misplaced components, solder whiskers, bridges and dry joints. Finally, clean all the flux residue off the PCB using a suitable solvent.

Final Construction

The specified housing is a custom designed rack-type casing, with pre-punched front and rear panels requiring no drilling.

The PCB mounting hardware is supplied with the enclosure.

Attach the front and rear panel labels to the enclosure; carefully align them, using a little sticky tape to hold one end in position, having removed the label backing beforehand. When applying, rub down the label carefully with a soft cloth; be careful not to trap any air bubbles. Once the label is attached, it will be impossible to remove without damaging it.

Refer to Figure 8, showing the construction of the front and rear panels. Fit the front panel PCBs to the metal front panel then bolt to the enclosure; fit the knobs to the control potentiometers. Fit the mains switch to the front panel, then fit the mains inlet socket and fuseholder to the rear panel. Bolt the transformer into position. Complete the mains wiring as shown in Figure 9, **except** for the transformer primary connections; don't forget to fit the insulator boots. It is important for **your** safety that the cable ties are fitted where specified. Check and double-check that ALL the wiring is correct before proceeding any further.

Attach two short lengths of wire (component lead offcuts) to the microphone; fit the rubber grommet to the rear panel then insert the microphone into it.

Fit the main and rear panel PCBs into position and fix them in place, as shown in Figures 8 and 10. Solder the microphone leads to the PCB pins. Preform the regulator leads; fit and bolt in position then solder the leads to the PCB.

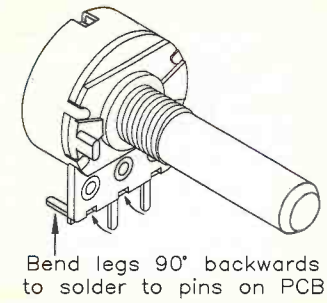


Figure 4. RV1 and RV2 leg modification.

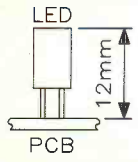


Figure 5. Setting LED height.

Make the connections between the transformer secondary and the PCB using component lead offcuts. Complete the mains connections to the transformer primary, and don't forget to fit the transformer cover before soldering. Fit the last of the cable ties.

Double-check **all** your assembly work before fitting the enclosure lid. Finally, fit the fuse into the fuse holder on the rear panel.

Testing and Instructions on Use

Turn the 'AUDIO LEVEL' control to minimum (fully anticlockwise). Power up the unit; the double digit display should read '0', the LEDs within the 'STOP', 'MANUAL' and 'PATTERN' scan switches should illuminate; the ENTER switch LED should briefly illuminate; the 'MEMORY' LED should also be illuminated.

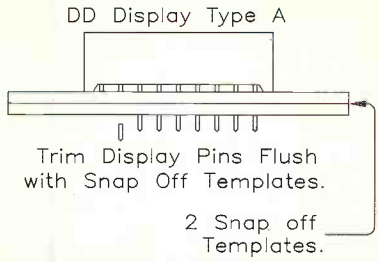


Figure 6. Preparing the double-digit LED display for PCB mounting.

Push the PATTERN scan down (▼) switch, the double digit display should 'roll over' to '99'; keeping your finger on the switch will clock the display down. Push the PATTERN scan up (▲) switch, the display should clock up, and 'roll over' to '0' and continue clocking up while being pressed.

Select pattern 60, push the 'ENTER' switch, and its LED should illuminate during depression. Push the 'ONE RUN'

Shot taken during pattern composition.
Prototype unit shown with development system.

switch, the 'ONE RUN' LED should remain illuminated; push the 'RUN' switch, the 'STOP' LED will extinguish and the 'RUN' LED will illuminate for one pattern cycle then extinguish; the 'STOP' LED will illuminate once again. While the 'RUN' LED is illuminated, a *Cylon (Battlestar Galactica)* or *KITT (Knight Rider)* style sweeping pattern will be displayed on the '1 to 8 CHANNEL' switch LEDs. Push the 'ONE RUN' switch again, and the LED will extinguish. Push the 'RUN' switch, and the same pattern will be displayed on the '1 to 8 CHANNEL' LEDs but in a continuous cycle until the 'STOP' switch is pushed. Leave the pattern running.

Push the 'TIMING' switch to select 'MANUAL', the 'MANUAL' LED will illuminate and the 'TIMING' switch LED will begin to flash. The 'FLASH RATE' control determines the 'speed' of the pattern; alter the control setting from fully anticlockwise to fully clockwise, which will change the pattern from slow to fast.

Push the 'TIMING' switch to select 'SOUND', the pattern will stop and the 'TIMING' switch will stop flashing and the 'SOUND' LED will illuminate. Clap your hands (or gently tap the bench or enclosure); no change should be observed. Turn the 'AUDIO LEVEL' control fully clockwise and clap your hands again; the 'TIMING' switch LED should briefly illuminate and the pattern advance one step. That is, if a

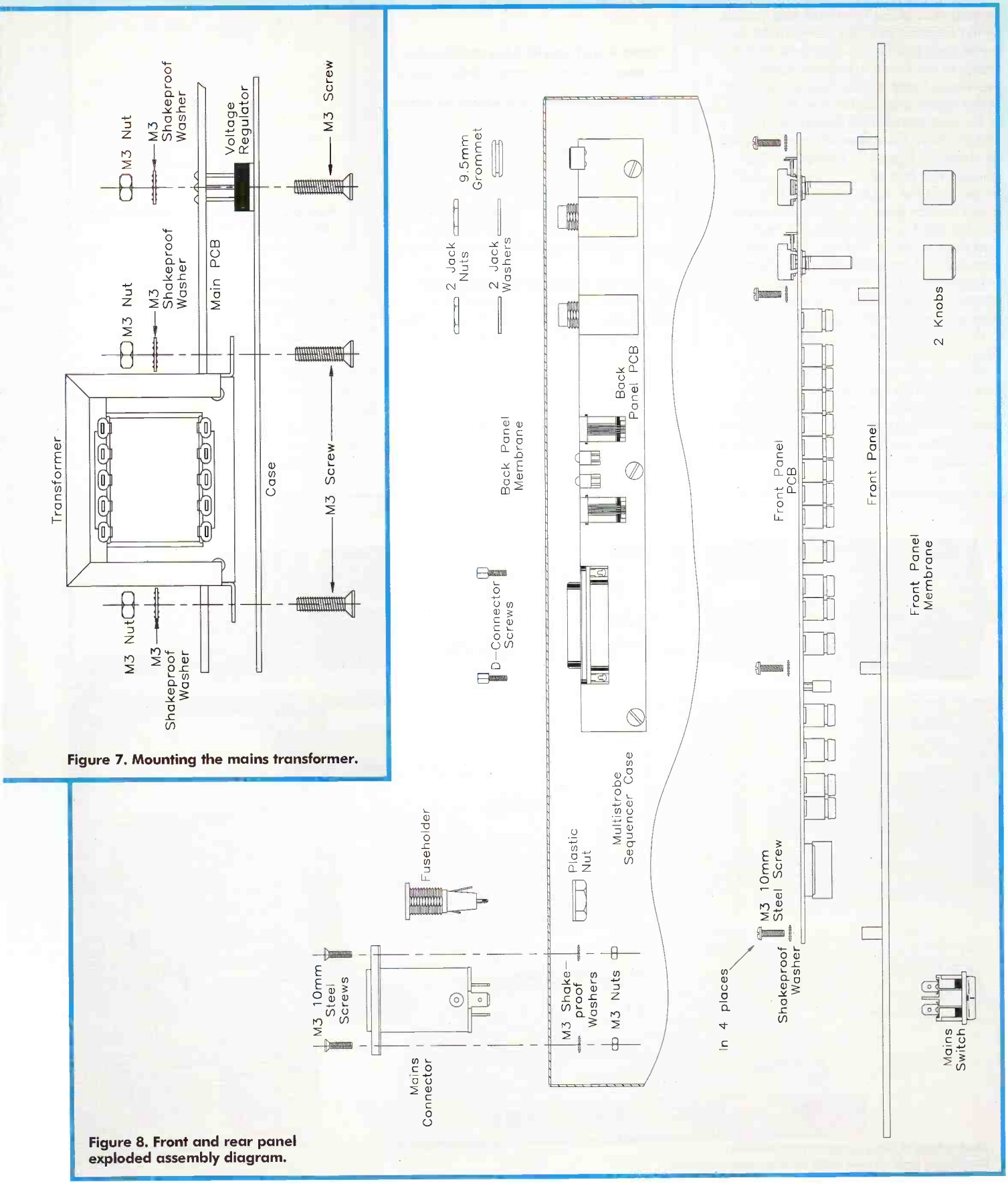
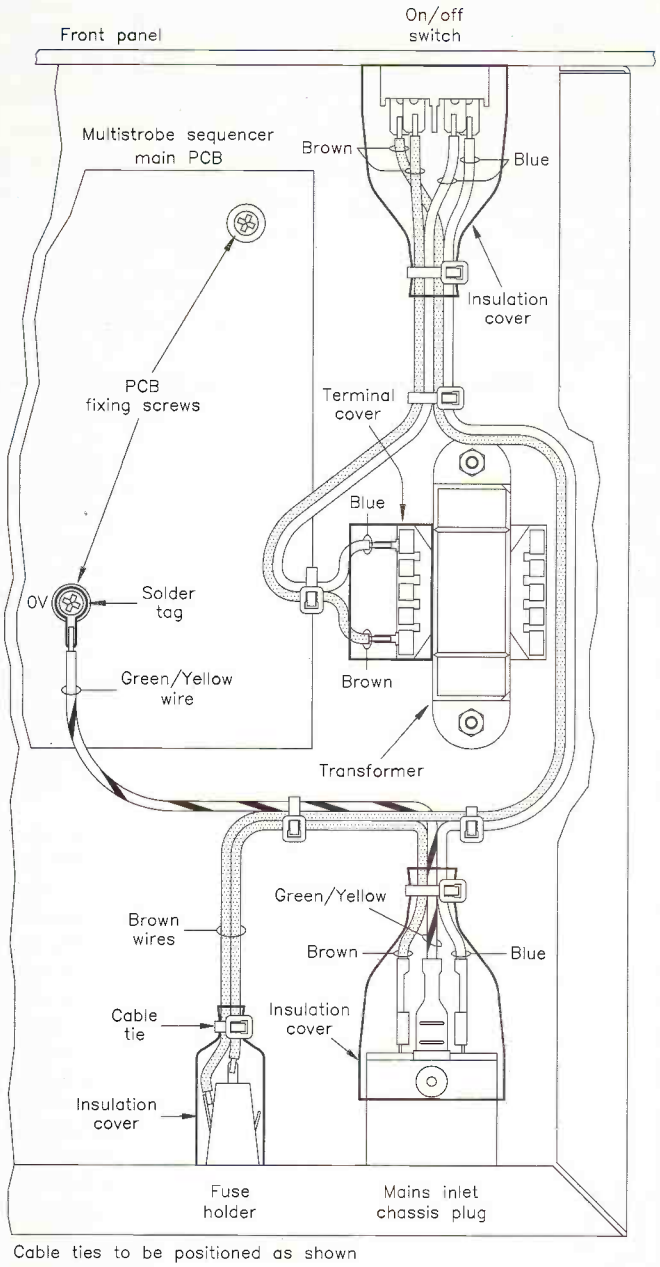


Figure 7. Mounting the mains transformer.

Figure 8. Front and rear panel exploded assembly diagram.

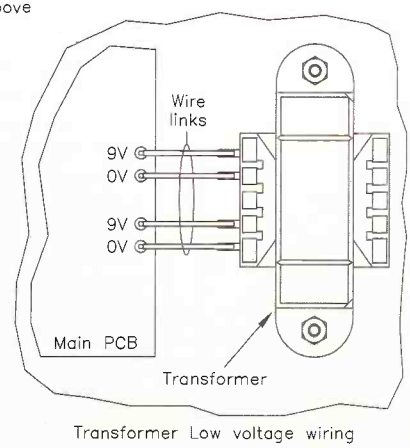
'CHANNEL' LED was illuminated, it will extinguish, or if all LEDs were extinguished, one will illuminate. Plug a microphone into the 'MIC' socket on the rear panel; tap the microphone, and the pattern will advance as before. Apply a line level signal (preferably music with some bass content) to the 'LINE' socket (this socket has priority over either microphone); the pattern will advance in an apparent random fashion. Unplug the microphone (if you haven't already done so) and unplug the line level signal.

Turn the 'AUDIO LEVEL' control to minimum, then push the 'STOP' switch. In turn, push the '1 to 8 CHANNEL' switches; the switch LED will illuminate for as long as the switch is depressed.



Cable ties to be positioned as shown

Viewed from above



Transformer Low voltage wiring

Figure 9. Mains wiring and earthing arrangements.

Push the 'MANUAL' switch, the LED will begin to flash; the 'speed' is determined by the 'FLASH RATE' control. Once again, push the '1 to 8 CHANNEL' switches; this time, the switch LED will flash at the same rate as the 'MANUAL' switch LED.

Push the 'TIMING' switch to select 'MEMORY'; connect a 'Strobe lead' to the 'CABLE LOOP TEST' 'IN' & 'OUT' sockets on the rear panel, then push the 'RUN' switch; observe the 'CLOCK' & 'DATA' LEDs (also on the rear panel), both of which should be extinguished. Push the 'STROBES ON/OFF' switch (the switch LED will illuminate); the 'CLOCK' & 'DATA' LEDs should now illuminate (NOTE, the 'CLOCK' LED will always be brighter than the 'DATA' LED); disconnect the 'Strobe lead' when checked but leave the pattern running.

Connect a wire link between pin 1 and pin 15 of the 'EXTERNAL CONTROL INPUT' 25-way D-type socket mounted on the rear panel; this will stop the pattern. Connect the wire link between pin 1 and pin 2 of the D socket, this will start the pattern running; push the 'STOP' switch.

In turn, connect the wire link between pin 1 and pins 3 to 10; this will illuminate each of the '1 to 8 CHANNEL' switch LEDs in turn.

To test the outputs of the D-type socket connections, either an oscilloscope or digital multimeter is required (at a push, you could use a 2mA LED with a 3kΩ series resistor to test only the logic outputs). Set the 'scope to DC coupled and 1V per division, or the multimeter to its 20V DC (or nearest) range. Connect the 'ground' or '0V' lead to pin 11 of the D socket; connect the probe or '+V' lead to pins 16 to 23. Push the '1 to 8 CHANNEL' switches in turn, a logic 1 TTL reading (+4 to 5V) should be obtained from the appropriate pin when the switch is depressed. Push the 'STROBES ON/OFF' switch (LED now extinguished) and repeat the test, a logic 0 reading (0 to 1V) should be obtained when the switches are depressed.

It is relatively easy to check the processed audio outputs using an oscilloscope. However, using a meter, no definite readings can be obtained, just an approximate representation of the levels; set the meter on the 2V DC range. Turn the 'AUDIO LEVEL' control fully clockwise; connect the +V lead to pin 24 (VOGAD output) and occasionally tap the microphone, whereupon a meter reading should be observed, occasionally as high as 150mV.

Connect the meter +V lead to pin 14 (AUDIO TRIGGER output) and repeatedly tap the microphone, once again, a meter reading should be observed, occasionally as high as 1V. Now set the meter to read 2V AC. Connect the meter +V lead to pin 25 (VARIABLE GAIN AMPLIFIER output) and then pin 12 (LOW-PASS AUDIO FILTER output) and again, a meter reading should be observed, occasionally as high as 350mV from both outputs.

Last but not least, we come to the setting of the dip switches on the rear of the Multi-Strobe units; if you have 8 strobes, set one per channel. If you have

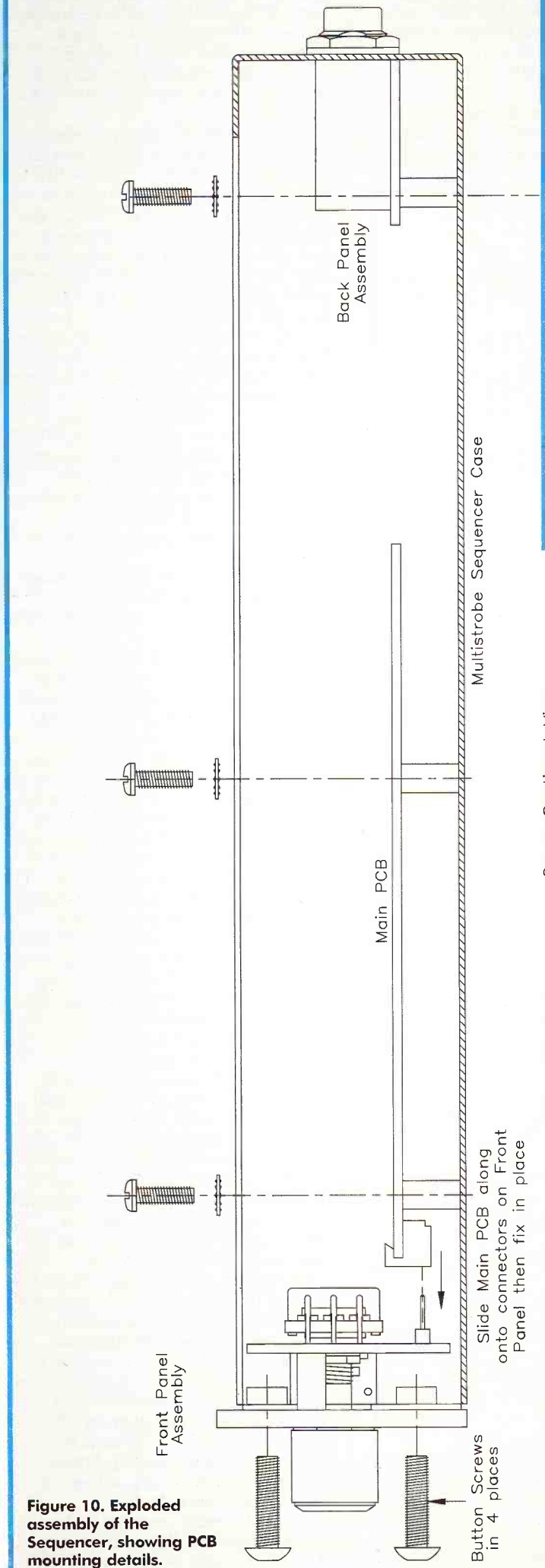


Figure 10. Exploded assembly of the Sequencer, showing PCB mounting details.

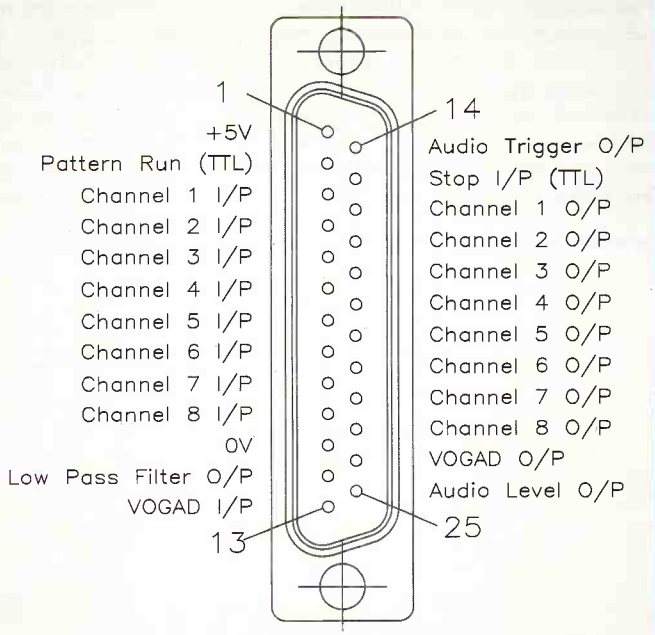


Figure 11. The Sequencer 25-way 'D'-type connector pinout.

only 2 strobes, set one on all the odd channels (1, 3, 5, 7) and set the other on all the even channels (2, 4, 6, 8). Do not set the same strobe on adjacent channels, i.e. 1, 2 & 3, as it will not trigger. Connect a strobe lead from the Sequencer 'CABLE LOOP TEST OUT' socket to the Multi-Strobe RS-232 input socket; 'daisy chain' the other strobes together with strobe leads and ensure that the strobe internal oscillator is switched 'OFF' (switch button out). Set the Sequencer to 'STOP' (if it isn't already).

Power up the strobes, and ensure that the 'STROBES ON/OFF' switch is set to 'ON'. Push the '1 to 8 CHANNEL' switches in turn, and the appropriate channel strobe should fire (in the case of 2 strobes, they should fire alternately); once tested, power down the Multi-Strobes and Sequencer. The sequencer has now been fully tested, and is ready for use.

IMPORTANT! Reset the Multi-Strobes to ONE channel only. Otherwise, some of the patterns could overdrive the strobe tubes, which will cause tube overheating, resulting in 'tube lockup' (permanent arcing), leading to premature failure of the tube. You have been warned.

The unit is designed to be rugged and resistant to fairly harsh treatment, as might be encountered in disco and party applications. Pressing several or all buttons will not damage the unit, and the links between the unit and the outputs are safeguarded against short-circuiting. However, to avoid the possibility of circuit damage, do not apply inputs higher than TTL (5V) levels to the D-type connector terminals – see Figure 11, and do not use the unit or the strobes in damp conditions or outdoors – the casings are not waterproof.

Always operate the unit in strict accordance with the mains safety guidelines printed elsewhere in this article. On a lighter note (puns intended), we hope that you will have lots of fun building and using this project!

MULTI-STROBE SEQUENCER PARTS LIST

RESISTORS: All 0·6W 1% Metal Film (Unless Specified)			
R1,58,60,64,68,71, 72,81,84,97,100	4k7	11	(M4K7)
R2,5,101,102,103	1k	5	(M1K)
R3	2k2	1	(M2K2)
R4,17,23,25,27, 28,31,38,39,40, 43,46-48,51,52, 54,56,57,59, 61-63,66,67,69, 70,75,76,78,79, 82,83,93-96	100k	37	(M100K)
R6,9,11,12,18, 19,33,36,37,49, 50,53,55,98	10k	14	(M10K)
R7	22k	1	(M22K)
R8,42	220Ω	2	(M220R)
R10	6k8	1	(M6K8)
R13-16	20k	4	(M20K)
R20,21,22,26,29, 30,32,41,44,85-92	270Ω	17	(M270R)
R24	12k	1	(M12K)
R34,35,45	1M	3	(M1M)
R65	10M	1	(M10M)
R73,74	47k	2	(M47K)
R77,80	150Ω	2	(M150R)
R99	470k	1	(M470K)
RN1,2	470Ω 8-resistor DIL Network	2	(DL85G)
RV1	100k Miniature Linear Potentiometer	1	(JM74R)
RV2	1M Miniature Linear Potentiometer	1	(JM76H)
CAPACITORS			
C1	220µF 16V Radial Electrolytic	1	(AT41U)
C2,3,5,7,10,57-60	47µF 25V Radial Electrolytic	9	(AT47B)
C4,43	1nF Ceramic Disc	2	(WX68Y)
C6,42,45,70,76	100pF Ceramic Disc	5	(WX56L)
C8,12-14,23,34	10µF 63V Radial Electrolytic	6	(AT77J)
C9,11,15,16,22,24, 26-31,33,38-41,46, 50,54,55,62,64,65, 68,69,72-75	100nF 50V Ceramic Disc	30	(BX03D)
C17	150nF Metallised Polyester	1	(BX77J)
C18,71	47nF 16V Ceramic Disc	2	(YR74R)
C19	33nF Metallised Polyester	1	(BX73Q)
C20	390nF Polyester Layer	1	(WW48C)
C21,35,37	10nF Ceramic Disc	3	(WX77J)
C25	1n5F Ceramic Disc	1	(WX70M)
C32,47-49,51,56,63	22µF 35V Radial Electrolytic	7	(AT56L)
C36	1µF 63V Radial Electrolytic	1	(AT74R)
C44	470pF Ceramic Disc	1	(WX64U)
C52,53	33pF Ceramic Disc	2	(WX50E)
C61	1,000µF 35V Radial Electrolytic	1	(AT63T)
C66,67	470nF 63V Radial Electrolytic	2	(YY30H)
SEMICONDUCTORS			
D1-14,19-30	1N4148	26	(QL80B)
D15-18	1N4001	4	(QL73Q)
LD1	Rectangular Shape Green LED	1	(YY46A)
LD2	Rectangular Shape Yellow LED	1	(YY48C)
LD3	Rectangular Shape Red LED	1	(YY45Y)
LD4,5	PCB Mounting Red LED	2	(QY86T)
TR1	BC549	1	(QQ15R)
TR2,3	BC558	2	(QQ17T)
RG1	L7805CV	1	(QL31J)
IC1	SL6270CDP	1	(UM73Q)
IC2,3	LM358N	2	(UJ34M)
IC4,17,19,23,39	HCF40106BEY	5	(QW64U)
IC5	HCF4017BEY	1	(QX09K)
IC6,18,26,32	4093BE	4	(QW53H)
IC7,24,36	ULN2803A	3	(QY79L)
IC8,9	HCF4029BEY	2	(QW20W)
IC10,13,14	M74HCT574B1R	3	(AE30H)
IC11	HCF4040BEY	1	(QW27E)
IC12	EPROM MS13	1	(95079)
IC15	HCF4068BEY	1	(QX24B)
IC16	HCF40103BEY	1	(QW61R)
IC20	HCF4072BEY	1	(QX27E)
IC21,22	HCF4013BEY	2	(QX07H)
IC25,31	HCF4060BEY	2	(QW40T)
IC27,34,35	HCF4075BEY	3	(QW45Y)
IC28,29	HCF4081BEY	2	(QW48C)
IC30	HCF4014BEY	1	(QW15R)
IC33	MAX232CPE	1	(FD92A)
IC37,38	SN74LS37N	2	(QQ52G)
MISCELLANEOUS			
S1	Click Switch with Green LED	1	(JU05F)
S2-17	Click Switch with Red LED	16	(JU04E)
T1	9V 6VA Chassis Mounting Mains Transformer	1	(DH24B)
DY1	Double Digit LED Display Type A	1	(BY66W)
XT1	2MHz Crystal	1	(FY80B)
SK1-5	12-way PCB Mounting Socket	5	(YW30H)
SK6,7	FCC68 PCB Mounting Socket Type 4C4P	2	(JW46A)
SK8	25-way Right-angled D-type Socket	1	(FG27E)
PL1-5	Pin Strip 1×36 Straight	2	(JW59P)
JK1,2	Sw PCB Stereo Jack Socket	2	(FJ87U)
	IDC Cable	1	(DY47B)
	Strobe Connecting Cable	1	(95078)
	Subminiature Omni-directional Microphone Insert	1	(FS43W)
	20mm Flush Fitting Fuseholder	1	(KU33L)
	50mA 20mm Time Delay Glass Fuse	1	(CZ85G)
	Fuseholder Boot	1	(FT35Q)
	Mains Inlet Filter Plug	1	(FT36P)
	Insulation Cover	2	(JK66W)
	5-Way 6VA Cover	1	(DM29G)
	Mains Plug and Cable, Black	1	(CY32K)
	DPST Rocker Switch	1	(DE62S)
	8-pin DIL Socket	3	(BL17T)
	14-pin DIL Socket	18	(BL18U)
	16-pin DIL Socket	11	(BL19V)
	18-pin DIL Socket	3	(HQ76H)
	20-pin DIL Socket	3	(HQ77J)
	32-pin Turned Pin Socket	1	(KW69A)
	9·5mm Grommet	1 Pkt	(JX63T)
	M3×10mm Pozidrive Screw	1 Pkt	(LR57M)
	M3 Shakeproof Washer	1 Pkt	(BF44X)
	M3 Steel Nut	1 Pkt	(JD61R)
	M3 Solder Tag	1 Pkt	(LR64U)
	1mm PCB Pins	1 Pkt	(FL24B)
	Brushed Aluminium Knob Type K8A	2	(YR64U)
	3-core 3A Mains Cable, Black	1m	(XR01B)
	Tie-Wrap Type 100	7	(BF91Y)
	Push-On Receptacle	1 Pkt	(HF10L)
	Square Stick-on Feet	1 Pkt	(FD75S)
	PCB	1	(90041)
	Case	1	(90042)
	Panel Labels	1	(95068)
	Instruction Leaflet	1	(XV47B)
	Constructors' Guide	1	(XH79L)
OPTIONAL (Not in Kit)			
	Multi-Strobe Kit	As Req.	(90015)
	Strobe Connecting Cable	As Req.	(95078)
	FCC68 Plug 4C4P	As Req.	(JW42V)
	FCC68 Cable 4 Core	As Req.	(XS27E)
	Plas FCC68 Crimp Tool 4C4P	1	(JW51F)
	Dynamic Mic, Black	1	(YT34M)
	Straight ¼in. Jack Lead	1	(YZ29G)
	Phono/Stereo ¼in.	1	(JK13P)
	Twin Phono-Phono Plug	1	(RW50E)

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

The above items (excluding Optional) are available as a kit, which offers a saving over buying the parts separately.

Order As 90040 (Multi-Strobe Sequencer) Price £199.99 H1

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

The following new items (which are included in the kit) are also available separately, but are not shown in the 1996 Maplin Catalogue.

Multi-Strobe Sequencer PCB **Order As 90041 Price £49.99 B1**

Multi-Strobe Sequencer Panel Labels **Order As 95068**

Multi-Strobe Sequencer EPROM MS13 **Order As 95079 Price £10.99**

Multi-Strobe Sequencer Case **Order As 90042 Price £34.99 A1**

IDC Cable **Order As 95077 Price £3.99**

Strobe Connecting Cable **Order As 95078 Price £3.99**

What's On?

Annual Physics Jamboree

The Annual Physics World Exhibition will take place in Telford for the second year running, from 23rd to 25th April. The programme of scientific events and conferences will cover topics as wide-ranging as recent developments in silicon sensors, and the physics of musical instruments.

Run in conjunction with The Institute of Physics Annual Congress, the exhibition enables scientists to evaluate, compare and place orders for the products and allied services displayed and demostrated by over a hundred leading scientific suppliers. Exhibitors will show a wide range of high-technology solutions relating particularly to vacuum and semiconductor processing, nuclear technology, environmental physics, spectrometry, microscopy, optics and lasers.

A brand new display on physics and the motor car of the future will be unveiled in an exhibition for local primary and secondary schools, as well as members of the public. There will be dozens of do-it-yourself experiments to try, in addition to on-site theatres and planetaria. Top scientists will give popular lectures and local companies will illustrate the ways in which physics can be applied to wealth creation.

Contact: The Institute of Physics, Tel: (0171) 235 6111.

RSGB Trip to Friedrichshafen

The Friedrichshafen 'Hamfest', in June, is Europe's largest amateur radio exhibition. The Barnsley and District Amateur Radio Club is co-ordinating a coach trip to Friedrichshafen on behalf of the Radio Society of Great Britain (RSGB). The coach will depart on 26th June and return 2nd July. Pick-ups can be arranged at predetermined locations en route.

Accommodation at Linau on Lake Constance is for four nights. The cost including bed and breakfast is £225 plus insurance. A deposit of £25 is required to secure a place, with the balance to be paid by 31st March. Places are being allocated on a first come, first served basis.

Contact: Ernie Bailey, Tel: (01226) 716339.

Get set to Celebrate

This year's National Science, Engineering and Technology Week (*set96*) falls between 15th and 24th March, and the centre for celebrations is once again, the Science Museum in London, which has over 60 events planned for all the family. BAYS days are held on 15th and 16th March, when members of the British Association's Youth Section are allowed to roam freely around the museum, having prebooked through the BAYS office. On Mothering Sunday, 17th March, an exciting programme of special events for women and their families will be held, with talks by women scientists and drama presentations featuring famous women throughout history. In association with The Body Shop, there will be complimentary skin consultations and workshops to make your own shampoo and shower gel, and kids can get their face painted for free, or make their own pop-up mother's day card! Between 18th and 22nd March, the museum is hosting special activities for schools. On 18 March, there will be a symposium on the role of biotechnology in food production, organised by the Food and Drink Federation (Contact: Carol Elasser, Tel: (0171) 836 2460). On the evening of 21st March, Science in Art looks at how writers often collaborate with scientists when researching their work. See prize-winning author, A. S. Byatt and leading geneticist, Steve Jones, and hear a talk by chaos expert, Robert May. 22nd March is the night for the Star Party, sponsored by the Particle Physics and Astronomy Research Council, when family visitors can experience the excitement of science beyond the twilight zone! The grand finale is the special Innovations and Inventions Weekend (23rd and 24th March), sponsored by the DTI, featuring talks, demonstrations, workshops and story telling of inventive developments.

For further information and a timetable, please call the Science Museum on (0171) 938 8008/8080.

DIARY DATES

Every possible effort has been made to ensure that the information presented here is correct prior to publication. To avoid disappointment due to late changes or amendments, please contact event organisations to confirm details.

23 February. Night on the Air, Mid Sussex Amateur Radio Society. Tel: (01) 444 241 407.

24 February. Radio Rally, Rainham, Kent. Tel: (01634) 365980.

24 February. Radio Rally, South Shields, Tyneside. Tel: (0191) 265 1718.

26 February. Test Equipment Evening, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

1 March. Quiz Night with Margaret 2E1BRD, Mid Sussex Amateur Radio Society, Tel: (01) 444 241 407.

6 to 9 March. Apple Expo, Olympia London. Tel: (0171) 388 2430.

7 to 9 March. Innovations and Inventions Fair, Barbican Exhibition Centre, London. Tel: (01202) 762252.

8 March. Cable and Antenna Renovation Talk and Demonstration, Mid Sussex Amateur Radio Society, Tel: (01) 444 241 407.

9 to 10 March. RSGB London Amateur Radio and Computer Show, Picketts Lock, Edmonton. Tel: (01707) 659015.

11 March. Visit to The Cable & Wireless Company College, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

17 March. Radio Rally, Norbreck, Blackpool. Tel: (01707) 659015.

19 March. Transforming Your Material Flow, IEE, Bristol and Bath Exhibition Centre. Tel: (0171) 344 5427.

19 March. Transforming Your Material Flow, IEE, Redwood Lodge Hotel, Bristol. Tel: (0171) 344 5427.

19 to 21 March. DB World, Olympia, London. Tel: (0181) 541 5040.

25 March. Surplus Equipment Sale, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

28 March. Agile Manufacturing, IEE, Cranfield Conference Centre, Cranfield University. Tel: (0171) 344 5428.

29 March. Club Shack Open Evening, Mid Sussex Amateur Radio Society, Tel: (01) 444 241 407.

31 March. Radio Rally, Magnum, Scotland. Tel: (01707) 659015.

31 March. 2m Fox Hunt at Ditchling Common, Mid Sussex Amateur Radio Society, Tel: (01) 444 241 407.

8 April. Annual General Meeting, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

11 April. Surplus Equipment Sale, 7.30pm Sharp, Mid Sussex Amateur Radio Society, Tel: (01) 444 241 407.

14 April. Radio Rally, Launceston, Cornwall. Tel: (01707) 659015.

19 April. Annual Construction Contest, Mid Sussex Amateur Radio Society, Tel: (01) 444 241 407.

21 April. White Rose Rally, Leeds. Tel: (01707) 659015.

22 April. The First Century of Sound Recording, Brian Hayward G8VXQ, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

23 to 25 April. Eighth International Conference on Road Traffic Monitoring and Control, IEE, London. Tel: (0171) 344 8425.

23 to 25 April. The Institute of Physics Annual Conference, Telford International Centre, Telford. Tel: (0171) 235 6111.

29 April to 3 May. Sixth International Conference on AC and DC Transmission, IEE, London. Tel: (0171) 344 5472.

4 May. RSGB Open Day, Potters Bar. Tel: (01707) 659015.

13 May. Astronomy, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

16 May. World Class Manufacturing for SMEs – Some of the Issues, IEE, The Dudley Centre for Competitive Manufacturing, West Midlands. Tel: (0171) 344 5446.

17 to 19 May. Mac Shopper Show, Wembley Centre, London. Tel: (0171) 831 9252.

20 May. Visit to Nickelodeon, Ashorne, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

21 to 22 May. International Conference on Public Transport Electronics Systems, IEE, London, Tel: (0171) 344 8432.

21 to 23 May. Internet World, Olympia, London. Tel: (01865) 730275.

27 May. Open Evening, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

10 June. 2m Direction Finding Contest, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

15 June. RNARS, HMS Collingwood, Hants. Tel: (01707) 659015.

18 to 20 June. Multimedia, Business Design Centre, London. Tel: (0171) 359 3535.

24 June. Repeater Management Group Chairman, Geof Dover G4AFJ, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

26 to 27 June. Electrical Engineering Exhibition, Airport Skean Dhu, Aberdeen. Tel: (01732) 359990.

30 June. Radio Rally, Longleat, Wiltshire. Tel: (01707) 659015.

6 July. Summer Social Event, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

8 July. 160m Direction Finding Contest, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

8 July to 30 September. Science Museum Superhighway UK Tour, Exploris, Northern Ireland. Tel: (0171) 938 8192.

22 July. Construction Competition, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

4 August. RSGB National Mobile Rally, Woburn, Beds. Tel: (01707) 659015.

18 August. Radio Rally, Manchester. Tel: (01707) 659015.

18 August. Radio Rally, Great Eastern, Kings Lynn. Tel: (01707) 659015.

1 September. Radio Rally, Telford, Shropshire. Tel: (01707) 659015.

4 to 5 September. Internet, Wembley Centre, London. Tel: (01923) 261663.

8 September. The Fifteenth Lincoln Hamfest, Lincolnshire Showground. Entry is £1.50. Morse tests available, plus all usual attractions. Caravans welcome (Saturday night only). Details from Sue Middleton, (XYL) (G8VGF) (QTHR), Tel: (01522) 525760.

18 to 19 September. EMC UK, Olympia, London. Tel: (01981) 590481.

21 September. Radio Rally, Scottish Convention, Glasgow. Tel: (01707) 659015.

24 to 29 September. Live '96, Earls Court, London. Tel: (0181) 742 2828.

25 to 26 September. Digital Signal Processing, Sheraton Skyline Hotel, London. Tel: (0181) 614 8042.

4 to 6 October. RSGB International HF Convention, Windsor. Tel: (01707) 659015.

Please send details of events for inclusion in 'Diary Dates' to: News Editor, *Electronics – The Maplin Magazine*, P.O. Box 3, Rayleigh, Essex SS6 8LR.

ELECTRONICS
The Maplin Magazine
RECRUITMENT ADS

To advertise your Recruitment needs in:
Electronics – The Maplin Magazine
Telephone Eric Richardson on (01932) 228063

Maplin Electronics plc, a leading source of electronic components to industry and the hobbyist, have, through continued expansion, the following exciting career opportunities:

Buyers

We are currently seeking talented Buyers to join our operation in Barnsley, to purchase a wide range of product areas. Your key tasks will include strategic management of the supply base and product sourcing to achieve maximum value to the business.

You are likely to be a graduate (or IPS qualified) with at least 5 years procurement expertise, including demonstrable experience of the electronics industry. An innovative, results-driven professional, you will work closely with Product Group Managers and Stock Control, and will feel comfortable in a competitive team environment.

Retail Inventory Controller

Reporting to the Stock Control Manager, your brief will be to achieve a level of stockholding that satisfies both customer service levels plus group inventory targets. Operating at the sharp end, you will liaise with Store-based personnel, responding to queries, addressing problems and advising on process. Working extensively with computerised systems, this role combines trouble-shooting and development work with some routine analysis and administration. Educated to 'A'-level or equivalent in mathematics or a related subject, relevant experience in retail with an inventory control or purchasing bias should be complemented by your commercial acumen and well-developed interpersonal skills. This position will be based in Barnsley.

Retail Operations

With an exciting store development programme for 1996, we would also like to meet potential store managers and their assistants.

Product Group Managers

We are seeking Product Group Managers to have sales and profit responsibility for either Hobbies and New Product Development (based Barnsley), Science & Education/Health and Safety or General Technical (both Essex-based).

As a Product Group Manager, you will be fully accountable for the marketing of a designated product group, which will include product range selection/management, promotional planning and brand strategy.

Ideally, you will be a Graduate seeking your second appointment in product marketing within the electronics or a related technical sector.

Product Managers

Reporting to a Product Group Manager, you will provide a key supporting role in the marketing activities associated with a defined Product Group.

Preferably, holding a recognised Business Studies/Marketing qualification, you will have a minimum of one year's experience as a Marketing Assistant in an FMCG environment. Although not absolutely necessary, relevant product experience would be advantageous.
In addition, you will be a confident self-starter, competitive and capable of working within a team.

These positions represent excellent development opportunities for ambitious candidates wishing to progress within product management or other business disciplines.

If you have the skills, motivation and experience to meet the criteria for these roles, send your c.v. including salary requirements to: Christine Slatford, Human Resources, Maplin Electronics plc, Maplin House, 274-288 London Road, Hadleigh, Benfleet, Essex SS7 2DE. Closing date for applications: 15th March 1996.

MPS MAPLIN *Professional*

MAPLIN

Design update by Robin Downs
Text by Robin Downs and Maurice Hunt

KIT AVAILABLE (95062)
PRICE £39.99
A1

RS232 Serial Line Tester Update

3 PROJECT RATING

FEATURES

* Easy to build/use * Multiple function * Versatile, pocket-sized unit * 8-bit PIC microcontroller-based * Four different Baud rates * Low current consumption

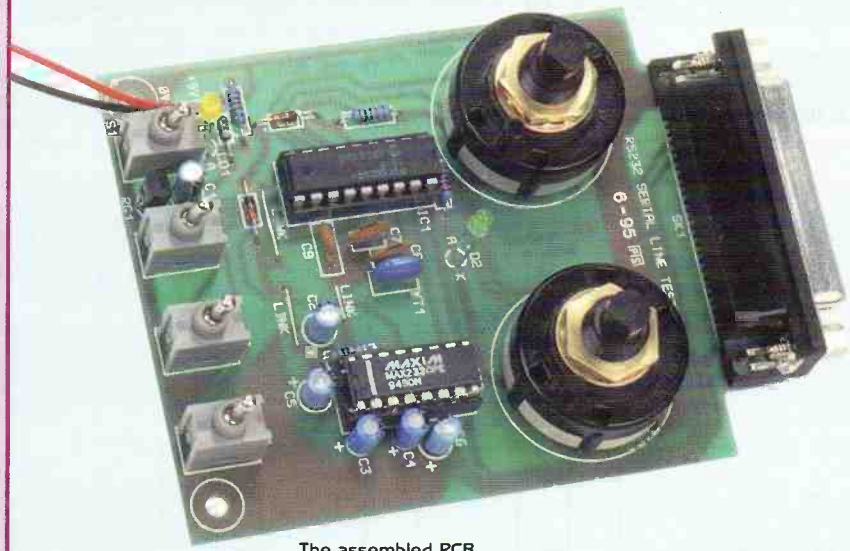
APPLICATIONS

* Terminals * Printers * Modems * Multiplexers * RS232 Cabling

This upgraded version of the RS232 Serial Line Tester project, previously presented in *Electronics* Issue 89, is a highly useful pocket-sized instrument allowing rapid testing of serial terminals, printers and other communications equipment using RS232 data cabling. It also provides a painless introduction to the world of PIC microcontroller-based projects, with no programming required!

Specification

DC power supply voltage:	Single 9V PP3 cell
Supply current (typical):	14mA
Battery life (estimated):	>30 hours (using recommended GP alkaline cell, Order Code ZB52G)
Visual indicators:	Two miniature LEDs provide power on/battery state and data flow indication
Test facilities:	80- and 132-column test modes Choice of three test patterns Choice of Baud rates (1200, 2400, 4800, 9600) Choice of data formats (7-bit Odd/Even/Mark/Space, 8-bit None) Visible confirmation of software flow control (X-On/X-Off) Printer carriage mechanism tabbing test



The assembled PCB.

THIS tester is an invaluable aid to diagnosing problems with serial RS232 equipment. For example, where a multiuser computer system has a large number of terminals and printers distributed around one or more sites, they are often connected via simple asynchronous RS232 data cabling for a cost-effective and flexible installation. However, when a device fails to operate correctly, usually at the furthermost point of the system (!), a way of testing the equipment quickly and independently of the host system can save a great deal of time in isolating the fault. The unit is a low-cost, portable, and easy to use test device, capable of providing several useful test functions to enable rapid troubleshooting.

The upgraded design, comprising of a reprogrammed PIC microcontroller, new 3-way (on-off-on) toggle switch and redesigned PCB and front panel label, incorporates a number of features to enhance the functional operation and test facilities over the existing design. The new components may also be purchased separately and retrofitted, in whole or in part, to the previous version, to enable an easy and cost-effective upgrade to the improved unit specification.

The enhancements consist of an extended screen-displayed menu (with 6 options) appearing while in Terminal/VDU testing mode, the menu options being selected from the terminal's keyboard, and an additional printer tabbing test function, designed to 'exercise' and check the reliability and accuracy of the carriage positioning mechanism, without using vast quantities of paper in the process.

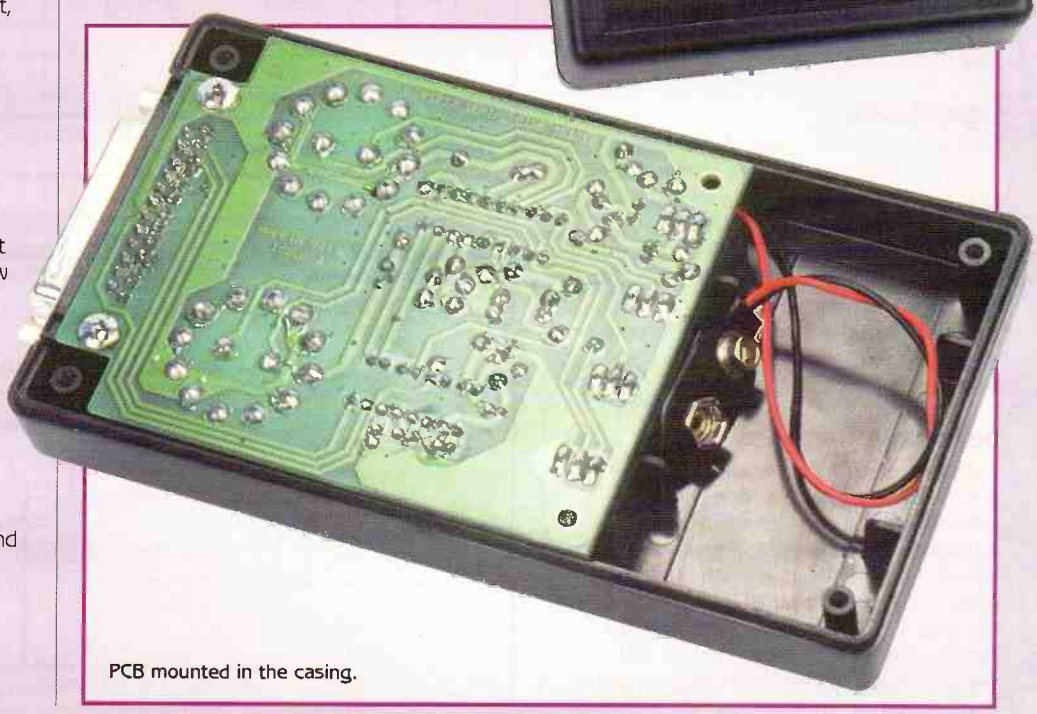
The tabbing test causes the printer to print a pattern of '|', '/' and '\' characters, working from the edges of the paper towards the middle and across to the opposite side. If the printer is operating as it should, a regular 'X' pattern should be produced: if it is a rather curvy or irregular 'X', this indicates that the printer's carriage positioning mechanism requires attention. The patterns cause minimal printing (and consequent noise levels), while maximising carriage movement. During the test, the printhead should move faster and faster towards the middle and sides of the paper, before advancing to the next print line after three passes per line (illustrated in Figure 9).

Because the print pattern includes a large proportion of unprinted space, most modern printers accelerate over the unprinted areas to increase printing speed. This is seldom tested properly by self-test or continuous printing routines.

The test is designed for matrix and daisywheel printers rather than laser printers or other types without a carriage as such. Some band or drum printers may make unusual sounds, but will not be damaged by the test pattern being produced.

This test has been used to demonstrate a fault that occurred on a customer's printer after 100 pages of printing, the fault showing after 4-5 lines of print in less than five minutes using this instrument.

Note. Some printers (only DEC units to date) have been found not to behave as above, printing the whole of the third pass in one go. This is due to their firmware not



PCB mounted in the casing.

printing unless overprinting or paper motion is requested. The first two passes of each line still print as expected, due to the end character being overprinted.

With good carriage positioning, the pattern will resemble a row of '*' characters, with regular spacing. Irregularities in the printout pattern highlight positioning inaccuracies in the carriage mechanism.

To select the tab test, the printer test switch, previously a 2-position SPDT toggle switch, is replaced by a 3-position (on-off-on) SPDTc switch (which looks identical and has the same pinout), with the previously unused connection now wired to pin 13 of the (reprogrammed) PIC microcontroller.

For terminals, the following test features are available, as shown in Table 1.

When used in 'Terminal' mode, the unit displays a short message and prompts for the user to select a test. This start up message can be used to try the various speed and parity options if the configuration is unknown, for both printers and terminals. The small amount of data sent will not generally cause a printer set at the wrong speed to print reams of rubbish.

On a VDU, the test number (1 to 5) is entered, followed by <CR> to start the test. Type 0 to return to the menu.

PCs used to emulate serial terminals via Kermit, MS Windows™ Terminal, Procomm™ or any similar package may also be tested in the same way.

In 'Printer' mode, tests are selected by front panel switches allowing two types of test print (sliding/straight) and two widths (80/132 Column) to be selected.

RS232 Communication – Overview

A brief description of asynchronous RS232 communications principles may be useful at this point as background to the use of the unit; Figure 1 shows a representation of the levels and timing for a 'typical' data byte.

Data Format

RS232 is a serial data protocol, i.e. each data WORD is sent one bit at a time, unlike a parallel printer port where there are eight data lines, one for each bit and a number of control lines to regulate the data flow.

Signal Levels

All signals are either driven high (+3V to +12V) or low (–3V to –12V) to signify a logic 0 or a 1, respectively. It should be noted that the idle state of the data lines is a logic 1, and the RS232 buffers invert on transmit and receive such that the data lines, when idle, are negative.

Each bit has the same period, defined as 1/(Baud rate), i.e. at 9,600 Baud, the bit period is about 104μs.

Serial Data Transmission

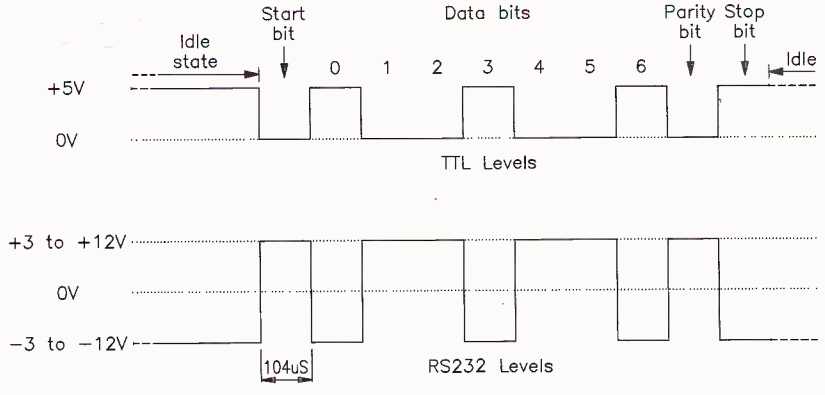
In order to send a data word, the sender initially sends a 'Start Bit' (Logic 0) to indicate that the receiver should expect a number of data bits to be sent, followed by the 7 or 8 data bits and terminated (optionally) by a 'Parity Bit' and a 'Stop Bit' (Logic 1). The parity bit was originally designed as a check bit to indicate that the data word contained an odd or even number of logic ones, hence odd or even parity, however, it is often unused (Space parity) or set permanently to logic one (Mark parity). In these cases only the parity bit is checked for correctness, the data cannot be verified. In any case, with parity enabled, only single or odd numbers of bits in error can be detected – there is no error correction information.

The stop bit is a gap of one bit period to allow a gap between characters for the receiver to resynchronize with the transmitter. In this way, slight speed differences can be accommodated between the sending and receiving units. At very low speeds, i.e. under 300 Baud, mechanical teletypes required longer stop periods of 1·5 or 2 bits between characters.

When the receiver detects the start bit,

Test option	Function
0	Menu
1	Display character set (straight pattern)
2	Display character set (revolving pattern)
3	Fill screen with selected character (to set screen focus, etc.)
4	Hex dump of received data (to test control/function keys)
5	Free type mode

Table 1. Terminal Display Options.



Example of sending ASCII chr 73 'I' ($2^6+2^3+2^0$) with spare parity and 7 data bits at 9600 baud.

Figure 1. Examples of serial data timing and signal levels.

Pin	Label	DTE	DCE	Description
1	Frame GND	–	–	Protective Earth
2	TXD	OUT	IN	Transmit Data
3	RXD	IN	OUT	Receive Data
4	RTS	OUT	IN	Ready to Send
5	CTS	IN	OUT	Clear to Send
6	DSR	IN	OUT	Data Set Ready
7	Signal GND	–	–	Signal Earth
8	CD	IN	OUT	Carrier Detect
20	DTR	OUT	IN	Data Terminal Ready

Table 2. RS232 Pinout Description.

Figure 2. RS232 Serial Line Tester block diagram.

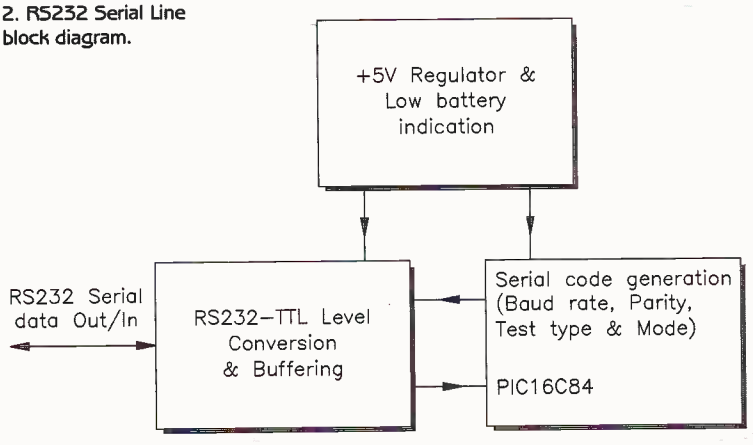
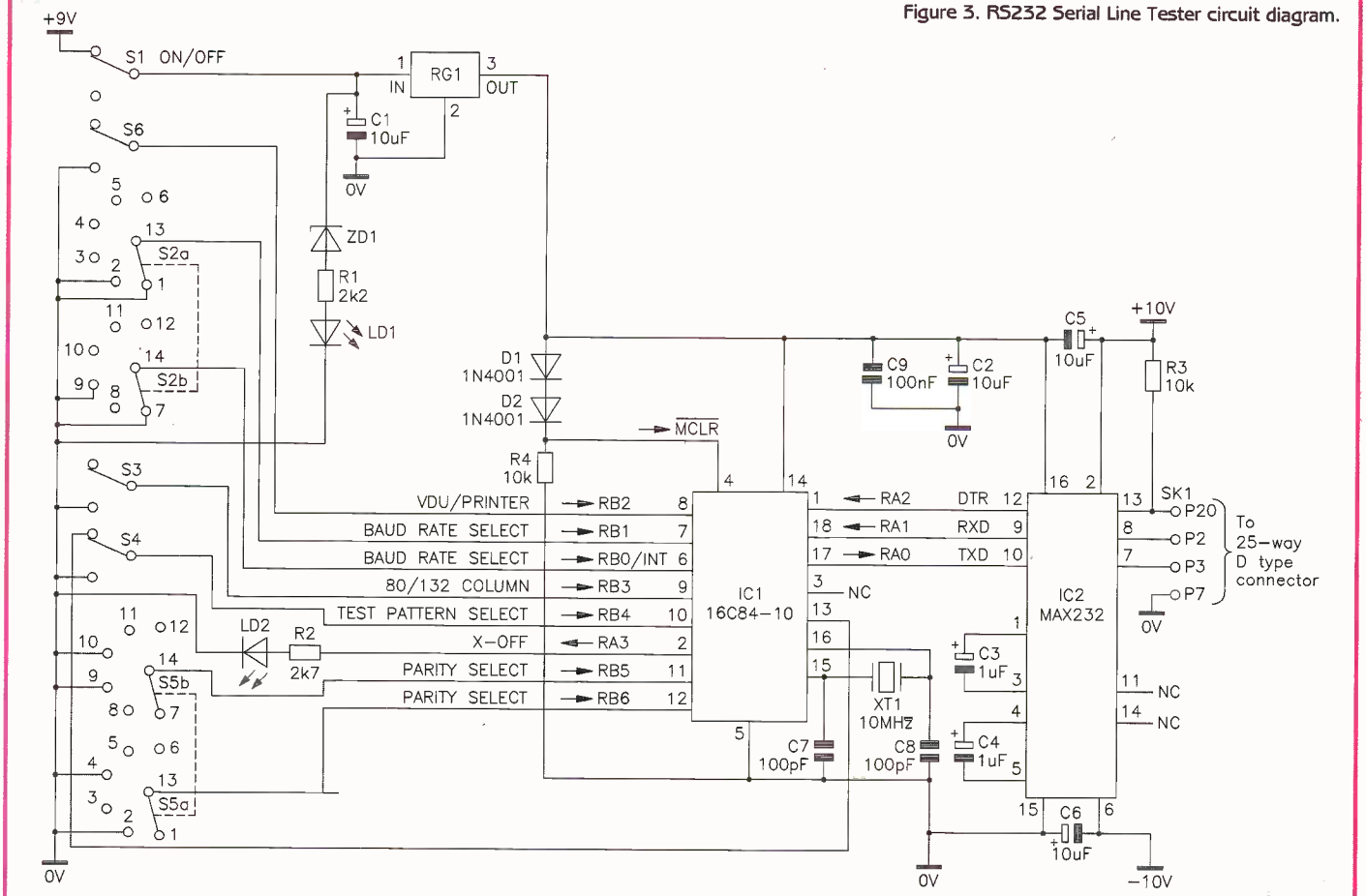


Figure 3. RS232 Serial Line Tester circuit diagram.



it counts halfway into the first data bit (to minimise errors) and then latches each data bit in turn into a shift register until all 7 or 8 data bits and parity are received. The parity bit is optionally checked and the data presented in parallel form to the receiving device.

Flow Control

Since devices are not always ready to receive data (printers, for example, cannot print as fast as computers can send data), a method of 'Flow Control' is required to stop the transmitting unit before the receiver runs out of buffer space.

HARDWARE flow control uses extra signal lines to signify if the receiver is ready or not. A high level generally indicates 'Ready', while a low indicates 'Not Ready'.

SOFTWARE flow control uses 'Stop' and 'Start' characters embedded in the transmit data to indicate if the device is ready to receive. Software flow control is generally harder to verify the correct operation of, due to the data being on the 'normal' data lines.

Classes of Devices

RS232 devices are split into two categories, Data Terminal Equipment (DTE) and Data Communication Equipment (DCE). All printers, terminals and systems are deemed to be DTE, while modems and similar devices are DCE. DTE and DCE have different pin connections to allow DTE and DCE to be connected with a simple 'straight-through' cable, as this is how most equipment used to be connected to mainframe systems.

Where a DTE to DTE (or DCE to DCE) connection exists, crossovers are inserted between Transmit and receive data and other like pairs. This is often called a 'Null Modem' cable, i.e. the cable required to replace the pair of modems that would normally have been used with a mainframe to remote site or PC-to-PC set up. Pin connections and data direction are shown in Table 2. Note that for a modem, Transmit data is an INPUT, the naming of signals for DCE equipment is relative to the link between the DCE, i.e. the telephone line for modems.

Note that the terms 'Straight-through' and 'Crossover' only have a sensible meaning where the pin connections are similar at both ends! When connecting to a 9-way serial port on a PC (for example), pins 2 and 3 are reversed compared to a 25-way connector, so a crossover cable to another DTE has pin 2 wired to pin 2, and pin 3 to pin 3. Thanks are due to IBM for that little piece of inspired standardisation! (Figures 8a to 8d show the connections for different configurations).

Circuit Description

As can be seen from the block diagram of Figure 2 and the circuit diagram shown in Figure 3, this project is based around a single Microchip PIC 16C84 chip microcontroller, effectively a complete (although small) computer system in itself with EEPROM, RAM, CPU and I/O all in a single 18-pin DIL chip. This updated version

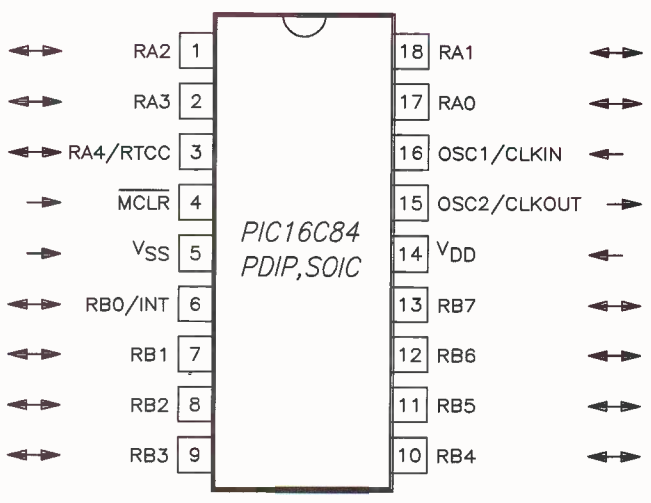


Figure 4. PCB microcontroller pinout diagram.

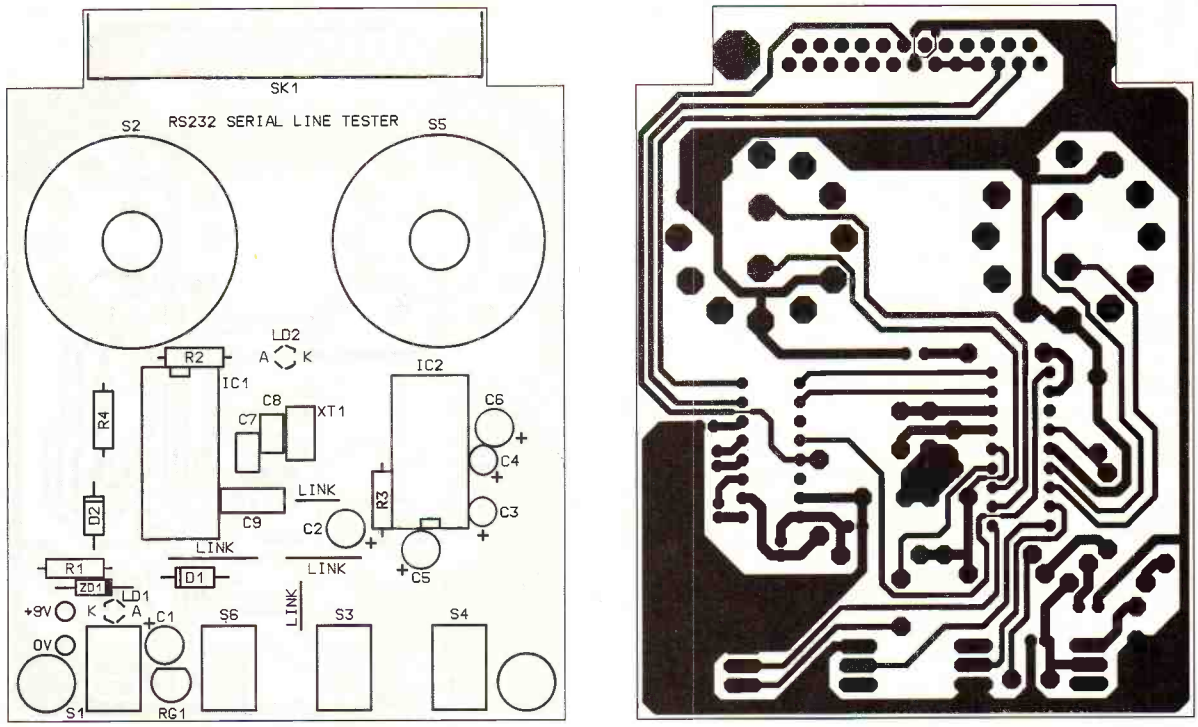


Figure 5. PCB legend and track.

of the project uses a reprogrammed PIC, which is available separately, to enable existing units to be upgraded. A MAX232-C RS232 buffer IC provides the required voltages for the serial interface and incorporates transmit and receive data buffers as well. The microcontroller has its own on-chip oscillator and uses an external 10MHz ceramic resonator to provide a stable clock source.

RG1 provides a regulated 5V supply from the 9V battery and the Zener diode, ZD1, and an LED, LD1, provide an indication of healthy battery condition, the LED dimming, and ultimately extinguishing, when the battery runs low.

Referring to the front panel layout depicted in Figure 7, you will see that the switches allow selection of a wide range of test modes and types, making the unit both versatile and simple to operate.

Dependent on the position of the switches, various I/O lines on the PIC will either be held at V_{DD} by an internal (on-chip) pull-up resistor, or taken low (to V_{SS}). These I/O lines are shown in Figure 4 as RB0 to RB6, and their different states are shown in Table 3.

Construction

Construction of this project is very easy! There is no hard wiring to switches*, etc., so provided that a reasonable amount of care is taken, a very professional piece of test equipment should be produced, first time around.

*A single wire link is required only when updating an existing unit to the new specification (see the section entitled Upgrading an Existing Unit).

PCB Assembly

There is no 'preferred' order for assembling the PCB components, but the following order is suggested, and referring to the PCB legend and track, shown in Figure 5, will assist assembly.

Firstly, solder the resistors and diodes in position, followed by the IC sockets, and using offcuts from component leads, install the wire links.

Fit and solder the ceramic capacitors, ceramic resonator XT1, and the electrolytic capacitors, ensuring their correct polarity. Solder voltage regulator RG1 in position with correct orientation, else none of the circuit will work, and keep its leads reasonably short (about 5mm or less), but without unduly stressing the component.

Solder LD1 and LD2 in position; note that the flat on the package and the shorter lead denotes the cathode and is marked 'K' on the PCB legend; the LEDs should be mounted with 13·5mm ±0·5mm between the base of the component and the top side of the PCB. An easy way to measure this is to cut a piece of thin card

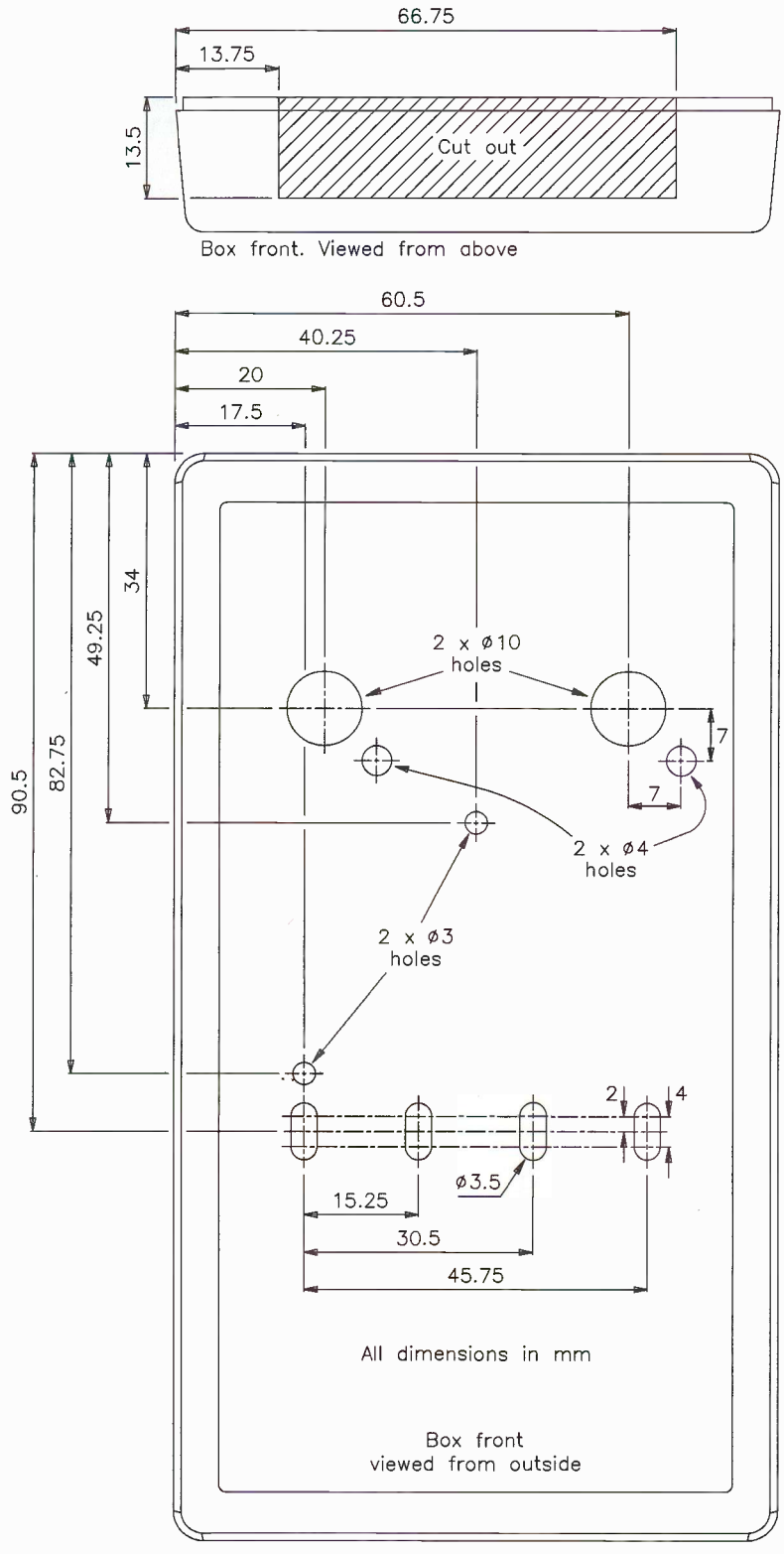


Figure 6. Box drilling diagram.

Baud Rate Select	RB0	RB1	Baud Rate
	LOW	–	1,200
	HIGH	–	2,400
	LOW	–	4,800
	HIGH	LOW	9,600
VDU/Printer Test	**RB2**		**Test Mode**
	LOW	–	VDU
	HIGH	–	Printer
80/132 Column	**RB3**		**Columns**
	LOW	–	80
	HIGH	–	132
Printer Test Mode	**RB4**		**Mode**
	LOW	–	Straight Pattern
	HIGH	–	Sliding Pattern
	RB7	–	Tabbing Pattern
Parity Options	**RB5**	**RB6**	**Parity**
	HIGH	HIGH	8-bit/None and 7-bit Space
	HIGH	LOW	7-bit Mark
	LOW	HIGH	7-bit Odd
	LOW	LOW	7-bit Even

Table 3. Test modes.

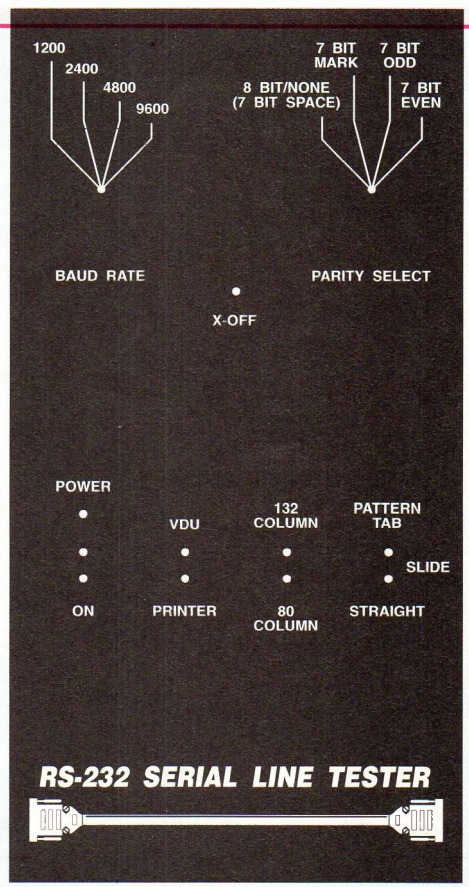
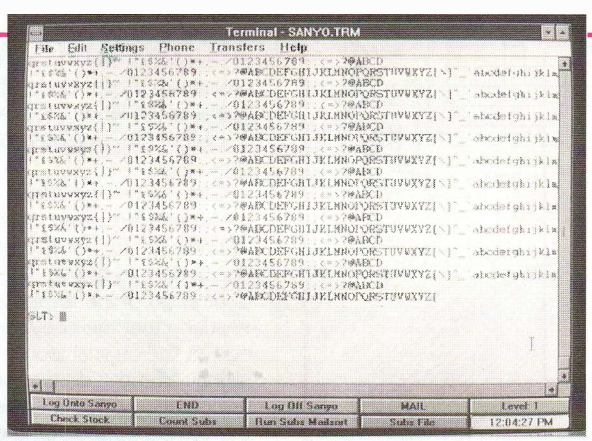
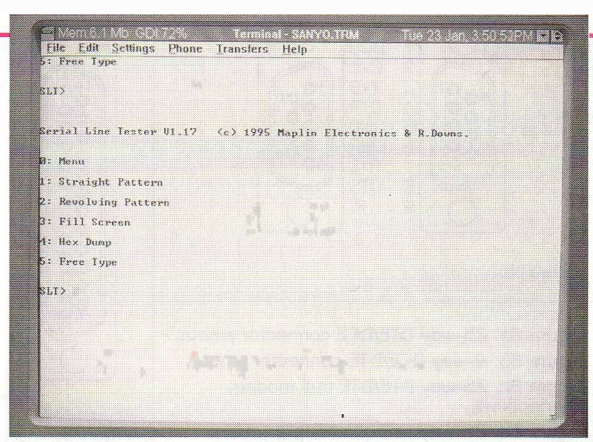


Figure 7. Box label detail (85%).

Two examples of screen displays.





13·5 x 13·5mm and use this as a gauge, held between the LED leads whilst they are soldered into position. Insert and solder the toggle switches in position, ensuring that they are seated firmly on the PCB. Do not confuse the 3-position switch (S4) with the two-position ones (S1, S3 and S6), else you won't be able to select all the functions!

With each of the rotary switches, carefully cut the spindles of the two wafer switches to leave 6mm protruding from the body of the switch. An easy way to cut these is to hold the end of the spindle (never the body of the switch) in a vice, cut through the spindle with a junior hacksaw, and using a small file, chamfer the edges.

Next, cut off the ends ('eyes') of each terminal with a stout pair of wire cutters, as close to the 'eye' as possible, and if necessary, straighten the remaining 'pins' carefully with a pair of pliers. Insert the switch with the moulded locating spigot aligned as indicated on the PCB legend, and solder it in place, ensuring that all the pins are soldered, including the unused ones.

Fit and solder the two PCB pins in the B+ and B– positions, and then solder the PP3 battery clip to the pins, with the red lead to the B+ pin. Finally, insert the two ICs into their sockets, taking suitable anti-static precautions; note that the notch in each DIL socket marks the pin 1 end of the IC, and that the ICs are inserted 'top-to-tail' in the board.

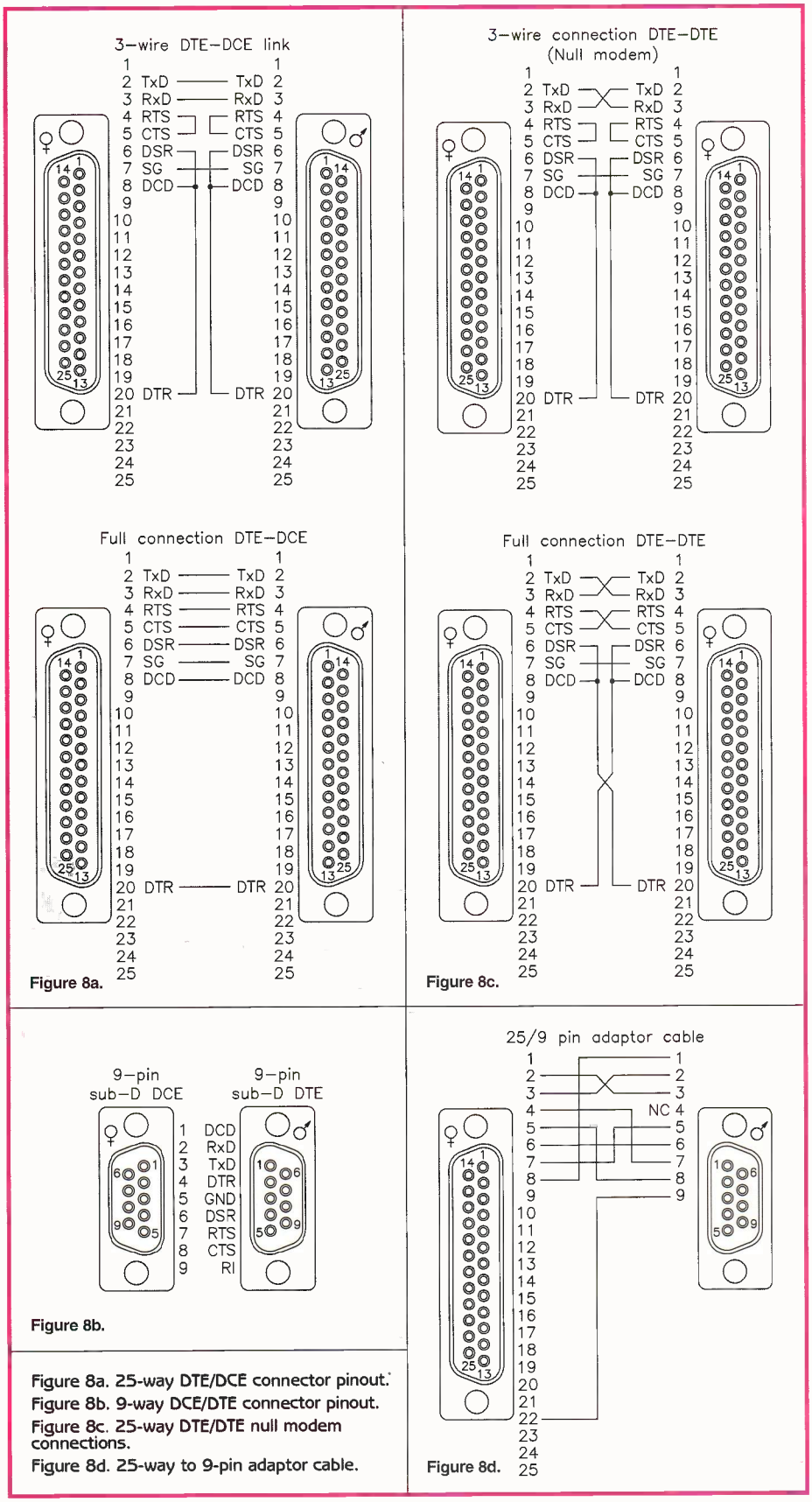


Figure 8a.

Figure 8c.

Figure 8b.

Figure 8d.

Figure 8a. 25-way DTE/DCE connector pinout.
Figure 8b. 9-way DCE/DTE connector pinout.
Figure 8c. 25-way DTE/DTE null modem connections.
Figure 8d. 25-way to 9-pin adaptor cable.

Upgrading an Existing Unit

The parts required to update existing units to the redesigned specification depend on whether you wish to fully or only partially update your unit. Either way, no further box drilling will be needed on the existing unit, although you will have to dismantle it to enable the modifications to be carried out. If you choose to opt for the full update, you will require the reprogrammed PIC microcontroller (95066), 3-position toggle switch (95065), and new front panel label (95064), plus a short length of insulated hook-up wire.

Alternatively, you can fit just the reprogrammed PIC chip into an existing unit by itself, in which case, the unit will function as per the previous specification, but will now incorporate the revised terminal screen menu display. This gives an extra menu option (No. 5), to select the 'Free type' function, whereby any character can be typed in on the terminal keyboard, and it will be sent in binary form to the Serial Line Tester, which will then send it back to the terminal. The new menu also gives an error message if an illegal option number entry is made. The partially upgraded unit will not, however, be capable of providing the printer tabbing test function.

The full upgrade requires the exchange of the new with the old microcontrollers, the replacement of the existing 2-position toggle switch in the location marked 'S4' on the board with the new 3-position type, and the length of insulated cable soldered into position on the underside of the existing PCB, between the previously unused switch contact and pin 13 of the microcontroller, as shown in Figure 4. The wire is not required for the new version of PCB (95063) – included in the new kits – since a track is included to achieve the same interconnection.

Finally, the new label should be fitted, either on top of the existing one, or, preferably, after having peeled off the old label.

Box Drilling and Cutting

This section only applies if building up a new unit – you can skip this if upgrading an existing one. A front panel label for the box is supplied in the kit, and is also available separately (Order Code 95064). Prior to applying the label, the box must be drilled to accept the switches and LEDs, as described:

Carefully drill the box in accordance with the drilling template of Figure 6, measuring the hole centres accurately, and double-check prior to drilling. Alternately, a photocopy of the template can be used, ensuring that the copy remains the same size as the original (some photocopiers slightly alter the dimensions!), then temporarily stick the copied template in the correct position on the box lid using Pritt Stick™ or similar adhesive, prior to drilling

Figure 9. Examples of RS232 Serial Line Tester outputs from printer.

```
Serial Line Tester V1.17  (c) 1995 Maplin Electronics & R.Downs.

0: Menu
1: Straight Pattern
2: Revolving Pattern
3: Fill Screen
4: Hex Dump
5: Free Type

SLT>
```

```
Serial Line Tester V1.17, (c) 1995 Maplin Electronics & R.Downs.
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
```

```
Serial Line Tester V1.17, (c) 1995 Maplin Electronics & R.Downs.
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmn
"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmno
#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnop
$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopq
%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqr
&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrs
'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrst
()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstu
)*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuv
*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvw
+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwx
,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxy
-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz
./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{
/0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|
0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}
123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~
23456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~
3456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !
456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"
56789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#
```

```
Serial Line Tester V1.17, (c) 1995 Maplin Electronics & R.Downs.
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABC
"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCD
#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDE
$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEF
%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFG
&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGH
'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHI
()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJ
)*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJK
*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKL
+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLM
,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNO
./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOP
/0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQ
0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQR
123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRS
23456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRST
3456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTU
456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUV
56789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVW
```

directly through the marked hole positions. The front panel label may well hide any holes drilled in the wrong place, but obviously it is preferable to get it right first time!

Having drilled the hole centres, use a small rat's-tail file to carefully elongate the four holes for the toggle switches, keeping to the guidelines shown by the drilling diagram.

Next, mark and cut out the top end of the box (i.e. the end *opposite* the battery compartment) for the 25-way D-type connector. This opening is not critical, so if you cut it out slightly larger than shown, don't worry, it should still be OK.

Clean up any rough edges, wipe the box clean, and ensure it is dry. If using the label template comprising of Figure 7, or a photocopy of it (beware, however, of slight distortion or a change in the size of the image that may occur with photocopies), cover the label with clear plastic film (Fablon) to protect it, this being available at any popular stationery or DIY store. The label should be cut out leaving a small overlap, then carefully stuck onto the box, the excess that extends beyond the raised edges on the box face can be removed, using a scalpel, and the label smoothed down with a soft cloth. Alternatively, the label could be cut out around its perimeter leaving no overlap, prior to sticking it to the box, but this leaves no margin for error, and a neater result will probably be achieved using the first method. With the label firmly in place, punch through the label in the positions where the box is drilled using a pointed instrument, and enlarge them to accept the switches, etc.

Final Assembly

After a final check for any dry joints, solder 'whiskers' or 'bridges', etc., the completed PCB is secured in the box by the mounting collars of the two wafer switches and by two self-tapping screws in the 'bottom' corners, as described below.

Remove the nuts and star washers from both wafer switches, along with each tagged locking ring, reinserting these with the 'tag' in the hole marked with a figure 4; this gives each switch a 4-way operation.

Without losing the locking rings, push the spindles of the switches through the relevant holes in the casing and gently manipulate the board until the locating spigots lock into place. Holding the box and PCB together, refit each star washer and securing nut. When both nuts are finger tight, apply a final quarter-turn with a spanner, being careful not to damage the front panel label.

Fit the two self-tapping screws through the fixing holes in the PCB, and drive them home until their heads are seated against the PCB. Do not over-tighten them; they are not needed to hold the PCB in place, but are provided to prevent the PCB from being pushed back if undue pressure is applied to the top of the toggle switches.

Thread the PP3 battery connector into the battery compartment and fit the bottom of the box, securing it with the screws provided. Fit the knobs to the wafer switch spindles, with the grub screws tightened against the flats of the spindles, and finally, install a PP3 battery – an alkaline type is recommended.

If the optional carrying case is purchased, two foam padding inserts will be needed to line the top and bottom of the case, and to hold the contents in place. These can be

made from foam padding obtained from craft outlets or upholsterers, etc., cut to size (320 x 210 x 40mm approximately), and then glued into each half of the case. Further cutouts can be made in the lower insert, to locate each of the accessories, along with the tester unit.

Testing

No test equipment is required to set up the completed unit – it is all done in the software! With the unit disconnected, turn it on and the POWER LED should be illuminated; if it is not, or is glowing very dimly, then the battery is either very low or completely dead, or a fault exists with the circuitry – if this is the case, the unit may still work, but the operation cannot be guaranteed. If a Mini-Tester is connected to the tester and it is switched on in VDU mode, then the Read Data (RD) LED should be illuminated.

A quick way of testing the finished unit is to connect it to a PC's serial port, e.g., COM1 or COM2, using a suitable direct connection lead and 9/25-way adaptor if required, and using a terminal program such as the one found with MS Windows™, conduct a series of trials by matching the terminal programs parameters with those of the Serial Line Tester, stepping through each test as laid out in Table 3.

If some of the tests appear to be OK but others do not, then a multimeter can be used to check the voltage levels on RB0 to RB6, referring to Figure 4 and Table 2 for the relevant pinout and expected levels for each switch position.

Operation and Use

The unit will be of greatest benefit when used in conjunction with a Mini-tester to indicate the status of the RS232 signal lines, and optionally with a gender changer where required. Figures 8a to 8d show a selection of typical RS232 cabling formats and their interconnections. The tester is wired as a 'DCE' to allow direct connection (with no additional crossovers) to either a terminal or printer. This is the most basic use of the device to test for correct operation of the peripheral.

If no fault is found with direct connection to the peripheral, then the data cabling can be tested as well by moving the tester further from the peripheral device in stages, as allowed by the data cabling at the site. If the data cabling includes crossovers (i.e. pins 2 and 3 are reversed at some point) then it may be necessary to connect via a simple crossover adaptor in order to connect the tester correctly.

A Mini-Tester will show the correct crossover orientation, by illuminating both Tx data and Rx data lights when the peripheral device and tester are correctly connected and powered up, equally, misplaced or non-existent crossovers will be shown by the same technique without dismantling the connectors at both ends of the cable.

By connecting the 'Mini-tester' to the data source (be it a system or this project) and the peripheral in turn, the signals from each end can be monitored. Two signals on the same line indicate a crossover problem, while no signal on 'Tx Data', for example clearly indicates a break in the cable at some point.

Plugging the cable together via the tester will show if shorts exist in the cable as the appropriate LED will extinguish. Two LEDs going dim or out, indicates a short between those lines.

A common failure with printers is lack of flow-control with the host system. While hardware (DTR/DSR or RTS/CTS) flow control is easily seen with a Mini-tester, software (X-On/X-Off) flow control is difficult to check for due to the very short duration of the single flow control characters (1ms at 9,600 Baud) providing insufficient time for an LED to illuminate noticeably. Figure 9 illustrates typical test outputs from a printer, showing all available characters, arranged in a straight or diagonal pattern.

The Serial Line Tester provides a front panel LED (X-Off) which lights when an X-Off is received and extinguishes when an X-On is received, hence when a device is handshaking correctly the LED will flash on and off, with no loss of data evident at the peripheral.

Note: Most modern VDU's will operate at 9,600 Baud without flow control if set to 'Jump Scroll'. Using Smooth Scroll or pressing 'Hold-Screen' will demonstrate the presence (or lack) of flow control.

RS232 SERIAL LINE TESTER PARTS LIST

RESISTORS: All 0·6W 1% Metal Film			
R1,2	2k7	2	(M2K7)
R3,4	10k	2	(M10K)
CAPACITORS			
C1,2,5,6	10µF 16V Radial Electrolytic	4	(YY34M)
C3,4	1µF 63V Radial Electrolytic	2	(YY31J)
C7,8	100pF Ceramic Disc	2	(WX56L)
C9	100nF 16V Disc Ceramic	1	(YR75S)
SEMICONDUCTORS			
D1,2	1N4148	2	(QL80B)
IC1	PIC16C84 MS07	1	(95066)
IC2	MAX232CPE	1	(FD92A)
LD1	Low Current Green LED (3mm)	1	(CJ56L)
LD2	Low Current Yellow LED (3mm)	1	(CJ57M)
RG1	LM78L05ACZ	1	(QL26D)
ZD1	BZY88C 4V7 Zener	1	(QH06G)
MISCELLANEOUS			
S1,3,6	SPDT Vertical PCB Toggle Switch	3	(JX90X)
S2,5	6-way, 2-pole, Rotary Switch	2	(FF74R)
S4	SPDTc Vertical PCB Toggle Switch	1	(95065)
XT1	10MHz Ceramic Resonator	1	(DJ38R)
	Collet Knob (15mm)	2	(JZ47B)
	Cap Black (15mm)	2	(JZ76H)
	Lined Nut Cover (15mm)	2	(JZ57M)
	16-pin DIL IC Socket	1	(BL19V)
	8-pin DIL IC Socket	1	(HQ76H)
	Plain HH2 Box	1	(ZB16S)
SK1	25-way D-type Right-angled Socket	1	(FG27E)
	Single-ended PCB Pin 1mm (0·04in.)	1 Pkt	(FL24B)
	PP3 Battery Clip	1	(HF28F)
	Front Panel Label	1	(95064)
	PCB	1	(95063)
	Instruction Leaflet	1	(XV93B)
	Constructors' Guide	1	(XH79L)
OPTIONAL (Not in Kit)			
	Alkaline PP3 Battery	1	(ZB52G)
	4 pairs of black 1in. Velcro squares	1 Pkt	(FE45Y)
	RS232 Mini Tester	1	(YP80B)
	Null Modem RS232	1	(YP85G)
	25-way Male-Male Gender Changer	1	(JM48C)
	25-way Female-Female Gender Changer	1	(JM49D)
	25-way Male-Female Serial Cable	1	(JC13P)
	9-way Female-25-way Male Adaptor	1	(JM08J)
	Carrying Case B	1	(ZF04E)

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

The above items (excluding Optional) are available as a kit, which offers a saving over buying the parts separately.

Order As 95062 (RS232 Serial Line Tester) Price £39.99 A1

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

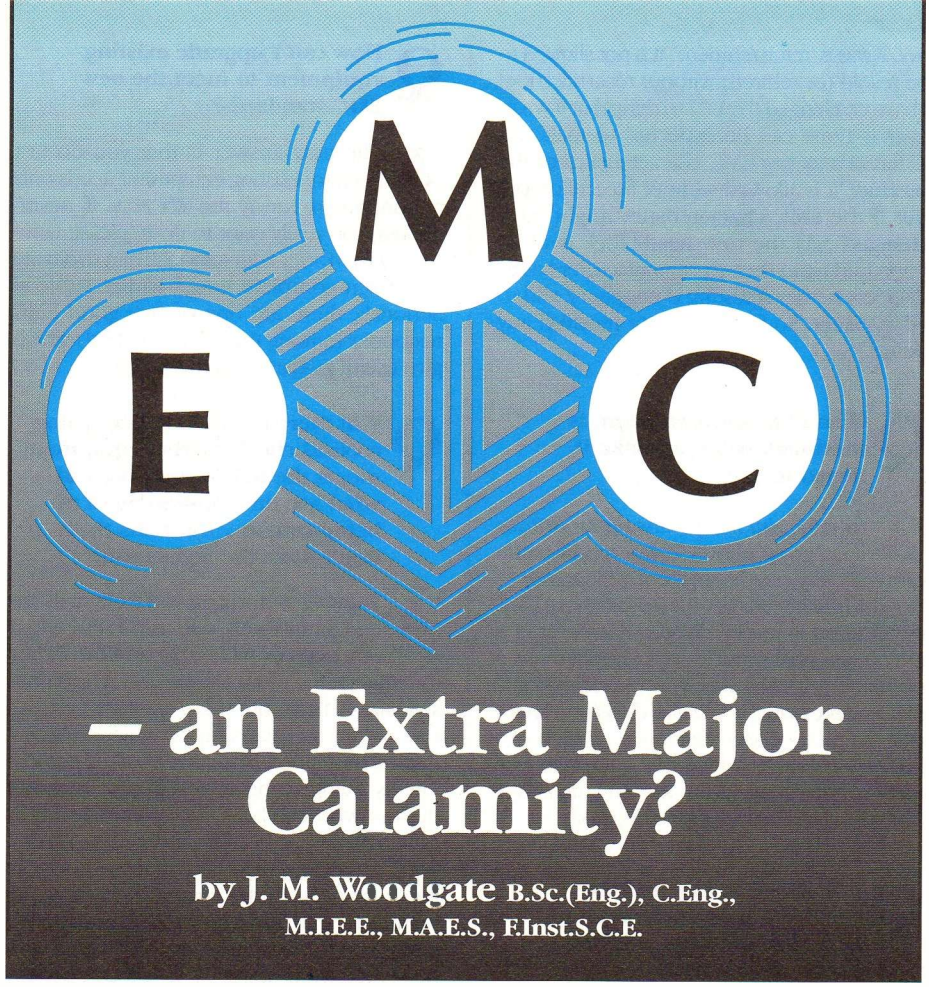
The following new items (which are included in the kit) are also available separately, but are not shown in the 1996 Maplin Catalogue.

RS232 Serial Line Tester PCB **Order As 95063 Price £3.49**

Front Panel Label **Order As 95064 Price £2.29**

SPDTc Vertical PCB Toggle Switch **Order As 95065 Price £1.49**

PIC16C84 MS07 **Order As 95066 Price £12.99**



– an Extra Major Calamity?

by J. M. Woodgate B.Sc.(Eng.), C.Eng., M.I.E.E., M.A.E.S., F.Inst.S.C.E.

Part 4 – Frequently Asked Questions (FAQs)

Although this part may seem complete as it stands, I would emphasise that to get the full picture (at the time of writing) you should read the preceeding three parts also. The reservation about 'at the time of writing' is essential, because the goalposts are still being moved, and human nature is such that many of the current 'frequently received complaints' (FRCs, which are usually less constructive than FAQs) are about the goal being made wider as the sheer impracticability of many of the detailed *legal requirements*, as opposed to the technical requirements, becomes evident, even to Directorate General No. III in Brussels (the Roman numerals may give an impression of the general philosophy of the Commission!).

THAT is not to say that there are no longer any technical problems at all – far from it. For example, the control of mains harmonic currents and mains voltage disturbances due to load changes (i.e. switching equipment on or off or between operating modes) is full of as yet unresolved difficulties, but we have managed to get the dates at which some of the new requirements are introduced made more realistic. Postponing the event, however, works only if the requirements are actually reasonable, but industry requires time to develop modifications or new designs: it is of *no help at all* if requirements are unrealistic. After all, the laws of physics do not change over a few years (if at all!)

Down to the FAQs

Due to the publishing schedule of *Electronics*, this article has to be written even before Part 1 of the series is published, so it is unlikely to be practicable to include FAQs from the readership at large (short of a 'STOP PRESS' item if a real gem or two is submitted), so these have come from my consultancy work and Maplin staff. However, I have tried to make the selection as realistic as possible.

Q Why should the EMC legislation concern me?

A Whether you are a home-constructor or in industry, your equipment may be either a source or a victim of electromagnetic interference (EMI). If it is a source, you could have a legal problem under one or more of three sets of legislation (in Britain): the UK regulations made under the EMC Directive, if you are in industry, the amateur licence regulations if you are a licensed amateur, or the old Wireless Telegraphy Acts (WT Acts) if you are a home-constructor. In any case, you are likely to have a social problem with the victim of the EMI, and maybe you would have a moral or conscience problem, particularly if someone had suffered undisclosed distress due to the interference. For example, I know of a case where an elderly lady stopped using mains electricity entirely for a week, until her daughter discovered what was going on. She 'thought it was going to blow up' when the lights began flickering from time to time. The source of the problem turned out to be a portable MIG welder used by a local car enthusiast several doors away. And this was not a monster, but one which would (just) run from a 13A socket.

Q Are the new EMC rules a waste of time, effort and money?

A The accepted way of answering a que tion like this, often raised, for example, about a new motorway, is to report the results of a cost/benefit analysis. Unfortunately, there is no agreement on whether any such analysis is valid or not – there are just too many variables and too much difference of opinion as to how much value should be placed on each benefit. How do you balance the cost to a company of, say, £100,000 to make a large product range conform to the Directive against the one in a hundred million chance, perhaps, that one of its products might interfere with the controls of a driver-less train and cause a crash with loss of life? Now reassess the balance if the crash was (a) in your home town, (b) in Beijing, (c) if your sister was a victim, or (d) if your sister designed the offending product and might be in trouble with the law.

Q How much does it cost to get EMC approval on a given item?

A Except for commercially available radio transmitting equipment and some equipment connected to the public telephone system, there is no requirement for 'approval' by a test house ('third-party certification'). What is required is that the *manufacturer* certifies that the product meets the requirements of the relevant standards, or of the Directive if standards cannot be applied. However, if a manufacturer voluntarily submits a product to a test-house, the test fee obviously depends on how complex the product's EMC 'signature' is, how much testing the relevant standard(s) require to be done, and how many times the tests have to be repeated after failure and corrective modification! Particularly due to the present huge demand for testing, despite Britain having more Competent Bodies than any other European country (or any country, for that matter), hourly rates are quite high, and very few submissions will result in a charge of less than £1,000. Indeed, if the charge is less than that, it probably wasn't a good decision to go to a test house in the first place.

Q Where does one go to get EMC approval on a given item, and is there a licence or certificate given if an item meets the standard?

A The DTI (Department of Trade and Industry) publishes a list of Competent Bodies, who have proved their ability to the satisfaction of the authorities. In addition, *anyone*, (even I) can offer to do EMC tests on a professional basis. There is no official 'certificate' (except for transmitters and telephone equipment, where a special test house, called a 'Notified Body' *must* be used), but you should require the tester to submit a report of the test results and any comments, especially on particularly good or bad performance.

Q If I buy and sell electronic circuits on a small scale to friends and relatives, do I need to get EMC approval on them?

A Once again, there is no 'approval' involved, except for transmitting

equipment and telephone equipment. The costly type-approval procedure practically rules out legal small-scale trading in telephone equipment, anyway, quite apart from any EMC consider-ations. If you are constructing amateur transmitting equipment on a very small scale for sale, I recommend that you should consult the RSGB for advice, because legally, you need third-party certification, which can be very costly, probably far more than the cost of your whole production of one item.

For any other sort of electronics, if you are trading, you must ensure that the product does not cause interference and is not unduly sensitive to it – i.e. it must meet the 'essential requirements' of the Directive. If interference occurs, *in Britain*, and a complaint is made (either to local Trading Standards or to the Radiocommunications Agency of the DTI), you would first be 'advised' what to do, and only if you ignored the 'advice' would legal action be taken under the WT Acts or the UK legislation implementing the Directive, whichever was thought most relevant. In other countries, the authorities might be either much more strict or very lax.

Of course, you can largely avoid problems of this nature by making up only Maplin kits, *precisely according to the instructions*, because these kits do have to be certified in prototype form by the manufacturer (either from in-house tests or via a test house) as conforming to the relevant standards under the Directive.

Q Can I sell second-hand equipment that does not have EMC approval?

A No matter how many times you ask, there is still no 'approval' involved, except as mentioned before! If we rephrase the question as: 'Can I sell second-hand equipment that does not have a 'CE' mark and was first used in Europe before 31 December 1995?', the answer is 'yes', provided that it does not actually cause any interference: if it does, the WT Acts can still be applied. There is no legal requirement for such equipment to be insensitive ('immune') to interference.

However, if a piece of second-hand equipment comes into Britain from outside Europe, or is modified or 'refurbished' after 31 December 1995, it cannot then be legally sold without conforming to the requirements. There is confusion as to what is implied by 'modified' and 'refurbished', because a 'repair' *is* allowed. A case which has arisen concerns the head-block on some types of professional video recorders. If the head-block fails, and is replaced, that is clearly a permitted 'repair'. However, head-blocks are often changed after 1,000 hours or so, whether they have failed or not. If this is 'refurbishment', it is not allowed to be resold (or rehired) without recertification! I have challenged the DTI to deny that if whatever is done can be expected to make no difference to the EMC characteristics of the product, it is allowed without recertification, but if the EMC characteristics might have changed (say the new head-block is of an improved type) then the manufacturer has to decide whether retesting is necessary, and to what extent. So far, I have not received any denial!

Q If an EMC-approved item is modified, will that make it illegal to use?

A *In my opinion*, the answer *in Britain* is as given above. If the modification cannot be expected to make any difference to the EMC characteristics, then the original EMC certification is not invalidated. However, if it is a commercial product, you should make a permanent record that you considered the matter and made a specific decision. There is a defence of 'due diligence', which can be very valuable when the goalposts are mobile, but it depends on keeping records of everything that was done or decided.

Q Is it illegal to buy and use non-EMC approved electrical items bought from markets, car boot sales, etc.?

A This is a case where the goal has been widened. If manufacturers had reacted correctly eight or nine years ago, when the new EMC Directive was being planned, all the products in manufacturers', distributors' and retailers' stocks would by now be certified and carry the 'CE' mark, but they didn't, and the latest Government ruling has recognised this. Manufacturers, etc., are supposed to tell their local Trading Standards office what stocks of uncertified, unmarked products they intend to dispose of after 1 January 1996, and will not be pursued in respect of those stocks. In other countries, the rules are alleged to be applicable from 1 January with full vigour, but since one of these countries is France, where the application of practically any law with full vigour is an historic event, there must be some lingering doubt.

Personally, I would be wary of buying any *product* without a CE mark after the end of *next* year. Note, however, that *components* are outside the Directive and it is illegal to put the CE mark on them (in Britain, anyway). Unfortunately, we have no clear definition agreed with the DTI or the Commission of what a 'component' is, so there may be some strange goings-on until we do!

Q How can I upgrade existing equipment to meet the new EMC standards?

A The easy answer is that you do not need to: existing equipment needs only to continue to satisfy the WT Acts. If, nevertheless, you really want to do it, please write to the *Electronics* Editor and ask him to devote about ten complete issues to the subject! Seriously, there are one or two good EMC textbooks (among the many on offer!) which give useful guidance on this subject.

Q Will there be 'EMC Police' going around checking that equipment meets the new standards, and what are the consequences of being caught with items that don't meet the legislation?

A Trading Standards officers will be checking retail sold products. Most local authorities won't be able to afford either the time or the money to be very active on a speculative basis, but there are rumours that one or two are planning 'crusades', which I think is misguided. The attitude of the authorities is going to be very different towards dealers who exhibit a 'don't care' attitude (who will be put in a pot and boiled till they are done, as Nanny used to say), than towards innocent (well, fairly) private individuals. In principle, if your equipment is causing interference, you must stop using it until it is prevented from doing so. If you co-operate, you will almost certainly not be prosecuted: if you do not, you almost certainly will be (barring the machinations of the CPS, of course!)

Q Does the EMC legislation apply everywhere in the world?

A Well, *some* legislation does, in most industrialised countries, but not exactly the same as in Europe, and it is enforced to varying degrees.

Q Does the EMC legislation apply to every electrical/electronic item on sale?

A No. There are three main sorts of exception: components (but see above for the problems of agreeing a definition of 'component') and 'electromagnetically benign' products, such as electric torches, which obviously do not radiate (below 400GHz, where the Directive stops) and which cannot be affected by external electromagnetic disturbances. The third exception is for items which are subject to special Directives of their own, or will be in the future, in some cases. Special Directives apply to some types of telephone system equipment (but unless you

IMPORTANT NEWS FOR OVERSEAS READERS!

Obtaining components and kits for the projects featured in ***Electronics*** is now easier than ever in the following countries and regions:

Channel Islands
C.I. Components Ltd.,
Crossways Centre,
Bray Road,
Vale, Guernsey.
Tel: 01481 44177
Fax: 01481 42291

Middle Eastern Region
Saudi Arabia
(Alkhobar Region)
Fadan Establishment,
P.O. Box 848
Alkhobar 31952
Kingdom of Saudi Arabia
Tel: 3 898 2737
Fax: 3 898 2737

United Arab Emirates (U.A.E), Bahrain, Kuwait, Oman, Qatar
Maplin Middle East Company,
P.O. Box 47019,
Hamdan Street,
Abu Dhabi, U.A.E.
Tel: (971) 02 760332
Fax: (971) 02 760317

Lebanon
N and Y Controls,
P.O. Box 175414,
Beirut, Lebanon.
Tel: (01) 443091/397467
UK Office:
Tel: (44) 1702 347614
Fax: (44) 1702 77161

African Continent
South Africa, Namibia, Botswana, Lesotho, Swaziland, Mozambique, Angola, Zimbabwe
Maplin South Africa (Pty) Ltd.,
P.O. Box 1846,
Somerset West, 7129
Republic of South Africa.
Tel: (024) 51 51 24
Fax: (024) 51 51 27

Mediterranean
Malta
Cam Services, Cam Centre,
Off Canon Road, Qormi,
QRM 09, Malta.
Tel: 484650
Fax: 447174

Gibraltar
Mail Order International,
c/o Medsun,
P.O. Box 225,
93-99 Irish Town,
Gibraltar.
Tel: 79797
Fax: 74664

Far Eastern Region
Pakistan
Link Pakistan, Suite Number 2,
2nd Floor,
I-R Plaza, Markaz F-10,
Islamabad, Pakistan.
Tel: 51 291406
Fax: 51 282319

Countries and Regions Not Listed
Export Department,
Maplin Electronics plc.,
P.O. Box 3, Rayleigh,
Essex, SS6 8LR, England.
Tel: +44 1702 554155
xtn 326, 327 or 351
Fax: +44 1702 553935

Export catalogue and pricing details are available from the listed distributors.

MAPLIN
ELECTRONICS AND BEYOND

are involved in a service supplier, you will not be affected), medical electronic equipment and equipment for fitting in vehicles. This last is the one which is likely to affect *Electronics* readers. The Automotive Directives have a totally different approach to EMC, and in fact, are in even a worse state than the main EMC Directive.

There is a small consolation that equipment fitted after manufacture will not need to conform until 2002, but there are no exceptions for 'benign' equipment, amateur transmitting or receiving equipment, *even if home built*, or home-constructed equipment! I hope that the RSGB will take up some of these points with the Department of the Environment (DoE) which, rather than the DTI, is responsible for the Automotive Directive. No doubt, this is partly responsible for the above problems: when they were encountered by the DTI in connection with the EMC Directive, they were not passed on to the DoE, nor was anything done at Commission level to ensure consistency. At present, the CE Marking Directive does not apply to products falling under the Automotive Directive, which has its own product marking scheme. It remains to be seen whether Trading Standards officers will know this, or will want to know why car radios, for example, are being sold with no CE mark!

Q If I build amateur radio equipment, especially transmitting equipment, does it have to pass the EMC standards?

A No, it is specifically exempted if you retain it for your own use. If you sell it soon after making it, you need advice which the RSGB may be able to give you. However, you must not use any equipment which causes you to violate the terms of your amateur licence. That should stop you using an unstable modulator, for example!

Q Do individual components have to meet the EMC standards?

A What is a component? If we stick to capacitors, inductors and resistors, it seems simple enough, and they are excluded from the Directive, but is a motor a component? What about a switch-mode power-supply module (SMPS) for building into a computer? Several years ago, I tried to explain this problem to the DTI, but my explanation was evidently not good enough. Further efforts are being made to clarify this, but it is a very difficult area.

Something which is not a component, but is clearly not a finished product, might be called a 'sub-assembly' (such as an SMPS). Now an SMPS can be operated and can be tested for EMC (but perhaps not for safety) by itself. However, something like the video recorder head block, which is also a sub-assembly, could only be tested 'by itself', by connecting it to a test jig that simulated the video recorder. So why not use the actual video recorder instead? In other words, there are two kinds of sub-assembly, one which can reasonably be tested by itself and one that cannot. The Directive is blissfully ignorant of all this, but industry cannot be!

Q Do plug-in PC cards need approval?

A Yes (certification, not approval, of course), if they are commercial products. It is alleged that the DTI asked a group of test houses about this and they said 'yes'. If you were a test house, would you say 'no'?

My advice is that 'if it has a printed board, then it needs to be certified' as a guide, but it does not cover motors, which raise even more fascinating questions. If I build a commutator motor into a piece of (commercial) gear, it may well not meet the emission limits unless the *motor manufacturer* installs capacitors, and maybe inductors as well, very close to the brushes inside the motor. So, I want to buy that motor against an EMC specification, so that if the production units do not meet it, I can reject them. This specification might need to be tougher than the standards, because there is more than one source of emission in the product. However, if the motor manufacturer is required to certify it to the standard so as to put the CE mark on it, he will probably not be at all interested in meeting my tougher specification! What do I do then? The same applies to thermostatic switches, although these cannot be tested for emission without a typical 'difficult' load connected, such as a refrigerator motor, or reasonable facsimile thereof.

Q If someone's computer interferes with my television set, whom do I get in touch with?

A The way to avoid wrangles and dissatisfaction is to CO-OPERATE, wherever possible. If you know whose computer is causing the interference, arm yourself with the requisite box of chocolates/bottle of cheap hooch and suggest a visit to look at the interference and some experimental moving of the computer and/or television (especially if it has an indoor or set-top aerial). If you have an indoor or set-top aerial, change, if you can, to a loft or outdoor aerial. If you are not allowed an outdoor aerial, consult your local television dealer, who may know a way around the problem. A stronger TV signal often brings other benefits, with the reduction of pick-up of local interference of all kinds.

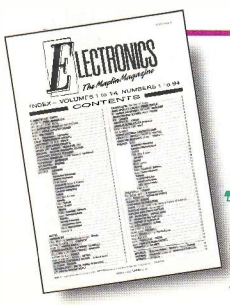
Perhaps the computer is causing interference because it is faulty. Does it misbehave in a way annoying to the user? Wouldn't it be a good idea to get that fixed, then the interference might go away as well? What if it breaks down completely; wouldn't that be a problem? Better get it fixed before the hard disk crashes! Is it the computer or the VDU? How about replacing the VDU – there are much better ones going for a song now?

If all else fails, the Radiocommunications Agency will investigate *serious* complaints, but if you want a report of the investigation, it will cost you about £40. At the time of writing, the relevant department can be contacted at present on (0171) 211 0211, but these numbers change so often, that there is no guarantee of this!

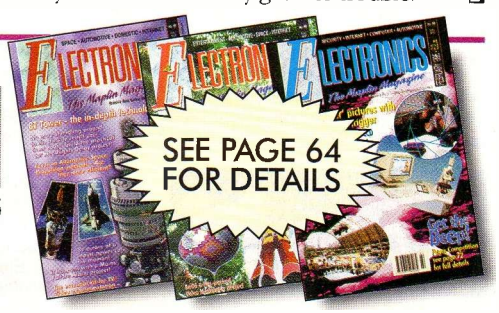
Q Nonentity electronics have had to withdraw several products from the market because they do not meet the EMC requirements, and I have been taken on to sort the problems out. My boss says it should not take more than a week. Where can I get a copy of the Directive? What should I do next?

A DON'T PANIC! On second thoughts, go ahead and panic! No way are you going to sort out EMC problems in a week if you need to ask for basic advice. First of all, you can get a copy of the Directive for a couple of pounds from Her Majesty's Stationery Office (HMSO), but it will be of virtually no help to you. What you need to know is which EMC standards apply to the products concerned, and you can find this out from the Information Section of the British Standards Institution (BSI) or by visiting your *main* public library, which will have a copy of the BSI Catalogue and copies of all the published standards, either as hard copies or on microfiche. However, you will almost certainly need to buy copies of the standards for your own use. These are not cheap, but are indispensable. Just make sure that you buy the right ones, so as not to waste money. On no account use out-of-date versions, which are likely to be highly misleading, and do not rely on what other people (except me, of course) say that the standards require. They are quite complex documents, and it is possible to be seriously misled by a half-true statement made in good faith.

Previous parts of this series give you a guide on which tests you may be able to do in your own company, and which you probably cannot. For purely analogue, low-frequency equipment, you may well not need to do any of the difficult emission and immunity tests that require test house facilities. For some products, such as consumer-type dynamic microphones, there are standards (EN55013 and EN55020 in this case), but they do not require any tests which a normal dynamic microphone (and probably very few electret types) could possibly fail, so you need not do any (in Britain, anyway). However, you MUST make a permanent record that you considered what tests should be done and concluded that none were required. This gives you the evidence of 'due diligence' if you do inadvertently get into trouble. E


ELECTRONICS The Maplin Magazine
INDEX VOLUMES 10 TO 14 NUMBERS 1 TO 6
CONTENTS

ELECTRONICS The Maplin Magazine
INDEX
Covers every issue from December 1981 to October 1995
AVAILABLE NOW!



NEWS Report

Landscape Monitor

Generally speaking, individuals that work with document-based PC applications such as desktop publishing and word processing use a standard, portrait-oriented A4 page format. However, because most PC users have landscape-oriented monitors, working on anything but the most simple layout can involve a lot of time-consuming scrolling and zooming. Hitherto, the only option for someone wishing to view a full-sized A4 page on-screen in its entirety was to invest in a 21in. monitor costing £1,300 or more.

Now, Taiwanese company ADI is offering users a less expensive option. The company's new MicroScan 17X is the first 17in. swivel-screen monitor for Windows PCs. With a unique rotating design that enables users to operate it in portrait as well as landscape orientation, the MicroScan 17X lets users view a complete A4-sized document without scrolling. In comparison, ordinary 17in. monitors show only about 65% of a full-size A4 page. Even 21in. monitors cannot show as much vertical display area as the MicroScan 17X.

Whereas earlier swivel-screen designs commanded a considerable premium for their ability to switch between landscape and portrait orientation, street pricing for the MicroScan 17X is likely to be around £699. This makes it only slightly more expensive than conventional 17in. models with a comparable high-quality display.

Contact: ADI Systems, Tel: (0181) 236 0801.

166MHz Pentium Performance for Under £1,500

Elonex is one of the first PC manufacturers to use the 166MHz Pentium processor recently announced by Intel. Fully-configured, ready-to-run Elonex PC-5166M/I desktop models start as low as £1,430. This buys a system comprising 8M-byte EDO RAM, 540M-byte hard disk, 1M-byte PCI graphics accelerator, non-interlaced 14in. monitor, 105-key Windows '95 UK keyboard, Microsoft mouse, and a choice of Windows environments.

Elonex's new PC-5166/I and MT-5166/I models feature interchangeable modular cache options and EDO (Extended Data Out) DRAM. This flexibility enables users to specify a configuration that matches their requirements exactly. The systems also use Flash technology to allow easy upgrading as new versions of the BIOS become available.

Built to customer order, the new PC-5166/I and MT-5166/I models are supplied with 8M-byte RAM as standard. Memory is expandable to 128M-bytes and EDO DRAM can also be used. EDO DRAM provides performance gains of around 5% over standard fast page SIMMs.

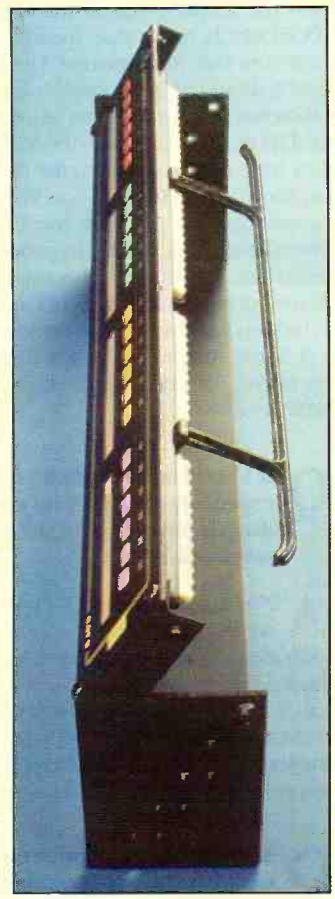
Meanwhile, as we went to press, Apricot announced the addition of a 166MHz series of machines to its PC range. The Apricot LS550, VS550 and VS660 range of high specification business systems are available immediately with prices starting from £2,199. Both Apricot and Elonex machines are available through PC World stores.

Contact: Elonex, Tel: (0181) 452 4444; Apricot, Tel: (0121) 717 7171.

Cable Management

Here's a story to get cabling engineers excited! Ortronics has come up with a neat wire management solution that enables installers to address applications more easily, with little or no rear access to panels. The company is introducing a product that incorporates a Category 5 110 PCB patch panel with a hinged 3·5in. wire management panel. This hinged panel mounts to a standard EIA relay rack and opens down for termination. After termination has been completed and horizontal cables have been dressed out, the installer simply lifts the hinged panel back into position.

Contact: Ortronics, Tel: (01904) 655393.

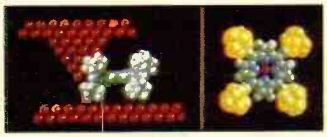


Molecules Positioning at Room Temperature

For the first time, scientists at IBM's Zurich Research Laboratory have succeeded in moving and precisely positioning individual molecules at room temperature, using the extremely fine tip of a scanning tunnelling microscope (STM). This is another important step towards being able to do a wide range of 'engineering' on the nanometre (one millionth of a millimetre) scale. It could help lead to the ultimate limits of miniaturisation and open the way to fabricating molecules with specific properties and functions, constructing computers of ultimately small size, and even to building minute molecular machines capable of cleaning or repairing nanoscale electronic circuits.

IBM scientists, and colleagues at the University of Cambridge, developed software that moves and positions the STM tip with extreme precision. The same STM can also be switched to the imaging mode by slightly increasing the distance between the tip and the surface.

Contact: IBM Zurich Research Laboratory, Tel: (+41) 1 724 84 43.



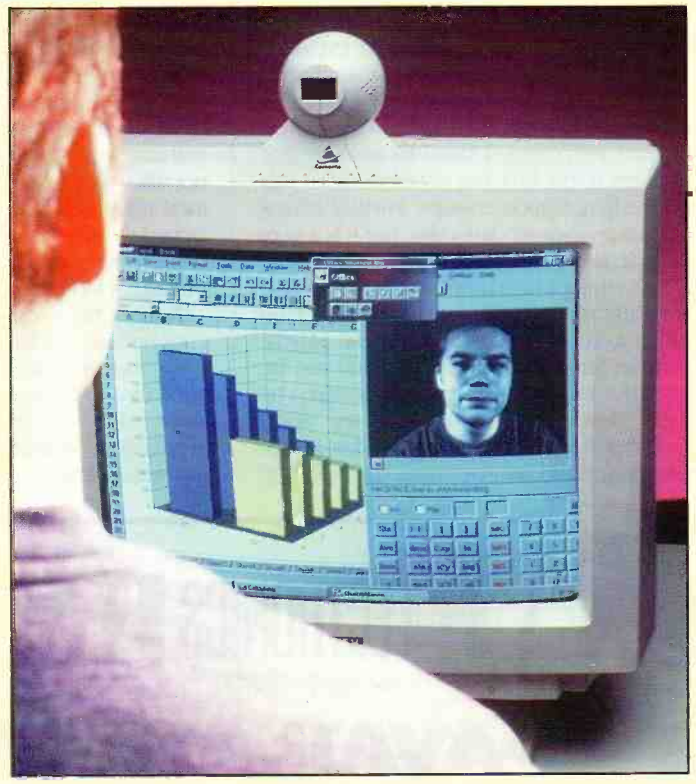
Desktop ISDN Videoconferencing System for £399

Despite the potentially wide appeal of desktop videoconferencing technology, it has yet to make any significant impression on the mass of PC users, because systems can cost anything between £600 and £3,000 per connection. Now, Electronic Frontier has introduced a cost-effective entry-level package that brings the price of videoconferencing within reach of many more people.

Priced at £399, Electronic Frontier's new Titan ISDN Desktop Videoconferencing System (DVS) comprises a Connectix QuickCam camera that plugs into a standard PC parallel port; a 16-bit dual-channel Titan PC-ISDN card that connects to BT's Basic Rate ISDN-2 service and a comprehensive package of videoconferencing and Internet access software. The Titan ISDN DVS requires a Windows PC with one available 16-bit slot, a 486DX2-50 or faster processor, 8M-byte RAM, a sound card and microphone, and an SVGA display card that can display 256 or more colours.

The Titan ISDN DVS allows users to see simultaneous, live black-and-white video pictures of each other, talk, and share a full-colour mark-up board. The system is particularly useful for companies with branches around the country or overseas.

Contact: Electronic Frontier, Tel: (01734) 810600.



New Association to Advance Electronic Commerce

The new Electronic Commerce Association (ECA) was formally launched last month, to offer advice and practical solutions to enable organisations across all sectors of the UK economy to make the most effective use of Electronic Commerce. The newly-named ECA, formerly the EDI Association (EDIA), is widening the scope of its activities beyond the original focus on EDI (Electronic Data Interchange), to encompass complementary technologies and business practices, commonly referred to as Electronic Commerce.

According to ECA President Sir Angus Fraser KCB TD, these changes mark a milestone in the Association's history. A reappraisal of established working practices in both public and private sectors offers the opportunity to take advantage of modern technology to conduct business electronically.

Chief Executive, Gary Lynch, outlined the wider scope now embraced by the ECA and commented, "If we are to continue to represent members' interests sucessfully, it is essential that an Association such as ours adapts to reflect the business environment in which our members operate. The recent rapid rise in the business use of the Internet worldwide clearly illustrates the growing acceptance of new ways of working."

Reflecting the wider scope of its activities, the ECA has launched a new information service designed to keep members up-to-date with Electronic Commerce via e-mail and the World Wide Web (WWW) at **http://www.eca.org.uk**. As well as news on Electronic Commerce and ECA activities, the site provides general advice and guidance on Electronic Commerce, information about suppliers, details of events and enables relevant papers and publications to be downloaded. A new monthly ECA Digest summarising latest industry and Association news will be sent to all members electronically via e-mail, giving them direct computer access to up-to-date information.

Contact: Electronic Commerce Association, Tel: (0171) 824 8848.

Flying High with Psion

The Richard Branson saga continues. Last month, we reported how electrical manufacturer Townsend Coats was helping equip and assemble the Virgin round-the-world balloon ahead of its expedition. As we go to press this month, Branson and his team are still waiting for suitable weather conditions to lift off.

The fact that he has yet to get off the ground has nothing to do with the amount of technology which the balloon is carrying. We have received reports that Branson has increased his chances of a successful mission by arming his crew with a set of Psion hand-held computers. The Psions are equipped with sophisticated navigation software that will enable the Virgin team to produce comprehensive global flight planning and analysis throughout their journey around the world.

The Flight Analyser software means the Virgin team will also have a sure-fire way of proving their altitudes and length of balloon flight by entering electronic barograph traces. The Flight Analyser can also provide Heading/Track figures for speed, distance, rate-of-climb and automatic preselection of climbs and descents.

Contact: Psion, Tel: (0171) 258 7248.

1·2V Regulator Saves on Current

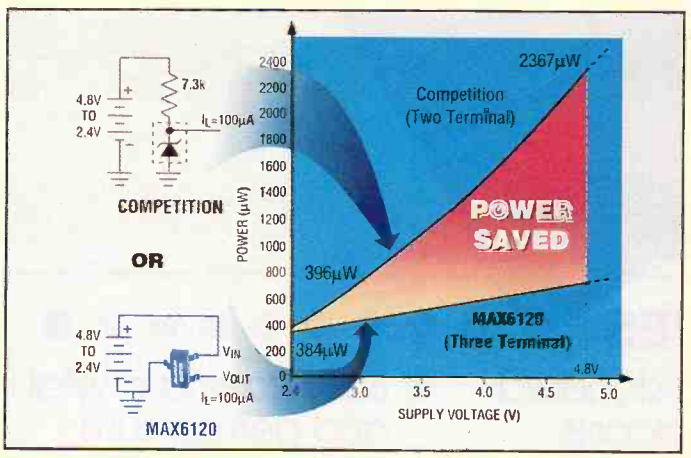
Maxim has launched a 1·2V voltage reference integrated circuit. The MAX6120 three-terminal device is targeted at 3V applications, where power consumption is critical. Unlike Zener devices which require a considerable current overhead and must be used in conjunction with a resistor, the MAX6120 has a maximum current drain of 70µA and operates as a standalone device.

Contact: Maxim, Tel: (01734) 303388.

Virtual Control

National Instruments has announced a collection of virtual instrument libraries that extends its Visual Basic development environment. ComponentWorks consists of four major functional components to enable engineers to build PC based virtual instrumentation, including: data acquisition (DAQ) controls; drivers for more that 70 instruments from Hewlett-Packard, Teltronix, Keithley, Fluke and Wavetek; analysis tools; and user interface controls.

Contact: National Instruments, Tel: (01635) 572400.



FTP and Firefox Get Together

FTP Software has announced a merger agreement with Firefox Communications, a supplier of server-centric departmental and LAN-based IP solutions and services. The merger is expected to extend both companies' ability to provide complete TCP/IP based solutions to the corporate and enterprise marketplace.

The merger will bring together Firefox's server-centric TCP/IP product range for the Novell NetWare market, and FTP Software's market leading desktop IP application suites. FTP Software client applications will also be able to take advantage of Firefox's server-based access control and firewall technology.

Through this merger, FTP Software will enhance its extensive offerings of Internet communication solutions. In the summer of 1995, FTP Software announced its intention to address the need for LAN server-based products with particular emphasis on the NetWare market. The merger with Firefox is expected to enable FTP Software to achieve this aim. The companies also plan to develop products in the areas of communications groupware, collaborative applications and messaging systems.

Contact: FTP Software, Tel: (+1) 508 685 4000; Firefox Communications, Tel: (+1) 408 467 1100.

Bell Laboratories CCD Comes Full Circle

The charge-coupled device (CCD), invented at Bell Laboratories in 1969 and now used worldwide in solid-state video cameras, has become part of the first panoramic viewer to provide a 360° live-action view from a single vantage point.

The Bell Laboratories system can be used in a wide variety of applications where other 360° cameras cannot, such as interactive TV, video conferencing, and home shopping. It could provide panoramic surveillance in prisons, department stores, casinos, and day-care centres.

Unlike other 360° panoramic viewers which use a rotating lens or multiple cameras, the system has no moving parts and 'sees' from a single vantage point, allowing it to be used for both still pictures and for full-motion video photography at all distances.

"Our omnidirectional viewer can simultaneously display the full 360° live-action view (and a 90° close-up in any direction the user chooses) to each of any number of users", said inventor Vic Nalwa, AT&T Image Processing Research Laboratory.

"Using a phone line from a remote location, each user can independently choose what to display on a PC and then change this view as though with a simple turn of the head, storing the images as desired", Nalwa added.

A current implementation of the system uses four CCD cameras aimed upward at four triangular mirrors. Special software reverses the mirror images and blends the individual pictures seamlessly into a single image on the monitor.

The system displays 7·5 panoramic frames per second with current hardware, but can be speeded up to 30 frames per second with additional hardware. Bell Laboratories has applied for seven patents on the system.

AT&T, an Olympics sponsor, plans to unveil the technology at the 1996 Centennial Games in Atlanta. Multiple systems will give spectators some unusual views of indoor and outdoor events.

The CCD was invented by Willard Boyle and George Smith, and led to the first solid-state TV camera. In 1969, it was a new class of semiconductor with applications in imaging, digital memory, and signal processing. It later became important to the design of advanced facsimile machines, and today, is used principally in image sensing – including capturing light from the most distant galaxies.

Contact: AT&T, Tel: (+1) 908 582 5330.

Sharp on the Move with PDA

Anywhere, anytime, is the tag-line Sharp is attaching the launch of its ZR-5000 PDA. With the addition of a PC Card modem, the palm-sized devices can send and receive e-mail via GSM cellular or LAN 'phone lines. In addition to these communications functions, users can take notes on an electronic pad, create drawings and manage database information.

The bad news is that the ZR-5000 is based on Sharp's proprietary 16-bit microprocessor. There is no room for open standards software here. That said, the machine is capable of running for up to two months on two AA batteries, and incorporates hand-writing recognition software that truly works.

Contact: Sharp, Tel: (0161) 205 2644.

CRYSTAL RADIO SET

1 PROJECT RATING

KIT AVAILABLE (95070) PRICE £21.95

Text by David Powell

How many people in radio and electronics (professional and amateur) started off by building a crystal set – probably from some now long forgotten Boy's Annual? Perhaps going back even further, when the crystal set was the only way of receiving signals. Take a step back in time and revive those early memories. If you are just starting off into radio and electronics, follow in the footsteps of the early pioneers, and enjoy the thrill of receiving radio signals without worrying about mains supplies, batteries or volume controls.

FEATURES

- Receives standard AM broadcasts
- Hardware supplied
- No PSU required
- Both galena crystal and germanium detectors supplied
- No soldering

Description

The crystal set with its simple detector is designed only to receive AM (amplitude modulated) signals, in this case on the medium wave band. These signals consist of a radio frequency (RF) carrier and audio information. RF signals from many radio stations operating on different frequencies throughout the radio spectrum will be present on the aerial. The signal levels reaching the antenna will depend on the distance from the transmitter and the power used.

The circuit diagram of the crystal set is shown in Figure 1. The aerial is tuned against ground (earth) via a tuned circuit which consists of a coil and capacitor connected in a parallel tuned circuit. As signals are present from throughout the radio spectrum the tuned circuit in conjunction with the aerial and earth enables radio stations to be selected on a particular frequency (in this particular case somewhere within the medium wave band).

Contents of project laid out.

The tuning is achieved by varying the capacitance of the variable capacitor (original crystal sets were tuned by variable coil inductors).

RF amplitude modulated signals have to be processed as they cannot be heard at this stage. The RF signals are rectified or detected by the crystal detector. Part of the RF modulated signal which consists of a carrier and sideband is lost in this process, the other half of the rectified signal is passed to either the earpiece or headphones.

Construction

The constructional details are quite different from any other Maplin project, but strangely enough, it is the modern methods of construction which have evolved from home construction of crystal sets. The board layout of the crystal set is shown in Figure 2.

Everything is provided in the kit apart from the aerial and earth wire, associated insulators and earth stakes. These are left up to the constructor's own preferences.

Winding the Tuning Coil

The wire for the main tuning coil is supplied as a loop of wire, which has in fact been doubled up from a larger loop. Care should be exercised before using this wire as it is very easy to become tangled.

Refer to Figure 3 and proceed to wind the wire tightly onto the wooden former. Every 20 turns, make a loop of wire and twist as shown.

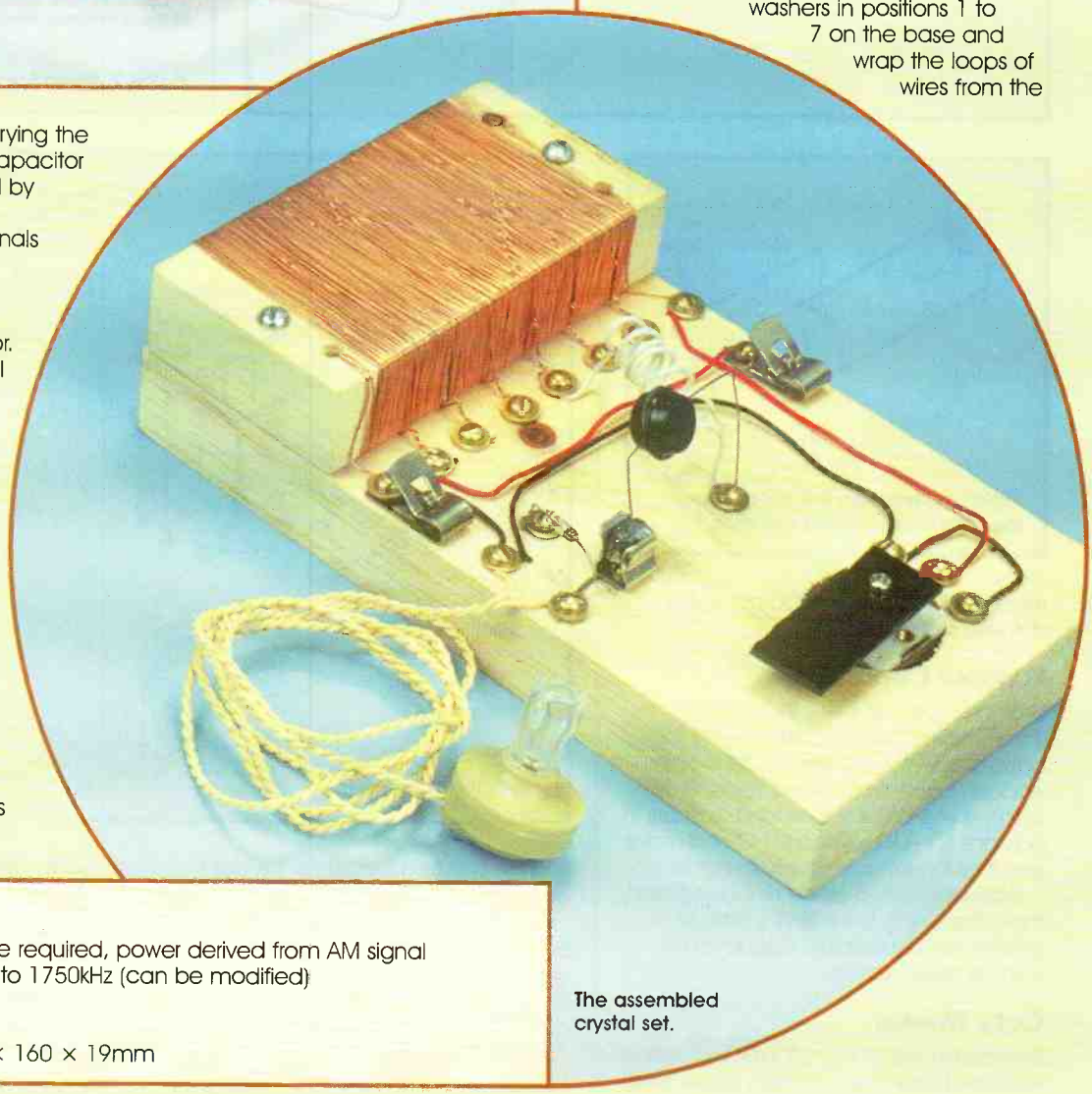
The six loops of wire that form the wire taps for the main coil should not be cut. Scrape the enamel off the loops of wire and the wires at each end of the coil, see Figure 4.

Before mounting the tuning coil use the board layout to mark out the locations for the coil, wood screws, the Fahnestock clips and the crystal holder.

Mounting the Tuning Coil

With reference to Figure 2, place the tuning coil onto the wooden base, make sure that the ends of the loops of wire from the coil are not trapped under the coil former. Use the two long wood screws provided to hold the tuning coil in position on the base as shown in Figure 3 (previously mentioned).

Next locate seven screws and washers in positions 1 to 7 on the base and wrap the loops of wires from the



The assembled crystal set.

Specification

Power source:	None required, power derived from AM signal
Frequency range:	530 to 1750kHz (can be modified)
Reception mode:	AM
Output impedance:	High
Dimensions of base:	90 × 160 × 19mm

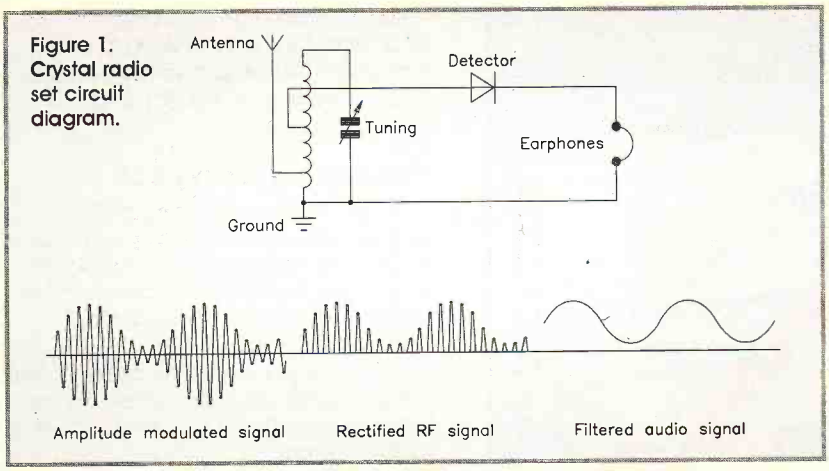


Figure 1. Crystal radio set circuit diagram.

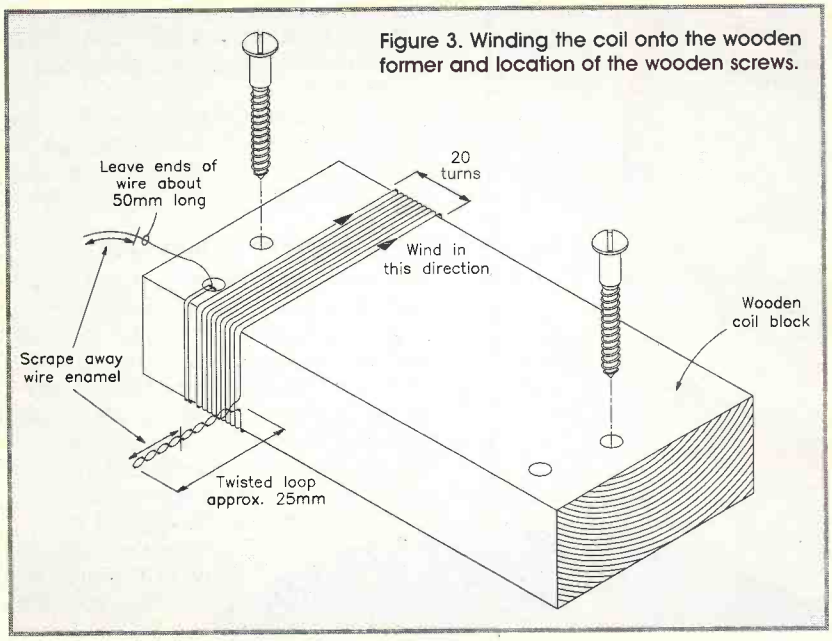
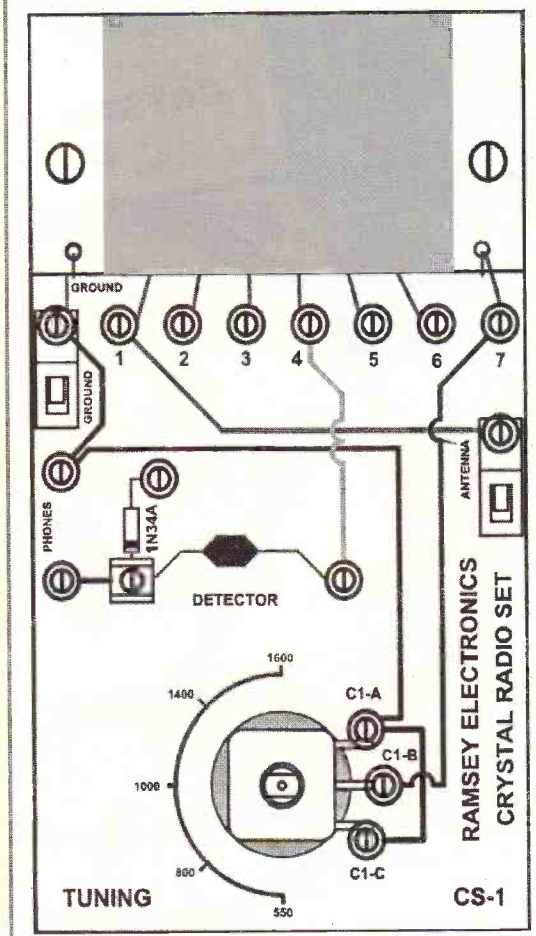


Figure 3. Winding the coil onto the wooden former and location of the wooden screws.



© Copyright 1996. Ramsey Electronics Inc., All Rights Reserved, Used by Permission.

Figure 2. Board layout of the Crystal set.

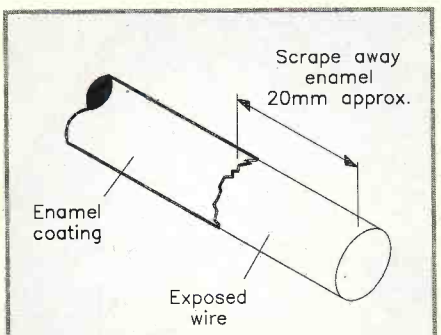


Figure 4. Removing the enamel insulation from the two coil ends.

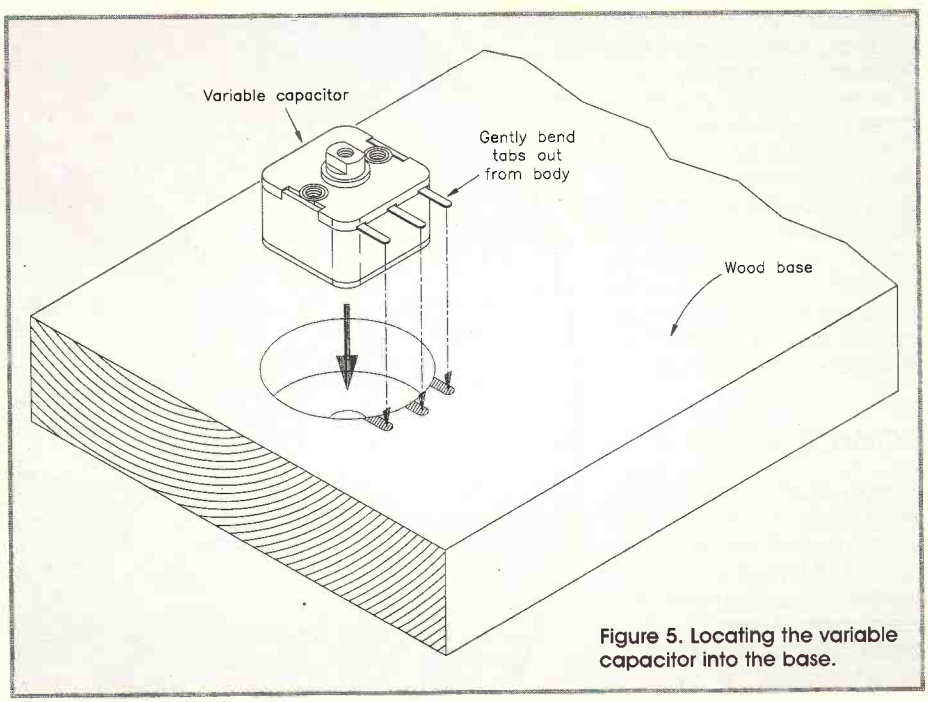


Figure 5. Locating the variable capacitor into the base.

tuning coil under them. Do not cut any of these loops.

Variable Capacitor

Straighten out the three leads from the variable capacitor and mount the capacitor in the predrilled hole on the wooden base, as shown in Figure 5. Next locate three brass screws and washers in positions C1-A, C1-B and C1-C and make sure that the brass washers do not touch.

Within the kit is a piece of black plastic this is the tuning knob and is held in position on the variable capacitor by a small metric screw.

Cat's Whisker

Supplied in the kit is a stiff piece of piano wire which has already been preformed into the required shape for the cat's whisker.

Before fixing the cat's whisker to the board, make sure that it reaches the galena crystal in its holder and the lead of the germanium diode closest to the coil.

Once the cat's whisker has been screwed into position locate the rubber pads, peel off the backing paper and stick to the wire, as shown in Figure 6.

Wiring Up

Locate the two 'Fahnestock' clips and screw in position on the wooden base using the brass screws and washers, also

fit any remaining screws and washers in other locations on the base.

Using the red, black and white hook-up wire provided connect between the various connections as shown in Figure 2. There is no reason in particular (apart from decorative) to have a small coil of wire from the cat's whisker to tap 4, as a single short length of hook-up wire will suffice.

Aerial and Ground

As with the crystal sets of old, a decent aerial and ground is essential for good operation of the crystal set. There is no set length of wire for the aerial, and a random length of wire will do. Figure 7 shows a suggested aerial and earth set up.

A quick alternative ground, is to connect a wire to a cold water pipe (as long as they are metal) or to a radiator pipe. Do not use the earth connection on the mains.

Operation

Connect the aerial and ground wires to the Fahnestock clips, and also the wires from the earpiece. Now all that is required to operate the crystal set is to connect up the detector. Use the cat's whisker to either connect to the galena crystal, or to the end of the germanium diode closest to the tuning coil.

As of old, when using the galena crystal, one must find the right spot on the crystal with the cat's whisker. Once found, signals will be heard in the earpiece. Galena (lead sulphide) was one of the more popular types of crystal, but it is possible to experiment with other pieces of crystal, and give rise to fun experiments. Comparisons can then be made to their efficiency, and against the modern crystal germanium diode.

Nostalgia

These days there are hundreds of stations on the medium wave and this can be viewed in two ways. On the plus side you will not have any difficulty in finding stations, but on the other hand, it may be a problem separating these stations. On using the crystal set, crowding of stations on the band was not found to be a problem. The coil dimensions and the suggested tap-off points were found to be correct, but do experiment with different tap off points.

The high impedance crystal earpiece is particularly efficient, but not a period piece. A pair of SG Brown headphones would have probably been used on the original crystal sets in Britain, but these now sound very tinny and hollow.

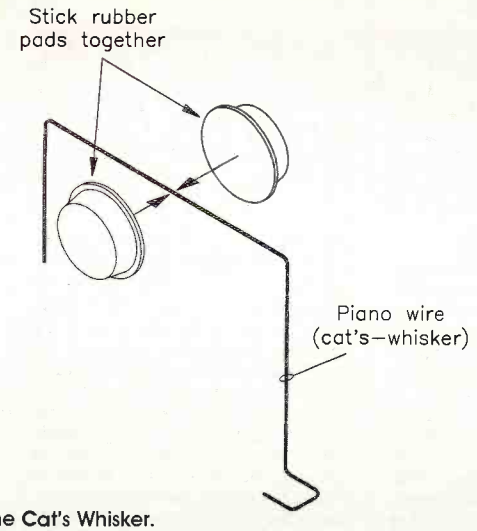


Figure 6. Making the Cat's Whisker.

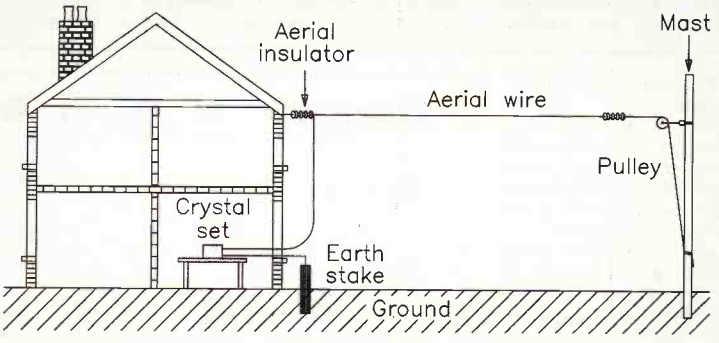


Figure 7. Typical aerial and earth arrangements for a crystal set.

Originally these headsets would have been used to receive Morse Code, where a reduction in audio bandwidth would have been achieved through the headset rather than through the receiver. The hollow sound effect would not have been noticed, as in those days as one was delighted in hearing any sounds at all, rather than worrying about quality.

Happy Listening!

CRYSTAL RADIO SET PARTS LIST

RESISTORS: All 0·6W 1% Metal film (Unless specified)			
Wooden Base	1		
Coil former	1		
High Impedance Crystal earpiece	1		
Galena Crystal	1		
Germanium Diode (1N34A)	1		
260pF Tuning Capacitor	1		
Tuning Pointer	1		
Metric Machine Screw	1		
U-shaped Spring Clip	1		
Fahnestock Spring Clips	2		
25mm Wood Screws	2		
Rubber Pads	2		
Brass Wood Screws	18		
Brass Washers	16		
Steel Piano Wire	1 length		
Hook-up Wire		As Req.	
Enamelled Copper Wire		1 length	
OPTIONAL (Not in Kit)			
Aerial Wire		As Req.	KR31J

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

The above items (excluding Optional) are available in kit form only.

Order As 95070 (Crystal Radio Set) Price £21.95

Please Note: Some parts, which are specific to this project are not available separately.

@Internet

Exploring the Ether

For Windows 3.1 and Macintosh users, Microsoft has just released a public beta version 2 of its Internet Explorer World Wide Web browsing software. Both versions are available for download from the Microsoft Web site, at: **http://www.microsoft.com**

For Mac users, the program marks a pleasant change from most of Microsoft's latest Mac releases, in that it's reasonably small (well under half the size of Netscape Navigator's current beta release) and the version actually looks like a proper Mac program instead of a Windows by-product. Indeed, rumour on the Internet is that it was designed for Microsoft by ex-Claris engineers.

Apart from just a couple of little niggles it runs quite smoothly and relatively glitch-free – for a beta version of software, that is. The niggles aren't immediately obvious either, so a new user to the Internet could be forgiven for thinking that it's a cracking piece of browsing software. Experienced users, on the other hand, will probably stick to Navigator for some subtle technical reasons.

For a start, Internet Explorer's favourite sites (the equivalent of Navigator's bookmarks) are stored as individual files. In contrast, Navigator's are stored as entries in a single hypertext markup language file. Conversion of an HTML file full of bookmarks to Explorer's method means a significant amount of disk space is lost.

Second, Explorer appears to use up temporary memory in the system heap quite alarmingly during operation – not nice if your machine isn't over-endowed with RAM, and potentially problematical.

Third, it allows use of some extensions to the standard HTML set which Microsoft has developed – sound tags, font specifications, page margins and so on. Without being too stuck- in-the-mud here it's easy to say these are real innovations when actually, they merely bend the HTML rules to a point where you should question whether they defeat the whole idea of HTML.

Finally, the program (well, the beta version anyway) isn't Internet Config aware, which for a new Macintosh Internet program *could* mean curtains before the overture. Microsoft must make this a priority for the final release.

Nevertheless, it has got some extremely good things going for it. For instance, as you launch for the first time it detects the presence of another browser and asks you if it should pickup the other browser's options. Also, apart from just a few areas which are obviously incomplete, the program seems pretty solid and reliable for a beta version. Screenshots in this month's Site Survey are all taken from Internet Explorer.

Viewcall First with Web Station

The Internet Web station debate continues to gather momentum. This month, Acorn announced that it has struck a deal with Oracle to manufacture a sub-£300 Web browser device. Another UK-company, Viewcall, has demonstrated its set-top box, which, coupled with a conventional TV set, will enable users to access Web sites and other online services.

Alongside regular Web access, Viewcall will be offering its own online shopping services, which will utilise a fractal-based image compression format to increase the speed of graphic manipulation to up to four times that of conventional PCs.

Viewcall has designed its own four-button teletext-style browser, which utilises Netscape software for the Internet. The back-end interactive shopping service will be driven by Sun's computer system, and will include elements of Java suitable to the low memory requirements of Viewcall.

The UK trial service was launched at the end of January with 1,000 users. By the end of the summer, Viewcall says it intends to bring the Internet to everyone, irrespective of technical ability or income, with £170 boxes available for rental or lease across Europe.

Contact: Viewcall, Tel: (0171) 439 3187.

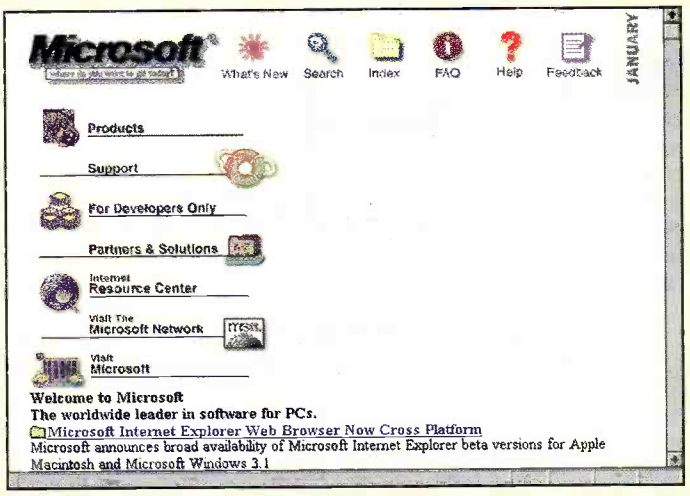
Microsoft and NBC Make News

Microsoft chairman Bill Gates is attempting to 'redefine' the way individuals access information. As part of his quest, he got into bed with NBC to launch a joint news service to deliver headline news across broadcast, cable, and the Internet.

However, the service will not be available to all. Interactive news content will be only accessible through the Microsoft Network. Is Gates trying to create his own Internet?

Cable operators will distribute the interactive online news via high-speed cable modems. The news service will extend its reach internationally via NBC's interest in NBC Super Channel in Europe, CNBC in Asia, CNBC in Europe, Canal de Noticias NBC in Latin America, and the soon-to-be-launched NBC Asia.

Contact: Microsoft, Tel: (01344) 710021; **http://www.microsoft.com**



HTML from PageMaker

Last month, we looked at an XTension to QuarkXPress called BeyondPress which allowed QuarkXPress documents to be exported in hypertext markup language (HTML) format – the language of pages on the World Wide Web.

Version 6 of PageMaker, that other well-known desktop publishing package, incorporates a new plug-in called HTML Author, which does a similar job. True it's not as comprehensive as BeyondPress in how it works, but it does the task well enough *and* it's built-into the program so doesn't cost a penny more.

Calling up HTML Author from within an existing PageMaker document brings up a dialogue box where you allocate the standard HTML styles to the document's own styles. As the document is exported HTML Author then converts each document style to the standard HTML style it has been allocated from and produces the HTML file. You can load this into a Web browser and check it, correcting and re-exporting where necessary until your pages are ready to upload onto the Web server.

It is quite simple to create and manage hypertext linked anchors within your exported HTML documents – up to 500 can be included in a single PageMaker document. Clicking on an anchor when viewing the HTML document in a Web browser jumps to the relative spot in the document. Similarly, you can include universal resource locators (URLs), so that clicking on the link points the Web browser to another document; whether it's on the same computer or elsewhere on the network. If the network happens to be the Internet, it will locate the computer around the world where the document is and open that document for viewing.

Café Internet Launches Doom Room

The Café Internet in London's Buckingham Palace Road has launched a Doom Room for the avid followers of this successful computer game. Customers who join the Doom Membership Club will be able to play the game at a special concessionary rate on the Café's multimedia workstations.

Gavin Sheppard, one of the founders of Café Internet, explains, "Most Doom participants play at home and only have one PC available, so they are limited to single-player Doom and its variants against the computer. There is no rivalry."

"At Café Internet, we have created Doom 'ladders', rather like a squash ladder at a sports club, where members can combat individually, in pairs or even in teams of up to four people. You can challenge total strangers for a place on the ladder, or just come along with friends for an enjoyable afternoon or evening out."

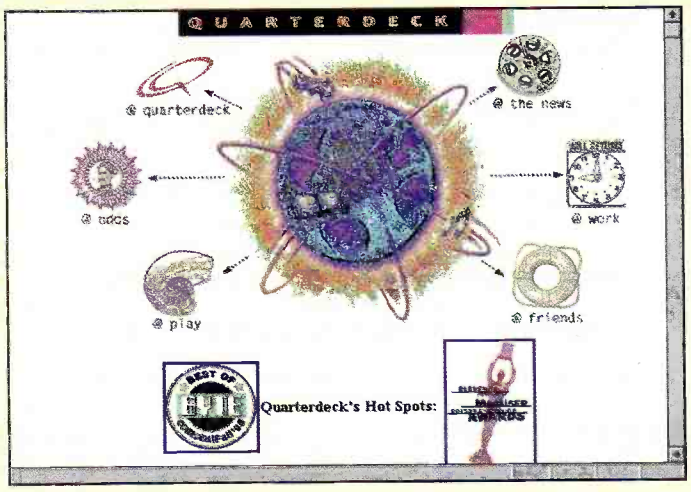
"And because the Doom Room is on the Internet, four separate games can be fought at the same time with people all over the world, giving combatants the opportunity to learn new skills and techniques to better their scores", says Sheppard.

Afternoon Doom sessions are available to players of all ages. Sessions after 7.30pm are restricted to those over 18 years of age, because the Café has a wine and bottled beer licence. Hot and cold foods are available throughout. Initially, the Café will offer original Doom, but new versions will be made available on demand.

Costs for just playing Doom will mirror the Café's usual Internet charge of £6 per hour, but members of the Doom club will receive a concessionary rate of £4 per hour in return for an annual fee of £5.

Café Internet is located at 22-24 Buckingham Palace Road, Victoria, London SW1, close to Victoria tube, train and bus stations in the direction of Buckingham Palace.

Contact: Café Internet, Tel: (0171) 233 5786.



WebTalk Gets Internet Community Talking

Two-way chat is now possible with WebTalk, a software suite from Quarterdeck that enables full duplex communication to take place over the Internet. The package has a retail price of around £50 for two licences.

WebTalk connections are simplified by use of an online server network. Users simply log into the network and initiate calls to other users by choosing their name from a list of entries in a topic-oriented chat room environment or from Hot Links in a Web page.

Full duplex communication is poss ible on a system as low as a 486, a 14·4K-bit/s modem and a sound card that supports full duplex communication. Half-duplex, or one-way communication, is possible for lower specified systems.

"We believe WebTalk is the most complete and competitive product for real time voice conversation over the Internet, and it is the only one that works together with the Web. Voice communications over the Internet will let people all over the world converse, and allow companies to offer a variety of new services, such as free customer support, promotions, and other interactive features", said Gaston Bastiaens, president and CEO of Quarterdeck.

"WebTalk offers quality connections, even over low bandwidth lines, and the two-user licence makes it excellent value", he added.

The WebTalk interface includes a world map which shows the geographical relationship and time zone differences between the two conversing parties. WebTalk also comes with a 'phone book for storing user names of frequently-called parties.

Contact: Quarterdeck, Tel: (01245) 496699; **http://www.qdeck.com**

Online Computer Monitoring Software

Software houses are working hard on solutions to the challenge of Internet pornography and the like. This month, a US-based company, Charles River Media, announced Internet WatchDog. Designed for managers, parents and teachers, Internet WatchDog is a monitoring tool for the Internet and PC. The software does not censor what is being displayed. Instead, it makes a record for later viewing by authorised individuals.

As new sites are added to the Internet everyday, Charles River Media claim it is impossible to 'block' unsuitable Internet activity. Internet WatchDog allows the parent, teacher or employer to monitor computer use – much like a telephone bill enables the caller to see a listing of 'phone numbers.

Internet WatchDog functions by capturing screen and other information while the computer is running. The parent or teacher can then review a grid-like screen with a series of thumbnail screen captures. For a closer look, a full-sized screen capture is available just by clicking on it. In addition, Internet WatchDog records usage of all software applications – Internet-related, or other computer activity. A password is required to access the monitoring capabilities of the program, and any attempt to circumvent or tamper with the Internet WatchDog is also recorded.

Contact: Charles River Media, Tel: (+1) 321 2198 366.

Phonelink and Royal Mail Develop Electronic Postal Service

PhoneLink and the Royal Mail have agreed to join services to provide a new electronic postal service for individuals and businesses. The service, to be provisionally known as 'Tel-Me – Royal Mail Electronic Services' will enable Tel-Me users to send correspondence electronically to anyone in the world, not just to PC users with e-mail addresses. We are struggling to work out whether this represents a step forwards or backwards.

Messages typed into the PC will be sent directly to Royal Mail's Electronic Services, simply by clicking on the send button within Tel-Me. The message will be printed at Royal Mail's Electronic Mail Centre located in Mount Pleasant, London, and automatically inserted into the distinctive yellow Electronic Services envelope for first class delivery.

"Internet users no longer need to run two separate systems, one for those with the necessary computer links and one for those without. They can now simply send their computer messages as normal, and Royal Mail and Tel-Me will sort out which can be delivered electronically and which should be printed off and posted via Electronic Services for next-day delivery", said Jim Cotton-Betteridge, Royal Mail's marketing director.

Contact: Royal Mail Tel-Me, Tel: (0800) 991155.

America On-Line Service (AOL) Launch in the UK

America On-Line Service (AOL) was recently launched in the UK, with aggressive plans to become the number one online service provider. AOL has created a unique online community – aimed firmly at the mass consumer market.

AOL is offering full Internet access – all within the framework of a simple, interactive multimedia interface, which has been specially redesigned for the new AOL UK service.

"What makes AOL fundamentally different to existing online services is that we create a sense of community for our members by providing a service they love", commented Jonathan Bulkeley, managing director of AOL UK. He went on, "By providing content that has been specifically developed for and in conjunction with the average UK consumer, AOL aims to be the UK's number one online service provider."

At launch, AOL has geographical coverage of 65% of the UK for local calls. 80% will be achieved by 15th February 1996 and 100% coverage will be achieved in April 1996. The high-speed network will allow users national access to the service at speeds of up to 28·8K-bit/s, ensuring fast downloading of AOL's highly graphical files.

All AOL services are included in the standard monthly charge – there are no surcharges for Internet access or use of AOL's UK high-speed network.

New members will receive one month's free subscription or 10 free hours access to the AOL UK service. Subsequent costs will be £5.95 for up to five hours of use, plus £1.85 for each additional hour.

Watch out for the AOL cover disk with next month's issue. As well as giving readers the opportunity to try out the new service completely free for up to 10 hours, *Electronics* will be taking a detailed look at the new service in a feature length article.

Contact: AOL, Tel: (0800) 3765432; **http://www.aol.com**

Site Survey

The month's destinations

If you're wondering who the eventual owner of the world will be, once Bill Gates' moon is in ther descendency, take a look at Sun Microsystems home page at: **http://www.sun.com/**

From there you can find out about Java and how the Internet is about to be transmogrified into one huge computer system.

Among hundreds of self-styled Internet computer information sites, c|net's is one of the best, at: **http://www.cnet.com/Index/ 0,1,65,0100.html?cool.torture1**

If you can get passed the impossible URL, it's worth a short look.

Into space for the next two, with a look at declassified US intelligence satellite photographs at: **http://edcwww.cr.usgs.gov.dclass/dclass.html** and Robert Lentz's Space Resources at: **ftp://explorer.arc.nasa.gov.pub/SPACE**

Don't let us hear you say we don't take you to the very edges of the world with @Internet. We'll have more Site Survey destinations in next month's *Electronics*.

Stray Signals

by Point Contact

A Tale of Two Decibels

Once upon a time, there was a sandwich student with one of the BIG electronics companies, studying for a degree in Electronic Engineering. Like any good (potential) engineer, he was interested in everything around him. (Notice the word *everything*; as a rule, men in general and engineers in particular, are interested in *things*, an interest in *people* being more commonly found in the ladies, bless them. Presumably, a lady engineer is interested in both things *and* people.) So, when one day in the laboratory, he saw an instrument labelled a 'Psophometer', he naturally asked an older colleague what on earth it was. The answer was, an instrument for measuring audio frequency noise. Further questioning as to why anyone should want to measure it, and what made a psophometer specially suitable to do so, elicited that it had a low noise input stage, using an EF37A, a premium version of a popular valve specially selected for low noise and microphony.

Years later, that same lad (now qualified and glorying in the title of Senior Design Engineer) had the task of designing a brand new psophometer for an important P.O. Supplies Department contract. The psophometer in the catalogue of the small firm for which he now worked, although being all solid-state, was large, clumsy and out of date, the design having originated years before with that same BIG electronics company in their laboratories not a million miles from Coventry. Now, a psophometer is known in the USA as a telephone voltmeter, the fancy Greek name being reserved for models that met the very tight psophometer specification published by the CCITT (the Comité Consultatif International Telephone et Telegraphe). This specified, among other things, that the 600Ω balanced floating input should have 126dB common mode rejection at 50Hz. These, together with user-selectable shaping filters simulating the frequency response of a normal dial-up telephone line and a broadcast circuit, were among the distinguishing features of the instrument. Another was the requirement for a true RMS response – easy in these days of RMS converter chips like the AD636, but not so in the late '60s. Hence, a circuit employing plenty of diodes was used, giving a bipolar logarithmic response. A following active bridge rectifier stage (also using one of the new μA709 op amps) turned the signal into full wave rectified AC, which was fed to a moving coil meter. The latter provided the necessary smoothing of the rectified signal, by virtue of its inertia, and also performed another important function. A meter with a linear voltage scale was specified, whereas the current was, in fact, still square law – the design did not include a square rooting stage. This function was performed by the meter, the moving coil of which was fitted with specially-shaped pole pieces. Undeflected, the moving coil sat in a very narrow gap, where the flux density was high, moving into a progressively wider gap as the deflection increased. It was wonderful what meter manufacturers could do in those days, especially as the CCITT specification also specified the dynamic response time when a signal was suddenly applied.

All seemed well, the prototype was approved and deliveries were about to begin, when disaster struck. The specification called for the instrument to provide an output to drive a strip chart recorder, so that the psophometer could be hung on a phone line to monitor the noise over hours or even days. Evidently in their tests, the P.O. laboratories had not evaluated the recorder output function as thoroughly as they should. The output provided simply placed the moving coil of the chart recorder in series with the psophometer's internal meter, via a break-jack. At this late stage, someone found that the chart recorder did not mimic the meter reading – for the movement in the chart recorder was a linear one, unlike the square-root response of the psophometer's meter. The financial consequences for the cash flow of a small company of a big redesign cycle did not bear thinking about, so – what to do? However, fortunately, the P.O. also had a red face, having already formally approved the prototype.

At this stage, a helpful suggestion that saved face all round came from someone in the P.O. Although the chart recorder was fitted with a linear meter movement, the chart paper itself was printed with a logarithmic scale covering 0 (full scale) down to –20dB, the scale was thus non-linear. A decibel scale was used, since in use, the interest was in how many decibels above the permitted level line noise was found to be. Logarithms being what they are, if you halve a logarithm, it is equivalent to square-rooting the value before taking the log. So it was agreed, that when using the recorder with the psophometer, the dB divisions on the chart paper would be read as half dB divisions, thus effectively implementing the square root function, which in the psophometer itself, was done by the special meter.

So two decibels became one and everyone lived happily ever after. (Including that Senior Design Engineer, who eventually retired, and took to writing electronic chat columns.)

The Light Fantastic

When PC was in the sixth form, he used to amuse himself with considering the possible applications of a –60W bulb: you plug it in, switch on, and the room gets darker by the same amount it would have got lighter if you had switched on an ordinary 60W bulb. Not much use if the midday sun was shining, but very effective near dusk – enabling the room to be used as a photographic darkroom earlier than would otherwise have been the case. Of course, his peers pooh-poohed the idea, pointing out that it was just plain impossible.

But apparently, not so. A recent news story reports that the Defence Research Agency, Malvern (previously RSRE and before that, RRE, prior to the merger with SRDE) has discovered the extraordinary properties of InSb (Indium Antimonide) when suitably doped. It holds the promise, when further developed, of transistors between 10 and 50 times faster than GaAs (Gallium Arsenide) devices and operation at sub-1V supply voltages. However, that's not all. This extraordinary material apparently contravenes Kirchoff's Law by absorbing infra-red radiation without re-emitting it. So, at least at IR, it 'shines black', and might, one day, be used to cloak soldiers and tanks so that they would merge into the background of their surroundings. This could be used to defeat 'smart' munitions, which home in on the IR reradiated from a target illuminated by a designating laser beam locked onto the target, from the attacking aircraft.

Yours sincerely,

Point Contact

The opinions expressed by the author are not necessarily those of the publisher or the editor.

BIG SAVINGS for SUBSCRIBERS!

That's right, if you subscribe to *Electronics–The Maplin Magazine*, or take out a subscription NOW, you will qualify for these amazing savings!

Hurry! Offers end 31st March '96

Code 51241

Non-Slip Mouse Pad

Catalogue Price £2.99

SUBSCRIBERS' PRICE £1.99

3·5in. Disk Drive Cleaning Kit

Catalogue Price £3.29

SUBSCRIBERS' PRICE £2.29

Code 51239

Lockable Storage Box

Holds 80 3·5in. Disks

Catalogue Price £9.49

SUBSCRIBERS' PRICE £6.99 A1

A Add UK Carriage £1.60

Code 51238

PC Vacuum Cleaner

Catalogue Price £7.99

SUBSCRIBERS' PRICE £5.99

Code 51243

Subscribe NOW! see page 42 for details

Code 51240

IBM PC, XT, AT, Serial 3-Button Mouse

Catalogue Price £12.99

SUBSCRIBERS' PRICE £9.99

Colour supplied: Ivory

Code 51242

Self-Adhesive Mouse Tidy

Catalogue Price £1.69

SUBSCRIBERS' PRICE 99P

As a fully paid-up subscriber you can use the special Subscriber-only order codes and save up to 40%

When ordering, please quote your Subscribers' Membership number (telephone Enquiries on 01702 552911 if not sure) and the special order code number. All items are subject to availability. Prices include VAT. Catalogue prices refer to the 1996 Retail Catalogue. Overseas subscribers telephone +44 1702 554155 Ext. 326 for carriage charges. Normal UK mail order carriage charges apply. E&OE.

NO WIRES†, NO FUSS, NO WORRY –with the latest, technically advanced,

WIRELESS HOME INTRUDER ALARM

IT'S SO EASY TO INSTALL!

– simply fix the units onto the wall, follow a few basic instructions and that's it – your home is alarmed!

†The Fox Wireless Home Alarm System has been specially designed to help protect your home and your family, without spoiling your decor with yards of unsightly wiring. As there is no wiring between the intrusion detectors and the control panel, the system can be easily fitted by anyone with average DIY skills.

This ergonomically designed system is so easy to use – just one remote button controls arming, disarming and panic functions! It is also fully expandable by adding more sensors and accessories from the extensive Fox Security range.

CONTENTS: Control Panel (with keys) *†2 Wireless PIR Detectors *†2 Wireless Contact Transmitters, 2-button Key-fob Transmitter, External Siren/Strobe, Instruction Manual and wall fixings.
Order Code H6 51248 £149.95

‡Requires PP3 battery.
Order Code 51249 £2.99

The Alarm system can use up to four remote control key-fob transmitters which are also compatible with all Vixen car alarms.

Additional Remote Control Key-fob
Order Code 51250 £9.99

Watch, Listen and Discover more about the Alarm System with the FOX WIRELESS HOME ALARM SYSTEM **VIDEO GUIDE** – An entertaining, informative way of showing how easy the Alarm is to fit, use and expand.

PLUS The video will include a special £5 VOUCHER that you can redeem when you buy a Fox Wireless Alarm or, should you decide against purchasing an alarm, we will refund the full PURCHASE PRICE OF THE VIDEO if returned to us within 28 days.

Video Guide £5
Order Code 51251

- **4 detection zones, part or full arming capability**
- **DTI approved**
- **Can use up to four key-fob transmitters for maximum convenience**
- **Built-in extra loud 120dB siren**
- **Automatic low battery warning**
- **Output for external siren, for extra attention**
- **Optional battery back-up for protection during mains failures**
- **Intrusion history display shows where the alarm was triggered**
- **Tamper-proof**
- **Unique code-learning feature eliminates manual programming**

FOX SECURITY

REMEMBER: This Alarm system is fully expandable by adding more sensors and accessories from the extensive FOX Security range.

HELP PROTECT YOUR HOME
at this breakthrough price

£149.95*

Order Code 51248 Add Carriage £6.00 H6

Order NOW on 0800 136 156

Ring 01702 552911 for details of your local store.

or visit your local Maplin or Mondo store in:

Belfast, Birmingham, Bradford, Brighton, Bristol, Cardiff, Chatham, Coventry, Dudley, Edinburgh, Glasgow, Ilford, Leeds (Mondo Superstore), Leicester, Liverpool, London (Edgware, Forest Hill and Hammersmith), Manchester (Oxford Road and Cheetham Hill), Middlesbrough, Milton Keynes, Newcastle-upon-Tyne (The Metro Centre, Gateshead), Northampton, Nottingham, Portsmouth, Preston, Reading, Sheffield, Slough, Southampton, Southend-on-Sea, Stockport and Stoke-on-Trent.

All prices include VAT. All items subject to availability. E&OE.