Are British ideas going down the drain?

Instruments for IEEE 488

New logic symbols

Novel sub-woofer
Directional power meter TM10

leads by a head

- Single detector head covers wide frequency and power band
- 25MHz to 1GHz  ■ 20mW to 100W and VSWR from 1 to 3
- Head can be used 1.5m from meter (e.g. inside closed car boot)
- Fully portable - works from internal battery or vehicle battery
- Mains adaptor/charger and rechargeable battery available
- Manufactured, tested and inspected to Min. Def. Std. 0524.

For colour brochure contact:
FARNELL INSTRUMENTS LIMITED
WETHERBY LS22 4DH
TELEPHONE (0937) 61961
TELEX 557294 FARIST G

CIRCLE 1 FOR FURTHER INFORMATION
NEW PRODUCTS

- **MINIATURE RUBIDIUM OSCILLATOR MODULE**
  Lower power, fast warm up, optional output frequencies, programmable frequency offsets.

- **RUBIDIUM FREQUENCY STANDARD**
  High performance, compact and rugged instrument. 2U rack or 1/4 ATR case options.

- **INTELLIGENT OFF-AIR FREQUENCY STANDARDS**
  Microcomputer controlled instruments, directly traceable to N.P.L., precision ovened local oscillator, comprehensive monitoring and status information, real time synchronisation.

- **LOW COST MSF FREQUENCY STANDARD**
  Instant operation, directly traceable to N.P.L., self-contained portable unit, no scheduled frequency changes, 24 hr transmission, real time synchronisation.

---

**FIELD ELECTRIC LTD**

3 SHENLEY ROAD, BOREHAMWOOD, HERTS.

Telephone: 01-953 6009

OPEN SIX DAYS A WEEK, 9.00am – 5.00pm
THURSDAY 9.00am – 1.00pm

CARRIERS WELCOME

---

**NEWRAD INSTRUMENT CASES LTD**

Unit 19, Parkengue, Kernick Road Industrial Estate, Penryn, Falmouth, Cornwall. Tel: Falmouth (0326) 76007

(*) A Circuit Services Associate Co.

---

**LINSLEY-HOOD**

**LATEST DESIGN**

Pre-amp Kit (complete) £98 + VAT
100W Power-amp Kit (complete) £135 + VAT
P&P £2 per order

Send S.A.E. for details and prices of part kits. Conversion hardware for fitting both units into a Hi-Fi tower system and also 19" Rack mounting options.

---

**Radiocode Clocks Ltd**

Unit 19, Parkengue, Kernick Road Industrial Estate, Penryn, Falmouth, Cornwall. Tel: Falmouth (0326) 76007

(*A Circuit Services Associate Co.)
March 1985

FEATURES

17
British invention, innovation and electronics
by R.E. Young
Background to new series

43
The new logic symbols
by Ian Kampel
The new standard explained

66
Alarmphone
by Per Andersen
This final part details the circuitry for the d.t.m.f. emergency autodialler, requiring no line connection

25
Floppy discs
by David March
Continuing the survey of disc storage in microcomputers

49
GPIB
An introduction to the bus accompanied by our equipment survey

70
Principles of optical storage
by J.R. Watkinson
This second article in our definitive compact disc series details the physics of the readout process

Sampled-data servos
The second part of Dr Taub's new analysis - outlining the sampling and aliasing processes - is held over to the next issue

31
Aesthetic sub-woofer system
by M. Bronzite
Analysis of path-length difference leads to an unconventional crossover design

REGULARS

6
Comment and News
Electro-reductionist challenge, World telephones, CB Snafu, Neutrons probe structures

72
Letters
Current dumping, Causality, IT education

37
Communications
New-look spectrum management?, External voices, Midgley's inventions, Cable & DBS

26
Events

61
Circuit ideas
Vmos squelch for pulse receivers, Bit-rate generator, Z80 instruction counter, Strobe probe

78
New products
Computer music, Low-cost modem, Image frame store

46
Literature received
British invention, innovation and electronics

This series is designed to show that Britain - with her unique technological strengths built up over the years - is as capable as ever of making contributions in these fields at the global level.

Front cover, designed by Philip Brooker and photographed by Kenneth Crook, illustrates R.E. Young's piece on British invention, which starts on page 17.

NEXT MONTH

Quartz crystals are by no means as simple as they might appear. Gordon Huyler of Cathodeon explains their characteristics and usage.

Aesthetic sub-woofer system

Practical guidance with particular reference to floor design

British ideas going down the drain?

In "How long is a piece of wire?", John Wiseman looks at electrically short transmitting aerials - those less than a quarter wavelength - which he describes as the no-mans' land of aerial design.

Current issue price 85p, back issues (if available) £1.06, at Retail and Trade Counter, Units 1 & 2, Burscough Industrial Centre, Hopton Street, London SE1. Available on microfilm; please contact editor.

By post, current issue £1.30, back issues (if available) £14.40, order and payments to EEP/Sundry Sales Dept., Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Tel.: 01-661 3378.


Subscription rates: 1 year £12.50 UK and £19 outside UK. Student rates: 1 year £10 UK and £12.70 outside UK.


Subscriptions: Quadrant House, Perrymount Road, Haywards Heath, Sussex RH16 3DH. Telephone: 0444 59198. Please notify a change of address.


USA mailing agents: Expediters of the Printed World Ltd., 527 Madison Avenue, Suite 1217, New York, NY 10022, 2nd class postage paid at New York.

© Business Press International Ltd 1985. ISSN 0043 6062.

www.americanradiohistory.com
HAMEG
MORE THAN JUST ONE STEP UP

HM208 £1200.
Dual Trace, Digital Storage 2mV – 20 V/cm
20 MHz Bandwidth Algebraic Add, Invert
X – Y, Component Tester 4 x Ik Stores,
20 MHz Clock, Roll, Refresh, Pre-trigger.

HM605 £515.
Dual Trace 1mV – 20 V/cm
60 MHz Bandwidth Algebraic Add, Invert
X – Y, Single Shot Delay Sweep,
Var Hold-off Component Tester, 14kV CRT

HM204-2 £365.
Dual Trace 1mV – 20 V/cm
20 MHz Bandwidth Algebraic Add, Invert
X – Y, Single Shot Delay Sweep,
Var Hold-off Component Tester

HM203-5 £264.
Dual Trace 2mV – 20 V/cm
20 MHz Bandwidth Algebraic Add, Invert
X – Y Component Tester
2 Year Warranty

FOR THOSE WHO COMPARE
74–78 Collingdon St. Luton, Beds, LU1 1RX
Tel: (0582) 413174 Telex 825484

PHILIPS

Philips Portable Computer P2000C
...an efficient IEC-Bus Controller
with several advantages

- IEC-625/IEEE-488 protocol fully implemented
- IEC/IEEE programming made easy with extended MBASIC
  and CP/M supplied with system
- bus analyser program included
- for commercial use: Word processing, spreadsheet and
  information management programs also included
- the P2000C is a full-function, easy-to-use, inexpensive
  personal computer.

For more information and a demonstration
POST COUPON TODAY

Name
Address
Phone

Distributor in Great Britain: Kingsway Data Systems, 30 Guildford Street,
Chertsey, Surrey, United Kingdom, Tel: (0392) 68 911

RADFORD
Audio Measuring Instruments, Audio Amplifiers, Loudspeakers and
Loudspeaker Components for the professional and enthusiast

10 BEACH ROAD
WESTON-S-MARE, AVON BS23 1AU
TEL. 0934 416033

CIRCLE 19 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985
GANG-OF-EIGHT is our FAST EPROM PROGRAMMER which handles CMOS or NMOS EPROMS from 2716 to 27256 (25XX too) using FAST or NORMAL programming methods. FAST programming 27128 takes 2 minutes, NORMAL programming takes 14. All possible levels of Vpp are covered including 25, 21 and 12.5 volts. GB has an LCD which tells you what you're doing — or doing wrong. BLANK CHECK, VERIFY and CHECKSUM facilities are included. Good value. .. £395

GANG-OF-EIGHT PLUS is now available PLUS what? Well, PLUS an RS232 INTERFACE which lets you download in INTELHEX, MOTOROLA S, TEKHEX, ASCII, SIMPLE HEX etc. Oh, yes, PLUS 50 quid too, but you might think it's worth it. .. £445

EMULATOR/EDITORS

SOFITY 2, our intelligent EPROM PROGRAMMER/EMULATOR, plugs into a TV, shows you memory and lets you TEXT-EDIT in HEX [INSERT, DELETE, SHIFT BLOCKS without overwriting or rewriting etc]. It also calculates ADDRESS-OFFSET'S in hex, UPLOADS and DOWNLOADS in SERIAL and PARALLEL, saves programs on TAPE, and PROGRAMS, COPIES and EMULATES EPROMS 2716, 2732 and 2532. Great DEVELOPMENT TOOL for PIGGY-BACK SINGLE-CHIPPERS and other small microsystems. TV lead, PROGRAMMER/cable with 24 pin DIL Plug and power supply included, ready to plug-in and use.

2764 and 27128 ADAPTORS lets SOFIT 2 handle larger EPROMS for £195

Z80 DEVELOPMENT TOOLS

MENTA is a Z80 development system designed by DATAMAN for the SCHOOLS COUNCIL. MENTA has a built in ASSEMBLER and TV hex display. it lets you enter program in hex or mnemonics and execute them FULL SPEED or A STEP AT A TIME. All the REGISTERS and the STACK are displayed on-screen and you can SEE MEMORY CONTENTS CHANGING as instructions are executed. MENTA is a microsystem with 24 bits I/O — it can be used as a controller for ROBOTS and intelligent machines. MENTA appears in GCE syllabusses; a TEACHER’S GUIDE, PUPIL READER and WORKSHEETS are available — also CONTROL MODULES — UNIVERSAL I/O, A to D, D to A, MOTOR and VARIABLE SWITCHED INPUT for less than £20 each. A MENTA with TV fitlead and power-supply costs £99

MICRODOCTOR is for DIAGNOSIS, finding troubles in microsystems. You just plug into the microprocessor socket, READ and WRITE to the MEMORY and I/O. MD does CHECKSUMS, RAMTESTS on memory, checks for SHORTS on the bus, and prints memory in HEX or ASCII. You can also DISASSEMBLE and print the SOURCECODE in Z80, 6502, 6800 etc. etc. when your SCOPE or MULTIMETER can’t find the problem — consult the MD. When you order say which processor you are concerned about and multiprocessor MD.

£295

CONNECTIVITY TESTERS

I.C.T. (Intelligent Connectivity Tester) is the project name for a 40 pin dual-in-line CUSTOM-CHIP developed by DATAMAN. The chip is called the MT72017 and it will appear soon in BARE-BOARD TESTERS, IDC CABLE TESTERS and LOOM ASSEMBLY EQUIPMENT all over the world. An EVALUATION-SYSTEM/CONTROLLER for the MT72017 is available on a EUROCARD and you can BUILD YOUR OWN custom connection-pattern tester for £295. The controller has full documentation, source-code, circuit diagram, parts-list and a description of operation. Each MT72017 tests 26 points and a single controller will handle hundreds of ‘em — thousands of test-points.

£25.00

LOGIC ANALYSER TA2080 by THANDAR which gives RS232 interface and prints TIMING and STATE diagrams — and DISASSEMBLES Z80, 6502, 6800 code on the screen or printer.

THANDAR TA2080 £1950 DATAMAN RETROFIT £295

Epson and NEC COMPUTERS make the Ox10, Hx20 and PX8, PCB800. ALL COMPUTERS are sold with a free bundle of useful software written by DATAMAN.

OLIVETTI TYPEWRITER INTERFACES designed by DATAMAN for ET121 and 221 — cheaper than a DAISYWHEEL printer RS232, HP18 (IEEE) and PARALLEL, including fitting.

£195

EPROM ERASERS from £39.00

If you need more data send for a FREE LIST-PACK and an ORDER FORM or, better still, JUST BUY THE PRODUCT AND EXAMINE IT — you may return any item within 14 days for A FULL REFUND (we deduct only postal charges). Add £2.50 for carriage to orders below £100. ADD VAT TO ALL UK ORDERS. Terms cheque with order. Dealers who mean business welcome. Goods normally in stock. TODAY DESPATCH IS POSSIBLE — please phone us DATAMAN DESIGNS, LOMBARD HOUSE, DORCHESTER, DORSET DT1 1RX. TELEPHONE: 418442. PHONE: (3705) 68066.
Electro-reductionist challenge

This journal has more than once commented on the threat to human life and ways of life posed by certain applications of electronics. There is now another, different kind of threat from this technology. It takes the form of a challenge to our understanding of what it is to be a human being.

Through a remarkable ability to simulate natural phenomena and processes as well as man-made systems, electronics technology is providing powerful support for the reductionist view of living beings. Reductionism, put crudely, is 'nothing but-ery.' We are arrangements of atoms and molecules — machines — functioning according to physical laws (which most of us accept) and 'nothing but' machines (which many of us vehemently reject).

This is not a doctrine to be easily dismissed. The philosopher John Searle in his 1984 BBC Reith Lectures admitted: "I just cannot square my conviction that I am a free agent with my conviction that... the surface features of phenomena are explained by the behaviour of macro-elements.

The first electronic simulators were analogue computers, and electronic analogues are still used to model living processes such as the electrical activity in tissues. Now, digital computer programs are taking over some of this biological modelling.

Professor Donald Michie, a researcher in machine intelligence, these new machines will function at "a higher level of conceptualization" than is possible with the existing Turing/von Neumann type computers. As an example, research is being done on distributed associative memories modelled on what is known of human memory processes.

Electro-reductionism, as it might be called, supports the instrumental view of human life epitomised by behaviourism and the technological fix. It is a challenge that must be met. It puts us on our mettle to defend and reaffirm our inner experiences, beliefs and values. Faced with the blind determinism of our own

The world needs more telephones

There is a gross imbalance in the distribution of telecommunications across the world. Three-quarters of the 600M telephones in the world are concentrated in only nine countries. Half the world's population live in countries with less than one telephone for every 100 persons and in such countries these are predominantly concentrated in urban areas, in many rural and remote areas there are no telecommunications at all. There are more telephones in Tokyo than in the whole of Africa. One can only speculate on the extent to which the absence of telecommunications has contributed to the disastrous famine in Ethiopia.

These are some of the startling facts which come from the findings of the Independent Commission for World Wide Telecommunication Development, set up by the International Telecommunications Union. In their newly published Report the Commission has made several recommendations to the ITU. The Commission's members came from India, the USSR, Kuwait, Japan, Federal Germany, Morocco, France, Tanzania, Venezuela, Gabon, Senegal, Romania, Indonesia, the USSR, Costa Rica and Saudi Arabia and was chaired by Sir Donald Maitland, the UK representative.

Their chief conclusion is that the industrial nations and telecommunications industries should aid the poorer nations in the development of their telecommunications. This will promote the shared interest in that a more comprehensive world network will increase international traffic and generate funds for investment; trade and other contracts would be stimulated and the standard and quality of life of countless millions would be raised to the general good. The high technology and other industries will then find new markets in the developing world for their products and their expertise. If this common interest is recognised and if higher priority is given to investment in telecommunications as an integral part of the process of development, there is no good reason, in the Commission's view, why be the early part of

"We're hoping to get rid of the dongle when it goes into production"
the next century all mankind should not be within easy reach of a telephone. This is the objective set by the Commission.

In practical terms the Commission proposes setting up of a Centre for Telecommunications Development. It would have three components: a Development Policy Unit, to collect and disseminate information about telecommunications policies and experience; a Telecommunications Development Service which would offer developing countries disinterested advice of the highest quality on every aspect of creating and operating an effective system; and an Operations Support Group which would provide specific assistance and complement the work of the Technical Cooperation Department of the ITU.

Although the Commission accepts that there is no instant solution, if their recommendations were to be accepted and implemented with vigour, the world wide situation could be transformed within 20 years.

A source for neutrons

What is claimed to be the world’s most powerful pulsed neutron source is to be fully commissioned in April. The Spallation Neutron Source (SNS) is at the SERC Rutherford Appleton Laboratory. Initial tests have found it to be a very useful tool and a small but significant discovery has been made in the distortion of the structure of nickel oxide.

The initial test consisted of accelerating protons to 550MeV in a synchrotron (800MeV will be used eventually). The protons are extracted from the synchrotron in high intensity bursts, 50 times a second, and are focused on a target of non-fissile Uranium 238 where 25 to 30 neutrons are released for each incident proton. The pulsed structure allows the measurement of neutron wavelength and energy. The neutrons so generated are too energetic and are therefore slowed down by ‘moderators’ of which the SNS has four: two of water at room temperature, one of liquid methane at 100K and one of hydrogen at 25K. The pulses of neutrons emerging from the moderators, now comparatively slow in particle terms, are used for experimental purposes.

Neutrons carry no electrical charge and can penetrate an atom and interact with the nucleus. Because they have wavelengths which range from less than the dimensions of an atom to that of large molecules, the neutron beams can be used to probe the structure of molecules and the arrangement of atoms and molecules in crystals, liquids, glasses and plastics. One example is investigating the structure of viruses. Neutrons are very penetrating and can be used to probe the internal structure of bulk materials, for example studying the setting of cement and internal strains in metals. Neutrons have relatively low energy, about 10^{-5} times less than that of X-rays of comparable wavelength. This allows the investigation of atomic and molecular motion within substances which in turn give information about the atomic-scale forces which

UK’s the place for US hi-tech

Geoffrey Pattie, who took over the Ministry for Information Technology has been exhorting Americans to locate their high technology industry in Britain. Addressing the annual meeting of the American Friends of Wilton Park, in Los Angeles, he pointed out that the UK consumption of integrated circuits alone grew 50% last year, to £450M. “The UK is now the largest European market for I.C’s. It is also the fastest growing and uses a higher proportion of integrated circuits in its products than any other European country.”

He outlined the Governments’ work in telecommunications and particularly the development of the TACS cellular radio system which should give 90% of the UK population the opportunity of making telephone calls from their cars by 1990. In another

In another part of his speech he decried the US restriction on the dissemination of unclassified technical data and scientific information. “Such moves have included the withdrawal of scientific and technical papers from open circulation; limitation on the attendance of non-US citizens at scientific conferences; restrictions on US scientists wishing to attend international conferences; and restrictions on the access of foreign students to US laboratories.
Ten-four breakers?

It appears that the old illegal CB radio rigs will soon become legal but the new legal sets will at the same time become illegal. The Radio Regulatory Division or their masters at the DTT have agreed to adopt the frequencies recommended by the CEPT for use in Europe. These are the same as the American FCC allocated frequencies for CB and were used illegally in this country until parliamentary lobbying, and widespread flouting of the law, forced the Government into making CB legal. The official reason given is that the frequencies allocated on legalization were the only ones useable in the short time-span then available. The CEPT recommendations now for a 40-channel service operating between 26.96 and 27.40 MHz with four watts power and using f.m. only. There is to be a gradual changeover with the final plans and dates not yet fixed. Some channels at the bottom of the band are still occupied by such services as hospital paging systems and most of these have been allocated new channels in Band III following the demise of the 405-line TV service. But eventually CB users will have to get new equipment or have their rigs modified to remain legal. The 934 MHz band is to be moved down by 12.5 kHz with the channels spacing reduced in order to fit 40 channels on this band. After all this has happened breakers will be able to use their sets all over Europe and it is presumed that as they all seem to communicate in their own weird language they should have few linguistic problems. Perhaps that is what Orwell meant by Newspeak? Our thanks to Reg Moore, G3GZT/VS6CD, for pointing out this addition to the CB snafu saga.

In brief

STC think they can find a niche in the market by providing a connector service. With this in mind they have set up a new company; Five Star Connectors, and have invested several million in buying stock, so that they can offer a same-day, off-the-shelf service for a wide variety of connectors from a number of leading manufacturers. Coinciding with the launch of the new company is the first issue of their catalogue. 104 pages long and seemingly covering any connector that one could imagine.

- Since the poison gas disaster in Bhopal, India, the Ever Ready battery company wish it to be known that they have no connection with Eveready batteries marketed in several countries (though not in the UK) by Union Carbide.

The first? Not by a long chalk

Whenever we take the words of a press release for granted, we are invariably wrong. Philips told us that their slow-scan TV system was the first to get BT approval (January News). Not so, says Ibsommain of Uxbridge. They had approval back in 1978 when BT was still part of the GPO. They claim that they were the first and know of at least three other companies in the same field with official approval. Ibsommain II is a transceiver that will also autodial, autoanswer, provide remote control of cameras, alarm systems etc. Its built-in line monitoring ensures privacy and there is no limit to the length of time a transmission will take. Moreover the product is British designed, British made and built almost entirely of British components.

Communications for the deaf

A profoundly deaf young mother from Leeds has called on the Government to provide financial assistance to enable similarly handicapped people to benefit from electronic mail. Doreen Naylor, deaf from birth, has contributed to a book, *Micros for the Handicapped*. She runs a network linking deaf families in Leeds and Bradford and is particularly pleased with the Commstar rom from Face which she uses in her BBC micro, along with a Pace modem. Doreen is one of several handicapped people who have written first-hand accounts of their experiences in the book, published in Whibey by Helena Press.

Alvey looks at wafers

A major project for developing fault-tolerant design techniques for wafer-scale integration. Plessey, GEC and ICL are to collaborate with Brunel University, Middlesex Polytechnic and King's College, London in the project. It is planned to take three and a half years and involve a total of 50 people's effort for one person.

The objective is to create circuits which can be reconfigured to avoid defects on the wafer. Several approaches have been proposed, but few tested in practice. Such a self-repair system has been described by Ivor Catt in this journal. For the Alvey project it is planned to produce two circuits, one will have a regular array structure while the other being a non-regular cell-based type. Cmos technology is to be used for these demonstration wafers. The project part of the overall VLSI architecture programme of Alvey which aims to produce a variety of methods for exploiting the possibilities of parallel processing offered by VLSI. The WSI project should produce manufacturing techniques of value to all designers of VLSI circuits.

Automatic telephone fault-finding

British Telecom are installing automatic line testing equipment to speed telephone fault detection and repair. Beginning in March the equipment will be installed in about 100 of BT's 360 repair service controls. It will automatically test customers' lines and equipment overnight to spot any degradation before it develops into a fault which could affect telephone service. It can also be operated by officers at the control centres in reply to faulty line calls by users dialling 151.

Eventually the records and automatic test computers will be integrated so that if a fault is reported, the customer service operator can call up the line's previous fault record, initiate the automatic test and read the results displayed on a screen. This will usually provide enough information to estimate the time needed to effect the repair and organize an engineer's visit.

Engineers at the IBA Engineering Centre have successfully received from Norway the first operational service to use the C-MAC/packet d.b.s. system. The pictures are being transmitted by NRK, the Norwegian broadcast corporation for reception in the Svalbard Islands off the northern coast of Norway, well within the Arctic Circle. This is the first service to use the C-MAC/packet system proposed by the EBU and based largely on the MAC system developed by the IBA. The Norwegians are using the eight sound channel capacity available in the specification to provide two stereo radio channels in addition to the sound accompanying the picture. IBA engineers are currently working on an experimental enhanced form of wide-screen MAC transmission.
The toroidal transformer is now accepted as the standard in industry, overcoming the obsolete laminated type. Industry has been quick to recognize the advantages toroidals offer in size, weight, lower radiated field and, thanks to I.L.P., PRICE.

Our large standard range is complemented by our SPECIAL DESIGN section which can offer a prototype service within 14 DAYS together with a short lead time on quantity orders which can be programmed to your requirements with no penalty price.

**Navy Section which recognise**

**SERIES SECONDARY RMS**

**TOROIDALS**

<table>
<thead>
<tr>
<th>VA</th>
<th>15</th>
<th>50</th>
<th>120</th>
<th>250</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>62-34mm</td>
<td>0.38kgs</td>
<td>Regulation 19%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIZES</td>
<td>SECONDARY RMS,</td>
<td>No.</td>
<td>Current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 12x12</td>
<td>1</td>
<td>2.50</td>
<td>1+014</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 25x25</td>
<td>2</td>
<td>2.50</td>
<td>1+015</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 35x35</td>
<td>3</td>
<td>3.50</td>
<td>1+016</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 45x45</td>
<td>4</td>
<td>4.50</td>
<td>1+017</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 55x55</td>
<td>5</td>
<td>5.50</td>
<td>1+018</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 65x65</td>
<td>6</td>
<td>6.50</td>
<td>1+019</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 75x75</td>
<td>7</td>
<td>7.50</td>
<td>1+020</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 85x85</td>
<td>8</td>
<td>8.50</td>
<td>1+021</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 95x95</td>
<td>9</td>
<td>9.50</td>
<td>1+022</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 105x105</td>
<td>10</td>
<td>10.50</td>
<td>1+023</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 115x115</td>
<td>11</td>
<td>11.50</td>
<td>1+024</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 125x125</td>
<td>12</td>
<td>12.50</td>
<td>1+025</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 135x135</td>
<td>13</td>
<td>13.50</td>
<td>1+026</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 145x145</td>
<td>14</td>
<td>14.50</td>
<td>1+027</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 155x155</td>
<td>15</td>
<td>15.50</td>
<td>1+028</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 165x165</td>
<td>16</td>
<td>16.50</td>
<td>1+029</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 175x175</td>
<td>17</td>
<td>17.50</td>
<td>1+030</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 185x185</td>
<td>18</td>
<td>18.50</td>
<td>1+031</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 195x195</td>
<td>19</td>
<td>19.50</td>
<td>1+032</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>0410 &amp; 205x205</td>
<td>20</td>
<td>20.50</td>
<td>1+033</td>
<td>0.50</td>
<td></td>
</tr>
</tbody>
</table>

Robots may also be bought by 'lead by the nose' method. Extensive software is supplied free with each robot.

Each available for connection to BBC ZX Spectrum, Apple II, Commodore 64 and similar systems. Most other computers are also easily usable with these robots.

**NEPTUNE**

**Model**

- NEPTUNE I: for clean hydraulic power - tap water is the hydraulic fluid.

**Kit from £1250**

**NEPTUNE II**

**Model**

- NEPTUNE II: advanced robot - tap water is the hydraulic fluid.

**Kit from £1725**

**MONTOR**

- Kit from £345

For Education, Training, and Industry.
Thandar SC 110A £175
10MHz, dual channel portable, bright trace, and economy. Includes: DC voltage and current, audible and visual logic, 10MHz sine, and sine triggering. Sensitivity 10mV to 50V.

Fluke 8024B £200
31/2 digit, LCD. Eleven functions include peak hold on voltage and current, audible and visual logic, selectable DC accuracy with 10MHz sine, 10MHz sine, and sine triggering.

Fluke 8026B £172
31/2 digit, LCD. Eight functions include: 10MHz sine, 10MHz sine, selectable DC accuracy with 10MHz sine, 10MHz sine, and sine triggering.

Analog Multimeters

Philips PM 2505 £151
True RMS, auto/manual ranging, dual channel, auto/manual ranging, automatic polarity indication, low power consumption.

IC 680 £32
48 MHz, 10 MHz, 10 MHz, DC sensitivity, 0.25% accuracy, 10 cm mirror scale and overload protection.

IC 680G £25
48 MHz, 10 MHz, 10 MHz, DC sensitivity, 0.25% accuracy, 10 cm mirror scale and overload protection.

IC 680B £19
48 MHz, 10 MHz, 10 MHz, DC sensitivity, 0.25% accuracy, 10 cm mirror scale and overload protection.

Pulse, Function, Pattern Generators

Philips PM 512 £940
1MHz/60Hz, 5MHz, 5MHz, 5MHz, sine square, TTL, positive, and negative, DVM, 0.01% accuracy, 10cm mirror scale and overload protection.

Philips PM 532E £1129
RF generator: 100kHz to 1MHz, AM/FM modulation, 0.5% frequency deviation, 0.5% frequency deviation, and 0.5% frequency deviation.

Philips PM 513 £1415
Function generator: 0.01 Hz to 20 MHz, frequency display, sine square, triangle, TTL, and square, 1MHz, 1MHz, 1MHz, sine square, triangle, TTL, and square.

Philips PM 533 £1085
Function generator: 0.01 Hz to 2 MHz, square, triangle, TTL, and square, 1MHz, 1MHz, 1MHz, sine square, triangle, TTL, and square.

Philips PM 512D £595
Function generator: 0.01 Hz to 2 MHz, sine, triangle, TTL, and square, 1MHz, 1MHz, 1MHz, sine square, triangle, TTL, and square.
prompt despatch to all parts of the country.

Electronic Brokers offer full technical support and expert advice on all aspects of electronic test and measuring.

Electronic Brokers Ltd 140-146 Camden Street
London NW1 9PB
Telephone 01-267 7070 Telex 298694
**SUPER HY LIGHT STROBE KIT**  
Designed for Drama, Rehearsal, etc.  
Approx. 100 capsule 40W outputs.  
VAT £34.95.  
Descriptive leaflet incl. VAT £1.99 inc.  
For further details SUNALTEC LTD, for full details including HY Light and Industrial Shown Kits.

**ULTRA VIOLET BLACK LIGHT**  
FLUORESCENT TUBES  
81 watt F33 £8.20 inc. VAT.  
77 watt F33 £7.34 inc. VAT.  
69 watt F33 £6.80 inc. VAT.  
175 volt F33 £8.00 inc. VAT.  
150 watt F33 £7.38 inc. VAT.  
60 watt F36 £3.89 inc. VAT.  
36 volt F36 £3.45 inc. VAT.  
20 watt F36 £2.55 inc. VAT.  
110 volt F36 £2.49 inc. VAT.  
230v AC Ballast Kit for either 6in, 9in or 12in tubes £5.50 inc. VAT  
200w inc. VAT £4.50 inc. VAT.  
150w inc. VAT £3.50 inc. VAT.  
100w inc. VAT £2.50 inc. VAT.  
50w inc. VAT £1.50 inc. VAT.  

**PERFECT FREQUENCY OPERATIONAL SIMULATIONS**  
Resistors, Operational Amplifiers in any circuit configuration.  
Performs FREQUENCY RESPONSE ANALYSIS on Circuits with up to 30 nodes and 100 components, for PHASE and Gain/Loss, Input impedance and Output Impedance.  
Ideal for the analysis of ACTIVE and PASSIVE FILTERS, AUDIO, WIDEBAND and R.F. AMPLIFIERS, LINEAR INTEGRATED CIRCUITS etc. etc.  
"ANALYSER" can greatly reduce or even eliminate the need to breadboard new designs.  
**USED BY INDUSTRIAL AND UNIVERSAL R&D DEPARTMENTS WORLD WIDE.**  

**NEW POWER RHEOSTATS**  
Now produced in improved deep drawn  
assembly, continuously rated.  
5½ WATT 4½/2½/1½/1/½/1/8/1/16/1/32/1/64/1/128/1/256/1/512W.  
1½ WATT 6/3/1½/1/8/1/16/1/32/1/64/1/128/1/256/1/512W.  
240V 60/50/400/380/360V.  

**INSULATED TESTERS NEW!**  
Test to E.E.C. Spec. Rugged metal construction suitable for bench or wall, withstands speeds in excess of 5m/s.  
Specify D.C. or A.C. 230V, 50/60Hz.  
150 watt lamps £124.95 incl. VAT.  
175 watt lamps £135.00 incl. VAT.  

**GEARED MOTORS**  
3 phase 230/400V AC or 240/415V.  
For further details including HY Light and Industrial Show kits.

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Power</th>
<th>RPM</th>
<th>Volts</th>
<th>Price (Inc. VAT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.C. GEARED</td>
<td>0.15/0.20/0.25/0.30</td>
<td>2000-3000</td>
<td>230/400</td>
<td>£175.00</td>
</tr>
<tr>
<td>D.C. GEARED</td>
<td>0.15/0.20/0.25/0.30</td>
<td>1500-2500</td>
<td>240/415</td>
<td>£200.00</td>
</tr>
</tbody>
</table>

**TALKING COMPUTER TERMINAL**  
**TDS2000 FOR PRECISION DATA INPUT**  

**SERVICE TRADING CO.**  
57 BRIDGMAN ROAD, CHISWICK, LONDON W4 5BB.  
Tel: 01-995 1560  
ACCOUNT CUSTOMERS MIN. ORDER £10

**CIRCLE 18 FOR FURTHER DETAILS.**

**ELECTRONICS C.A.D. "ANALYSER"**

**PERFORMANCE ANALYSIS OF LINEAR CIRCUITS using the**  
**BBC MODEL B AND SINCLAIR SPECTRUM 48K MICROS**

Simulates Resistors, Capacitors, Inductors, Transformers, Bipolar and Field effect Transistors and Operational Amplifiers in any circuit configuration.

**PERFORMS FREQUENCY RESPONSE ANALYSIS ON CIRCUITS with up to 30 NODES AND 100 COMPONENTS, FOR PHASE AND**  
**GAIN/LOSS, INPUT IMPEDANCE AND OUTPUT IMPEDANCE.**

Ideal for the analysis of ACTIVE and PASSIVE FILTERS, AUDIO, WIDEBAND and R.F. AMPLIFIERS, LINEAR INTEGRATED CIRCUITS etc. etc.

**"ANALYSER" can greatly reduce or even eliminate the need to breadboard new designs.**

**USED BY INDUSTRIAL AND UNIVERSAL R&D DEPARTMENTS WORLD WIDE.**

**VERY EASY TO USE. PRICES FROM £20. PAYMENT BY ACCESS OR AMERICAN EXPRESS WELCOME."**

For further details write or phone NUMBER ONE SYSTEMS  
**DEPARTMENT VW**  
9A CROWN STREET, ST IVES  
HUNTINGDON  
CAMBS. UK. PE1 4EB.  
TEL: 0480 61778  
TELEX: 32339

**CIRCLE 88 FOR FURTHER DETAILS.**

**TALKING COMPUTER TERMINAL TDS2000 FOR PRECISION DATA INPUT**  

**SANGAMO WESTON TIME SWITCH**  
Type 220A.  
For use on all types of A.C. circuits with partial switch systems.  
230/415V.  
Price £30.00  
(£15.00 inc. VAT & p&p.)  
Also available with timer (5A)  
Incl. VAT £40.00  
(£20.00 inc. VAT & p&p.)

**NEW! MANUFACTURED IN JAPAN**  
60V.  
15 & 30 ampere versions.  
Contactors and test leads.  
Golds hardware selected within 7 days.

**CIRCLE 74 FOR FURTHER DETAILS.**
The Source of All Good

Test Equipment

Electronic Brokers Second User Test and Measurement Equipment Division

Oscilloscopes
- Tektronix 700 Series
  - 7A19 600MHz
  - 7A30 1GHz
  - 7A40 200MHz
  - 7B80 1GHz
  - 7C80 500MHz

Telemetry
- TD501 Digital Delay
- TD502 Low Frequency
- TD503 Function Generator

Analog Analyzers
- Tektronix
  - PM2532 10MHz
  - PM3505 50MHz

Logic Analyzers
- Fluke
  - 301A Programmable Logic Analyzer

Power Supplies
- Tektronix
  - 7B20

Signal Generators
- Tektronix
  - 7L12, 7L13, 7L14

Waveform Generators
- Tektronix
  - 491 Spectrum Analyzer
  - 495 Spectrum Analyzer

Display
- Tektronix
  - 495A Linear

General Equipment
- Avocet
  - 314 Peak Power Meter

Decomputers
- Electronic Brokers
  - DEC 1000

Electronic Brokers Guarantee
- Electronic Brokers guarantees all new second-hand test equipment sold by us carries a 12 month warranty. If you buy from Electronic Brokers you know the equipment is in top notch condition. It is refurbished in our own service laboratories and checked to meet the original manufacturer's sales specifications. And it's serviced by our own highly qualified technicians.

Electronic Brokers is Europe's largest specialists in quality second-hand test equipment. Established 17 years ago we have pioneered the second user concept in Britain, and many overseas territories. To support our growth we have a skilled team. This includes trained sales staff, whose role is not only to sell, but provide a helpful information service to our many customers. Packing this team is our own service laboratory where technicians monitor each item of equipment we sell. Our aim is service, and those who have dealt with us will know that we endeavour to always live up to our reputation.

Save up to 50%

Electronic Brokers Ltd
140-146 Camden Street London NW1 9PB
Telephone 01-267 7070 Telex 298694

Electronic Brokers

CIRCLE 201 FOR FURTHER DETAILS.
The Northern Amateur Radio Societies Association will be holding their 23RD ANNUAL RADIO & ELECTRONICS EXHIBITION AND MOBILE RALLY in The Central Hall, Belle Vue, Redgate Lane, Longsight, Manchester on Sunday 10th March 1985 commencing at 11.00 a.m.

Admission will be £1.00 to the exhibition. OAP's and Children 50p.

Car Park facilities (80p) will be available as will restaurant & bar.

Contests and a raffle will take place. There will be a play area for children.

Talk in will be on S22, SU8, or any other clear frequency.

CIRCLE 9 FOR FURTHER DETAILS.

LOOK AHEAD!
WITH MONOLITH MAGNETIC TAPE HEADS
VIDEO HEAD REPLACEMENT KIT
DOES YOUR VCR GIVE WASHED OUT NOISY PICTURES - IT'S PROBABLY IN NEED OF A NEW HEAD - FAST FROM OUR EX-STOCK DELIVERIES.
SAVE £££££ ON REPAIR CHARGES.
OUR UNIVERAL REPLACEMENT VIDEO HEADS FIT ALL MODELS OF VHS OR BETAMAX VCRS. FOLLOWING OUR REPLACEMENT GUIDE AND WITH A PRINCIPAL ABILITY YOU CAN DO THE WHOLE JOB IN YOUR OWN HOME WITH OUR HEAD REPLACEMENT KIT.

KIT CONTAINS - NEW VIDEO HEAD, 5 CLEANING TOOLS, HEAD CLEANING FLUID, CAN OF AIR BLAST, INSPECTION MIRROR, ANTI STATIC CLOTH, VHS/BETAMAX MAINTENANCE MANUAL, CROSS HEAD SCREWDRIVER, HANDLING GLOVES, MOTOR SPEED DISC, SERVICE LABEL, HEAD REPLACEMENT GUIDE.

BETAMAX KIT £75.25, VHS KITS £65.25. Prices include P&P and VAT.

HOW TO ORDER: PLEASE STATE CLEARLY THE MAKE AND MODEL OF YOUR VCR. THERE ARE TWO VERSIONS OF THE VHS HEAD AND YOUR ORDER CAN BE PROCESSED FASTER IF YOU CHECK THE SIZE OF THE CENTRE HOLE OF THE HEAD WHICH WILL BE EITHER 5mm OR 10mm DIAMETER.

CATALOGUE: For our full Catalogue of Replacement Video & Audio Cassette/Reel to Reel Heads, Motors, Mechanisms, etc. Please forward 50p P&P.

THE MONOLITH ELECTRONICS CO. LTD.
5-7 Church Street, Crewkerne, Somerset TA18 7HR, England
Telephone: Crewkerne (0460) 74321
Telex: 46306 MONLTH G

CIRCLE 81 FOR FURTHER DETAILS.

USED TEST EQUIPMENT & COMPUTER PRODUCTS

FROM CARSTON

99, Waldegrave Road, Teddington, Middlesex TW11 8LL
Telephone 01-943 4477 Telex 39290 (Euhire)

Used test equipment and computer specialist

CIRCLE 123 FOR FURTHER DETAILS.

MITSUBISHI

MGF-1400
MGF-1402
MGF-1412

GaAs FETs
FROM STOCK

Aspen Electronics Limited
UK representative for Mitsubishi Electric
2/3 Kildare Close, Eastcote, Ruislip Middlesex HA4 9UR
Tel: 01-868 1188 Tlx: 8812727

CIRCLE 83 FOR FURTHER DETAILS.

Z80A MICRO-CONTROLLERS

• 4MHz Z80A CPU
• 4x EPROM - 2K supplied with MC2V.0
• 4K battery backed RAM - 2K supplied
• 4 x 256A PIO's (64 I/O lines)
• 780A CTC
• Standard 100mm x 160mm Eurocard
• Cost effective prices (£94.04-10 off)

Designed to meet the power and flexibility of today's world - Z80A micro-controllers. The GNC Z80A makes full use of the powerful Z80A family's capabilities. Micro-controllers are available with up to 256K RAM, 16K EPROM, 32K-ROM etc. Modules include circuit diagrams and assembly language listings. No U/L's, PAL's or other harnesses. Write, phone or circle to find out more about our powerful range of Z80A micro-controllers and much - tasking software.

PRICES
$193.44
$22.00
$23.50

Please add 1.00 for P&P plus V.A.T.

GNC ELECTRONICS
Little Lodge, Hippon Road,
Thatcham, Dist. Herford, IP2 1JK.
Tel: Dist. (0379) 898313.

CIRCLE 36 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985

www.americanradiohistory.com
TERMS OF BUSINESS

- All prices exclude VAT and carriage. Please add VAT 15% before adding VAT.
- Carriage charges extra on all orders as follows:
  Components: £0.75
  Discs: £1.50
  Strictly cash with order or credit card (Access or Visa)
- Delivery is normally from stock but please allow up to 28 days.
- Any query or complaint regarding an order should be made within 7 days of receipt of the order. No telephone queries will be entertained.
- Goods incorrectly ordered cannot be accepted for replacement without our prior agreement. Due to high processing costs, a minimum of 15% handling charge may be levied on any returns or cancelled orders.
- We will issue a full immediate refund if, requested, for out of stock items.
- All items carry full manufacturers warranty.
- A VAT receipt will be supplied with all orders.
- Prices quoted are correct at the time of going to press but we reserve the right to effect changes without prior notice.

LINEAR/INT. DEV.

<table>
<thead>
<tr>
<th>Type</th>
<th>4702</th>
<th>4050</th>
<th>4050A</th>
<th>4050B</th>
<th>4050C</th>
<th>4050D</th>
<th>4050E</th>
<th>4050F</th>
<th>4050G</th>
<th>4050H</th>
<th>4050I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>£2.10</td>
<td>£2.50</td>
<td>£2.80</td>
<td>£3.40</td>
<td>£4.00</td>
<td>£4.60</td>
<td>£5.50</td>
<td>£6.20</td>
<td>£6.90</td>
<td>£8.00</td>
<td>£8.40</td>
</tr>
<tr>
<td>Voltage</td>
<td>9V</td>
<td>12V</td>
<td>15V</td>
<td>18V</td>
<td>24V</td>
<td>36V</td>
<td>48V</td>
<td>60V</td>
<td>72V</td>
<td>90V</td>
<td>110V</td>
</tr>
</tbody>
</table>

FAIRCHILD

- 7400 Series
- 74AC Series
- 74AL Series
- 74HC Series
- 74LS Series
- 74S Series
- 74T Series

FAST

- 74F Series
- 74H Series
- 74L Series
- 74LS Series
- 74S Series
- 74T Series

CMOS

- 74HC Series
- 74L Series
- 74LS Series
- 74S Series
- 74T Series

HIGH SPEED

- 74F Series
- 74H Series
- 74L Series
- 74LS Series
- 74S Series
- 74T Series

LEADFRAME COMPONENTS

Hi-Tech Components
Hi-Tech Components, Gilray Road, Diss, Norfolk, Tel 0379 4131

CIRCLE 77 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985

15

www.americanradiohistory.com
Add 8 channels to your oscilloscope

New Thurlby OM358 multiplexer £169 +VAT

The new Thurlby OM358 enables any oscilloscope to display 8 channels of information simultaneously.

The OM358 is ideally suited to analysing digital waveforms (in many cases it can be used to solve problems that would otherwise need a high speed logic analyser) but, unlike dedicated logic test equipment, it is equally suited to the display of analogue waveforms.

The ability to simultaneously observe 8 waveforms is an invaluable aid in analysing the complex relationships that exist between signals in today's increasingly sophisticated equipment. Typical application areas include microprocessor-based products, data transmission systems, analogue to digital converters, phase-locked loops, frequency dividers etc.

The OM358 is a professionally specified instrument with a 3% calibration accuracy and a bandwidth of 35MHz. Each input has an impedance of 1MΩ-20pF and accepts signals up to ± 6V. A mode switch allows an 8 channel, 4 channel or single channel display, and triggering can be selected from any input.

OM358 multiplexer complete with two off BNC cables for connection to oscilloscope £197.80 (incl P + P and V.A.T.)

The world's most advanced low-cost bench multimeter!

Thurlby 1905a £325 +VAT

A complete high performance bench DMM

- 5½ digits; 0.015% acc; 1 µV, 1mΩ, 1nA.
- Full ac and current functions as standard

A sophisticated computing and logging DMM

- Linear scaling with offset; null/relative
- Percentage deviation; running average
- dBV, dBm general logarithmic calculations
- Limits comparison; min and max storage
- 100 reading timed data logging
- RS232 and IEEE-488 interface options

Thurlby Electronics Ltd
New Road, St. Ives, Huntingdon, Cambs. PE17 4BG
Tel: (0480) 63570.

CIRCLE 62 FOR FURTHER DETAILS.

Hitachi Oscilloscopes

the highest quality the most competitive prices

Hitachi Oscilloscopes provide the quality and performance that you'd expect from such a famous name, with a newly-extended range that represents the best value for money available anywhere.

V-212 20MHz Dual Trace (illustrated) V-209 20MHz Mini-Portable
V-222 20MHz Dual Trace V-509 50MHz Mini-Portable
V-203F 20MHz Sweep Delay V-1100 100MHz DMM/counter
V-353F 35MHz Sweep Delay V-134 10MHz Tube Storage
V-422 40MHz Dual Trace VC-6015 10MHz Digital Storage
V-653F 60MHz Dual Timebase VC-6041 40MHz Digital Storage

Prices start at £299 plus vat (model illustrated) including a 2 year warranty. We hold the complete range in stock for immediate delivery.

For colour brochure giving specifications and prices ring (0480) 63570
Thurlby-Reltech, 46 High Street, Solihull, W. Midlands, B91 3TB

CIRCLE 64 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985
British invention, innovation and electronics

This series is designed to show that Britain — with her unique technological strengths built up over the years — is as capable as ever of making contributions in these fields at the global level; and is doing so.

Some thirty years ago, Great Britain seemed poised to leap ahead in a technological world centred on electronics and electronically-based systems and techniques. Much of the lead that this country possessed came out of the developments of World War II, notably from radar. Equally important — from parallel peacetime work on UK high-definition television.

A comparable position had also been reached with British computers by this time; and this is examined in more detail in later articles. Suffice to say at this stage that the world's first stored-program digital computer (program and data held in the same store) — first operated successfully in Manchester University in June, 1948.

This series is intended to show that Britain — with her unique technological strengths built up over the years — is as capable as ever of making contributions in these fields at this global level; and is, in fact, doing so.

This is, of course, in direct conflict with the adverse criticism which has been voiced in recent years, especially with regard to Britain’s alleged failure to keep up with modern technological developments, not only in the high technology of electronics, but also in their application to the older, traditional industries. The key word here is developments — most critics agree that the British are still a nation of inventors, but that their record for bringing their new ideas to fruition is increasingly open to question.

Exceptions to this reading of the situation will immediately spring to mind, one of the most outstanding being British computer-based process and similar control. Other major examples are to be found in aerospace and over the full range of medical electronics.

Nevertheless, it has to be accepted that since the late 1950s, a significant number of projects, potentially of world standing, have not reached their target. In extreme cases they have been abandoned; in others the project time scale has become so extended and the overall cost so high that the further development, which it would have been uneconomic to have carried out, has been completely blocked.

The unsuccessful project is not by any means confined to the British.

However, although the declared aim of this series is to give a considered account of the positive contribution that the UK can make to technology, it is just as vital to safeguard these contributions by indicating where “It can go wrong” as, for example, when the impression is given, falsely, of drive and impetus having been lost.

Education — the concealed but crucial factor

Thus part of this first article will consist of a short review of the changes that have taken place in education in Britain over the period in question, and which have affected engineering policy, ‘engineering’ being taken in its widest sense.

With the amount of public comment and debate which has been devoted to higher education in Britain it has been possible to see how attitudes to technology have been reflected in the educational field. Perhaps the most significant instance of this is that the Robbins Report, with its far-reaching recommendations, was first published in 1963, i.e. at the beginning of the period.

The Robbins Report, basically concerned with the provision of graduate education in the UK, called for an unprecedented increase in the places available in universities and polytechnics. This expansion was to be achieved by literally increasing the numbers of both; the former objective being attained largely by bringing the old Colleges of Advanced Technology to University status, and the latter involved the setting-up of 30 new polytechnics.

The Robbins Report and its implications have continued to receive attention in a number of connections, particularly with regard to the demand which developed following the Report to reduce specialization in degree courses. As recently as May 8th, 1984 two letters in The Times clearly advocated a change away from “our over-specialized and over-academic upper secondary and higher education.”

Possible consequences, such as ‘dilution’ and inadequate course duration (two years proposed for the initial undergraduate course) are clear; but in general academics in the UK seem to have agreed that there were advantages in pursuing the proposals, and that the implied “mass attack” principle was acceptable.

by R.E. Young, B.Sc. (Eng.), F.I.E.E., M.R.Ae.S.

ELECTRONICS & WIRELESS WORLD MARCH 1985
Fig. 1 Distribution of UK national inventive capacity

More recently they have been able to cite Japan as well as the United States and France as providing this kind of two-year course. In contrast, the outcome of the Robbins Report has been somewhat different for UK engineering and invention. The two major issues which have arisen lie in two areas. 

'N.H.C.' In the past Higher National Certificate, with its specialist endorsements, had provided a route to Chartered Engineer status through a combination of part-time study and 'real job' working. This represented an element in the technical education which has been described as being the envy of the world. In fact the N.H.C. — superficially 'down' in academic content — has been seen to provide a unique form of broad technical education which has served the country well in the past. Surprising though it may seem, this has applied with special force to engineering research and development, where much of the actual innovative contribution to the 'small team' approach came from H.N.C. members, particularly where systems engineering was concerned. Also the H.N.C. approach provides a reference base for broad technical (engineering) education. There are, of course, other ways of achieving such education. One proposal — already tried out quite comprehensively — is to introduce advanced graduate-apprenticeship type schemes as a main part of career structures, enabling innovative ability to be recognized and built up under real-life conditions.

Early education and technological thinking.

Similar but less noticeable changes have appeared over this period in conventional education in the UK where the trend has been to reduce the attention given to basic subjects (the '3 Rs' in English parlance). That the effect of these changes should enter into later life particularly where engineering is concerned — may seem unlikely. Nevertheless, analysis shows that what can be regarded as a change in policy has had repercussions extending over the whole range of technological thinking. As will be shown in this and subsequent articles, these basic subjects become, if anything, increasingly vital with progress up the career ladder, and with the corresponding demands placed on technical grasp. Thus, representative examples of this spread can be quoted in terms of the ability to write clear unambiguous English. In the ultimate, this ability can make all the difference between a patent application being accepted or being rejected, or between success and failure in bringing an invention (or any new equipment for that matter) into production, where the hand-over between development and the manufacturing side must be complete. This aspect is examined in more detail later, especially with regard to maintaining continuity of design during this critical, and often lengthy, transfer.

The need for precise English almost certainly becomes most apparent in the preparation of software. This need remains, in fact, until any computer-based scheme is completed; and as seen in the production of the 'system facilities statement' in the design and development into which it leads and which is consequent upon it. It is, however, in the process of 'setting to work' that one fully realizes how necessary it is to go back to first principles whenever an obscure (effectively intangible) problem arises; and how clear it becomes that these principles and the way of thinking that goes with them have been absorbed during early education. Examples which can be quoted...
in this general connection include the radar installation which appears to be working, and yet is actually 'blind', and the large control complex where a fault on a critical piece of instrumentation is literally hidden by its failure to provide information — and can lead to a complete system breakdown.

Workers in this and comparable fields will be well aware that in these cases the solution is usually simple in the extreme; but they will be equally aware that the process of reaching that solution is not only long and involved, but is almost invariably underestimated. In summarizing, it has to be stated that one cannot put staff of too high a calibre on clearing troubles at this level and the parallel with systems R and D is almost total; while 'sub-inventions', for instance, will be generated as spin-off from the primary investigations.

The inventor, the team and "high technology"

While still at school, the writer was privileged to see the inventor's model of a mechanical system for removing impurities from brick clay; and made before electronics had taken over. The equivalent of a low-speed centrifuge was represented by concentric circles drawn on paper covering a table top. From there on, however, the model was a scale replica of the final scheme. With much of the operating mechanism made from black strip iron, including the 'signal-box' type controls, the final assembly was a tribute to the friend who had built it from the inventor's design. The large brick-making company for which they both worked provided the greater part of the favourable circumstances and environment which are so necessary for the inventor to have; and which are set out in the 'individual inventor' column of the distribution table.

In this instance, the company — providing a connected employment base and potential interest — had pioneered new techniques in the industry, notably in electrification; and formed part of that type of diversified engineering area which seems to favour British invention and original thinking generally.

In the present instance, the area was that of Peterborough where Sir Henry Royce was an apprentice in "the (then) Great Northern Railway Works". Here he gained an insight into classical engineering and the "painstaking workmanship" it requires, and in the climate mentioned above. It is felt to be more than apposite to quote the example of Sir Henry Royce in the present context. His technological flexibility in moving from mechanical, through electrical, to automobile and aeronautical engineering, combined with his technical insight, match up to all the demands of 'high technology'.

The career and technological achievements of Sir Henry Royce are well documented. Outstandingly he was 'there' when high technology, defined as advanced engineering permeated by electronics, took its shape in Great Britain. The developments of this time are seen, for example, in World War II, when radar became an integral part of aircraft operation.

In this and in a wider connection, the use of 'high technology'; as with R and D, is inescapable; but unfortunate in that both these terms fail to convey anything like the breadth of the fields they cover. Also, and particularly in the UK, high technology is all but synonymous with the silicon chip, and, with this, as only having appeared some two years ago; and there is no doubt that this view has added indirectly but significantly to forming the criticism of British ability to bring ideas to fruition.

To give perspective, it is possible to quote an article "published in the first October 1962, issue of Industrial Electronics on 'Microminiaturization in Electronics' which could almost be a 1984 description of the chip and its manufacture — to produce active and passive components in a silicon block' (the word 'chip' came later).

In the light of the opening to this series this original publication is of special significance, not least that it marks the firm establishment of 'big-system' control in the UK; the cover picture shows the assembly on site of a mainframe computer used for process and similar control. There is no need to stress the date — but in view of the criticism of the post-1970 period, it is worth recording that British computer based control systems continue to hold their place internationally.

As a more general and broad picture, it may be pointed out that Britain had built up a major presence in this technology at the beginning of this decade. A UK newspaper report (September 15, 1980) can be quoted with regard to the basic manufacture of "semi-conductor processing equipment" in the Bristol area, when it was said that "Much of their products are exported to the main chip-making centres in Japan and the US".

'Cluster' areas

This somewhat cryptic heading covers areas exemplified by Bristol and Peterborough, where a number of diversified, adaptable, industries are grouped together to produce a powerful cluster with wide-ranging technological facilities and experience; and providing that climate so necessary for the inventor and for innovation generally.

Such areas can be seen to have existed, e.g. in the Midlands and in the North of England, for many years; and, within the experience of many, can be identified even in the smaller centres of population in the country. All have the key feature of adaptability and the ability to move into new technology which can almost be called a national characteristic.

Instances of this have already, in effect, been given, as for example, with the computer work in Manchester with its heritage of the original innovative cotton (and other) industries of the Industrial Revolution.

A justifiable digression here is that when the new electronic and instrument industries moved into the erstwhile cotton mills of the North West, they found ample evidence of the existence of flowline and other modern production techniques in the buildings they
had taken over.

Reverting to the pure electronics semiconductor, processing equipment made in Bristol, it is not invidious in the present context to point out that the work carried out in this area on the Anglo-French Concorde airliner is representative of the capabilities of this cluster.

The joint achievement of the two national teams in evolving this unique successful supersonic aircraft will be used in a later article to bring out the complexity of such systems engineering. Contrary to virtually all stated opinion, it will be submitted that this project was kept under remarkable R and D management control, with false trail and other sources of development crisis peaks contained.

One of the main elements in the back-up potential of these areas is obviously suitable skilled labour; and it has to be admitted that increasing numbers of announcements of shortages of such labour in the UK represent a threat to any future expansion. However, it is possible to give a specific example showing that these skills are still not far below the surface. The frequency output transducer in the photograph was built earlier this year by an ex-Polytechnic student working, in this instance, under conditions corresponding with those of the graduate-apprentice type of scheme mentioned earlier. The craftsmanship which he contributed much more than is usually realised to British engineering; and who have constituted one of the country's hidden strengths.

**Inventive observation and analysis**

To complete this extremely brief survey of British inventive capability, two widely separated case histories will be given which show how native talent for inventive observation and analysis can be fostered and brought into coordinated R and D. The first example is taken from the aerospace/electronics world with a piece of test equipment centred on a calibrated measurement display. As originally envisaged, the calibration facility was to be provided as an electronic graticule with its spaced horizontal lines representing specified measurement ordinates. At the first planning meeting, following closely on initial briefing, the suggestion was made that the graticule should be replaced by a single calibration line which could be selected from a stepped set of chosen frequencies or be made continuously variable. This suggestion — although it demanded no basic changes to the original concept — went far to transforming the whole project, not least with regard to the facility it gave for clear 'At-a-glance' reading. A consequent advantage was that the speed of development was increased markedly with the more definite — simplified — design criteria which came out of the change, and which applied to most of the sub-system modules.

That it proved possible to improve project flow in this and other ways owed much to the coordinated team attitude, with its full interchange, adopted almost automatically by the six engineers concerned. It may be noted that their technical qualifications were H.N.C. or the equivalent; and that their experience of manufacturing methods and techniques contributed in great measure to the process of finalising the product as development proceeded.

In comparison with the first example, the case history for the second may appear mundane at first sight in that it can be summed up as being the clearance of a fault, actually put on in manufacture. The steps leading up to its clearance, however, cannot be dismissed in this manner, following as they did the long and involved pattern described earlier; and where suspicion of trouble is more a matter of intuitive awareness than of 'solid' detection.

In this instance, slightly high standing-wave ratios on the open wire feeders of a multi-element radar aerial array were eventually traced to incorrect connection in phase — of one pair of dipoles out of a total of sixteen, arranged in four stacks of four. With horizontal polarization, it will be appreciated that it was extremely difficult to pick up the mis-connection on the individual vertical stack feeders by visual inspection, with fifteen out of sixteen being correct.

In the event, and bearing in mind all the possible explanations of high standing-wave ratio, especially when small, it was clearly necessary to bring into independent check method, which could be relied on to eliminate or preferably confirm one of the unknowns. That the latter was made possible by an ingenious adaptation of the radar set itself to display the aerial radiation polar diagram pair the plan position indicator), with the bearing known and the amplitude of the radial time base proportional to radiated signal. Bringing in this method showed that 'kinks' did indeed exist in the polar diagram; and the clearance of that fault became a matter of visual checking of the array.

This example is of interest in its own right; but is quoted with this amount of detail to show how the experience and know-how built up during World War II is still relevant in today's thinking.

First of all, this testing method, with all the neatness of a good invention, had been evolved in a small station in the national radar network. That the circumstances existed for this to take place, and for the information to be made available throughout the network, was a tribute to the flexible management attitude adopted both at immediate and at upper levels of authority. This seemed the unified national effort concentrated on radar, typically British, with much of the coordination and organization developing almost automatically. It would appear that the bringing together of technological effort on this scale has not really been seen in the UK since that time; but there are grounds for suggesting that — as with the instrument making quoted earlier — the potential is even now far below the surface.

The other main aspect is that the basic methods of gathering evidence and data generally, which were developed at that time, do not have to be rediscovered, and are being, and will continue to be, applied in the future. For instance, the gathering and sifting of technological anecdotal evidence developed in analysing obscure radar faults, have been applied to Human Communications. This forms the subject of a later article in this series, and has been generously described as a new discipline by accepted authorities.

Further articles in this series are as follows:

- Radar and television-interchange and spin-off
- Aerospace
- R and D management and economics
- 'Big-system' automation and telemetry
- Vehicle instrumentation
- Human communications
- The future

**Electronics & Wireless World** March 1985
The Keithley 175 Autoranging DMM – sets new standards in bench/portable technology. It outperforms every other unit in its class and has all the features you'd expect of a full function multimeter – 4½ digits, 10 μV, 10 nA, 10 mΩ, TRMS AC – as well as many more you wouldn't expect even on some meters costing twice as much. For instance...

Fast Autoranging on DC volts, ohms, AC volts and dB. Manual range selection too.

100-Point Data Logger stores readings at six different rates from three per second to one every hour.

Digital Calibration for increased reliability and ease of calibration. All calibration constants are stored digitally.

Min/Max Reading Hold stores both highest and lowest readings – over lunch, overnight, over weekends.

dB/Relative dB makes direct dB readings over a wide dynamic range and frequency spectrum.

Relative Reference used to null or zero the display – ideal for monitoring small changes in input signal.

Add IEEE bus and battery options and see for yourself how well the 175 comes up to the mark on your own bench – phone our hotline now for further information.

Keithley Instruments Limited
1 Boulton Road
Reading Berkshire RG2 ONL
Telex 847047

CIRCLE 70 FOR FURTHER DETAILS.
**INTEGRATED CIRCUITS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA3086</td>
<td>AC176K</td>
<td>1.95</td>
<td>2.95</td>
</tr>
<tr>
<td>LA415P</td>
<td>M51521L</td>
<td>1.95</td>
<td>2.95</td>
</tr>
<tr>
<td>LA412</td>
<td>LC7137</td>
<td>5.95</td>
<td>5.50</td>
</tr>
<tr>
<td>LA410</td>
<td>8C158</td>
<td>0.50</td>
<td>0.40</td>
</tr>
<tr>
<td>LA400</td>
<td>BC148B</td>
<td>1.95</td>
<td>1.95</td>
</tr>
<tr>
<td>LA402</td>
<td>8C141</td>
<td>1.95</td>
<td>0.60</td>
</tr>
<tr>
<td>LA405</td>
<td>8C117</td>
<td>1.95</td>
<td>0.60</td>
</tr>
<tr>
<td>LA406</td>
<td>AU110</td>
<td>0.50</td>
<td>0.04</td>
</tr>
<tr>
<td>LA408</td>
<td>AF239</td>
<td>1.95</td>
<td>0.60</td>
</tr>
<tr>
<td>AD161</td>
<td>DIODES</td>
<td>1.95</td>
<td>0.89</td>
</tr>
</tbody>
</table>

**SEMI CONDUCTORS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD703</td>
<td>TBA5200</td>
<td>1.95</td>
<td>0.96</td>
</tr>
<tr>
<td>AC212</td>
<td>TBA510</td>
<td>1.95</td>
<td>1.50</td>
</tr>
<tr>
<td>AC213</td>
<td>TAA570</td>
<td>1.95</td>
<td>0.96</td>
</tr>
<tr>
<td>AC211</td>
<td>TBA920</td>
<td>1.95</td>
<td>1.25</td>
</tr>
<tr>
<td>AC829K</td>
<td>TBA560C</td>
<td>1.95</td>
<td>0.97</td>
</tr>
<tr>
<td>AC870X</td>
<td>TDA2030</td>
<td>1.95</td>
<td>1.25</td>
</tr>
<tr>
<td>AC878</td>
<td>TDA1190</td>
<td>1.95</td>
<td>1.25</td>
</tr>
<tr>
<td>AD712</td>
<td>TDA440</td>
<td>1.95</td>
<td>1.25</td>
</tr>
<tr>
<td>AD43</td>
<td>R2323</td>
<td>1.95</td>
<td>1.25</td>
</tr>
<tr>
<td>AD44</td>
<td>0C23</td>
<td>1.95</td>
<td>1.25</td>
</tr>
<tr>
<td>AD45</td>
<td>BT100A/02</td>
<td>1.95</td>
<td>1.25</td>
</tr>
</tbody>
</table>

**ELECTROLYTIC CAPACITORS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>13000051E</td>
<td>1.95</td>
<td>0.96</td>
</tr>
<tr>
<td>17</td>
<td>13000061E</td>
<td>1.95</td>
<td>0.96</td>
</tr>
<tr>
<td>17</td>
<td>13000071E</td>
<td>1.95</td>
<td>0.96</td>
</tr>
<tr>
<td>17</td>
<td>13000081E</td>
<td>1.95</td>
<td>0.96</td>
</tr>
<tr>
<td>17</td>
<td>13000091E</td>
<td>1.95</td>
<td>0.96</td>
</tr>
</tbody>
</table>

**NEW BRANDED CATHODE RAY TUBES**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A5550</td>
<td>A5353</td>
<td>1.95</td>
<td>2.95</td>
</tr>
<tr>
<td>A5550</td>
<td>A5353</td>
<td>1.95</td>
<td>2.95</td>
</tr>
</tbody>
</table>

**TAPE HEADS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDA2571</td>
<td>TDA3310</td>
<td>1.95</td>
<td>2.95</td>
</tr>
</tbody>
</table>

**ELECTRONICS & WIRELESS WORLD MARCH 1985**
### A SELECTION FROM OUR STOCK OF BRANDED VALVES

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1334</td>
<td></td>
<td>7.50</td>
<td>0.545</td>
</tr>
<tr>
<td>E1634</td>
<td></td>
<td>6.85</td>
<td>0.95</td>
</tr>
<tr>
<td>E2833</td>
<td></td>
<td>5.95</td>
<td>1.00</td>
</tr>
<tr>
<td>E1354</td>
<td></td>
<td>4.25</td>
<td>0.545</td>
</tr>
<tr>
<td>E1635</td>
<td></td>
<td>5.95</td>
<td>0.95</td>
</tr>
<tr>
<td>E1335</td>
<td></td>
<td>5.95</td>
<td>1.00</td>
</tr>
<tr>
<td>E1636</td>
<td></td>
<td>4.25</td>
<td>0.545</td>
</tr>
<tr>
<td>E1355</td>
<td></td>
<td>4.25</td>
<td>0.95</td>
</tr>
<tr>
<td>E1637</td>
<td></td>
<td>5.95</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Note:**
- Prices are in British Pounds (£).
- Quantities are in packs of 100 unless otherwise specified.
- The table includes a variety of branded valves with different descriptions and quantities.

---

**CALLERS WELCOME**

- **Entrance on A227**
- **50 YDS SOUTH OF MEOPHAM GREEN**
- **Car Parking Available**

Open Mon-Thurs 9am - 5:30pm, Fridays 9am - 5:00pm.

**Access and Barclaycard Orders Welcome**

**Export Orders Welcome. Cargage/Post at Cost.**

---

**CIRCLE 39 FOR FURTHER DETAILS.**

**Electronics & Wireless World March 1985**
METER PROBLEMS?

137 Standard Ranges in a variety of sizes and styles available for 10-14 days delivery. Other Ranges and special scales can be made to order.

Full Information from:
HARRIS ELECTRONICS (London)
138 GRAY'S INN ROAD, W.C.1
Phone: 01-837 7937
Telex: 892301

Circle 37 for further details.

Lynwood GD1 VDUs: Intelligent Green microcontrolled, RS232, printer port, 101 key k/b. Full Video enhancements. ONLY £149 + £15 P&P (S/H)
Burrngha MT686/7/7D10: Intelligent Green 12" VDU with 4 micros and 64K store. RS232, Programmable. Only £199 new or £149 S/H + £15 P&P
Open Chassis Video Monitors from above VDUs. £40 + 7.00 p&p
Multirail Switching PSUs from above 5v 4A 12v 2-4v. £25 + £1.50
Data General 6012 VDU's very attractive display working RS232 with integral 73 key k/b either terminal mode or stage buffered. Only £120.00 + £15.00 p&p
Centronics 300 Line printers: Professional fast (120 cps), superb quality 90 column printer. Parallel/ld... ONLY £399 + £15.00 P&P
Osborne Executive Portable CP/M system with diskette of software. Twin floppy drives £900 + £15.00 P&P
Diablo 530 Delaywheel printer. OEM MT £335/0 + £15.00 P&P
Calcump 565 Drum Plotter, 1000 steps. ONLY £450 + £100 P&P

Lynwood GD1 VDU, RS232 Interface £149 + £15 p&p

Check with your local supplier for further details.

Circle 37 for further details.
Floppy discs

David March concludes his survey of disc storage systems for microcomputers with a look at the subtleties of Tandy’s TRS-DOS

The original TRS-80 Model I supported up to four external 5½in disc drives daisy-chained together, each of single-density, single-sided type. Later the TRS-80 Model III was developed with up to two built-in 5½in drives operating in double-density, single-sided mode. Subsequently an upgrade for the Model I was issued which incorporated many of the features of the Model III operating system including double density.

Both operating systems, known as TRS-DOS, provide many facilities beyond straightforward file handling. Overlays are used extensively, making a resident system disk essential; but in single-drive systems, there is the drawback that space for user files is considerably reduced.

The TRS-80 Model II was a much more expensive business computer using 8in drives.

On start-up the Model I loads and executes a bootstrap program from track 0, sector 0. This track is always recorded in single-density and so allows the upgraded Model I to run either operating system. The bootstrap loads in further TRS-DOS programs which remain in memory and provide the core of the operating system.

Directory structure

The directory occupies the whole of track 17. This track was chosen because it is half-way across a 35 track disc and so minimises head movement when TRS-DOS accesses the directory. This is very important because even system files are accessed via the directory.

The allocation of a whole track to the directory seems at first sight extravagant but it does provide two significant advantages. The f.d.c. used in the Model I supports at least two distinct synchronizing patterns for data fields. By applying one pattern exclusively to the directory track a major benefit ensues: the directory cannot be accessed by normal read/write commands and so is protected from inadvertent access or corruption. Each directory entry is quite generous, allowing comprehensive file security to be implemented.

Two sectors of the directory track contain ancillary information about the disc in general as well as an index to the actual directory entries.

The first sector holds three separate sets of information. First, a bit map indicating which granules are in use, known as the granule allocation table (Gat). Second, a map indicating any faulty tracks. Both tables use one byte per track and are sized to allow up to 96 tracks. Lastly, the remainder of the sector contains the disc name and password, creation date and an auto start-up command.

The second sector contains an index to the directory entries in the remaining sectors of the track. Known as the hash index table (Hit), this uses one byte per directory entry. The value of each byte is derived from the file name plus extension by a hashing algorithm whilst its position in the Hit defines the sector and slot within sector where the corresponding directory entry may be found.

The cost of these two sectors is justified by several benefits:
(a) any granule can be allocated to any file —
• redundant space in a file is limited to less than one granule,
• files can be freely extended or reduced in size at any time,
• by allocating different files to separate areas of the disc, any extension will (probably) be achieved in physically adjacent sectors and so will keep access time short.
(b) the characteristics of a disc are recorded on the disc itself —
• thus TRS-DOS can handle mixed drives of 35, 40 and 80 tracks in any combination.
• a disc with minor damage can be salvaged and the unusable tracks locked out.
• even the use of track 17 for the directory is not sacrosanct as the directory track number is held as a parameter in the bootstrap sector of track 0.

<table>
<thead>
<tr>
<th>Field</th>
<th>Bytes</th>
<th>Field name</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-95</td>
<td>Granule allocation table</td>
<td>One bit per granule</td>
</tr>
<tr>
<td>2</td>
<td>96-191</td>
<td>Track lockout table</td>
<td>255 = track locked out</td>
</tr>
<tr>
<td>3</td>
<td>192</td>
<td>Disc size</td>
<td>Number of usable tracks</td>
</tr>
<tr>
<td>4</td>
<td>193-205</td>
<td>—</td>
<td>Not used</td>
</tr>
<tr>
<td>5</td>
<td>206,207</td>
<td>Disc password</td>
<td>Encoded in Ascii padded with spaces</td>
</tr>
<tr>
<td>6</td>
<td>208,215</td>
<td>Disc name</td>
<td>In Ascii mm/dd/yy</td>
</tr>
<tr>
<td>7</td>
<td>216-223</td>
<td>Creation date</td>
<td>Start-up option</td>
</tr>
<tr>
<td>8</td>
<td>224-255</td>
<td>Auto command</td>
<td></td>
</tr>
</tbody>
</table>

TRS-DOS directory details: GAT Sector

TRS-DOS directory details: directory entries

ELECTRONICS & WIRELESS WORLD MARCH 1985

by David March
**TRS-DOS directory details: Hit sector**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hash index</td>
<td>0-127 bytes</td>
</tr>
<tr>
<td>2</td>
<td>System file</td>
<td>128-207 bytes</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>208-255 bytes</td>
</tr>
</tbody>
</table>

Whole sector used for 64 entries in single density TRS-DOS
Not used
Only in double density TRS-DOS

Within the limits of the hashing algorithm, search time for a particular directory entry is minimised —
- unallocated file names will be detected by a single search of the Hit.
- allocated file entries will be accessed directly via the Hit.

**System files**

In single-density TRS-DOS, the system files (limited to 16) used the reserved file extension/SYS and occupy the first two slots in each of the remaining directory sectors. This limits the number of user files to 48 but enables the same access mechanism to be used for all files.

In double-density TRS-DOS, a separate system file table holds abbreviated file location information. This minimises access time since no searching is needed, protects system files from unauthorised access and allows up to 128 user files. Each system file entry occupies two bytes and stores file position and length.

In double density, fields 7-9 of each primary entry contain the creation date of the file. This is held in binary with the month in byte 1 and the year in byte 2.

**File protection**

Fields 1, 14 and 15 provide a high measure of security for files but their use is entirely optional.

Security is invoked in the first instance by quoting a password (up to 8 characters) when a file is created. Subsequent access will be available only if the password is correctly appended to the file name.

The introduction of a second password allows separation of the updating and access security facilities. The update password allows complete freedom to load, run, modify, rename or even delete the file. Operations available via the access password are limited by the value of field 1 (access control). For example, consider a Basic program file having the following particulars —

<table>
<thead>
<tr>
<th>File name</th>
<th>TARDIS</th>
<th>File Extension</th>
<th>BAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access control</td>
<td>EXECUTE</td>
<td>Update password</td>
<td>PRIVATE</td>
</tr>
</tbody>
</table>
| Access password | PUBLIC | The normal user will be privy to all particulars except the update password. The only valid reference by this user will be RUN "TARDIS/BAS.PUBLIC".

Any attempt to access the file for reading, writing, loading or whatever is inhibited unless the update password is quoted. In the above example the access password could equally well have been blank, making the whole security mechanism invisible to the normal user. The user simply enters

RUN "TARDIS/BAS"

In double-density TRS-DOS, the system monitors the running of protected programs and wipes the memory clear on normal or abnormal end of the program.

Each granule assignment pair can take one of three meanings:

(a) First byte less than 254 (this byte is the track number and the next byte defines the position within the track and length of the segment);
(b) The first byte = 254 (this indicates that the second byte holds a pointer to an overflow entry);
(c) The first byte = 255 (this is a flag to indicate that the end of the file has been reached).

As a Gap holds only the starting position and length of a segment of a file, additional Gaps are needed whenever the storage ceases to be contiguous. Up to four separate segments can be addressed via the primary entry (the fifth Gap is needed to indicate the end of the file).

For any file which is segmented more, an overflow entry is created. In this case Gap5 is used to point to the overflow entry and subsequent file segments are addressed via the Gaps in the overflow entry. This can be carried on indefinitely, but each overflow entry reduces by one the maximum number of user files available.

Access to multi-segment files is slow because of repeated references to the directory. The only way to alleviate such a file is by copying it to a fresh disk since the physical position of storage areas on the disc is not available via TRS-DOS.

**FLOPPY DISCS:**

**Further reading**

An introduction to microcomputers
vol. 3: Some Real Support Devices, by Jerry Kane and Adam Osborne, Osborne Associates Incorporated.


Data sheet on FD1771-01 floppy disc format-controller, Western Digital Corporation.

Data sheet on SA8179z floppy disc format-controller family, Siemens Aktiengesellschaft.

Data sheet on WD1691 floppy support logic, Western Digital Corporation.

Data sheet on WD1243-01 four phase clock generator, Western Digital Corporation.

BBC disc system user guide, Acorn Computers Ltd, Cambridge.

The CP/M handbook (with MP/M), by Rodnay Zaks, Sybex Corporation.


TRS-80 Model I double-density disk system owner's manual, Tandy Corporation.

Microsoft Basic decoded and other mysteries, IJG Computer Services.

TRS-DOS 2.3 decoded and other mysteries, IJG Computer Services.

Super Utility Plus user's manual, Breeze/QSD Incorporated.

---

**EVENTS**

**February 26**

Electromagnetic aspects of optical devices; IEE Colloquium, IEE, Savoy Place, London WC2. Tel: 01-240 1871 Ext. 269.

**February 26 to 28**

H.F. communication systems and techniques; IEE (and others) Conference at Savoy Place, as above.

**March 4**

Future communications satellites; IEE lecture. Details as above.

**March 6**

Software reliability;

IEE Colloquium, Details as above.

**March 8**

Cellular mobile radio —

Splitting for growth? IEE Lecture. Details as above.

**March 9**

Design = Quality; IEE/Design Council Colloquium, Savoy Place. Details as above.

**March 10**

To measure is to know. IEE Lecture. Details as above.

**March 14**

IGs above 1GHz; IEE Colloquium. Details as above.

**March 14**

Engineering of the human brain; IEE 76th Kelvin Lecture. Details as above.

**March 18 to 21**

Telecommunication transmission; IEE (and others) international conference at Savoy Place. Details as above.

**March 20**

Connectors 85;

Symposium and Exhibition, Post House Hotel, Leicester. Details from Robert Allen. Tel: 0789 204116.

**March 24 to 27**

VIDEQ ’85, Video and techniques exhibition. NEC Birmingham. Details from NEC. Tel: 021 780 4141, Ext 710

**March 26 to 28**

Interconnection Technology; Exhibition, Olympia, London.

---

**www.americanradiohistory.com**
APPLICATION EXAMPLES
* REMOTE INTELLIGENT DISPLAY
* ROBOT CONTROLLER
* PASSWORD SECURITY APPLICATIONS
* SMALL SYSTEM PROCESS CONTROL
* LEARNING TOOL FOR ASSEMBLY LANGUAGE
* WATCHDOG MONITORING
* PRINTER INTERFACE

FIBRE-OPTICS EDUCATOR

A New Concept in Optical Equipment

The Fibre-Optics Educator is a low-cost, versatile instrument designed primarily for organisations involved in or about to enter the field of fibre-optics.

It can function as:
TEST EQUIPMENT e.g. for accurate fibre attenuation measurements to a range of 50dB, optical level measurements, and for testing out analogue and digital optical transmitters and receivers. Also, it may be set to give an audible indication of low level infra-red radiation using the analogue loudspeaker output or the digital buzzer output, with a length of optical cable acting as a probe.

TRANSMISSION EQUIPMENT for both analogue and digital data, over free-space as well as optical fibres. It is also ideal for:
TRAINING engineers, technicians and executives in the growing field of fibre-optics. Suitable for industry, colleges and technology training centres.

The Fibre-Optics Educator comprises fully portable optical transmitter and receiver units, optical cables, together with numerous accessories, a comprehensive manual, and carrying case.

Designed and Manufactured in the U.K.

For further details contact:
ELLMAX Electronics Ltd., Unit 29, Leyton Business Centre, Elloe Road, Leyton, London, E10 7BT.
Tel: (01) 539 0136

CIRCLE 82 FOR FURTHER DETAILS.

New from ORYX-PORATASOL
Portable Gas Soldering Iron

ORYX – market leaders in soldering irons and accessories introduce the revolutionary PORTASOL. This new approach to catalytic soldering iron technology is truly pocket portable (173 mm) and independent of any external energy source. PORTASOL is powered by ordinary cigarette fuel and one filling lasts for 60 minutes continuous use.

* Small, light and can be carried in the top pocket.
* Powered by ordinary cigarette lighter fuel.
* Flint ignition system built into the cap.
* Adjustable temperature equivalent to electric soldering irons 10 to 60 Watt.
* Ease of soldering for engineers, hobbyists, repair men etc.

To: Greenwood Electronics, Portman Rd, Reading, Berks RG3 1NE.
Please send (........(qty.) PORTASOL at £17.25. I enclose cheque/P.O./cash for £................. or debit my Barclaycard no........................Access no........................Expiry date.........

NAME

ADDRESS

ORDER WITH THIS COUPON TODAY

ONLY
£17.25
INCLUDING VAT. P&P

To: Greenwood Electronics, Portman Rd, Reading, Berks RG3 1NE.
Please send (........(qty.) PORTASOL at £17.25. I enclose cheque/P.O./cash for £................. or debit my Barclaycard no........................Access no........................Expiry date.........

NAME

ADDRESS

ORDER WITH THIS COUPON TODAY

ONLY
£17.25
INCLUDING VAT. P&P

To: Greenwood Electronics, Portman Rd, Reading, Berks RG3 1NE.
Please send (........(qty.) PORTASOL at £17.25. I enclose cheque/P.O./cash for £................. or debit my Barclaycard no........................Access no........................Expiry date.........

NAME

ADDRESS

ORDER WITH THIS COUPON TODAY

ONLY
£17.25
INCLUDING VAT. P&P

To: Greenwood Electronics, Portman Rd, Reading, Berks RG3 1NE.
Please send (........(qty.) PORTASOL at £17.25. I enclose cheque/P.O./cash for £................. or debit my Barclaycard no........................Access no........................Expiry date.........

NAME

ADDRESS

ORDER WITH THIS COUPON TODAY

ONLY
£17.25
INCLUDING VAT. P&P

To: Greenwood Electronics, Portman Rd, Reading, Berks RG3 1NE.
Please send (........(qty.) PORTASOL at £17.25. I enclose cheque/P.O./cash for £................. or debit my Barclaycard no........................Access no........................Expiry date.........

NAME

ADDRESS

ORDER WITH THIS COUPON TODAY

ONLY
£17.25
INCLUDING VAT. P&P

To: Greenwood Electronics, Portman Rd, Reading, Berks RG3 1NE.
Please send (........(qty.) PORTASOL at £17.25. I enclose cheque/P.O./cash for £................. or debit my Barclaycard no........................Access no........................Expiry date.........

NAME

ADDRESS

CIRCLE 58 FOR FURTHER DETAILS.

CIRCLE 58 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985
BBC Micro Computer System

BBC Computer & Econet Referencing Centre

BC Micro Computer System

Model B: £348 (a) B+DFS: £400 (a)
Model B+NFS: £389 (a) B+NFS+DFS £450 (a)
ACORN 10 Mbyte Hard Disc £1300 (a)
ACORN 2nd Processors: 6502: £175 (a) Z80: £352 (a)
TORCH UNICORN: Z80 Card: £275 (a) Z80 Disc Pack: £650 (a)
UNICOMM: Packaging Code: £159 (b) 20 Mbyte Hard Disc £400K Floppy £1950 (a)

We stock the full range of ACORN hardware and firmware and a very wide range of other peripherals and firmware for the BBC. For detailed specifications and pricing please send for our leaflet.

ACCESSORIES

EPSON: RX80FT £225 (a); FX80 £315 (a)
FX100 £435 (a); RX100 £345 (a) RX80T £215 (a)
KAGA TAXAN: KB810 £255 (a); KB910 £359 (a)
BROTHER: HR15 £340 (a);
JUKI 8100 £340 (a).

PRINTERS

EPSON Serial Interface: 8143 £10 (b); 8148 with 2K buffer £57 (b)
EPSON Paper Roll Holder £17 (b); FX50 Tractor Attach £37 (b); RX80T Dust Cover £45 (d)
EPSON Ribbons: MXRX/ FX50 35.00; MXRX/FX100 £10 (d)
JUKI: Serial Interface £66 (c); Tractor Feed £99 (a); Ribbon £2.50 (a)
BROTHER HR15: Sheet Feeder £199; Ribbons £1.00 (a)
ACORN 2nd Model

SOFTY II

This low cost intelligent eprom programmer can program 276, 2716, 27256, and with an adaptor, 2564 and 2764.
Display and printer on TV. Has a serial and parallel I/O routes. Can be used as an emulator cassette interface. Softly II £195.00 (b)
Adaptor for 2764 £25.00

28

DISC DRIVES

These drives, fitted with high quality JAPANESE mechanisms are supplied in attractive steel cases painted in BBC colour. The drives are fully Shugart A4000 compatible. All dual drives are supplied with integral power supply whilst a single drive is supplied with power only.

All drives come complete with data & power cables, manuals and BBC formatting disk.

1x100K (25KDD unformatted) £100 (a)
1x440K (1MDD unformatted) £145 (a)
1x200K (5MDD unformatted) £250 (a)
4x200K (MDM unformatted) £360 (a)
C5100 TEC with psu £125 (a) 40/80 Switch Module £30 (c)
C5200 TEC with psu £165 (a) 3in. Athick 100K 40T £105 (b)
C5400 MTS with psu £195 (a) £12/200K £115 (a)

DRIVE ACCESSORIES

FLOPPICLENE Disc Head Cleaning Kit with 28 disposable cleaning discs ensures continued optimum performance of the drives. £14.50 (c)

3M FLOPPY DISCS

Industry Standard floppy discs with a lifetime guarantee Discs in packs of 10
40 Track SS DD £15 (c) 40 Track DD £16 (c)
80 Track SS DD £22 (c) 80 Track DD £24 (c)

DUAL DISC DRIVE

Single Disc Cable £8.50 (d) Dual Disc Cable £8.90 (d)
10 Disc Library Case £1.80 (b) 30 Disc Storage Box £6 (c)
50/40 Disc Lockable Box £14 (c) 100 Disc Lockable Box £18 (c)

MONITORS

MICROVITEC 14in. RGB
1416 Std Res £160 (a); 1411 Std Res PAL/Audio £210 (a); 1411 Med Res £280 (a); Super 16 in. £399 (a); 2031 20ln. Std Res £250 (a); Plinth for 14in. Monitors £58.50.
Microvitec Monitors with TTL/Linear inputs also available.

KAGA TAXAN 12in. RGB
Vision III Hi Res £240 (a); Vision III Super Hi Res £340 (a)
Green Screens, KAGA 12G £99 (a); SANYO DMB 1111 £120 (c; £99 (a);
Swinval Stand for Kaga Green £21 (c)
BBC Leads: KAGA RGB £5 Microvitec £3.50; Moticrome £3.50 (d)
SANYO CZ 3125 £14. RGB Std Res £172 (a)

USB ERASERS

UV-1Eraser with built-in timer and mains indicator. Built-in safety interlock to avoid accidental exposure to the harmful UV rays. Can handle up to 5 eproms at a time with an average erasing time of about 30 mins. £19.98 + £2.50 (c)
UV-1 as above but without the timer. £47 (c)
For Industrial Users, we offer UV140 & UV141 erasers with handling capability of 4 eproms. UV141 has a built in timer. Both offer full built in safety features £40/ UV141 £41.97 + £2.50.

CONNECTOR SYSTEMS

Connectors: 36 way plug Connectors (solder 350p) 475p
36 way pin Connectors (solder 550p) 650p
24 way plug (solder) 385p
24 way snap-on (solder) 475p
50p (solder) 500p
36 way SNAP/B ATT Plug £1.50
24 way .70p £365p

GENERIC CONNECTORS

Cable Type Male to Male £10 Female to Female £10

DIL SWITCHES

Type 4-way 90p 6-way £105 8-way £120 10-way £115

TELEPHONE CONNECTORS

No. of Wires 4-way 6-way 8-way
1p 5p 1.00p 1.10p 1.60p
2p 5p 1.00p 1.10p 1.60p
3p 5p 1.00p 1.10p 1.60p

DIL HEADERS

Type D/PP 14 pins 16p 18p 20p 25p
Type E/PP 14 pins 16p 18p 20p 25p

RIBBON CABLE

Single 4-way 6-way 8-way 10-way
25p 75p 125p 125p

MISC CONNS

21 pin female together £250
8 pin video connector £200

ATTENTION

"All prices in this double page advertisement are subject to change without notice.

All prices exclude VAT. Please add £2.50 (a) £1.50 (b) £1.00 (c).

ACORN INTERFACE

A full implementation of the IEEE 488 standard, providing computer control of compatible scientific & technical equipment, at a lower price than other systems. Typical applications are in experimental work in academic and industrial laboratories. The interface can support up to 16 devices, and would typically link several items of test equipment allowing them to programme the communication and control in turn.

INDUSTRIAL PROGRAMMER

EP8000. This CPU controlled Emulator Programmer is a powerful tool for both Eprom program development and development work. EP8000 can emulate and program all eproms up to 268 bytes, can be used as an on-line unit for editing and duplicatingEPROMs, as a slave programmer or as an eprom emulator £895(a)

TECHNOMATIC LTD

01-208 1177

www.americanradiohistory.com
<table>
<thead>
<tr>
<th>Computer Components</th>
<th>Datasheets</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPROMs</td>
<td>DB1414/2</td>
</tr>
<tr>
<td></td>
<td>1.93</td>
</tr>
<tr>
<td></td>
<td>TC9543</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>IC2026</td>
</tr>
<tr>
<td></td>
<td>3.05</td>
</tr>
<tr>
<td></td>
<td>IC2071</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>TC1436</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>7815C</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>7812C</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>7805C</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>7809C</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>7818C</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>7810C</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151A</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151B</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151C</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151D</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151E</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151F</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151G</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151H</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151I</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151J</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151K</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151L</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151M</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151N</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151O</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151P</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151Q</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151R</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151S</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151T</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151U</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151V</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151W</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151X</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151Y</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>74151Z</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
</tr>
</tbody>
</table>

Please add 50p p&p & 15% VAT. (Export: no VAT, p&p at cost). Orders from Government Depts. & Colleges etc. welcome.

Detailed Price List on request. Stock items normally by return of post. Minimum Telephone Order £5

Circle 71 for further details.

Electronics & Wireless World March 1988
Not only in height is the range of Clark Masts wide but also in the field of application. Every model, mechanical or air-operated, has been created in response to customer requirement and proved in service, for over 25 years.

Major users in the Communications Industry, Broadcasting, Civil Authorities and Military Commands worldwide, have all contributed and benefited from Clark Masts' reliability and ceaseless engineering improvement.

Write for your copy of Clark Masts' "Fast Guide to Mast Selection" and see what we mean.

CLARK MASTS


CIRCLE 42 FOR FURTHER DETAILS.

VIDEO NASTIES?

Pictures that wobble, won't lock or suffer from noise bars? – machines that won't latch, lace or light up? – our pages are full of guidance on VCR servicing problems. TV too – chopper, colour and linearity problems of every sort. Plus news and information on technical developments. March issue features...

ELECTRONIC SPEECH FOR TVS AND VCRs

The theory of synthesised speech and a practical circuit that gives clear speech.

MARCH ISSUE

TELEVISION SERVICING PROJECTS VIDEO DEVELOPMENTS

IN VIEW OF THE EXTREMELY RAPID CHANGE TAKING PLACE IN THE ELECTRONICS INDUSTRY, LARGE QUANTITIES OF COMPONENTS BECOME REDUNDANT. WE ARE CASH PURCHASERS OF SUCH MATERIALS AND WOULD APPRECIATE A TELEPHONE CALL OR A LIST IF AVAILABLE. WE PAY TOP PRICES AND COLLECT.

R. Henson Ltd.
21 Lodge Lane, N. Finchley, London, N.12. 5 mins. from High Ho corner
Telephone 01 445 2713/0749

CIRCLE 52 FOR FURTHER DETAILS.

MICRO CONTROL BOARD

K85 MICROPROCESSOR DEVELOPMENT SYSTEM

The complete, low cost, highly portable development tool to develop, test and debug programs and hardware for 8085 based micro boards.

- In-circuit emulation
- Eprom programmer (memory mapped)
- High speed symbolic assembler (15 sec source code in approx 15 secs)
- Disassembler
- Program editor
- Powerful debugger program
- STD or Euro bus expansion
- Unique storage/retrieval of library source files to and from eprom

K85 (computer, MT885-1, kybd) £1995

All prices exclude VAT and p&p
Kimberry Ltd, 29 Thorney Hedge Road, London W4 5SD. Telephone: 01-995 6470.

CIRCLE 66 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985
Aesthetic sub-woofer system

Practical guidance with particular reference to filter design

With the latest improvements in recording techniques and with the potential use of compact discs in mind, I felt that it was time to extend the low frequency capability of my current speakers. Initial discussions with a higher authority indicated a certain lack of enthusiasm for adding 'useless clutter' to her living room, but agreement was ultimately reached that a coffee table could be added to the room at any convenient wall location. The usual constraints of low cost and small size completed the somewhat unorthodox specification for the design, and the notes which follow indicate one approach to providing such a product.

Much like impending motherhood, the functional status of a loudspeaker is reasonably self-evident at one glance, and, again like i.m., has always been so. So the first problem was to find some basis of operation where the actual loudspeaker could be hidden, and this is supplied by data given in ref.1. Copied directly from Figs 5 and 6 of ref.1, Fig.1 shows that up to about 250Hz there is little difference in performance between a front-facing or rear-facing speaker of reasonable dimensions. Above this frequency there is a 10dB lift which makes the approach unacceptable for a full-range system. However, if the incoming signal is limited with a suitable low-pass filter, then a rear or floor-facing speaker becomes feasible for sub-woofer application, and the speaker, vent, control panel and wires can all be hidden from critical gaze.

Path-length effects

The central problem of sub-woofer application lies in the fact that it almost certainly will not be at the same distance from the ear as the other two speakers. It may be placed adjacent to a different wall and path differences may extend to one or more wavelengths of the filter crossover frequency, i.e. one or two metres. Thus it became necessary to generate a model for examining the impact of gross path differences between two speakers on the phase of the signals involved, and from this to evolve the variation of the overall amplitude of received signal.

This model is outlined in Appendix 1 which shows how the filtered performance of one speaker can be modified to include path difference effects, and then sum the resultant outputs. With the aid of some standard filter coefficients and a somewhat userphobic computer and using the model already mentioned, the curves for two filters are given for different normalized frequencies in Fig.2. The results are interesting. Having ignored the direct effect of distance on received signal (= 1/d) for convenience, the curves also indicate the effect of any phase change (lead or lag, loudspeaker inductive effects) as equivalent to path difference. Thus, A = 0.5 (path separation 0.5λ) is the same as ϕ = 180° in the speaker coil at the crossover frequency. One could go on, but the main conclusions are clear: (a) for any filter, there will always be a null at crossover frequency at some path separation, and (b) the higher the order of filter, the narrower the frequency band of response perturbation due to path differences.

If, as a consequence, a high-order filter is selected then another problem is introduced — that of phase distortion. This is related to the passage of a non-sinusoidal signal, say a drum beat, through a signal-processing circuit where the phase of the harmonics has been changed in the reconstituted signal with respect to the original. With a steep filter system such phase changes will be severe. Fortunately, while detectable in an anechoic chamber, these phase effects are very difficult to hear in a reverberant environment such as a normal living room — see page 593 of ref.2. Similarly, the problem of signal phase-null will also be minimized in such an environment due to the multiple reflections that will be generated. In any case I felt that by restricting the possible amplitude effects to a narrow frequency band it would be more difficult to detect any degradation to the total music or speech signal.

Filter implementation

Recall that application of a rear-facing speaker requires that the high frequency response of the woofer shall be well attenuated by 250Hz. Conversely, with currently available small speaker systems, the low frequency roll-off occurs at about 100Hz which ideally should not affect the overall system performance. Thus a high-order symmetrical filter centred at about 160Hz will be required, which is fully in line with the discussion on unequal path length aspects. The selection of a fourth-order 0.5dB ripple Tchebycheff filter appeared to reasonably satisfy all the imposed constraints.

The design was carried out by way of a nostalgic trip back to the classic Sallen and Key format using ref.3 as a basis. The 3dB frequency was selected to be 155.2Hz simply to optimize the resistor values (on an E24 grid) for the high-pass filter, while the low-pass equations were modified to allow the use of standard value capacitors and to reduce simple gain in the low frequency path.

The last-mentioned — about 10dB — is required to take up the 6dB attenuation introduced by the resistive summing of the two input signals, and to ensure that an adequate signal level is presented to the woofer power stage.

A sub-woofer is normally required to work over a restricted frequency range operating in a reverberant environment. With these assumptions, the problems of phase distortion and path difference signal null were taken as less important, which allowed the use of an unusually high-slope filter network. It is this filter which acts to restrict the overall impact of path difference effects and to permit speaker locations which can meet some decorative as well as technical demands. The design allows the filter to be embedded in virtually any amplifier configuration and the system to work with any existing stereo speakers. The Active Coffee Table seems to have proved a viable concept.
**SUB-WOOFER**

![Butterworth Tchebycheff](image)

**Fig. 2.** To investigate effects of path-length difference between two speakers, on amplitude response, one speaker’s performance was modified to include the consequent phase effects and the two outputs added (modelled as in Appendix 1).

![Fig. 4. Effect of varying capacitor and gain values in crossover region](image)

**Fig. 4.** On this basis, 1% resistors and 2% capacitors are used throughout.

**Loudspeaker box design**

In the first place it is necessary to define the speaker requirements and it seemed reasonable to aim for a 3dB-down frequency of about 40Hz, with a 1 watt acoustic capability at that frequency. With a typical 1% efficiency, this is equivalent to a driver amplifier and speaker capability of about 100 watts. In addition, to meet the 1 watt/40Hz criterion the speaker linear displacement volume ($V_d$) will need to be about 400cm$^3$ (Fig.19, page 314, ref.4). In effect, a long-throw, 30cm diameter, 100 watt speaker is needed with suitable parameters to match a low-volume box, and the Philips type AD12250/W8 was selected as a low-cost component for use with a vented-box approach.

Box design was carried out by means of equations provided in ref.5 and repeated in Appendix 3 along with the required calculations. These equations effectively define the box and vent requirements for a ducted system provided that the Theile-Small parameters for the speaker are known i.e. $V_m$, $f_m$, and $Q_v$ (see Appendix for definition). Equation 1 includes a function of the negative ripple that may be used to extend the frequency response at the expense of a larger box requirement and a dip in the response curve. If not required put $R_n = 0$.

**Practical details**

Once the required internal box volume is known, the actual design, style and dimensioning of the layout is open to personal choice. In this case an upright box was built using the customary glue, screw and silicone sealant. The selected amplifier and power supply (types HY248 and PSUS54X from ILP of Canterbury) were mounted inside the box using rubber washers or gaskets to minimize vibration, while the
box vibration itself was reduced using an aluminium L-beam attached to the wall behind the speaker and a 25mm diameter rod about 1mm longer than required forced between the speaker wall and the back wall close to the speaker aperture. These box strengthening techniques were taken from page 93 of ref. 6. The vent, comprising a flanged plastics tube was found in the plumbing department of a hardware shop.

The box is fully sealed (vent apart) and entry is via the speaker opening. For this reason wiring was done with connection boxes for ease of maintenance, with fuses and the level adjustment potentiometer brought to a small aluminium panel below the speaker. To avoid potential earth loops, the power lines are two-terminal only while the signal input is provided by a two-wire screened cable (about five metres long), where the screen is attached to the aluminium panel and the rectified power ground within the speaker cabinet. Constructional details are illustrated in Fig. 5.

The filter was designed to take minimum additional power from the existing amplifier supply rails using two TL074 quad op-amps, and the supply circuits are shown in Fig. 6. The anti-thump circuit also shown is not technically necessary but subjectively reassuring.

The total cost including speaker, electronics, chipboard and veneer came to about £120.

Results

The test equipment comprised the UREI model 200 automatic plotting system used in conjunction with an AKG type C451EB microphone. With this equipment, the filter responses (suitably adjusted for gain differences) are given in Fig. 7. While the responses do not fully match the design objectives, they are probably adequate — being about 18dB down at 100Hz and 250Hz respectively.

The woofer is matched to its location and the other speakers by providing a continuous input tone at the crossover frequency. The level pot. is adjusted until the sound coming from the woofer is equal to the sound from the other sources — detected at

---

**Fig. 7.** Though not quite up to the design objectives, measured filter response is adequate at 18dB down at 100 and 250Hz.

**Fig. 5.** Vented enclosure is designed according to equations of Appendix 3, given the Thiele-Small parameters for the speaker. Top and bottom of enclosure, not shown, are fashioned for decorative appeal.

**Fig. 6.** Filter circuits of Fig. 3 using TL074 quad op-amps take a minimum of power from the amplifiers used (IPP types, see text). This anti-thump circuit is optional.
some sensible monitoring point. This level may then be checked and readjusted by carrying out a full frequency sweep and ensuring that the mean l.f. level is comparable to the mean h.f. level over the range, say, 50-500Hz.

The overall speaker performance in the room was measured using a one-third octave wbler attachment to the recorder system and is shown in Fig. 8, where the bottom curve is for the woofer alone while the upper curve is for the woofer plus one existing full-range speaker. Again, not fully meeting design spec, but a chartable view would be 3dB-down at about 43Hz. The upper curve was taken with the microphone placed centrally in the room and its location must have been particularly fortunate because subsequent brief tests with other locations showed variations of about ±4dB in the crossover region. However, from the path length discussion, this is only to be expected.

Vibration tests were carried out with functionally related test sensors placed on top of the speaker — coffee cups — and while 'cup chatter' could be detected at reasonable volume, it was only in conjunction with resonance noises from the cabinet doors and chatter from the room windows.

Subjective listening was positive. For those who enjoy a 'thump' — be it from beat, electronic or classical sources — the added octave can certainly be detected and appreciated, and no degradation was discernible at any location in the room.

Thanks to D.L. Hermans and H. Wiens for their forthright assistance and particularly to J.P. Vanderreydt for his tolerant and comprehensive guidance.

— M.B.

REFERENCES

Appendix 1

Phase effects of path length
Consider two speakers (a) and (b), from a receiver with a planned cross-over frequency of f1 corresponding to a wavelength of λu. Then let:
\[ l_1 = l_1 = \frac{\lambda_u}{2} \]
where A is a multiplier. Then:
\[ (1 - \frac{1}{2}) = Ac1 = AC \cdot 2\pi l_1 \]
and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]

and for the nearer source:
\[ \varphi_1 = \frac{1}{2} \cdot \omega c \]
The Leader range of high performance oscilloscopes are designed to suit most requirements, offering comprehensive specification and long term reliability, yet remaining low cost.

LBO-514A is a dual trace 15MHz bandwidth 1mV sensitivity low cost general purpose oscilloscope

LBO-522 is a dual trace 20MHz bandwidth 500µV sensitivity oscilloscope featuring XY vanable hold off plus full TV triggering.

LBO-523 is a dual trace 35MHz oscilloscope offering similar features to the LBO-522 plus internal graticule dome mesh tube with 7W acceleration (pda).

LBO-524 is a 35MHz dual trace oscilloscope similar to the LBO-523 plus the added facility of delayed sweep and base.

LBO-525L is a 50MHz dual trace oscilloscope offering comprehensive triggering and timebase facilities.

LBO-516 is a 100MHz dual trace oscilloscope offering optimum performance at a competitive price.

LBO-518 is a 100MHz quad channel oscilloscope with eight trace capabilities offering comprehensive triggering and timebase options.

LBO-5825 is a digital storage oscilloscope with a real time speed of 50MHz.

LBO-3085 is a batterymains dual trace 20MHz small compact oscilloscope offering all the features normally found in a bench scope.

For further information contact: Thandar Electronics Limited
London Road, St. Ives, Huntingdon
Cambridgeshire PE17 4JR, England
Telephone (0480) 64646 Telx: 32250 Test

THE LOGICAL CHOICE

WHY ILP? Years of experience in audio, unique designs, world wide sales and outlets, reliable delivery and friendly service.

BIPOLAR MODULES

Ideal for Hi Fi, Full load line protection integral Heatsink, slew rate 15v/µs.

Distortion less than 0.01% Type Output Load Power Impedance Watts (ms) Price

<table>
<thead>
<tr>
<th>Type</th>
<th>Output</th>
<th>Load</th>
<th>Power</th>
<th>Impedance</th>
<th>Watts (ms)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HY30</td>
<td>15</td>
<td>4</td>
<td>8</td>
<td>2.45</td>
<td>8.45</td>
<td>£26.95</td>
</tr>
<tr>
<td>HY60</td>
<td>30</td>
<td>4</td>
<td>8</td>
<td>19.45</td>
<td>20.95</td>
<td>£39.95</td>
</tr>
<tr>
<td>HY124</td>
<td>60</td>
<td>4</td>
<td>8</td>
<td>20.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HY128</td>
<td>60</td>
<td>8</td>
<td></td>
<td>20.95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MOSFET MODULES

Ideal for Disco's, public address and applications with complex loads (line transformers etc.). Integral Heatsink slew rate 20v/µs distortion less than 0.01%

Type Output Load Power Impedance Watts (ms) Price

<table>
<thead>
<tr>
<th>Type</th>
<th>Output</th>
<th>Load</th>
<th>Power</th>
<th>Impedance</th>
<th>Watts (ms)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOS128</td>
<td>60</td>
<td>4</td>
<td>8</td>
<td>20.95</td>
<td></td>
<td>£39.95</td>
</tr>
<tr>
<td>MOS248</td>
<td>120</td>
<td>4</td>
<td>8</td>
<td>39.95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

POWER SUPPLY UNITS

Type For Use With Price

<table>
<thead>
<tr>
<th>Type</th>
<th>For Use With</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSU712</td>
<td>1 or 2 HY90</td>
<td>£11.95</td>
</tr>
<tr>
<td>PSU712</td>
<td>1 or 2 HY96</td>
<td>£13.95</td>
</tr>
<tr>
<td>PSU723</td>
<td>1 or 2 MOS129</td>
<td>£22.95</td>
</tr>
<tr>
<td>PSU723</td>
<td>1 or 2 MOS129</td>
<td>£24.45</td>
</tr>
<tr>
<td>PSU732</td>
<td>1 or 2 HY244</td>
<td>£21.95</td>
</tr>
<tr>
<td>PSU732</td>
<td>1 or 2 HY244</td>
<td>£22.95</td>
</tr>
<tr>
<td>PSU742</td>
<td>1 or 2 HY364</td>
<td>£22.95</td>
</tr>
<tr>
<td>PSU742</td>
<td>1 or 2 HY364</td>
<td>£24.45</td>
</tr>
<tr>
<td>PSU762</td>
<td>1 or 2 MOS364</td>
<td>£45.95</td>
</tr>
</tbody>
</table>

FOR FREE DATA PACK PLEASE WRITE TO OUR SALES DEPT.

Post to: ILP Electronics Ltd., Dept. 6
Graham Bell House, Roper Close, Canterbury, Kent. CT2 7EP
Tel: (0227) 454778 Telex: 965780

CIRCLE 28 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985
Three new names from IQD—the leaders in DTMF equipment.

**CODEPAD**
IQD offers the most advanced DTMF signalling equipment on the market.
IQD Codepad: the best in portable tone diallers, available in three models.
IQD Micropad: a microphone with not only the standard functions, but many additional features including an illuminated keyboard version.

**MICROPAD SELLCALL**
Telephone (0460) 74433 for further information.

**R. Withers Communications**
If you have not heard of (R. Withers Communications) we are main distributors or agents for the following, Yaesu, Icom, Kenwood, M Modules, Jaybeam, Toeyna, Revco Antennas, Clearline, Mupek, Dara, F.D.K. Tonna, Weiz, Zycomm, Neve Radiotelephones. We are also stockist (British Telecom Approved) of a wide range of cordless telephones and telephone systems. We are also agents for hundreds of other radio communications equipment known the world over, we also manufacture our own range of VHF—UHF beam antennas which are also used by leading broadcast companies for wireless mic applications. We supply a large range of power transistors & modules to the trade. These we import ourselves directly from Japan. Listed below are just some of the many services we offer:

- Supply & repair of all amateur & business radio equipment
- Complete check of your transceiver on a spectrum analyser (with comprehensive report) for the all in price of £12.50 subject to an appointment being made
- Supply & complete installations of business radio systems including competitive maintenance contracts, local authorities included
- Supply of 10 metre converted radios LCL, DNT, ICOM
- Only supplier of modified Revco RS 2000 S0-S20 MHz continuous coverage scanning receiver modified by (R. Withers Comms)
- Probably the largest seller of second hand radio equipment in the country because of our commission sale agreement (3 month warranty) plus equipment facility
- The fastest growing retail & wholesale company in the British Isles. Send for details of any of the equipment or services we offer whether you are in the profession of just an interested party as we will speed up your enquiry
- For all your communication needs give R.W.C. a try we promise you will not be disappointed
- The largest selection of radio allied services offered under one roof, with no expense spared on test equipment and qualified staff

584 Hagley Road West, Oldbury, Warley B68 0BS (Quinton, Birmingham)
Tel: 021-421 8201/2 (24 hr answerphone)
Overseas customers welcome. We speak German & Japanese. Import/Export no problem. Please telephone during working hours.

Circle 29 for further details.

**Fylde**
TRANSDUCER and RECORDER
AMPLIFIERS and SYSTEMS

reliable high performance & practical controls, individually powered modules—mains or dc option single cases and up to 17 modules in standard 19” crates small size—low weight—realistic prices.

Fylde Electronic Laboratories Limited.

49/51 Fylde Road Preston PR1 2XQ
Telephone 0772 57560

Circle 34 for further details.

Electronics & Wireless World March 1985
NEW-LOOK SPECTRUM MANAGEMENT?

The report in the Financial Times on December 24 that the Government is already actively pursuing the possibility of charging higher "commercial" fees for the use of the radio spectrum clearly has important implications for all users of radio frequencies. The DTI has already invited consultants to tender for a feasibility study. Possible changes were foreshadowed in last-minute changes to the British Telecom prospectus, including the warning to investors that the Government was considering "some form of pricing for the radio spectrum in place of, or in addition to the present licence fee basis." The profits of BT as a main user of the spectrum would clearly be adversely affected by what would amount to introducing a new form of revenue collection. It could amount, in effect, to a new tax on communications, broadcasting, radio navigation, amateur radio etc. At present, DTI licence fees are intended to cover little more than the cost of administration and the less-than-effective regulation of the spectrum. Government departments, particularly the Defence services, are major users of the spectrum.

The ethics of selling a natural resource such as the radio spectrum to the highest bidder seems questionable, akin to the infamous window tax of history that sought to make householders pay for access to light. While it might, or might not, encourage more use of spectrum-conservation techniques, it could have a devastating effect on some services. What, for example, would be the cost of a transmitting licence for television transmission with its 8MHz channel bandwidth? Would licences differentiate between fees payable for Morse, s.s.b., a.m., f.m., broad-band data etc.? Would there be individual DTI licences for cordless telephones, cellular radio etc.?

In the USA, an attempt a few years ago to introduce revenue-raising licence fees for the use of the radio spectrum failed, but there are reports that the FCC are being urged to try again. Annex M of the Mermian Report of 1983 discussed the use of price mechanisms in spectrum management, based on papers from the Radio Regulatory Department (then part of the Home Office) and two other Government bodies. The Committee itself recommended the progressive development of more general techniques in costing spectrum to encourage more use of the less congested frequency bands and to encourage the use of less congested frequency bands and to encourage the use of less bandwidth-demanding equipment. While few would quarrel with such aims, the fact remains that increased charges could be used in pursuit of Government policies having little to do with efficient spectrum management.

EXTERNAL VOICES

Bert Gallon, chief engineer, BBC external broadcasting, interviewed on the weekly "Waveguide" programme, has stated that construction of new overseas relay transmitter complexes at Hong Kong and at Mahé in the Seychelles is due to begin shortly. The stations should become operational in 1987 and 1988 respectively. This will give the BBC a working base of a life of only ten years before the return of the colony to China, though the BBC are hopeful that it may prove possible to continue to use the transmitters, when Hong Kong becomes Chinese territory.

The new 500kW. Telefunken h.f. transmitters at Rampisham, Dorset — the highest power h.f. transmitters so far commissioned by the BBC are now in full operation. This follows severe delays while the manufacturers investigated problems with the high-power valves and aerial switching.

Search for a successor to the wartime h.f. transmitter complex at Skelton, Cumbria is now divided between Bearley, near Stratford-on-Avon and Oxford, Sussex.

Seven new studios have been completed at Bush House where the BBC has taken over the entire building. These are acoustically suitable for stereo recording and the BBC contemplate producing music and drama programmes in stereo, for rebroadcasting on their v.h.f. outlets in Berlin and Singapore and by the increasing number of overseas broadcasters who relay some BBC programmes on their domestic services. Relay bases are now served by high-quality digital feeds using the Intelsat Indian Ocean and Atlantic Ocean satellites.

Bert Gallon sees no prospects of any early use of direct broadcasting of sound radio from satellites, pointing both to international agreements that rule out the use of d.b.s. for programmes deliberately targeted at other countries, lack of any suitable frequency allocation and the high cost of transmission and reception. He forecast that there would be little reduction in the use of h.f. for external broadcasting during the next ten years.

Although BBC World Service is carried on m.f. and f.m. for many hours each day — and attracts a roughly 4 per cent share of the UK radio audience — there seems little prospect of any formal recognition of its domestic audience, as this would require the renegotiation of performers fees and, more importantly, might affect the Foreign & Commonwealth Grant-in-Aid on which all external broadcasting depends.

MIDGLEY'S INVENTIONS

Increasing specialization, even within the electronics discipline with its growing barriers of mutual incomprehension between the users of advanced analogue and digital techniques, has led inevitably to the phasing out of the general-purpose inventor/entrepreneur prepared to use mechanical, electrical and electronic techniques in his search for product innovation.

Already it is being forgotten how much electronics owes to the ingenuity of those who trained as mechanical or electrical engineers but turned their fertile minds to radio reception in the 1920's. So prolific were some of the pioneers in a variety of disciplines that it is very difficult, even for those interested in the history of technology, to assess their contributions.

I suspect that relatively few readers could immediately place A.H. Midgley (1881-1981). Yet as a recent exhibition, "A British genius — the inventions of Albert Midgley" at the entrancing Watford Museum, amply demonstrated, Midgley made a lasting mark in a string of inventions (212 UK patents) including starting motors and lighting systems for vehicles; tuning mechanisms and fuses for weapons in two World Wars; the pioneering of multi-electrode thermionic valves made to his design by Captain S.R. Mullard in 1927 for his "One-Det" one-valve loudspeaker receiver; a 1931 master oscillator for the production of musical tones by electrical means; the Kinestron cinema organs: the development of high-quality loudspeakers and amplifiers for electronic organs and domestic hi-fi systems; the electronic guitar; even the first British tape recorder marketed by Boosey & Hawkes and based on the German wartime development of h.f. biasing. His often tempestuous career included work with C.A. Vandervell and a string of enterprises that bought him into conflict with powerful industrial rivals and former associates, yet the evidence that he had a remarkably fertile and truly inventive mind seems overwhelming. In the early 1920's he was awarded the then substantial sum of £14,000 as "Award to Inventors" for the Allways Fuse used in bombs and Mills grenades. But little other professional recognition seems to have come his way until now, 24 years after his death, with the Watford exhibition. Perhaps this was because is work was firmly directed towards the invention and development of saleable products rather than "pure" research.

CABLE & DBS

American cable-television penetration at mid-1984 has been estimated at about 42 per cent of television households, representing about 35.7-million homes. The providers of premium subscription channels, such as Home Box Office, continue to complain of large
numbers of illegal viewers by means of unauthorised cable taps, reception of microwave (2.5GHz) multiplex distribution systems, and 4GHz reception from distribution satellites. There appears to be a significant market in decoders that overcome the relatively crude encryption systems in use in the USA. HBO however is supplying some 10,000 descrambler units for the Video Cipher 2 system for satellite distribution to cable network operators.

An experimental optical fibre network is operational in Biarritz, France, providing 15 channels and a videophone service to some 1500 subscribers. TDF is increasing the amount of subtitling for the hearing-impaired to about 12 hours per week, and has placed a bulk order for 30,000 Antiope decoders. The UK, however, would appear to remain well ahead in the field of broadcast teletext with decoders still significantly below the cost of the comparable Antiope units. The launch of the pre-operational French direct-broadcasting satellite has been put back to allow more time to develop the high-power travelling wave-tube package following the problems when it was used in the Japanese satellite launched in January, 1984. The alternative German t.w.t. has still to be tested in orbit.

Amateur Radio

STUCK WITH IT!

In the December issue I drew attention to the effect of the falling pound/yen and pound/dollar exchange rates on the cost of amateur radio equipment in the UK — indeed costs have gone up still further since then. The policy of the major Japanese firms in appointing in the UK: "authorised distributors" capable of servicing and maintaining their equipment has also tended to maintain retail prices, without the many "special offers" and discounts found on similar equipments of the USA. One result has been that a significant number of British amateurs have found it cheaper to buy equipment overseas and then bring it into the UK as a personal import. Then, if necessary, modifying it to suit UK standards, regulations or practices.

What could prove a major disincentive to this practice and which also has implications for the more experimentally-minded amateur is arising from the new forms of hybrid construction, including the use of chip-type, surface-mounted assemblies, now in growing use for this class of equipment. This follows its successful use in recent years for consumer electronics such as the Sony "Walkman" etc.

For the customer, the use of these techniques has the advantage of counteracting the rising cost in Japan of conventional printed board assembly, offering consistent performance and excellent reliability as well as the possibility of packing even more complexity into very compact units.

There is little doubt that the new forms of automatic assembly and hybrid microelectronics have come to stay. But equally there is no doubt at all that it is no longer a simple matter to introduce any modifications, or to troubleshoot and repair such equipment without access to specialised techniques.

For example, the chip components no longer carry any identification: the parts are held in place not only by dip soldering but by epoxy adhesives which are subsequently oven-hardened and then further hardened by the heat from the dip soldering. There is thus virtually no way in which an owner can himself remove or change components, even for what has in the past been the relatively simple modification of v.h.f. or i.f. channel spacings etc. In some equipments not even the factory can modify equipment once it has been dip soldered.

Thus are thus, as Kjell W. Strøm, G3SCP, the Yaesu European manager based in Italy, points out, both advantages in better value for money, higher reliability etc. in the manufacturing techniques but also some significant loss in flexibility — and possible disappointment for those importing their own equipment. It means that the "black boxes" no longer can form the basis of an experimental rig.

The rush to counter rising costs by adopting new manufacturing processes is also leading to a succession of new models, rather than progressive modification of established models. The Yaesu FT101 transceiver and FRG7 receiver for example were marketed for many years in various versions staying on the assembly lines "until their metal stamping tools were completely worn down" to quote Kjell Strom.

RSGB IN-FLIGHTING

The 1984 annual general meeting of the RSGB proved, in some ways, a rather disheartening occasion with an undue amount of the time taken up with procedural wrangles over matters that never became clear to the majority of those present. Summing up beneath the surface was a split between Council members over the election of Mrs Joan Heathershaw, G4CHH as the 1985 President, reversing an earlier (disputed) appointment "by acclamation" of Ing. Lundegard, G3GW, to the post. This all rather overshadowed the news that the RSGB has obtained from the DTI the concession (for one year from April 1, 1985) that Class B receivers may apply to the society for a letter of variation to their licence permitting the use of Morse code on frequencies above 144MHz with a view to on-air training, etc. The AGM also saw an award presented by IARU Region 1 and the RSGB's "Calcutta Key" to C.C. Godsmark, G5CO. The Marconi Medal was awarded to a group of West German amateurs, who as DFOEEM, have specialized in 2.5GHz "moon-bounce" work using an impressive 10-metre diameter parabolic reflector dish aerial. The RSGB has changed the name of its headquarters building at Potters Bar from Alma House to Lambda House.

IN BRIEF

The New Year's Honours List brought a well-deserved British Empire Medal to Mrs Frances Woolley, G3LWY, for her services to the Radio Amateur Invalid and Blind Club of which she has been honorary Secretary for many years.... British amateurs continue to encounter difficulties that appear to be due more to interference problems than to questions of equipment when applying for planning permission to erect mast and towers, though in several cases recently local authority refusals have been overturned on appeal... The "Sir Walter Raleigh" which will circumnavigate the world during the next four years for "Operation Raleigh" will operate on the amateur bands as GB2SWR/MM... The Post Office is now providing amateurs, as they renew their licences, with a new "Amateur Radio Validation Document" to provide a wallet-sized means of proving current validity of the licence, and for notifying the Post Office of any changes of address, etc... NASA has confirmed that Tony England, G3GW, will operate from the Space Shuttle during the 51-F mission now tentatively scheduled for July 1985... The West Kent Amateur Radio Society is planning an expedition this summer with a view to attempt to make a 144MHz direct two-way contact across the Atlantic, a feat that has so far defeated the efforts of many amateurs.

An attempt is to be made to revive the meetings of the Radio Amateurs 'Old Timers' Association. Although the weekly 3.5MHz on-air net (3570kHz, Tuesday, 11 a.m.) continues there have been no meetings since the death of "Uncle Vic" Corsham, G2UV. The possibility of a meeting in the Midlands this Spring is being mooted... The three remaining operational Russian amateur satellites in orbit, TSS, RS7 and RS8 are each active on only two days of the week in order to limit the now falling power sub-systems. One satellite is switched on each day except Wednesday when there is no operation...
SCOPES
UK. C P. £2050.
or £1500 Seconday.

HITACHI
2-Wave 10 MHz scope
ALL MODELS WITH
2 traces 250/500V, 2000
VZ22 Dual 20 MHz & CRT
Proof tested.

VID2 As 212 plus 0C effect etc.

V229F Dual 20MHZ Sweep delay 5's
All other models available.

$298.00
$359.00
$445.00

HAMEG
2 years warranty
HM-103 Single trace 12MHz 20MHz.
$178.50
$198.00
$237.00

CROTECH
3030 Single trace 10MHz.cpm
3025 Small scope 1MHz.cpm
3035 Single trace 15MHz.cpm
$198.00
$218.00
$257.00

SCOPEX
14015 Dual 15 MHz TV
SYNCH 2 £250.00
$198.00
$218.00

$264.00
$285.00
$315.00

THANDAR
Scope generator 1-20 MHz.
$3.95
$4.95
$5.95

ASCl KEYBOARDS
Contact us for active key only.
$6.50
$7.95
$8.95

$10.95
$12.95
$14.95

2070 COMAT S& AC KEYBOARD
Contact us for active key only.
$12.95
$14.95
$16.95

$19.95

ITT 2020 CABINET
Professional compact c/w a keyboard centre.
$11.95
$13.95
$15.95

$24.95
$27.95
$30.95

ORDER BY POST OR PHONE
Up to £1000 instant credit
Available through Lombard Tricity Finance

www.americanradiohistory.com
NEW from Kontakt
The capability and effect of compressed air in a handy can. Tension 67 efficiently removes dust and deposits from electronic components, electronic and electrical apparatus, microscopes, medical equipment, cabinets, etc. Absolutely no spay residues. No compressed air line needed. With plug-in nozzle even blows around corners. Ready for use in the service kit.

Kontakt 60
Dissolves oxides and sulphides, removes dust, oil, resin and traces of metal abrasion. Protects against erosion. Ensures perfect contacts.

Kontakt 61
Special cleaning, lubricating and anti-corrosion fluid for NEW from oxidised and specially sensitive contacts. An excellent lubricant for all electrical and electro-mechanical systems.

Spray Wash WL
A rapid cleanser for reliable washing and degreasing of electrical equipment and components. For removal of dirt, grease, oil, soldering residues and other impurities.

ALSO AVAILABLE:
A COMPLETE RANGE OF INDUSTRIAL AEROSOL SPRAYS
SK10 Soldering Lacquer, K75 Cold Spray, K70 Plastic Spray, K86 Oil Spray, K701 Vaseline Spray, K90 Video Spray, K35 Graphite Spray, K100 Anti-static Spray, K101 Fluid Spray and, of course, Positiv of course. Please mention this publication when replying.

Details from:
Special Products Distributors Ltd.
81 Piccadilly, London, W1V 0HL
Tel: 01-429 9556, Telex: 265298 (answerback RACEN).
Cables: Speciprod, London, W1

CIRCLE 7 FOR FURTHER DETAILS.

FOR QUALITY COMPONENTS
BY MAIL ORDER

FREE
44 PAGE
PRICED AND ILLUSTRATED CATALOGUE ON REQUEST

ELECTROVALUE LTD
28 St Jude's Road, Englefield Green, Egham, Surrey TW20 0HB Phone Egham (0784) 33603. Telex 264475
North Branch, 680 Burnage Lane, Manchester M19 1NA
Phone 061-432 4946
Please mention this publication when replying

CIRCLE 15 FOR FURTHER DETAILS.

The Microvalue Group dealers shown below represent part of the Gemini network.
For expert advice and full details on the Gemini System, contact your nearest dealer today.

AMERSHAM COMPUTER CENTRE LTD
18 Woodside Road, Amersham, Bucks HP7 0BH
Tel: 02403 22307 Telex: 837788

BUSINESS & LEISURE LTD
16 The Square, Kenilworth, Warwickshire CV8 1ED
Tel: 0926 512127

CENTIFLEX MICROSYSTEMS LTD
Unit 6, Perry Road, Staple Tye, Harlow, Essex CM18 7NW
Tel: 0279 442233

ELECTROVALUE LTD
28 St. Jude's Road, Englefield Green, Egham, Surrey TW20 0HB
Tel: 07843 3603 Telex: 264475

E.V. COMPUTING
700 Burnage Lane, Manchester M19 1NA
Tel: 061-431 4866

HENRYS RADIO
404 Edgware Road, London W2
Tel: 01-402 6822

LEEDS COMPUTER CENTRE
55 Wade Lane, Merrion Centre, Leeds LS2 8NG
Tel: 0532 458877

OFF RECORDS LTD
Computer House, 58 Battersea Rise, Clapham Junction, London SW11 1HH
Tel: 01-223 7730

SKYTRONICS LTD
357 Derby Road, Nottingham NG7 2DZ
Tel: 0602 781742

SPARTACODE LIMITED
69 London Road, Bognor Regis. West Sussex, PO21 1AE
Tel: (0243) 826161

CIRCLE 12 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985
Every card's a winner. The versatile 80-Bus system can be used for a host of applications: Process Control, Batch Counting, Robotics, Colour Graphic Displays, CAD/CAM, CNC; In Manufacturing, Telecommunications, Instrumentation, Laboratory Testing, Security Systems, Plant Control, Data Collection and Distribution.

Also, in smaller companies it can handle Accounts, Payroll, Wordprocessing, Stock Control, Program Compilation and Data Base Management... whilst still being able to run specialist applications.

And because there is no wasted capacity with a Gemini, a system can cost a good deal less than you might think.

With Gemini you can buy a complete system, upgrade your existing 80-Bus system, or build your own.

So when you've had a look at the pack of cards below, plug yourself into our dealer network to discover how opening a new pack of cards with Gemini will help you pick a winner.

These represent just a small selection from the range of over 25 cards.

**GM813 CPU/64K RAM BOARD** - This card provides system 4 MHz, 280 CPU, 64K user RAM and both serial and parallel I/O.

**GM811 CPU BOARD** - An industrial standard 4 MHz, Z80 controller board with parallel and serial I/O together with a variable Bytewise memory capacity.

**GM888 CPU BOARD** - A new card featuring the Intel 8088 processor to provide a dual processor system.

**GM832 SVC BOARD** - Provides conventional 80 x 25 or 40 x 25 screen format together with graphics capability. Includes full keyboard support and overseas character sets.

**GM862 256K RAM BOARD** - Supports both page mode and extended addressing facilities and can be used with all of the Gemini CPU cards.

**GM833 512K RAM-DISK BOARD** - Provides 'pseudo disk' facility in a MultiBoard system.

**GM829 FDC/SASI BOARD** - Combines floppy disk controller and SASI board supports up to four floppy disk drives plus Winchester controller cards.

**GM837 COLOUR GRAPHICS BOARD** - 256 × 256 sixteen colour graphics display. Output to either PAL UHF or RGB.

**GM816 MULTI I/O BOARD** - Provides three Z80A PIO devices plus CTC and battery backed Real Time Clock.

**GM848 SERIAL I/O BOARD** - Utilises two Z80A SIO chips providing four synchronous/asynchronous serial channels with software selectable baud rates.

**GM836 NETWORK INTERFACE BOARD** - Provides RS422 communication protocol for networking CPU boards.

**The dealer's choice**

Gemini Microcomputers Ltd., 18 Woodside Road, Amersham, Bucks, England HP6 0BH. Tel: (02403) 28321. Telex: 837788

CIRCLE 69 FOR FURTHER DETAILS.
**Vigilant micon HF Communications Receivers**

**MICROPROCESSOR CONTROLLED RECEIVERS**

* Type SR 530 USB/CW/AM/Telex – 10 Hz Steps (Marine)
* Type SR 532 USB/LSB/AM/CW – 10 Hz Steps (Static/Transportable)
* Type SR 531 USB/LSB/AM/CW – 100 Hz Steps (Static/Transportable)

**DESIGNED AND MANUFACTURED TO HIGHEST INTERNATIONAL SPECS**

- **Freq. Range**: 50 KHz to 30 MHz
- **Increments**: 10 Hz or 100 Hz Steps
- **Stability**: ± 1 Part in 10⁴/°C
- **Tuning**: Keypad and Spin Wheel
- **Power Supplies**: 110/240V AC and 24V DC
- **FULLY MODULAR ‘PLUG IN’ CONSTRUCTION**

**Memory**: 200 Channels Freq/Mode/Filter Scanning: Full memory or discreet parts Automatic or Manual Stop Manual step on or Reverse

**NOW AVAILABLE AT HIGHLY COMPETITIVE PRICES**

Send for Technical Brochure to: Tel: (0344) 885656 Vigilant Communications Ltd. Telex: 849769 Vigcom G Unit 5, Pontiac Works, Fernbank Road, ASCOT, BERKS SL5 8JH, ENGLAND

**CIRCLE 27 FOR FURTHER DETAILS.**

---

**Andelos 68000 SYSTEM**

Powerful 68000 runs at 10MHz without wait states. Up to 32KB EPROM and 4 or 16KB fast static RAM. 24 line programmable parallel I/O port. RS232 programmable serial port. Comprehensive monitor in 2764 Eeproms. Optional plug-in Eeprom programmer card. Cross Assemblers for Z80 based microcomputers. Code can be developed, downline loaded to 68000, debugged, and then written into Eeprom.

* 10MHz 68000 CPU Board...
* EPROM PROGRAMMER card...
* CROSS ASSEMBLER for Z80 hosts...

**Andelos Systems**

Telephone: (0635) 201150

**CIRCLE 114 FOR FURTHER DETAILS.**
LOGIC SYMBOLS

The new logic symbols — 1

The national standards of all major technological countries are changing to comply with a new international standard. This new standard will affect everyone concerned with digital electronics, and the implications of the change should not be underestimated — especially if digital electronics is your profession. Be warned: the new logic symbols are far more than mere substitutions for existing symbols — they take an entirely new approach to representing logic circuitry. Is it all for the better or for the worse? Read on!

This is the first of three articles intended to make readers aware of the new logic symbols. This first part concentrates on explaining why the symbols are to change, indicating the advantages and disadvantages, and explaining the basic principles. The second part will explain some of the more complex symbols and features such as the common-control box and dependency notation, and the third part will discuss trends and the way ahead using the new symbology.

The background
My own interest in what I here term the 'new' logic symbols stems from documentation work undertaken on Concorde many years ago for American use. These particular handbooks were written to the American ANSI Y32. 14-1973 Specification (equivalent to IEEE Std 91-1973), and although I had been in the field of technical documentation for some time, nevertheless they then represented a major deviation from any previous understanding I or my colleagues had of logic symbols. I must confess it did serve to baffle us initially.

In more recent years I have been involved in documentation work for Army Equipment Service Publications (AESPs) to British Standard 3939: Section 21 (Issue 2), Binary Logic Symbols, which went part way to conforming to the previously mentioned American standard, but led us into all kinds of difficulties because it was not a full specification: too many symbols were missing for it to be rigidly applied. If I say here that this British Standard uses rectangular symbols, I know that many will imagine they are familiar with it, assuming that it simply substitutes rectangular symbols for previously existing characteristically shaped curved symbols. In fact, this notion harks back to a still earlier standard, for Issue 2 of BS3939, Section 21, is far more sophisticated than that: it was, in fact, a half-way house towards the standard that I now wish to talk about, the standard that BS3939 is due to conform to very shortly.

The fact of the matter is that for over a decade there has been international co-operation in an active attempt to develop an internationally acceptable standard for logic symbols that would be recognised throughout the world and would be versatile enough to cope with the ever increasing complexity of modern digital circuits.

France, Germany, Netherlands, Japan, the UK and USA and many more now intend to bring their own national standards fully or broadly in line, which stresses the importance of this subject to every digital engineer. There are other countries actively involved in the discussions whose intentions are less well known, but in due course, may well also conform.

Anyone working for a large company has seen from personal experience that committees generally design camels with surplus humps and that international committees can never see beyond the humps. It is therefore no mean feat for a body to have reached the stage where all these countries are in broad agreement on a new standard. Such a body is the International Electrotechnical Commission (IEC), based in Geneva.

After a decade of discussion, a document entitled IEC Publication 617:12, Binary Logic Elements, has been published, and it is this document which is to be the basis of numerous revised national standards. Like the United Kingdom, many countries intend to publish 'Chinese copies' of this source document. The digital engineer is therefore probably the first in the field to get

Acknowledgements
The author is greatly indebted to Mr D.B.J. Hicks of the British Standards Institution, Messrs C.J. Stanford and L. van Rooij, General Secretary and Deputy General Secretary of the International Electrotechnical Commission, for their invaluable assistance in the research work for my book, Mr N. Warnock-Smith of Butterworth Scientific Ltd, for his kind cooperation in the use of illustrations from my book for this article, and Ms J. Molyneaux, who penned the excellent illustrations.

Mr Kampel has produced a book on this subject, entitled A Practical Introduction to the New Logic Symbols (Butterworth Scientific, 1985). It is based on IEC Publication 617:12 — Ed.

by Ian Kampel, M.I.E.R.E.
Fig. 1. Symbol composition. Length/width ratio is arbitrary.

Fig. 2. Binary logic element—a Nand gate with one negated input.

Fig. 3. Combination of symbols. Logic connections must only pass edges in direction of signal flow.

Fig. 4. Embedded symbols.

Fig. 5. Illegal (a) and legal (b) mixtures of polarity indicators and negation symbols.

what amounts to his own international language.

I use the term 'language' advisedly, for the new logic symbols are really just that. Admittedly it is a sign-language, but like any true language, it does allow the user freedom of expression. That is where it differs so greatly from anything that has gone before.

New frontiers
The new logic symbols open up new frontiers and new levels of sophistication. They enable diagrams of complex logic circuits employing similar circuitry to be dramatically reduced in size and complexity, without any loss of detail. Furthermore, as I intend to show in the third article of this series, it enables circuits to be represented at different levels of detail with each and every level accurately depicting the overall logic functions. This can be usefully employed in industry, for a systems engineer can design a high-level circuit and pass this on to a project or equipment engineer; he, in turn, can create a medium-level design showing more precisely the methods of implementation which he can pass down to a design engineer; the latter can then produce a component-level design. In all cases the new logic symbols may be employed, and in each level conversion, there can be no doubt as to what is required. All this can be achieved without words or even block diagrams.

Good news or bad news?
At this juncture you will no doubt have mixed reactions if all this is news to you. Is it good news or bad news for the profession? What was wrong with the popular 'curvy' (MIL-STD-806B) logic symbols which have proliferated so much in recent years? And before someone else points it out, I did prefer to use the latter standard (also to be seen in this journal), in my recent book: Practical Design of Digital Circuits (Newnes Technical Books, 1985). The reason for that choice, as explained in an appendix, was simply that these symbols were so familiar. Had I introduced the new logic symbols, it would have completely detracted from the principal aim of the book: to teach design principles. For do not under estimate the complexity of the new logic symbols: learning to use them is a subject in its own right.

Let me give you the bad news first. Yes, you do need to put your thinking cap on again in order to learn to use and interpret the new logic symbols, for unfortunately, complexity is the price you have to pay for sophistication. Military projects will increasingly require use of the new symbols to give the documentation immediate international status. But even more significant to any 'digital practicalioner' is the fact that the American manufacturers of digital components are well embroiled in the transfer to the new symbols on their data sheets, and even the most determined ostrich will therefore be forced to learn the new language—or take early retirement on a reduced pension!

I was a design engineer for many years and I know such a change will not be popular. I am presently involved with design engineers on a day-to-day basis, and I still know the change is not popular. How could it be when such persons are already overworked, underpaid, and unappreciated? But that is where the argument must end, for I am talking of a fait accompli. It is here and it will stay. There has been too much commitment for retraction now. Your only concern should be how long it will be before it affects you. So far as the international committees are concerned, it is too bad that we're still trying to get to grips with decimalisation in Great Britain.

There is more bad news. From my own researches, it is plain that this matter will come as somewhat of a bombshell to the majority of engineers in this country, not to mention lecturers, whose duty it will be to educate themselves before their students take them to task. I say again, the new logic symbols are not mere substitutions for presently known alternative symbols—except at the simplest level.
To my mind, they represent the need for a new endorsement subject for those studying digital electronics.

Now for the good news. The new logic symbols are logical! They also offer a very clever means of simplifying circuitry in order that a circuit function can be more easily comprehended. Where a present-day block diagram and associated text is needed to explain a circuit function, the new logic symbols equally straightforwardly represent and fully define the circuit function without the absolute need for words. Where a complex device was previously represented by an annotated rectangle which required further reference to a data sheet to explain it, many such devices may now be clearly defined by their symbol. There is also another great bonus. The new logic symbols can even remove problems associated with positive or negative logic conventions. What more could an engineer ask for? — save something simple!

The learning curve
Because of my involvement in the technical documentation industry, I have been aware of the forthcoming problem for some time. Apart from an engineer's revised national standard, there seems nowhere for him to turn to for practical help in this situation for, with the best will in the world, a standard cannot be regarded as bedtime (or even coffee-time) reading. Not that this is in any way meant to detract from the value of any given standard, for such is needed to clearly define requirements. By virtue of the need to unambiguously define, however, such works cannot be informal in their approach and are inherently different from the ideal teaching document which takes one idea at a time and develops it.

Brief notes on the new standard may be found in such publications as The TTL Data Book for Design Engineers (Texas Instruments), but when it is taken into account that such a treatise is far shorter than the actual standard, it is clear that it is far from exhaustive. It really does need a full-length book to do the subject justice.

Since the standards are weighty tomes, it might be supposed that I cannot tell all in three magazine articles. The aim here is therefore to give you a taste of the new logic symbols — to whet your appetite as it were — and, hopefully, to convince you that this is not something that can be ignored.

Symbol composition
Symbols are used to represent binary logic elements. As depicted in Fig. 1, a symbol comprises: an outline, a general qualifying symbol denoting the function of the binary logic element, and input and output lines. The outline is rectangular and the length: width ratio is arbitrary. The preferred location of the general qualifying symbol is at top centre of the outline, although a central location is also acceptable.

It is preferred to have input lines on the left of an outline and outputs on the right of an outline, so maintaining left-to-right flow. Unless otherwise unavoidable, inputs and outputs should be placed on opposite sides of an outline. In special cases where a horizontal symbol is approved (e.g. counters and shift registers — although vertical orientation is still preferable if possible), a top-to-bottom data flow is preferred.

Whilst a general qualifying symbol is normally required within an outline in order to specify the function of that element, there are circumstances where the function is completely defined by the qualifying symbols associated with inputs and outputs, thereby making a general qualifying symbol redundant.

Figure 2 depicts an example of a simple binary logic element: in a positive logic convention this represents a NAND gate with one negated input (the familiar circular qualifying symbol indicates negation — or inversion).

In order to reduce the space requirements on diagrams, separate symbols for basic functions may be abutted provided that there is no logic connection between logic elements where the common side/s of their outlines is in the direction of signal flow, and that there is at least one logic connection between the elements where the common side/s of their outline is perpendicular to the direction of signal flow.

This is made plain by the example given in Fig. 3. It will be seen that there is 'at least one' logic connection between element d and each of elements a, b and c, although there is no logic connection between elements a and b or b and c.

Another way employed of gaining space is to embed one symbol inside another, as shown in Fig. 6. Examples of combinative devices — 7400 and 7437.

Fig. 7. Example of a more exotic symbol — octal flip-flop with common enable, the 74LS377.

Fig. 8. Even more information in one symbol — the 74690 4-bit synchronous counter with output registers and multiplexed tri-state outputs.
Fig. 4. Any symbol may be placed inside another providing that the result is unambiguous and the relationship between the two is clearly defined either by position or by internal connection lines.

Logic convention

I think it fair to say that today there is a general preference for a positive-logic convention, which implies that the H (high) level of a physical quantity — such as voltage — represents the logic 1-state of a binary variable, and the L (low) level represents the logic 0-state. A negative-logic convention is the converse of this. Because the physical aspects of a circuit vary according to the convention being applied, it is essential that the convention is always clearly defined. Ideally it should be stated on every diagram, but in practical terms, it should be sufficient to state the convention in use within a single document or working environment. The only real justification for using a negative-logic convention is where a negative supply is used for logic devices.

Providing that the logic convention has been defined, the conventional circle may be used as a qualifying symbol to indicate negation. If the situation arises where both logic conventions are mixed — say at the interface between two manufacturers’ equipments — then a more complex situation arises: one that causes endless confusion with previous methods of logic representation.

The new logic symbolology overcomes this problem in a very elegant fashion by the use of polarity indicators.

A polarity indicator is a triangularly shaped qualifying symbol placed on an input or output line such that the apex points in the direction of signal flow. The polarity indicator on an input or output implies that the internal 1-state corresponds to an external L-level (i.e., low level). Thus the polarity indicator effectively converts between external physical voltage levels and internal logic states.

If the decision is taken to employ polarity indicators on a circuit diagram then logic conventions become superfluous — they no longer apply. By implication, if this is undertaken, there should be no negation symbols on any inputs or outputs, since their presence demands a logic convention.

The use of polarity indicators does not mean that negation symbols are a total anathema on diagrams, and this is a potential source of confusion. It must be remembered that you are dealing with pure logic within a binary logic element, and here polarity has no significance! So negation symbols are always employed within elements to indicate negation, but external polarity indicators are employed externally.

Figure 5 depicts legal and illegal use of polarity indicators. To the left of the diagram (a) a mixture of polarity indicator and negation qualifying symbols are shown: the presence of so much as a single polarity indicator on a diagram bans the use of the negation symbol on any inputs or outputs, since it implies no logic convention in use. To the right of the figure (b) is shown a legal mixture of the symbols: external polarity indicators show that a low voltage is required on the top two inputs to produce corresponding internal 1-states, whereas the two lower inputs require high levels on their inputs to produce internal logic 1-states. The internal negation symbols have their customary logic significance with respect to the common element, and the final output produces a high level for a logic 1-state.

Combinative devices

Figure 6 depicts two simple combinative devices, and serves to illustrate a number of points. Firstly it serves to show that the lowest level of representation with the new logic symbols is at device level: here are depicted the 7400 and 7437 devices, referred to as quad 2-input positive Nand gates and quad Nand buffer driver respectively. Note that the symbol for the 7400 employs external negation symbols and therefore this means that it is necessary to qualify the logic convention as positive — for in the negative logic convention we would have an Or gate with negated inputs. On the other hand, the 7437 is shown with polarity indicators on the outputs, signifying that two high inputs on any gate input produces a low on the output. The gates in both devices perform identical logic functions and are here represented in two different ways. It is necessary to become accustomed to interpreting diagrams of either form, and both will therefore be used in this series.

To avoid any confusion, it may be assumed that throughout this series, a positive logic convention is used when such is applicable (i.e., when no polarity indicators are used).

The next point to note about Fig. 6 is that it is unnecessary to repeat a general qualifying symbol in an array of identical elements. The & general qualifying symbol in the upper element of the 7400 device is taken to apply to all four elements. The same applies for the 7437, but here the buffer general qualifying symbol is included in the upper element to signify its driving capabilities.

This is also a useful point to highlight the fact that the polarity indicator has the inherent property to indicate signal flow. As such, its presence on a particular signal line can make the need for a directional arrow (required to indicate non-preferred directional signal flow) superfluous.

Conclusion

That concludes this basic introduction to the new logic symbols. In the next article I shall consider some of the more complex aspects including dependency notation and the common control block, but in order to illustrate these points the more complex logic symbols are far from direct substitutions of existing symbols, I leave you with a foretaste of two of the symbols to be discussed in future parts. Figure 7 depicts an octal flip-flop with common enable and Figure 8 shows a 4-bit synchronous counter with output registers and multiplexed three-state outputs. These symbols employ both dependency notation and the common-control box, but more of that in due course!

LITERATURE RECEIVED

'The biggest variety of semiconductors in any retail shop' is the proud boast of Cricklewood Electronics. It certainly seems to be borne out in their stock list! catalogue which also lists the passive components, hardware, tools and other equipment that they stock. Telephone, mail-order and credit-card purchases are acceptable as well as callers to the retail shop at Cricklewood Electronics Ltd., 40 Cricklewood Broadway, London. NW2 3ET. EWW 259

A handy reference guide to 50-33

surface-mounting transistors and diodes is available from Ferranti Electronics Ltd., Fields New Road, Chadderton, Oldham, OL9 (GMP). EWW 259

A state-of-the-art home built preamplifier is available as a kit from B&J Sound. The design is modular and may be tailored to meet specific requirements for matching existing equipment. Kit lists are available along with details of a power supply and a guide to the selection components. Full constructional details are available for £6.90. B&J Sound, Kirkby Lane, Tattershall, Lincoln. LN4 4PD. EWW 260

A new series of Unix-based computers, built around National Semiconductors' 32000 family of processors and peripherals, is described in a brochure. The N932032 is a 3-bit processor which is combined with a N932082 memory management unit to give 'virtual memory', a method of dividing the available memory into pages...

Individual pages may be retained in the computer's internal memory or on disc and may be called as required. Using this system, the virtual and physical address spaces are divided into 32768 pages each of fixed size, 512 bytes. The series also includes the N932091 floating point processor, to provide 32-bit floating point operations. The chips are really a single unit and as v.l.s.i. methods improve, they could be combined into a single circuit. The brochure also discusses the implementation of Genix a super-set of Unix. National Semiconductor (US) Ltd., 301 Harpur Centre, Home Lane. Bedford MK40 1TR. EWW 257

ELECTRONICS & WIRELESS WORLD MARCH 1985
IT WON'T COST YOU A PENNY.

BEING WITHOUT ONE COULD COST YOU DEARLY.

The 1985 Midwich catalogue is now available, absolutely free.

It's the most comprehensive catalogue yet, containing many of the latest and very best computer components on the market, at highly competitive Midwich prices and a service that is second to none.

Which means it will provide your organisation with a vital source of information including numerous technical specifications and pin-out diagrams.

Fill in the coupon and send for your copy today.

You'll soon discover why no organisation can afford to be without one.

Reply to Dept EWW3 Midwich Computer Company Limited Gilray Road, Diss, Norfolk IP22 3EU

Name

Organisation/Company

Position

Address

Postcode

Tel. No.

MIDWICH

COMPUTER COMPANY LIMITED
Dual-Purpose Storage...

The Gould 1421 Digital Storage Oscilloscope (DSO).

A Dual-Purpose DSO for Electronics and Transducer applications. Compare the benefits of the low-cost 1421 and its suitability for two diverse application areas, with the performance of our competitors. The 1421 has a storage bandwidth up to 20MHz in single and dual-channel modes.

Take a look at the heavyweight performance details of this compact, lightweight DSO:

- No trace degradation with time.
- Storage of pre-trigger information.
- 20MHz 8-bit ADC for transient capture.
- 20MHz repetitive signal storage.
- 1k store per channel.
- X10 post-storage expansion.
- Pen recorder output.
- Single channel trace hold for waveform comparison.

Conventional 'scope operation up to 20MHz. And all the usual benefits of a Gould Digital Storage 'Scope.

Ask for more details now from Gould Instruments Ltd., Roebuck Road, Hainsuit, Ilford, Essex IG6 2UE.

Telephone: 01-500 1000. Telex 263785.

BRITISH MADE
TWO YEAR WARRANTY
Introducing GPIB

Having first been considered some 20 years ago, GPIB could probably be improved upon but it is so well established that it is likely to remain the foremost standard for connecting instruments to computers for many years yet.

General-purpose interface bus, GPIB, is a method used throughout the world for linking instruments and computers. Providing a means for both setting up instruments and reading information from them directly back into a computer ready for processing, the bus’s main applications are in research and development and in automatic testing, measurement and quality control systems. Controlling instrumentation by computer means

— faster processing
— reduced risk of human error
— increased accuracy through computer correction techniques
— elimination of tedious repetitive tasks
— convenient data storage and hard copy

Internationally, GPIB is defined by the IEC625-1 standard and in America by ANSI MC1.1 and IEEE488-1978. It is often misnamed the ‘IEEE bus’ and called HPIB by its designers, Hewlett Packard who started its development in 1965. The bus is also covered by a British standard, BS 6146.

Carrying eight-bit parallel data and using eight control/handshaking signals, GPIB is generally much faster than a serial link and, being designed for a specific task, it has an edge over other common microcomputer buses where computer-controlled instrumentation is concerned. But as with all such standards, it is not the ideal solution for all applications; the main reason for using it now, some 20 years after its conception, is the large number of GPIB-compatible instruments and controllers available.

Cost of implementing the bus is high. One short-cut is to use a microcomputer with an add-on interface such as those available for the BBC microcomputer, QL, Apple, IBM PC and DEC Rainbow.

Although still too expensive for most enthusiasts, these relatively cheap add-ons bring automatic measurement and quality control — or at least the bus to provide them — within the reach of even the smallest of organizations. Equally cheap instruments and software, not to mention cables, may be a little harder to come by.

There are a few general-purpose microcomputers like the Commodore Pet, 64, 4000 8000 700. RML Link 4802Z, Sharp MZ80K and IBS750 that have built-in GPIB interfaces and there are some mainly for design and research, like the HP Technical Computers range, that are designed with GPIB control in mind. Lastly, there are computers and controllers whose hardware and software is designed solely for use in GPIB applications.

GPIB-compatible instruments, ranging from tape drives to communications receivers and logic analysers, are also expensive. Besides having the digital control and interface circuits necessary for computer control, the majority of bus-controllable instruments also have manual controls and readouts which increase their cost. We are still at the stage where most instruments are designed for manual use with GPIB compatibility available as an add-on.

Incompatibility

The standards mentioned above only specify electrical and mechanical parameters for linking units together — they don’t say what data passing through the bus should look like. Sadly, this means that there is no guarantee that a system happily controlling a GPIB instrument from one manufacturer will work with a similar instrument from another source. Suggestions for code and format convention — like

---

ELECTRONICS & WIRELESS WORLD MARCH 1985
IEEE 728, BS6146 part 2 and IEC 625-2 have only recently appeared.

On the brighter side, GPIB signal functions are defined, which means that one should be able to resolve compatibility problems by rewriting the programs used to control the instruments. Because of these incompatibilities, many GPIB product manufacturers freely provide documentation and application notes relating to their own protocols and data formats. There are no active elements in the bus itself, i.e., all signals passing along the bus are produced within the instrument or a computer with a GPIB controller, which makes the task easier.

The bus
There are three terms used to describe devices connected to the GPIB — talkers, listeners and controllers. Instruments are either talkers or listeners or both. Because these terms are normally associated with humans, you may find it a little unfriendly that GPIB talkers and listeners do so to the bus and not to the user.

A controller talks and listens but it also dictates what goes where on the bus. There may be more than one controller on a bus but only one is allowed to act at a time. Controllers vary from a dedicated piece of apparatus with special software, in which case the user will need to know little of how the bus works, to a microcomputer with a GPIB interface which the user has to program in a high or low-level language.

In the most basic system there is only just a talker and a listener. At the other end of the scale, although the standard only allows for 15 devices to be connected to the bus on a cable of up to 20m, there are products called bus extenders and multiplexers which share out one allocation. Not all devices connected to the bus need be measuring instruments; there are converters, for say RS232 to GPIB, floppy-disc drivers and printers to mention but a few.

Essentially, the bus carries an eight-bit parallel data word, three data- transfer control signals and five interface management signals. All control signals are at t.t.l. level and active low. The bidirectional data bus not only carries data but also address and status information at rates of up to 250 Kbyte/s (higher rates are possible under certain circumstances). Incompatibilities between products from different manufacturers and, according to Tektronix even between different instruments from the same manufacturer arise through differences in the form of the data. For example, some systems may use Ascii and others hexadecimal-formatted data. The table gives some idea of what the bus control signals are.

There are large-scale integrated circuits, such as the Texas 9914, which reduce the complexity of implementing GPIB and are gradually bringing down the price of both instruments and controllers. Using such an i.c., the GPIB section of a computer need only consist of three i.c.s, two of which are bus drivers. Software and the cost of instruments for use on the bus are the biggest headaches for most.

Finally, note that two types of connector are found on GPIB instruments, a 24-way type on IEEE488-based equipment or a 25-way type defined in the IEC standard.

GPIB Instruments

Prices are given here only as a guide and should be checked with suppliers. Value-added tax is not included.

Adret Electronique make several GPIB instruments for use in telecommunications, two signal generators, models 730A and 740A, covering 300Hz-180MHz and 100kHz to 1.12GHz respectively; a universal r.f. generator of high spectral purity for up to 1.3GHz with pulse modulation capability, for use with radionavigation systems; a 15-200kHz standard frequency receiver; a 2kHz-18GHz signal source attenuation calibrator, with a dynamic range of ~130dBm to +20dBm; and a programmable voltage and current reference standard. Racial-Dana Instruments Ltd., Duke Street, Windsor, Berkshire SL4 1SB. EWW210

Ains Instruments offer at present just one GPIB model, a low-distortion sine-wave oscillator covering 9Hz to 330kHz. The LD2001 (5385) has ten memory locations, a quadrate output and a liquid crystal display. It can also be controlled from an RS232 interface. From Instruments, Edison Road Industrial Estate, St Ives, Huntingdon, Cambridgeshire PE17 4NF. EWW211

Amplicon's 4-digit panel meter is claimed to be the first to have an integral IEEE interface. Features of the model 87 include led display, 160dB common mode rejection and 0.01% accuracy. With the interface included the basic price is £210. Other models offer 31-digit display and liquid crystal display. Ampicon Electronics Ltd., Richmond Road, Bagshot, Surrey. EWW212

Ando make instruments for use in optical fibre communications. Model AQ-1301 is a light source which can be swept from 0.6 to 1.6 micrometres and is intended for measuring characteristics of optical transmission systems. There is a choice of three optical power meters of differing sensitivities, all of them suitable for normal or laser light. Other models include an optical wavelength meter for measuring the central-wavelengths of emission devices, an optical fibre reflectometer (model AQ-1720), an optical spectrum analyser (AQ-1417B) and two optical loss measurement systems. Aspen Electronics Ltd., 2-3 Kildare Close, Eastcote, Ruislip, Middlesex HA4 9UR. EWW213

Bird: the model 4381-832 RF Power meter digital wattmeter is available with a GPIB interface from Aspen Electronics Ltd., 2-3 Kildare Close, Eastcote, Ruislip, Middlesex HA4 9UR. EWW214

Boothon produce several instruments suitable for GPIB control. For radio frequencies, there is an autoranging millivoltmeter covering 10Hz to 1.2GHz and giving readings in mV, dBmV and dBm; a single- or dual-channel microamperemeter, 0.1uA-10kHz; 50Hz which stores calibration data for up to eight sensors, and an f.m./a.m. modulation meter. Also available: a 1MHz automatic bridge and an adaptor for interfacing the Boothon digital meter to GPIB. Euro Electronics Ltd., Lancaster Gate House, 319 Pinner Road, Harrow, Middlesex HA1 4HF. EWW215

Brown-Boveri make a microprocessor-controlled portable multimeter (model M2110-01) with a 4-digit liquid crystal display. It has seven operating modes, including one for testing capacitances between 10pF and 3mF; it handles direct current measurements up to 20A and on a c. range it measures true r.m.s. values. British Brown-Boveri Ltd., Normies Division, Grovelands House, Longford Road, Exhall, Coventry CV7 9ND. EWW216

Bruel & Kjær's catalogue lists some 16 instruments equipped with a GPIB interface and several others which can be connected with a special adaptor. The instruments include audio spectrum analyzers, fast Fourier transformers, a filter set, a digital graphics plotter, an X-Y plotter, a digital cassette recorder, a portable thermal printer and diagnostic

Datron's Autocal precision multimeters

www.americanradiohistory.com
PUSH-BUTTON PERFECTION

The great thing about the IC-M5 is the quick and easy access to its functions.
This is made possible thanks to the 16 button keyboard entry to all international and U.S.A. channels, semi-duplex memories, memory scan and priority functions. Private channels can be easily installed.
This VHF 5 watt marine transceiver is water-resistant and boasts features found on no other model, including: all U.K. channels plus ten weather channels (U.S.A. only), and ten owner-programmable memories with internal lithium memory backup. Three built-in scanning systems for memories, all channel and weather channel scanning.
Dual watch enables you to simultaneously monitor channel 16 and communicate one other channel of your choice.
Easy-to-read digital readout, day or night. Ready to go to the accessories needed to get you operational.
The IC-M5 and M12 handheld marine transceivers will still be available.

ICOM
The World System

Thanet Electronics Ltd.
Suppliers of Radio Communication Equipment to the Ministry of Defence
143 Reculver Road, Herne Bay, Kent, England
Tel (02273) 63859/63850 Telex 96579
CIRCLE #5 FOR FURTHER DETAILS.

TURN YOUR COMPUTER INTO A REAL TIME IMAGE PROCESSOR WITH THE IMAGE III FRAME STORE

OVERSEAS AGENTS REQUIRED

PRICE £1,990.00

IMAGE III is a high resolution Frame Store which can capture and display pictures in real time from any 625/525 line video source. Once captured in the 512 x 512 frame memory, the computer can access the stored image for processing or manipulation. The store utilizes 6 bit A/D and D/A converters to give up to 64 grey levels per pixel. A major feature of this store is that if a lower resolution picture is selected then the store can be partitioned to store multiple pictures, e.g. for 256 x 256 resolution, four pictures can be stored. This allows the computer to compare two or more pictures captured from the same or different video sources.
The IMAGE III Frame Store turns your computer into a low cost image processing system and opens up a range of possibilities such as Robotic Vision, Medical Imaging, Factory Inspection etc. Alternatively the store can be used in applications where picture data is arriving slowly e.g. weather satellite transmissions, ultrasonic imaging, enabling the user to have a steady display without the need for long persistence display devices.
IMAGE III is available for the IBM PC, Apple and BBC computers. The interface card connects directly to the expansion ports of the computer and software is supplied which demonstrates the features of the store.
The TV Picture Store Board used in IMAGE III was developed by British Telecom Research Laboratories and is manufactured under licence by Eltime Ltd. This board can be purchased separately for OEM applications.

ELTIME LTD.
Unit 020, Meddon Industrial Estate, Fulbridge Maiden, Essex CM9 7LP
Tel: 0921 59508
CIRCLE #4 FOR FURTHER DETAILS.

THE ENGINEERS Z80 COMPUTER WITH IEEE 488

* 2 x Z80 CPU's (4MHz)
* 64K I/NAMC RAM
* UP TO 32K EPROM
* FLOPPY DISK CONTROLLER FOR 3", 5" and 8" Disk Drives
* 2 x RS232 SERIAL I/O CHANNELS
* I/O MAPPED VIDEO GEN. 80 Cols. 24 Lines
* 4 x PARALLEL I/O CHANNELS
* PARALLEL KEYBOARD PORT (POWERED)
* IEEE 488 INTERFACE
* HARDWARE REAL TIME CLOCK
* 2 x 8 BIT SWITCHES I/O MAPPED
* MONITOR PROGRAM IN PROM
* PROM BASED SOFTWARE AVAILABLE such as ASSEMBLER/EDITOR, and XTAL BASIC WITH IEE DRIVERS

The IBS 750 is an Industrial Quality Product designed for reliability and ease of use. It is normally supplied fully built and tested but is also available in a number of partially-built options. The Monitor PROM contains 22 user commands which will assist in writing and debugging of the SBC's console and printer requirements by just opening or closing links on the PCB. The same configured version of CP/M 2.2 is available for various Disk sizes. A complete Development System and Desk Top Computer based on this board is available with a variety of Disk Drive sizes and case styles to suit users requirements and environment.

Tel (0294) 75000/73333
CIRCLE #30 FOR FURTHER DETAILS.

IRVINE BUSINESS SYSTEMS LTD
1 Montgomery Place
 Irvine, Ayrshire
 KA12 8PN
 Tel: 7771582

ELECTRONICS & WIRELESS WORLD MARCH 1985
ultrasound equipment. Bruel & Kjaer (U.K.) Ltd., Cross Lances Road, Hounslow, Middlesex TW2 2AE. EWW217

Burleigh Instruments make a meter which can measure the wavelength of any c.w. laser operating between 0.4 and 4 micrometres. Lambda Photochromics Ltd., Lambda House, Batford Mill, Harpenden, Hertfordshire ALS 5BZ. EWW218

CEC make a GPIB-compatible signal conditioning system which, they say, can access the user money. The PSC-8000 is of modular construction, with up to 12 channels per 19in. mainframe. Each channel has plug-in modules for interfacing to strain gauges, thermocouples or other sensors. CEC Instrumentation Ltd., Lennoxx Road, Basingstoke, Hampshire RG22 4AW. EWW219

Chase offer a pair of high-performance receivers covering 25-3000MHz and 25-1000MHz, for applications such as field-strength measuring, interference measuring and radio monitoring. The sets can be used as selective r.f. voltmeters, even in the presence of strong r.f. fields. Accessories include dipole, log-periodic and biconical aerials. Chase also supply a controller for r.f. and e.m.c. measuring equipment, model EC5000. This has a 6in. monochrome display monitor and one or two 3in disc drives. The operating system and Basic language are compatible with the BBC Micro. Chase Electronics Ltd., St Leonard's House, St Leonard's Road, London SW14 7LY. EWW220

CIL produce a variety of instruments with GPIB capability. The Multi-Monitor TA880 is a voltmeter, millivolt source, temperature indicator, thermocouple simulator and strain indicator all rolled into one. Other models include multi-channel a-to-d converters with 12 and 16 bit accuracy (prices from £475), a thermocouple converter, a multi-function control and measurement interface and a GPIB bus analyzer. CIL also offer a GPIB interface card for the Apple computer (£130). CIL Microsystems Ltd., Decoy Road, Worthing, Sussex BN14 8ND. EWW221

G.P.I.B.

Clarke-Hess's wideband voltmeter will provide true r.m.s. measurement, independent of wave-shape and power factor. Model 255, the cheapest, costs £1,885 with GPIB interface. Lynx Instruments Ltd., Ware Road, Hoddesdon, Hertfordshire EN11 9DX. EWW222

Cushman make an automatic test set for mobile radio equipment, model C6488. Racal-Dana Instruments Ltd., Duke Street, Windsor, Berkshire SL4 1SB. EWW222

Datacapture offer a compact portable remote measurement system. The Datablock DB4000 accepts a variety of sensor inputs, can memorise hundreds of thousands of measurements to an accuracy of 0.025% and can store data indefinitely on plug-in exchangeable memory boards. It can measure and display up to 16 input channels at once. Prices start at £3,385, including GPIB interface and software. Datacapture 1984, 21 St John's Street, Hertford, Hertfordshire IP1 1EG. EWW224

Datalab have developed a range of filters especially suited to high-speed data acquisition and waveform analysis systems. The DLF-100 is a series of finite impulse response decimating filters, which the company say will make new data acquisition architectures possible and will improve the performance of existing systems. Also available is a range of waveform recorders. Model 912 (about £5,000 with GPIB interface) has two channels, a split timebase mode, signal capture at up to 5MHz, a 4Kbyte memory, expansion possibilities and an output to drive an X-Y plotter. Accessories are available. The modular 2000 series offers up to 30 channels with wide dynamic range and sampling rates of up to 50kHz: prices depend on facilities, typical systems costing £60,000 or more. Data Laboratories Ltd., 28 Water's Way, Mitcham, Surrey CR4 4HR. EWW225

Data Proof produce a scanner for comparing standard cells using the method recommended by the U.S. National Bureau of Standards. Model 160A (for up to 16 cells) costs £4,290 and model 320A (up to 32 cells) £7,340. Lyons Instruments Ltd., Ware Road, Hoddesdon, Hertfordshire EN11 9DX. EWW226

Datron's Autocal digital multimeters feature bus control of almost every function except mains on/off. Prices range from £1,095 to about £3,000 according to the optional extras fitted. These meters can be calibrated in situ using Datron's two automatic calibrators, which are claimed to provide levels of accuracy previously obtainable only in temperature-controlled laboratories. The 4000 (d.c.) costs from £8,495 and the 4200 (a.c.) from £15,945. Datron Instruments Ltd., Hurricane Way, Norwich Airport, Norwich NR6 6BJ. EWW227

DI-AN Microsystems provide a range of interfacing GPIB controllers to sensors and actuators both digital and analogue. Data transfer is possible at up to 250kHz. A mother-board accommodates the user-configurable i/o modules: there is a range of ten at present, DI-AN Microsystems Ltd., Mersey House, Battersea Road, Herne Hill, London SE5. EWW228

Difa's Sicos signal conditioning system is built up of modules such as programmable filters and precision amplifiers. A choice of filter characteristics is available and the frame can house up to 64 channels. If only two channels are required, there is a lower-priced alternative in the PFD3000 (from £1,900). Technic Instruments Ltd., Boy Valley Road, Maidstone, Kent, ME14 1EG. EWW229

Dolch make a series of GPIB-controllable logic analysers having up to 64 channels and covering frequencies to 300MHz. Accessories include a probe for tracing and recording GPIB activity. Dolch Logic Instruments Ltd., Foresters House, 4 London Street, Andover, Hampshire SP10 2PA. EWW230

E.D.A. expect to launch in May a 10Mbyte Winchester disc drive which will allow any computer with a GPIB interface to access the disc without the need for a separate interface card or operating system. Price is likely to be £1,800. Already available is E.D.A.'s GPIB interface for the Apple II computer (£250). E.D.A. (Software) Ltd., 10 Victoria Road, Oxford OX1 5HY. EWW231

E.I.P. specialize in microwave test and measurement instruments. The model 925 is a combined sweeper and spectrum analyser covering 1-18GHz, with a c.r.t. display. Model 545 is a microprocessor-based 10Hz-1GHz counter with 12-digit led display; and model 54A is similar, but with an upper limit of 110GHz. The source locking counters model 575 (up to 1GHz) and model 578 (up to 110GHz) can convert any conventional swept-frequency signal source into a synthesizer. Also available is the model 451 925MHz-18GHz pulse counter. Racal-Dana Instruments Ltd., Duke Street, Windsor, Berkshire SL4 1SB. EWW222

Electronic Development Corporation manufacture an a.c. calibrator covering 10Hz to 11kHz with amplitudes from 0.1mV to 111V (model 4500, £7,245) and a companion d.c. calibrator (model 5200, £4,410). Lynds Instruments Ltd., Ware Road, Hoddesdon, Hertfordshire EN11 9DX. EWW233

Exact Electronics produce a 2GHz programmable pulse and function generator with a very wide selection of waveforms and operating modes. It also has a self-calibration facility and non-volatile memory capable of storing 20 complete front panel settings. Racal-Dana Instruments Ltd., Duke Street, Windsor, Berkshire SL4 1SB. EWW224

Farrell Instruments: items with GPIB control include the low-cost DTS-12B two-channel 12MHz digital storage oscilloscope (£980), a programmable auto-ranging bench power supply providing more than 1kW at up to 60V and up to 50A (APD500, £1,700), an automatic synthesizer signal generator for 10Hz to 1GHz or 2GHz (from £4,300); the SSS5200 10MHz signal synthesizer, an 8-channel signal generator, designed especially for maintenance of mobile communications equipment (from £8,000), and a test set for radio transmitters of up to 100W output (model TTS20, from about £3,900). Farrell Instruments Ltd., 111V, WIRELESS WORLD MARCH 1985

This portable data logger from Microdata stores up to 100 input channels on a standard tape cartridge.
THE ANSWER TO LOW COST 1EEE 488 BUS CONTROL

The EDA Instrument Controller combines low cost with flexibility. Based on the Apple Ille computer, the EDAIC is fitted as standard with an IEEE 488 bus controller, clock/calendar, 80 column x 24 line VDU, 128k user RAM, floppy disk storage, and 80 column printer. Optional extras include 5mByte Winchester disk drive, A3 plotter, and a range of parallel and serial interface ports.

Programming is in BASIC or PASCAL and the IEEE 488 bus can be controlled with simple-to-use high level commands.

The EDAIC is ideal for use in factories and laboratories for test and process control work.

Prices:
- EDA Instrument Controller £1950.00 + VAT
- 5mByte Winchester Disk p.o.a.
- A3 Plotter p.o.a.
- IEEE 488 Controller Card (Apple BASIC version) £250.00 + VAT
- (SSM PASCAL version) £350.00 + VAT

Available now from:
E.D.A. (Software) Ltd.
10 Victory Road, Chertsey,
Surrey KT16 8BL
Telephone: 09328 63758
Trade inquiries welcome.

CIRCLE 86 FOR FURTHER DETAILS.
This waveform acquisition and processing package from Tektronix is aimed at applications such as fibre optic testing.
Our cards take the gamble out of systems integration!


You'll find we give more value or more functions, or save you money or space in your backplane.

Our technical support is by people who really know computer buses, our sales and service engineers are factory trained to know our products.

Whether its serial I/O, analog I/O, digital I/O, comms, bubble memory, system fault analysis or bus conversion, our board level products give you more, to help you build a better system.

For the best deal in cards call us, we'll see that YOU WIN.

**LSI-II SERIAL I/O**

Model 304 four channel serial I/O port for interfacing Q Bus to asynchronous serial data channels. A direct replacement for the DLV11-J, totally software compatible. Each port may be independently configured for RS232C, RS422 or RS423, at nine jumper selectable data rates from 150 to 38.4K baud generated by an on board clock. An external clock may be provided for up to 250K baud data rate.

Four level vector interrupt structure capability for multi user environments with the possibility to configure channel four as the system console. All this on a standard 8.9" x 5.2" card with despatch the same day you order.

Amplicon Electronics Limited
Richmond Road Brighton East Sussex BN2 3RL UK
Tel: Brighton (0273) 608331 Telex: 877470 AMPCON G.
**TA 880**
Multi monitor IEEE RS232 for temperature, voltage, strain indicator and simulator  
circle no 96

**DTR 1000**
Up to 10 sec. at 20 KHz audio transient recorder for analysis and playback – IEEE RS232  
circle no 99

**SGA 1100**
Multi purpose signal conditioning system for strain and temperature measurements  
circle no 102

**DTR 1681**
IEEE and RS232 digital voltmeter with 16K BASIC option for AC and DC to ± 0.01%  
circle no 97

**DTR 1680**
Dual IEEE and RS232 digital voltmeter with 16K BASIC option for AC and DC to ± 0.01%  
circle no 100

**DTR 1682**
Front panel programmable 16K BASIC 64K RAM IEEE and RS232 digital voltmeter  
circle no 103

**MFI 1010**
Programmed to become a specified instrument or system via RS232 for industry  
circle no 98

**DTR 3000**
Signal processing computer with data acquisition and audio large scale storage  
circle no 101

**DTR 2000**
Pocket computer programmable with various industrial datalogging applications.  
circle no 104

---

**Electronics Ltd**
Decoy Road, Worthing, Sussex BN14 8ND  
Telex: 87515 WISCO G CIL  
Tel: Worthing (0903) 204646
FOR THE FUTURE

PCI 6380
Intelligent IEEE or RS232 interface with 8 analogue inputs, 4 outputs, 4 relay contacts

circle no 105

PCI 1280
High speed 16 bit A-D conversion for computers with IEEE or RS232 links

circle no 108

PCI 2080
8 channel relay closure unit to operate from the IEEE or RS232 links

circle no 111

PCI 3080
8 channel D-A converter designed to operate from the IEEE or RS232 links

circle no 106

PCI 1002
12 channel IEEE compatible thermocouple converter based on the PCI 1000

circle no 109

PCI 1000
Low cost 16 channel 12 bit IEEE analogue to digital converter

circle no 112

PCI 5080
IEEE-488 Bus analyzer record/playback facilities and transparent to BUS

circle no 107

DTR 1580
High speed (20μS) large storage intelligent 16 bit A-D for IEEE and RS232

circle no 110

PUPPI & PUSSI
Low cost multifunction interfaces for Commodore 20 to 80 series and SX64

circle no 113

Microsystems Ltd
Decoy Road, Worthing, Sussex BN14 8ND Telex: 87515 WISCO G ATT CIL
Tel: Worthing (0903) 210474
VERSATILE INTERFACE BOARD
FOR USE WITH OUR 6809 OR 6502 CONTROLLERS

- Program in BBC BASIC, FORTH, PASCAL
- 100 Digital I/O Lines
- Real Time Calendar Clock
- RS422/423 Serial Channel
- Centronics Printer Port
- 8 Programmable Timers
- Full Technical Support
- 6502 and 6809 Development Systems
- Add:
  High Resolution colour graphics
  12 Bit ADC
  IEEE Talker listener controller
  Eprom Programmer
  Industrial Racking System

Move over to CMS today

CIRCLE 79 FOR FURTHER DETAILS.

SE 2650 BUS CONTROLLER THE IEEE 488 BUS CONTROLLER MEETS ALL THE DEMANDS OF TODAY'S MEASUREMENT AND CONTROL SYSTEMS - PLUS DESK TOP COMPUTING POWER AS AN ADDED BONUS.

JUMP ON THE IEEE BUS

SE 2750 INTERFACE CONVERTER
A COMPLETE SOLUTION TO YOUR INTERFACING PROBLEMS BETWEEN THE IEEE BUS, SERIAL, 8/16 BIT PARALLEL AND BCD DATA SYSTEMS.

Phone or send for details of the range of IEEE Bus compatible instruments from THORN EMI Datatech:

SE 2650 - IEEE Bus Controller
SE 2450 - Frequency Response Analyser
SE 1700 - Programmable Digital Filter System
SE 2550/60 - Transient Recorders
SE 2750 - Interface Converter
SE 3000/7000/9000 - Instrumentation Tape Recorders
SE 6400 - Galvanometric Recorders

CIRCLE 65 FOR FURTHER DETAILS.
multimeter with built-in thermal printer; and an A3-size graphics plotter (SR6602) with one pen or up to line 8 pens, instruments, Edinburgh Way, Harlow, Essex CM20 2DF. EWW253

Keithley offer a large choice of G.P.I.B. instruments; among them are the model 195A six function programmable multimeter (ranges include temperature in °F or °C) at 110V; a four function programmable electrometer and voltage source which can handle over 14 decades of current and 110V; and 17 of resistance (model 617); a nanovoltmeter (model 181, £3,395), an autoranging picocammeter (485 £1,120) and a microvolt multimeter (197, upwards of £700); a multi-function programmable current and voltage source which can source or sink up to 100W (model 228); the 705 and 706 system scanners with 50 and 100-channel capacity and a range of seven switching cards, and the DAS Series 500 workstation for data acquisition and control. Keithley Instruments Ltd., 1 Boulton Road, Reading, Berkshire RG2 0NL. EWW254

KikuS1's products include storage oscilloscopes, programmable a.e. power sources and high-reliability power supplies. Oscilloscope prices begin at around £1,700 (including GPIB interface). The 522 dual channel model (£2,845), with a conversion speed of 500ns, offers post-storage expansion and an optional high-pass or low-pass mode. Many models are now available with Cauer response for anti-aliasing applications in digital systems. KikuS1 Limited, 9-12 Goodwood Parade, Elmers End, Beckenham, Kent BR3 9QZ. EWW255

Kikus1's products include storage oscilloscopes, programmable a.e. power sources and high-reliability power supplies. Oscilloscope prices begin at around £1,700 (including GPIB interface). The 522 dual channel model (£2,845), with a conversion speed of 500ns, offers post-storage expansion and an optional high-pass or low-pass mode. Many models are now available with Cauer response for anti-aliasing applications in digital systems. KikuS1 Limited, 9-12 Goodwood Parade, Elmers End, Beckenham, Kent BR3 9QZ. EWW255

LeCroy Research specialize in instruments for use in scientific research, in high energy physics especially. Available in modular form, these units include fast data loggers, amplifiers, triggering units, memory modules and transient waveform recorders capable of sampling at up to 200 million samples per second. A GPIB software is available. LeCroy Research Systems Ltd., Elms Court, Botley, Oxford OX2 0LH. EWW257

Marconi Instruments. Products from Marconi with GPIB compatibility as standard or as an option are the following: a.m, f.m. r.f., generators for up to 100MHz; a modulation meter for use with a.c. or d.c. (model 2305); a radio communication test set (model 2955); four d.m.s for frequencies up to 2GHz; a 10Hz-2GHz microphone counter with 0.1Hz resolution (model 2440); several items of p.c.m. test equipment; a true RMS voltmeter; and the 6500 automatic microwave amplitude analyzer, to which new firmware and hardware enhancements have been added. Marconi Instruments Ltd., Longacres, St Albans, Hertfordshire AL4 0JN. EWW258

Microdata offer a variety of data acquisition and logging systems. These can be housed in racks or laboratory instrument cabinets, in portable cases or in sealed suitcase-style enclosures for harsh environments. Plug-in cards accept signals from any commonly-used analogue or digital transducer. Up to 100 input channels are possible with some models. Microdata Ltd., Montem House, Station Road, Radlett, Hertfordshire WD7 6JX. EWW259

MS (Mess + System Technology) produce a comprehensive system of data acquisition, logging and process control. The ADP65 is capable of handling 1000 analogue and 320 binary digital inputs, 30 analogue and 160 digital outputs plus 100 counter channels. Also available: the MIDP82 series of signal and data I/O modules, an intelligent data recorder using standard audio cassettes and a high quality cassette recorder capable of data rates up to 9600bpd. Selectk Instruments Ltd., The Old Ped Bull, High Street, Stanstead Abbotts, Hertfordshire SG12 8AB. EWW260

National Instruments specialize in computer-to-GPIB interfaces. Cards and software are available for the IBM p.c. and DEC Rainbow, for VME bus, Multibus, S-100, STD and SXK buses and for VME and Unibus. The company also makes a GPIB tester, controller and extenders. Amplexon Electronics Ltd., Richmond Road, Brighton, East Sussex BN2 3RL. EWW261

Norma Messtechnik: products include a 120MHz five-mode counter (D9635) and the System 4000 family, comprising a precision digital multimeter, a true r.m.s. meter, a two-channel meter, a precision wattmeter and a metalized-paper data printer with built-in printer. STC Laboratory Services, Edinburgh Way, Harlow, Essex CM20 2DF. EWW262

Panasonic Industrial's principal GPIB products are the 4D104 dual-trace storage oscilloscope with linear interpolation, a yes/no decision mode, a digital 2K memory (model VP-5730P), a fast Fournier transform analyzer covering 0–40kHz and with a data memory of 64Kwords (VS-3510P) and a 32-channel logic analyzer for microprocessor development, with clock speeds of up to 200MHz, 10MHz or 100MHz (VP-3620P and VP-3662P). There are two graphics calculators: a six colour analogue model (VP-6801P40) and an eight-colour A3 version with a plotting speed of 450mm/s (VP-6802). Panasonic Industrial U.K. Ltd., 290–290 Bath Road, Slough, Berkshire SL1 6JG. EWW263

Philips have an extensive range of GPIB instruments. Examples are timers, counters and r.f. synthesizers for frequencies up to 1GHz; an I.f. synthesizer (PMS190, £1,495); automatic digital multipliers (from £495 for the 4 digit PM2516951); storage oscilloscopes (from £3,250 for the PM308C); a video generator (PMS349); a digital cassette

Testing mobile radio equipment with instruments by Racal-Dana

Racal-Dana have a full range of GPIB components, which currently include 4) and 5-digit multimeters; a 4) 6-digit true r.m.s. a.c. measurement system: a 10kHz 2GHz r.f. level meter; counter-timers for frequencies up to 3GHz, some computing versions among them; r.f. generators covering 10kHz-10MHz or 3GHz; d.c. channel spectrum analyzers, function and pulse generators, a timing generator with real-time clock, a series of switching systems with driver and relay modules covering signal levels up to 1kW and frequencies to 180kHz; a GPIB analyzer, and two 20-channel, thermal printer-plotter, ones with a built-in clock. Racal-Dana Instruments Ltd., Duke Street, Windsor, Berkshire SL4 1SB. EWW268

Rohde & Schwarz issue a measuring equipment catalogue which this year runs to over 430 pages and includes signal generators for up to 2GHz, test receivers and modulation analyzers, radiotelephone test sets, a set-up for testing f. cables, r.f. attenuators, sweep generators, vector network analyzers, logic analyzers, and a group-delay measuring set, meters of all kinds, relay matrices for audio and r.f., a digital thermometers a temperature controller, a dot-matrix printer and a 16-function pneumatic interface. Rohde & Schwarz U.K. Ltd.

Fluke's 8840A autormating multimeter


electronics & Wireless World March 1985
The PM3305 35MHz storage oscilloscope from Philips

Technical Projects manufacture a versatile test set for rapid audio measurements. The 401D, which is aimed especially at the broadcast industry, measures level, noise, frequency, harmonic distortion and spurious signals and there are add-on power for phase measurements, rumble, wow and flutter and so on. Display is on a fast-acting analogue peak programme meter. The optional GPIB interface controls all front-panel functions and provides a digital output of the analogue meter readings. Technical Projects Ltd., Unit 2, Samuel White’s, Industrial Estate, Medina Road, Cowes, Isle of Wight PO3 7LP. EWW275

Tektronix: this manufacturer’s GPIB range is very broad, with components or ready-packaged systems. It’s producing virtually every need in testing, measurement or signal acquisition. A special feature is consistency of commands and data formats to make configuring and debugging simpler. One recent advance is the TMS5000 logic analyser, built around two mainframes which can be fitted with any of seven intruments — counter-timers, a multimeter, a function generator and so on. For setting up a system the EZ-Test software generator package (about £1,000) enables the user quickly to create his own test software without having to learn a special programming language. Tektronix U.K. Ltd., P.O. Box 69, Harpenden, Hertfordshire AL5 4S8. EWW276

Tektronix & Berkeley have recently introduced their TCD series tunable bandpass filters. These are available in three or five section versions covering any one octave in the range 32MHz to 3GHz. Tektronix Instruments Ltd., Boyo Valley Road, Maidenhead, Berkshire SL6 4EG. EWW277

Thorn EM1 Datatech make several GPIB-compatible instruments; a frequent response analyzer (model SE2450) with a graphics option giving Nichols, Nyquist or Bode plots on a screen; a programmable transient recording system (BE526) with a choice of memory sizes and sampling rates of up to 50MHz; an eight-channel transient recorder with built-in screen display and menu control (SE5250); and a signal conditioner (SE1700) with a capacity of up to 256 channels. A pair of counter units makes it possible to link GPIB to other interface systems (SE750) or to analogue signals (2A–488). Thorn EM1 Datatech Ltd., Spar Road, Feltham, Middlesex TW14 0TD. EWW278

Thurley Electronics are to launch in April a range of programmable bench power supplies with high-resolution computer interfaces start at £850 for a 0-30V, 0-2A supply. Already available is a digital multimeter with computing and data storage functions, model 1905a, which with IEEE interface costs £495. The IEEE bus itself can be examined with Thurley’s LA-160 logic analyzer, which is usable with any conventional oscilloscope, comes with 16 or 32 data channels and has a 2000 word data acquisition memory with powerful search-and-compare facilities. The 16MHz version is priced very competitively at £385 plus £54 for the LC-03 GPIB connector. Thurley Electronics Ltd., New Road, St. Ives, Huntingdon, Cambridgeshire PE17 4BG. EWW279

Tri-Phenix manufacture a programmable pulse generator offering repetition rates of up to 20MHz and pulse widths down to 100ps. Price is £5,755. Also available is a radar range for testing radar systems, model PX219, at £9,855: this generates a return pulse capable of being dynamically controlled to simulate movement of the target. Lyons Instruments Ltd., Ware Road, Hoddesdon, Hertfordshire EN11 9DX. EWW280

Wandel & Goltermann describe their large range of instruments for the telecommunications industry in a catalogue of nearly 400 pages. GPIB-compatible units include signal generators, level meters and spectrum analysers, with GPIB interface sets for measuring noise and distortion on radio links and satellite systems, a data line test set, active and digital signal analysers, and test sets; a harmonic analyzer for a.c. power lines. Wandel & Goltermann make a complete range of instruments from frequencies up to 160MHz. W & G Instruments Ltd., Prospect House, 413 Long Road, Greenford, Middlesex UB6 9AH. EWW281

Wavetek: most items in the current range are GPIB-compatible. Example: two spectrum analysers with up to four channels, one of them with built-in disc storage and even an integral word-processor, function and waveform generators for frequencies up to 50MHz; a.m./f.m. r.f. generators; signal processing filters; signal analysers for up to 26.5GHz; microwave generators and measurement systems. Wavetek Electronic Ltd., Tag Lane, Reading, Berkshire RG10 9LT. EWW282

Wayne Kerr manufacture several GPIB-controllable instruments for testing, including a 4720 automatic LCR meter. With a basic accuracy of 0.1%, has percentage-deviation and hysteresis facilities for automatic component grading, is able to polarize capacitors and can identify the type of component plugged into it. The B905 automatic precision bridge has auto-ranging, auto-trimming and displays results on a screen; the B4515 precision component analyzer has six-figure resolution and features a display screen with software-labelled function keys for use when manual control is required. Wayne Kerr Instruments Ltd., Durham Road, Bognor Regis, Sussex PO22 9RL. EWW283

Zehntel produce a range of systems for production testing of analogue and digital printed circuit boards. Two of these, the 810 and the low-cost 310, can be enhanced by interposing GPIB control systems which then have access to the systems’ test points. Zehntel Ltd., Sexton House, 500 Avery Boulevard, Saxon Gate West, Milton Keynes MK9 2NJ. EWW284

G.P.I.B.

Roebuck Road, Chessington, Surrey KT9 1LP. EWW269

Scientific Atlanta have introduced a signal analyser (model S380) based on a mainframe which accommodates expansion up to four channels and options such as data storage on disc, disc, spool compensation for easy interpretation of machine signatures. Features include real-time digital zoom, 3-D cascaded waterfall display. Scientific Atlanta Ltd., Horton Manor, Stanwell Road, Horton, Slough SL3 9PA. EWW270

Siemens manufacture a large family of instruments: a choice of three multimeters and four power meters, pulse and function generators, a generator-comparator for waveform curves storing up to 512 x 1024 points, a digital voltmeter, generators operating at up to 2MHz, transient recorders with up to 64 channels, two frequency counters, a data line analyzer for telephony, a fibre-optic reflectometer for locating fibre breaks and measuring the loss of splices, d.c. voltage calibrators and programmable power supplies, a 30-channel chart recorder, two X-Y plotter and a thermal printer. Siemens Ltd., Windmill Road, Sunbury-on-Thames, Middlesex TW16 7HS. EWW271

Solartron make many GPIB instruments. Digital multimeters and precision voltmeters are available with displays of up to 8 digits. A logic analyzer (7610 series) has up to 48 channels with a 1KHz memory for each, multiple timebases and the option of a 400MHz input module. The model 1200 signal processor is an advanced spectrum analyzer offering a programmable display format and a cepstrum analysis function. A data logger, the Orion Delta 3530D, can run eight tasks with different levels of accuracy, waveform analyzers and channels (600 with slaves) and has a powerful data processing ability. The 4040 communications test set is designed to meet all radiotelephone test requirements from audio to u.h.f. For radio testing and surveillance monitoring the Minilock measuring receiver can sweep and measure in the range 100MHz to 1GHz. Also in the range are storage oscilloscopes, signal generators, a five-colour plotter and a p.c.m. data transmission test set. Solartron Instruments, Victoria Road, Farnborough, Hampshire GU14 7PW. EWW272

Systron-Doner’s extensive range of instruments includes many with GPIB control as standard or as an option. Among these are a modular optical communications system capable of handling video, an MSF-synchronized clock, counter-timers and signal generators covering frequencies from 100MHz to 2GHz, pulse generators, a programmable power supplies for laboratory or systems applications. Systron-Doner Ltd., St Mary’s Road, Leamington Spa, Warwickshire CV3 1QW. EWW273

Takeda Riken produce a range of signal analyzers and capture systems. The last Fourier transform analyzers for accurate and servo-system applications to perform analyses covering frequencies up to 20GHz. Also available are a floppy-disc digital data recorder, some microcomputer frequency counters and signal generators for audio and radio frequencies. Chase Electrics Ltd, St Leonard’s House, 20 Leonard’s Road, London SW14 7LY. EWW274

PPM’s model 8000 bus switching system

ELECTRONICS & WIRELESS WORLD MARCH 1985
VMOS squelch for pulse receivers

This circuit uses the baseband p.p.m. (pulse-position modulation) output of a battery-powered v.h.f. a.m. telecommand receiver to switch on high current post-detector stages. Design requirements call for fast attack on receipt of the first 50ms pulse in a five-bit sequence, followed by a hold time of at least 1.5s to permit command activation.

Using a cmos op-amp with buffer transistor gives low standby current drain while allowing up to 250mA to be switched. Time between a high output from the comparator and the buffer transistor switching on is determined by R, and gate capacitance of the transistor. A fully-on gate threshold of 2.5V and gate capacitance of 100pF give an attack time of 0.13ms.

Capacitor C1, isolated from the gate by D1 during turn on, is charged towards the supply rail through R3 and D2, for the pulse duration. When the comparator output goes low at the end of a received pulse, C1 discharges through R3 and D1, with the time constant R3C1 determining time elapsed before load power down (around 1.8s).

If D1 is replaced by a short-circuit, attack time is increased to around 2.4ms. In this case a lower drive-pulse slew rate can be tolerated so the op-amp quiescent current may be reduced to 10mA for low-power applications.

N.E. Evans
Ulster Polytechnic
Co. Antrim

Bit-rate generator

Originally designed for use with a 6850 a.c.i.a., this circuit provides a cheap programmable bit-rate generator for most uarts with ×16 or ×64 clock inputs.

Two four-bit counters in the LS393 are cascaded to form an eight-bit counter for dividing the crystal frequency down to those shown in the table. The seven lowest frequencies from the counter are fed to the LS151 eight-input data selector whose D, input may be used for an alternative clock signal. Data select inputs of this i.c. can either be connected to switches or to a computer i/o port for software control of the data rate.

P.J. Griffiths
Uppingham
Leicestershire

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Frequency (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>B</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
**Instruction counter for Z80 simulator**

One function of a microprocessor simulator is to run a preset number of instructions of a program being debugged and then stop so that register and memory contents may be examined using a monitor program. In Z80 systems, the breakpoint is often implemented in software by replacing an instruction in the test program with a Restart instruction (a single-byte Call to a fixed address).

For this approach, the test program needs to be in ram and working out exactly where to place the Restart code is complicated by the varying length of Z80 instructions. Also, a bug in the test program could prevent the restart code from being reached. In this design, the test program does not need to be tampered with, so that routines in ram may also be single-stepped for demonstration purposes. (The usual wait-state generation technique for single-stepping precludes the use of dynamic rams.)

A programmable counter provides the breakpoint by counting M1 (op-code fetch) cycles and generating a non-maskable interrupt (NMI) when the preset number of instructions has been executed. Correction is automatically made for two-byte op-codes—those beginning with CB, DD, ED or FD—which have two M1 cycles. Counting is suspended during interrupt servicing so that, for example, display handling interrupts can be allowed to run without affecting the test. Sixteen op-codes are decoded by IC1:b. If CB, DD, ED or FD is detected on the data bus at the end of an M1 cycle, the Q output of IC6b is clocked low by the trailing edge of the RD pulse. The RFSH refresh pulse, which always occurs after an M1 cycle, clocks IC6b whose Q output goes high and prevents the second M1 pulse from reaching the CTC (counter/timer circuit). Output Q is fed back through IC5b to ensure that the next instruction is not also inhibited should the second byte be CB, DD, ED or FD.

When the CTC down-counter reaches zero, it sends a short positive pulse on its ZC/TO pin. This pulse is inverted to provide the c.p.u. NMI signal. It also sets the Q output of IC9b high which in turn sets the Q output of IC9c high to inhibit further counting. Using the non-maskable interrupt means that the circuit works whatever bugs there may be in the test program. The CTC channel used has its normal interrupts disabled.

The NMI service routine dumps all the register contents into a reserved ram area and then enters the monitor program which allows ram to be examined and altered as required. A continue command to the monitor reloads the CTC and copies the register storage ram back into the registers. A normally unused instruction, LD L, L (op-code 6D), is executed to clear IC9a and hence remove SET from IC9b.

Finally, a return instruction is executed. This retrieves the address of the next instruction from the stack, where it was placed when the NMI was recognized, and the test program continues from the point where it was interrupted. The RET op-code is counted by the CTC, but the monitor allows for this by adding one to the number of instructions to be run. Up to 255 instructions may be run.

Instruction counting is prevented during interrupt servicing by IC9a, whose Q output is set high when an interrupt acknowledge cycle is detected (M1 and IORQ both low). Output Q of IC9b goes low when op-code ED is detected, and if the second byte is 4D, i.e. if the instruction is RETI, then IC9c is toggled. The SET signal is removed from IC9b and counting continues from the next op-code.

Clearing of the two JK bistable elements of IC9 occurs whenever the processor is
reset. Connections from Q to J ensure that the devices remain cleared until forced to change state by a low on the SET input.

Circuit IC8q is cleared by a CB op-code. The low Q output inhibits latching of a following ED byte by IC6, and hence prevents IC8q from being toggled to its clear state by a SET 5, I instruction followed by LD C.L (op-codes CB ED, 4D). Similarly, the high Q output of IC8q keeps the K input of IC9 high after a CB byte so that IC9q is not cleared by the second byte of the instruction BIT 5, L (op-code CB 61).

In the timing diagram, (a) shows removal of the second op-code byte, (b) resumption of counting after a RETI instruction and (c) resumption of counting after an LD L,L instruction.

If no use can be found for the three remaining CTC channels, this device can be replaced by a chain of any desired number of LS163 presettable four-bit counters.

Peter Ferris
London

Strobe probe
This probe has proved invaluable in tracing relationships between read, write and chip-select lines on microprocessor-based circuit boards. It has two channels. Section A is the window input and its led lights to indicate that a window has occurred. Probe input is fed to section B. The led in this section pulses on if a signal at the B input occurs during the window at A.

Polarity of the window and probe inputs is selected by the respective switches. When a switch is high, its associated circuit responds to active-high inputs and vice versa.

D.J. Ford
Welwyn Garden City
Hertfordshire

4-20mA indicator
Output from industrial process instruments is often a constant-current signal in the range 4-20mA d.c. This simple device is a monitor for such signals. Its accuracy depends largely on the meter used and with careful calibration, an error of ±1% f.s. is possible.

Presence of a signal is indicated by the led. The three-terminal i.e. provides a 4mA offset which is set using the potentiometer to the left of it. Voltage drop provided by the zener diode ensures that there is sufficient voltage to operate the led and i.e. The second potentiometer is for setting to full-scale deflection at 20mA.

M.C. Polgreen
Birmingham

Electronics & Wireless World March 1985
Versatower:
A range of telescopic towers in static and mobile models from 7.5 to 26 metres with lift-over facility enabling all maintenance to be at ground level.

Designed in accordance with CP3 Chapter 5: part 2: 1972 for a minimum wind speed of 140 kph in conditions of maximum exposure and specified by professionals world-wide where hostile environments demand the ultimate in design, quality and reliability.

Suitable for mounting equipment in the fields of Communications, Security surveillance — CCTV, Meteorology, Environmental monitoring, Geographical survey, Radsence range-finding, Marine and aero navigation, Floodlighting, Airport approach lighting.

Further details available on request.

STRUMECH ENGINEERING LIMITED
Portland House, Coppice Side, Brownhills, Walsall, West Midlands WS8 7EX, England
Telephone: Brownhills (0543) 43 111
Telex: 335234 SELG.

CIRCLE 31 FOR FURTHER DETAILS.

FREQUENCY COUNTERS

The brand new Meteor series of 8 digit Frequency Counters offer the lowest cost professional performance available anywhere.

- Measuring typically 2Hz - 1,000Hz
- Sensitivity <50mV at 1GHz
- Setability 0.5ppm
- High Accuracy
- 3 Gate Times

PRICES (Inc. adaptor/charger, P & P and VAT)

METER 100 (100MHz) £116.72
METER 600 (600MHz) £147.77
METER 1000 (1GHz) £204.12

LOW COST, HIGH RELIABILITY, LOW COST.

BLACK STAR LTD, Dept.W.W, 4 Stephenson Road, St Ives,
Huntingdon, Cambs PE17 4NU, England.
Tel: (0440) 62440 Telex: 32339

CIRCLE 33 FOR FURTHER DETAILS.

TIME WRONG?
MSF CLOCK is EXACT
8 DIGIT display of Date, Hours, Minutes and Seconds.
SELF SETTING at switch-on, never gains or loses, automatic GMT/BST and leap year, and leap seconds.
EXPANDABLE to Years, Months, Weekday and Milliseconds and use as a STOPCLOCK to show when something happened.

COMPUTER or ALARM output also, parallel BCD (including Weekday) and audio to record and show time on playback.
THE SECRET? MSF Clock receives and decodes Rugby 60KHz atomic time signals, has built-in antenna, 1000Km range.
LOW COST, fun-to-build kit only £79-70 (ready-made to order) includes 5x8x15 cm case, pcb, ALL parts, by-return postage and list of other kits, GET the TIME RIGHT.

CAMBRIDGE KITS
45(WQ) Old School Lane, Milton, Cambridge, Tel 860150.

CIRCLE 35 FOR FURTHER DETAILS.

SATELLITE TV RECEIVING EQUIPMENT

1.9M, 2.5M and 5M Dishes.
Receivers. Downconverters, Low Noise Amplifiers, Feed Horns available.

Complete systems installed anywhere in the world. A full report on reception feasibilities at any location is available — price £25.00. Please state Longitude and Latitude.

For further details contact
HARRISON ELECTRONICS
22 MILTON ROAD, WESTCLIFF-ON-SEA, ESSEX SS0 7ZA Tel: (0702) 332338

CIRCLE 50 FOR FURTHER DETAILS.

ESSEX ELECTRONICS CENTRE
Wivenhoe Park, Colchester, Essex CO4 3SQ
Telephone: Colchester (0206) 865089

CIRCLE 28 FOR FURTHER DETAILS.

Designed and manufactured in Britain

£116.72
£147.77
£204.12

Illustrated colour brochure with technical specification and prices available on request.

Further details available on request.

PREMIUM FORTH FROM

Free for full information.

Our small size, low cost FORTH target system could be the answer to your control needs.

send for full information.

VERSATOWER: A range of telescopic towers in static and mobile models from 7.5 to 26 metres with lift-over facility enabling all maintenance to be at ground level.
Right to the point

The point is accuracy, under all conditions. Something only a DMM with true RMS AC measurement can achieve. For £165*, something only Philips new PM 2518 can offer.

Look at the table and you'll see how important true RMS can be. Look at the PM 2518 and see how much more you get – DC accuracy of 0.1%, plus wide-ranging standard and optional facilities (including "Backlite" display).

Like the idea of bench-top spec. with the convenience and price of a portable? Take a closer look at Philips PM 2518. You'll find the point is well made.

Authorised distributors:
Electronic Brokers (01-267 7070)
Philips Service (01-686 0505)
Wessex Electronics Ltd (0272-571404)

Philips Test and Measuring
Pye Unicam Ltd
York Street Cambridge CB1 2PX
Tel (0223) 358866 Telex 817331

* Price excludes VAT and is correct at time of going to press.
This second part of Per Andersen’s article details the circuitry for the emergency autodialler that requires no line connection.

When the motor is running, the $L_1$ coil in the pump monitor detects the magnetic field around it. Comparator IC$_{22}$ converts this signal to a square wave that is rectified and taken through a couple of Schmitt trigger inverters to generate the stop signal (STOP). This is ‘or-ed’ to the fail signal providing the term $H_K$. Under normal conditions STOP is high, and therefore the solenoid is not activated. When $H_{al}$ is low, IC$_{19}$ is constantly triggered supporting a low fail signal to the line and pump monitors. On switch-on RESET set RFD high. However, when the motor stops, $H_{al}$ goes high activating the solenoid and releasing IC$_{18b}$. The ready-tone is picked up and amplified around 70dB by IC$_{18a}$, presenting a signal of 1.5V r.m.s. at the input of the tone decoder, IC$_{19}$. The band-width and output delay values chosen require a steady signal for at least two seconds before the output of IC$_{19}$ goes low. Circuit IC$_{19}$, is coupled as an inverter triggering the reset input of the bistable flip-flop IC$_{18b}$. Line RFD now goes low preventing IC$_{18b}$ from generating the fail signal and triggering the set input of the dial latch. If the ready tone is not detected within six seconds, the not-ready timer runs out supplying the fail signal to IC$_{18b}$, forcing its output to stay high whatever happens at the resent input, and deactivating the solenoid.

The high output of the dial latch starts the 1.2Hz generator, IC$_{19b}$ which controls the memory output buffer and address counter. The buffered signal is taken to the b.c.d.-to-d.t.m.f. tone converter consisting of IC$_{19}$, IC$_{3}$ and D$_{31}$-D$_{35}$, then to the driver stage and the transmitter/loudspeaker.

Comparator IC$_{19}$ compares the outputs of the memory and display address counters and upon equality, which means when the encoded number is dialled, the output goes low triggering the dial latch to stop the 1.2Hz oscillator. The EOD and RFD signals are now ‘and-ed’ for starting the alarm generator, which will run 1½ minutes determined by IC$_{18c}$. At the end of the period the ALST signal takes the reset input of the...
Circuitry requires a solenoid supply as well as 5V supplies; a battery charger is included in this version.

Waveforms at various points in circuit are identified in circuit above and on page 67 by encircled numbers.

not-ready timer low which generates the fail signal which sets the machine in the stand-by mode.

The alarm generator produces a sound similar to certain police sirens. This was chosen so that whoever answers the call, probably not you, is able to distinguish it from all the other telephone signals. The tone is easily made by taking the output of the first section of IC5 to the control voltage input of the second section thereby modulating it with this lower frequency.

To write the telephone number, which can have up to 16 digits, into the memory you simply take S1 to the write position and key the number at the keyboard. As a control the number is read out on the display. On completion S1 is taken to the read position. Keyboard data goes from IC6 (10-to-4 line converter) via IC2 (4-bit latch) to the memory, IC2. Each time a key is depressed, a strobe pulse of around 1ms is generated from the outputs of IC6. The negative strobe is used for the write signal to memory and for unblanking of used digits at the display. The positive strobe is incremented the memory and display address counters for each depression of a key. When S1 is taken back to the ‘read’ position the memory address counter is reset because of the capacitor C3. The display address counter remains at the number of digits that previously was entered. A read cycle therefore goes on until equality of the two counters.

On switching on the machine the necessary reset pulses, which have a duration of about 200ms, are generated from IC3 and IC5. The reason for designing a display for the machine was the ability to control the number to be encoded. On a normal telephone you simply hang on and make a re-try if you get the wrong connection. In this case, you wouldn’t know if the right number was dialled, because the connection was made when you were not at home. This is where the display comes in. As it was the most expensive unit in this construction, it is designed in a way that makes it easy to leave out if not wanted. Or it could very easily be reduced to eight* digits, if

* Or one digit for that matter, with sequential readout. Mr Anderson has suggested the circuit on page 69 for this low-cost option. The original circuitry for an 8 or 16 digit display is available from the editorial office.—dep.ed.

ELECTRONICS & WIRELESS WORLD MARCH 1985
Signal Explanation

ALST To the line monitor from the alarm generator to notify that all functions were completed, and to generate the FAIL sign.

BLNK From the keyboard logic to the display to shift the blanking registers each time a key is depressed.

COMP From the keyboard logic to the dial latch to let it know that all digits from the encoded number were dialed.

DTMF Tones from the tone dialer to the output stage.

EOD The end-of-dial signal goes from the dial logic to the alarm generator to provide the alarm signal for the transmitter, when the dial sequence is finished.

FAIL From the line monitor to the pump monitor to deactivate the solenoid, when all functions are completed, or when the ready-tone did not occur within six seconds from the point where the receiver was lifted off the hook.

HOFF From the pump monitor to the line monitor to enable the six-second timer, whenever a pump malfunction took place. Ready-for-dial goes from the line monitor to the dial latch to indicate that the ready-tone was detected. It also goes to the alarm generator, where it will be used in conjunction with the EOD signal, to generate the alarm signal.

RST Clears the memory address counter upon power-up or when the function switch is taken to the read mode.

RESET Clears the display address counter upon power-up.

Set the line monitor latch Hi after power-up, and causes IC2b to remain inactive until the RF signal is received.

STOP Message from the pump monitor to the solenoid driver to let it activate the solenoid and generate the HOFF signal.

This is enough for local telephone numbers. It was designed with 16 digits to make it fit to the memory capacity of the machine, and to allow viewing of the number dialed at any time.

The four data lines to the display are buffered in IC1g and then taken to the display data bus. Position of the digits are determined by the 4-to-16 line decoder, which is controlled by the display address lines. The address is incremented by one each time a key is depressed, and this will enable the digits in turn from left to right. To keep unused digits blanked, the two 8-bit shift registers, IC11, IC12, are coupled as blanking latches controlling the BI-terminal on the displays. The latches are reset during power-up to provide a blank display before entering any digit.

As the instrument is battery powered the supply circuit is simple. Only a couple of voltage regulators with the necessary capacitors at the outputs are used. Of course a regular mains supply could be used to support the power in the stand-by mode, which will reduce the capacity of the battery essentially. In this case the battery is only needed for less than two minutes, which is the time it takes to make the dial and deliver the alarm tone. Proper switching from mains to battery will in such a case be required to secure storing of the memory contents.

It might be necessary to adjust the machine to different types of telephones, as these could have diverging input/output levels from the one the machine was developed for. But this will be fairly simple, as it is only a matter of changing the gain of the input amplifier and the driver stage. The only thing to consider is that the tone decoder needs an input of around 1.5 to 2Vr.m.s., and that the transmitted d.t.m.f. signal must not suffer from any kind of distortion.

The sense coil is easily made, as it monitors 50Hz. In my case the coil from a scrapped relay was used with good results, but almost anything will do. Some of the functions in the circuit could be made in a simpler way, but they were designed partly to keep the expenses down, and partly because the components were available.

The d.t.m.f. circuitry is supplied from a separate regulator to secure optimum performance and correct functioning of the dial logic. As there are no adjustments in the machine, it should work immediately after careful assembling.

Author's original 8 or 16-digit display can be used to check the stored number; alternatively this sequential single-digit circuit offers a low-cost option. The inverters are type 7407.

While reading through the various telephone exchanges in Europe will handle dtmf dialing, only a minority of UK public exchanges (unlike private branch exchanges) can at present. British Telecom expect that over two million subscribers will be able to use dtmf dialing by the end of 1986 as a result of continued expansion of System X. As with modem designs, such equipment must have BATB approval to be legal.
Principles of optical storage

This second article in our new series details the physics of the readout process.

A fundamental goal of the compact disc is that it should not require any special working environment or handling skill. The bandwidth required by digital audio is such that high density storage is mandatory if reasonable playing time is to be obtained, and this implies short wavelengths. The advantage of optical playback is that the readout beam can be focused onto the medium from a distance, whereas magnetic recording requires intimate contact and implies a wear mechanism, a need for periodic cleaning, and susceptibility to contamination in the domestic environment of reading.

The first article (January issue) introduced the idea through the thickness of the disc. This approach causes the readout beam to enter and leave the disc through the largest possible area of the surface, see Fig. 1, which shows dimensions involved. Despite the minute spot size — around 1.2µm dia. — light enters through a 0.7mm dia. circle. Thus surface debris has to be three orders of magnitude larger than the readout spot before the beam is obscured. The size of the entry circle is a function of the refractive index of the disc material, the numerical aperture of the optical system and the thickness of the disc.

Because of readout through the thickness of the disc, surface scratches on the readout side are tolerated very well. In extreme cases of damage, the scratch can often be successfully removed with metal polish. Conversely, the label side of CD is much more vulnerable, as the lacquer coating is only 30µm thick. For this reason, writing on the label side is not recommended; pressure from a ballpoint pen could cause mechanical damage to the information layer, and solvents from marker pens have been known to penetrate the lacquer and corrupt the disc. A common party piece is to show off the error correction system by writing on the readout side with a felt tip pen. This is relatively harmless as the disc base material is impervious to most solvents.

The base material of CD is a polycarbonate plastics material produced by Bayer under the trade name of Makrolon. With excellent mechanical and optical stability over a wide temperature range, lends itself to precision moulding and metalization. It is commonly used for automotive indicator clusters for the same reasons.

An alternative material is polymethylmethacrylate (p.m.m.a.), one of the first optical plastics, known by the trade names of Perspex and Plexiglas, and which is used extensively in illuminated signs and aircraft canopies. Makrolon is preferred by some manufacturers because it is less hygroscopic than p.m.m.a.

In the readout process the depth of the steps is designed to be a wavelength of the light used, Fig. 1, so that light reflected from the mirror surface travels 1/2 further than light reflected from the step surface, and so results in destructive interference. The principle is optimized for one wavelength, and so light source must be monochromatic.

The wavelength in the medium is determined by the refractive index; the specified light source has a wavelength in air of 780nm and the refractive index of 1.55 causes this to become 500nm within the disc. The step height is about one quarter of this figure at 0.11 to 0.13µm. As the incident light cannot return the way it came because of interference, it will exit at any angle that permits constructive interference as a diffraction pattern along a disc side.

Dimensions of the track structure are closely comparable with those of the Philips Laservision disc, on whose optical technology the compact disc is based. Both are diffraction-limited, i.e. the dimensions involved are as small as permitted by the wave nature of light.

It is not possible to focus light to a point even with a lens free from aberrations. When this is attempted, the result is an Airy disc whose size is a function of the wavelength and the numerical aperture of the objective.
When the master is cut, the effective spot size is about 0.4µm, determined by balancing the power of the cutting laser against the sensitivity of the resist. The resist has two sensitivity levels, a level where etching will just begin, and a level where etching will go through to the glass blank, Fig. 3. Increasing the exposure produces pits with gradually sloping edges, which release from the mould easily but are optically inferior to steeper edges. A compromise is reached by control of the exposure.

To achieve the very small effective spot size needed for cutting, the resist sensitivity is in the area of the half-power level of the Airy disc intensity function, and a krypton laser with the short wavelength of 780nm is used. This requires an aperture of about 0.7. It is the thickness of the resist that determines the height of the bumps on the finished disc, which should be the wavelength of the player laser in the disc material.

Optimum size for the playback spot is rather larger than that of the cutting spot: for destructive interference to cause complete cancellation in the reflected beam the energy reflected from the top of a step should equal the anti-phase energy reflected from the mirror surface. This simplistic condition is never obtained in practice, and typically the presence of a long bump reduces reflected power to about 25% of that obtained from the mirror surface. A larger spot in the player also eases the task of track following, permits the use of a low-cost visible wavelength laser and a smaller aperture, which in turn improves the depth of focus.

The specified wavelength of 780nm and n.a. of 0.45 produce an Airy function where the half-power level is at a diameter of about 1µm. The first dark ring will be at a diameter of about 1.9µm.

Allowable crosstalk between tracks then determines the track pitch. The first ring outside the central disc carries some 7% of the total power, and limits crosstalk performance. Track spacing is chosen such that with a slightly defocused beam, and a slight tracking error, crosstalk due to the central spot seeing adjacent tracks is no worse than the limit. Since objective aberrations will increase spot size and crosstalk, the CD specification requires that the objective performance shall be within the Marechal criterion. Clearly the n.a. and wavelength must also be closely specified.

The cutter spot size determines the reader spot size, which in turn controls the shortest wavelength of modulation along the track that can be read. The optical cut-off frequency, where the output falls to zero, is 2V x (n.a.)/λ, where V is the linear track velocity. The minimum linear velocity of CD is 1.2m/s so the cut-off frequency becomes

\[
 f_c = 2 \times 0.45 \times 1.4 / 780 \times 10^{-9} = 1.67 \text{MHz}
\]

The frequency response of the pickup falls linearly to the cut-off frequency and Fig 4 that actual measurements are only a little worse. It is necessary to limit the maximum operating frequency to about half the cut-off frequency otherwise immunity to noise and crosstalk is impaired. Maximum frequency is 720kHz, which represents an absolute minimum wavelength of 1.666µm, or a step length of 0.833µm when the minimum speed of 1.2m/s is used for a 75 minute disc.

Standard one-hour discs have a minimum step length of 0.972µm at a track velocity of 1.4m/s. The maximum frequency, 720kHz, the bit rate; these are different due to the channel code used and is discussed later.

Fig. 5 shows the structure of a maximum frequency recording and the relationship of the spot intensity function.

The next article deals with the mechanisms necessary for track following and focus.

References

Fig. 3. Two levels of exposure sensitivity of the resist determine the size and edge slope of the steps on the disc surface. A large exposure results in large step with gentle slope (a) while less exposure results in smaller bump with steeper and sloped sides (b).

Fig. 4. Amplitude response of laser pickup. Maximum operating frequency is about half of cut-off frequency \( f_c \).

Fig. 5 Structure of a maximum-frequency recording, related to the intensity function of an objective of 0.45 (n.a.) with 780µm light. Spacing puts adjacent tracks in dark rings, reducing crosstalk. As the spot has an intensity function, it is meaningless to specify spot diameter without some reference, such as an intensity level.

71
CAUSALITY
The idea of causality as time delayed control is essential to logical reasoning (February Editorial). Reasoning is a process of the mind so it is true that causality, as "a necessary connexion", exists in the mind.

Conversely if the reasoning corresponds to events in reality then causality can be said to exist there just as much. This is the working hypothesis for scientific theorizing, and causality provides the essence inherent in mechanistic "explanation", conferring a sense of 'understanding' in appreciation of this knowledge.

The problem of whether reality is logical is itself beyond reason: logic deals with relations between things that already have the attribute of 'existence'. When we come to ask how does anything at all exist we have progressed beyond the confined circular structure of logic into the realm of metaphysical speculation.

To demonstrate that causality does exist in reality external to any mental framework consider an idea that occurred to me of using Lenz's law of induction for a system of magnetic braking to support an elevator against free fall.

As the coil falls around the magnet (or vice versa) the motion through the lines of flux induces a current which in turn produces a field tending to oppose the motion.

The important aspect of the interaction in this abstract 'control system' is that the response tends to oppose the stimulus. It can never cancel it exactly simply because of the chain of causality. (There is similar behaviour in a virtual earth feedback amplifier, virtual being the 'operative word'.) So causality demonstrably exists in reality.

In formulating his mechanics, Newton found the need to invent the mathematical language of 'the calculus' of fluxions' to describe such time delay interactions. In the limit as the interaction time tends to zero we may use exact derivatives and formulate our laws using differential equations which then remain valid only for pseudo instantaneous or asymptotic steady state interactions.

Conversely however, some people may be misled into saying that since the time interval tends to zero it is negligible. Then the "constant conjunction" means that the change of flux and induced e.m.f. are so essentially simultaneous as to be impossible to unravel. This is an ingenious erroneousness.

The incorrectness of this argument can be simply explained using a special case as an example so that the truth seems obvious. Consider the "thought experiment of increasing the size of the coil so its separation from the magnet at its centre is enormous (such as the radial distance to the nearest star, about 4 light years). As an initial condition we may suppose the magnetic field has existed throughout all space for all time up to the (god-like) 'present'. When the coil moves relative to the magnet it cuts lines of flux instantaneously in its environment and an e.m.f. is induced. However the information that the coil has moved and produced an e.m.f. and opposing magnetic field propagating out at the speed of light will take a definitely significant time (compared to a human lifetime) to read the magnet and reciprocally for this to react and oppose the relative motion. (With such action at a distance explicitly formulated it also becomes obvious that at each instant (God's point of view) forces cannot possibly be 'equal and opposite' and so we need a system of mechanics even more fundamental than Newton's).

When we can vary the degree of Hume's "constant conjunction" then, even the most stubborn of anti-scientific psychedelic mind-destroyers ought to agree (out of common courtesy) that "there must truly be some causal connection in reality, that is, external to any mind: though as to the mechanism, that needs further elucidation."

For the example suggested in the editorial of current in a wire connected to an e.m.f., the interaction is too fast for human reaction or contemplation. The initial transient interaction could be time expanded and analysed in detail as it settles down to an asymptote which corresponds to the classical circuit laws.

P.J. Ratcliffe
Stevenage
Herts

CURRENT DUMPING
Mr McLoughlin's replies to the letters regarding his article on current dumping (Letters, 1984 February pp. 46, 49, 50) need a response, since we feel some of our statements have been misinterpreted.

We think that the "cautious comparisons with other arrangements", which "had to be withdrawn on grounds of instability" are important, for the success of an electronic technique such as current dumping often depends on the practicalities of typical circuits.

Should one think of current dumping as dominated by feedback or by feedforward error correction? We think most of us would agree that without feedback the majority of amplifiers would be impractical. However, current dumping establishes a new concept in amplifier design that is clearly different from normal feedback, and is clearly traceable to Black's original feedforward concepts. We have never stated that "feedforward alone is the only correct explanation of current dumping". On the contrary, we have always insisted that current dumping is a blend of both error feedforward and feedback (see our second paragraph), and we feel it is most improper to represent our views in such a biased manner.

It is very clear from our AES article that the inductor characteristics refer to those inductors which we constructed for our model circuit. Thus "this damaging criticism of the Quad 405" is wholly inaccurate. There is nothing wrong with the inductor in the Quad 405. Mr McLoughlin's theoretical analyses of current dumping have descended to unjustified, unsubstantiated criticisms of the Quad 405 specific design. If he doesn't like the 405, he is at liberty to say so, but he should not say that "it is quite incapable of using the current dumping technique" without some experimental substantiation. Our model circuit does this, and we are convinced that the design does incorporate a feedforward novelty. There is a clearly discernible distortion null in the 405 (albeit not perfect) as the bridge components are varied, and the unmodified amplifier is fairly close to optimum. We are sceptical that a circuit of comparable performance and simplicity (with the dumpers biased off) can be produced without the feedforward technique. Mr McLoughlin states that the 405 operates by relying on the modification of the feedback at h.f. provided by the inductor L. He argues that "It is left to the usual negative feedback from E (his Fig. 12) to reduce" the dumper distortion. We would claim that there is no usual feedback from E, and that the feedback from before L is merely put in to correct the signal after L. This is error cancellation and is not associated with normal feedback, although it is used with feedback. The 405 may not embody the technique perfectly, as many of the details show, but the primary claim that it uses an error cancelling technique is in no way compromised. One could insist on sticking to a feedback-only explanation, but once one sees how the concept is clearly traceable to feedforward error correction, then it seems to us only logical that subsequent descriptions are based on the two intertwined techniques.

J. Vanderkooij
S.P. Lipshitz
University of Waterloo
Ontario
Canada

MORSEMAKER
After completing a Morsemaker (June, 1985), it was found that some of the 4013 devices did not change state in a reliable manner, and the following modifications were required before the unit would function properly.

An additional 10n capacitor was connected in parallel with...
that already existing between pin 3 and earth of i.c. 4013/2(a), directly to pins 3 and 7 on the underside of the printed-circuit board. Without this capacitor, "nonsense" characters consisting of dots only, appeared. A 10n capacitor was connected between pins 11 and 7 of i.c. 4013/3(b) on the underside of the p.c.b. Without this capacitor, a few dots were generated, followed by a continuous tone. Both capacitors are of the miniature, low-voltage ceramic type.

With the two capacitors in place, figures were generated correctly, but letters involving more than one changeover, e.g. CXPQY etc., were not produced, and also the "blocked" dit-dah-dah frequently occurred. This was cured by removing the 10n capacitor from pin 3 of the dotted latch 4013/1(a).

Randomising was also improved on this particular model by shorting-out the diode connected to pins 3, 4, 5, of i.c. 4025/5(b) which considerably reduced the number of consecutive 'repeats' in a string of characters.

Switching disturbances on the positive supply line had been previously observed on an oscilloscope, and found to be due to the effect of the series resistance of the safety diode on the supply voltage regulation. Whilst there was no apparent effect on the performance of this unit, it was considered desirable to augment the 2u and 10n capacitors already incorporated across the supply lines with several 47p 10V electrolytic capacitors to provide additional smoothing and de-coupling at various places on the p.c.b., particularly as the device is powered by a battery, which could develop internal resistance in the course of time, adding to that exhibited by the diode.

Finally, a useful addition to the Morsemaker is an adjustable delay between characters which enables the character generation speed to be increased so that rhythm is apparent, yet allows a slow reader respite between characters.

This was achieved by interposing a "one-shot" between the wiper of the "character-end" switch and the SET pin 8 (previously isolated as described below), of control-latch i.c. 4013/1(b). The pulse from the switch activates the 'one-shot', causing the output to go high, this in turn holds the control-latch in the "character-end" mode for the duration of the 'one-shot' pulse. The "one-shot" was formed by connecting two elements of a 4001 quad 2 input Nornate as shown in the sketch, the remaining i.c. inputs being connected to pin 7 (OV). Small portions of the printed-circuit track on either side of pin 5 of figure 1 were carefully removed (leaving pin 8 isolated), pin 7 of i.c. 4013/2 being re-connected to pin 7 of i.c. 4013/1 via a wire link. Pin 8 of i.c. 4013/1(b) was then connected to pin 4 of the 'one-shot'. The extra i.c. and associated components were mounted on a small p.c.b., located near the main board from which is obtained the necessary power supply. The delay-control spindle was brought to the outside of the instrument case, for convenience.

R.J. Canaway
Maidenhead
Berks.

**IT EDUCATION**

In November, 1983, the commission of the European Community issued the following facts as part of its official journal no. C321, volume 26. "More than 6% of the Community's gross domestic product (GDP) is produced by Information Technology (IT) industries. A further 29% of GDP is produced by industries which apply IT in a major way. Another 20% of GDP is derived from other industrial sectors with a high information content". In other words, over half of the GDP of Europe is derived from, or is heavily dependent on, IT. By 1990, IT will be the world's largest manufacturing sector.

The new information technologies will be the key to industrial advance in our lifetime and national (i.e. UK) participation in these advances demands national development of the skills required to provide the labour and intellectual infrastructure to such advances. Tilt it may be, but no less true, that we are undergoing a revolution in industrial methodology. Moreover, in parallel, the very fabric of our lives is being irreversibly influenced by IT: our shopping, recreation, home life and education are all affected — and will increasingly become more so. These facts and conclusions are not in dispute. It is how we as a nation are addressing this present and future that prompts me to write today.

For I believe that our primary and secondary school education system is not reflecting the importance of IT. IT is not about a computer in every school. IT is about many things, but, primarily:

- **information processing and manipulation, communications, machine intelligence, man-machine interface, data base networks, citizen's privacy, word recognition and machine speech, software, microelectronics, advanced information processing, expert systems — one could go on and on.**

Can it then be right that we as a nation spend more money and skilled resource on teaching French and German in schools than we do on IT? How much is that effort going to contribute to our GDP in five years time? How can we justify departments of Business Studies in schools but no departments of IT? Has anyone considered whether we should be giving over half of the school curriculum to IT education? Do we really believe that our present curriculum is equipping our children to deal rationally with the world as it is and as it will be? Do we really believe that a child's job prospects could be anything but improved by a far higher understanding of the technologies of the future?

Let us acknowledge that we, in Europe, are engaged in a battle with the Americans and the Japanese for mastery of the high added-value industries of the future. Some we have lost irrecoverably e.g. mainframe computers. But, on the whole, much of the rest is up for grabs. And if this is true of Europe, how much more is it of the UK, with its tremendous dependency on exports?

It is conceivable that some may regard the repositioning of IT in the curriculum as a delibrasalising move; that the school may become less arts oriented. The latter is inevitable but the former need not be so, with sensitivity and care. One would not recommend the abolition of arts subjects, but rather their de-emphasising.

From my view in one of our advanced technology companies, some of the future can be seen — many others in the IT industries see likewise. Surely it is time for a dialogue to start between the educationalists and the IT industrialists? Our children's part in the future could be at stake.

Ian Bilsland
Graphic Information Systems Limited

**ELECTRONICS & WIRELESS WORLD** MARCH 1985

www.americanradiohistory.com
CABLE T.V. HEAD END AND REPEATER AMPLIFIERS

CHANNEL CONVERTERS
TCUU UHF-UHF Single channel converter. Gain adjustable +26dB to -16dB. Maximum output +30dBmV. Crook controlled oscillator. Power requirement 14V 25mA. (Quote Channels required).

TCU As TCU except UHF to UHF converter. (Quote Channels required).

TCVU As TCU except UHF to VHF converter. (Quote Channels required).

QUALITY AT LOW COST
TAYLOR BROS (OLDHAM) LTD
LEE STREET, OLDHAM - TEL. 061-652 3221 - TELEX 669911

CIRCLE 120 FOR FURTHER DETAILS.

CIRCUIT ANALYSIS
on CBM/PET or COMMODORE 64
An all machine code program for the rapid analysis of linear electronic circuits.
This package evaluates voltage gain, current gain, input impedance and output impedance in magnitude phase angle form.
Program features:
Capacity 30 nodes, 100 passive components, 20 active sources.
Uses 32k RAM
Handles transistors, F.E.T., Op-amp., transformer and transmission line. Ctc model may be simple or complex.
Simple, rapid, component value or parameter changes.
Hardcopy of all results, including graphs.
Graph axes may be LIN/LOG/db as appropriate with automatic scaling.
Maximum or minimum value of all circuit functions.
Unity gain bandwidth and slope of voltage gain characteristic at this frequency.
Bandwidth at 1/bdb down on the response at any freq.
Hardcopy of component list and performance summary.
Filing of circuit details and last used parameter values for the rapid loading of the circuit.
Comprehensive instructions with many examples.
State model and disc drive number. Cassette to order.
Written by a design engineer for other engineers.
Many satisfied users. In use for two years.

S.J. BRANSON
111 Park Road
Peterborough PE1 2TR
Tel: (0733) 67604

CIRCLE 76 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985

HOME CONTROL CENTRE
This kit enables you to control up to 16 different appliances by means of coded pulses in the mains wiring which may be decoded by special receivers anywhere in the house. The transmitter may be controlled manually or by the computer interface enabling your favourite micro to make your coffee in the morning, switch lights anywhere in the house, start electric blanket in your bedroom. Just think of the possibilities — and no wiring! This kit comprises a transmitter with pre-drilled box and two receivers.

XX 112 Additional Receiver £2.00
XX 111 Receiver £10.00

ELECTRONIC LOCK KIT
With hundreds of uses indoors, garages, car anti-theft devices, electronic equipment etc. Only the correct easily changed four digit code will open it. Requires a 5-15V DC supply. Output 150mA. Fits into standard electrical wall box. Complete kit (except front panel) £31.50

MICROPROCESSOR TIMER KIT
Designed to control 4 outputs independently switching on and off at preset times over a 7 day cycle. LCD display of time and day, easily programmed via 20-way keyboard. Ideal for central heating control, or controlling lights and other equipment. 18 time settings

CT600X £39.00
Xx 114. Relay Kit for CT600 includes PCB connections and one relay. Will accept up to 4 relays 3A 240V 24V DC £3.90
301 115. Additional Relays £1.65

CIRCLE 24 FOR FURTHER DETAILS.
NEW TG501 FUNCTION GENERATOR
0.005Hz to 5MHz; sine, square, triangle, ramp, pulse and
harmonic waveforms; free-run, triggered or gated modes;
variable start/stop phase; variable DC offset; variable 50Ω output; TTL output; external sweep mode.

NEW TG502 SWEEP/FUNCTION GENERATOR
Main generator features as TG501 plus internal sweep
generator; 1000:1 linear or 10,000:1 log sweep range; precise
dial-and-enter setting of sweep limits; marker with variable
duration and out-of-range indicator; variable sweep
rate; single sweep mode; sweep reset and hold; sweep and pen-lift outputs.

NEW TG503 PULSE/FUNCTION GENERATOR
Main generator features as TG501 plus normal,
double and delayed pulse modes; pulse width variable from
50ns to 50ms, delay variable from 100ns to 50ms; 10MHz
capability in double pulse mode; complement mode; symmetrical, positive-going or
negative-going outputs with adjustable baseline.

For further information contact:
Thandar Electronics
London Road, St. Ives, Huntingdon, Cambridgeshire PE17 4HJ
Telephone: (0480) 64646 Telex: 32250.

Happy Memories

Part type | 1 off | 25-99 | 100 up
---|---|---|---
4116 200ns | 1.25 | 1.15 | 1.10
4164 150ns Not Texas | 3.35 | 3.10 | 2.90
2114 200ns Low Power | 1.75 | 1.60 | 1.55
2018 150ns | 3.65 | 3.35 | 3.10
6116 200ns Low power | 7.75 | Call | Call
6264 150ns Low power | 19.95 | Call | Call
2716 450ns 5 volt | 3.85 | 3.45 | 3.30
2732 450ns Intel type | 4.75 | 4.25 | 4.10
2732A 350ns | 5.25 | 4.69 | 4.50
2532 450ns Texas type | 3.85 | 3.45 | 3.30
2764 300ns Suit BBC | 5.95 | 5.50 | 5.25
27128 300ns Suit BBC | 14.20 | 13.65 | 12.60

Low profile IC sockets:
Pins 8 14 16 18 20 24 26 40
Pence 12 13 14 16 18 24 27 38

Available now—The ROAM BOARD for the BBC Micro. Reads
Roms via a Low Insertion Force Socket and saves their
contents as files, then reloads a file into its sideways Ram as
required. Full details on request.

74LS series TTL, large stocks at low prices with DIY discounts
starting at a mix of just 25 pieces. Write or phone for list

Please add 50p post & packing to orders under £15 and VAT to total.
Access welcome, 24hr phone service on (054 422) 618
Non-Military Government & Educational orders welcome, £15 minimum.

E.M.S. POWER SYSTEMS

Solve all your Power Problems by contacting E.M.S.
E.M.S. specialise in systems to eliminate your power problems.
Products range from 35VA switched square wave
Power Packs to 1KVA fully uninterruptible sine
wave systems.

E.M.S. also manufacture chargers which range up to
60 amps.

For further details please contact:
E.M.S. Manufacturing Limited
Chairborough Road
High Wycombe
Bucks
Tel: (0494) 448484

HAPPY MEMORIES (WWW)
Gladestry, Kington
Herefordshire HR5 3NY
Tel: (054 422) 618 or 628
From Shure, a microphone system that mixes automatically.

Privacy buttons, free discussion or single speaking facilities — and many other important capabilities.

The AMS offers a choice of four effective types of microphone for all purposes: the unimittag Low-Profile AMS22, the AMS28 Lavalier for wearing around the neck, the adaptable AMS26 Probe for table, floor stand or gooseneck mounting, and the AMS24 Condenser specifically designed for the gooseneck unit.

In short the AMS represents a major advance in sound technology. For further information or a demonstration, simply contact Shure at the address below.

AMS by Shure

HIW International 3-5 Eden Grove London N7 8EQ Tel 01-607 2717

CIRCLE 126 FOR FURTHER DETAILS.

Sowter Transformers

Presenting a remarkable breakthrough from Shure — microphones, mixer and logic technology all combined in one totally integrated system of style, astoundingly high quality. Each microphone has complete independence within the system, eliminating all unwanted sounds.

AMS 24

outside a specially tailored 120 acceptance window. And continuously analysing its own local acoustic environment allowing each channel to adapt itself autonomously as audio conditions change.

In fact the AMS (Automatic Microphone System) is so simple to use that an operator's only concern is presetting the individual volume levels. Its mixers (4- and 8-channel available) can easily be linked to control over 200 separate microphones. Which makes the AMS absolutely ideal for conferences and symposiums (though it performs equally impressively in churches, courtrooms, teleconferencing and broadcasting).

And advanced logic terminals provide unprecedented flexibility for including

AMS 26

Manufacturer and Designers

E. A. Sowter Ltd.

E. A. SOWTER LTD. (Established 1941) Reg No. England 303990
The Boat Yard, Cullingham Road, Ipswich IP2 8BD, England
P. O. Box 36, Ipswich, IP1 2EL, England
Phone: 0473 52794 and 0473 213390
Telex 887030 Sowter

CIRCLE 115 FOR FURTHER DETAILS.

Oscilloscopes

Gould DSO 2000 Digital Storage Dual Trace $950
Gould DSO 3000 Digital Trace 50MHz Dual Trace $1000
TELEquipment TD 08 Dual Trace 50MS/s Dual Trigger £400
Phillips PM 37070 Digital Trace 150MHz Dual Trigger £600
Cossor CDU 150 Digital Trace 50MS/S Dual Trigger £250
E.E. Leds SM111 Trace 1MHz A.C. or external DC 3MHz £150
Ex-Ministry CT 436 Dual Beam 6MHz £75

Signal Generators

HEWLETT PACKARD 4201A 7-1100MHz £950
HEWLETT PACKARD 6183B.8-7.5GHz £1350
Marconi TM 3600 240-1250MHz £160
Marconi TF 5008 AM/FM 10KHz £120
Marconi TF 5008B AM/FM 10-470MHz £300
Marconi TF 5008A AM/FM 1.3-220MHz £300
Marconi TF 1411A 10KHz-72MHz £220

Multimeters

Philips DM 592517 4½ digit. Auto-ranging etc. £85
Complete with Battery, Leads, Calibration and Case £115
Avo 8 MK4 Complete with Batteries, Leads and Type Case £200
Avo Test Set No.1 (Versimility-AVOS) £150
Complete with Batteries, Leads & Type Case £175
Avo Multimeter Mk5 Complete with Batteries, Leads & Type Case £225
Avo Multimeter Mk6 Complete with Batteries, Leads & Type Case £250
Marconi TP 5000 Volt METER 12 ranges 1mV-300V/50 £180
Kinghill Statified P110 Model 500-0-100V-0-5.5m amps. Current Limiting Metered. Meters £45
Varian 5 AMP. Input 240V. Output 0-25mV £95
Goding London Resistance Box — Managin 0.1-1111 Ohms (decade) Un-used. P&P £85

All above Instruments in Working Order and Supplied with Manual (F) £20

New Equipment

Hammar Oscilloscope 505 Dual Trace 60MHz £115
Hammar Oscilloscope 2035.5 Dual Trace 50MHz £265
Black Star Frequency Counters P&P £4
Meters 100-1000MHz £15
Meters 600-1000MHz £215
Meters 100-1500Hz £35
Black Star JAPTOR 500 Function Generator see below £110

Oscilloscope Probes Switched X10 X100 £8

Tandon 5½ Floppy Disc Drives £75
Simple Single-Double Density £75
Double Single-Double Density £110
Brand New Complete with Information p/p £130

Stepper Motors

Type 1.3 200 Steps 4 Phase (3 wire) 12/24V DC £15
Type 2. 6/1200 Steps 4 Phase 12/24V £20
£17.50
Type 3. 24 Steps 6 wire 5V 3.3A 0-230V DC £30
£25.00 PowerPack £25
Type 3. 24 Steps 120V (3 wire) 250mA £25
£18
P&P and VAT extra

This is A VERY SMALL SAMPLE OF STOCK.
Please check availability before ordering.
Carriage all units E10
VAT to be added to Total of Goods & Carriage

CIRCLE 127 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985
## ELECTRONICS

**ELECTRONICS**

**AH2511** 90.00
**2SC4561C** 69.50
**2N3375** 92.00
**ECL86** 3.90
**ECC85** 2.20
**ECC70** 3.70
**ECC40** 12.10
**ECC32** 2.50
**E1301** 23.50
**DX453** 12.00
**CK5687WA** 0.90
**2SC5356** 0.38
**ECL86** 3.90
**313140** 15.63
**513140** 31.50
**EF93** 1.60
**PCL305** 1.85
**2K25** 111.00
**8.50**
**750**
**925**
**390**
**65.00**
**517400**
**516641**
**NL601**
**GZ31** 3.50
**2SC177**
**2SC169**
**2SC1165** 6.95
**2SC1251** 10.00
**2SC1972** 11.00
**BLW64C3** 65.00
**MRF317** 73.00
**MRF5175** 22.50
**59.00**
**69.40**
**52101**
**5022**
**5022**
**1832**
**144.01**
**162.0**
**0.40**
**2SC1241** 15.00
**06028**
**062-50**
**1.11**
**2SC2494** 16.00
**2SC2370A** 18.00
**2SC2053** 0.80
**2SC1968** 17.50
**6AV6** 2.55
**F.A.** 4.15
**50.0**
**12DW7**
**8F07** 2.00
**6HF5** 3.85
**20PE11**
**6085** 8.60
**8006**
**8S57GT6**
**6SL7GT**
**MRF243** 35.00
**MRF233** 14.30
**MRF750** 6.50
**MRF497** 18.50
**MRF466** 24.50
**MRF455** 16.00
**MRF316** 55.00
**10(G6Á**
**12DW7**
**124074**
**12417**
**8F07** 2.00
**604**
**603**

### R. F. POWER TRANSISTORS

**2SC375** 11.93
**2SC644** 0.25
**2SC1717** 18.00
**2SC1684** 2.70
**2SC1685** 3.50
**2SC1446** 17.50
**2SC1416** 17.50
**2SC1716** 3.39
**2SC1717** 3.39
**2SC1718** 4.90
**2SC1719** 6.60
**2SC1720** 8.60
**2SC1721** 10.60
**2SC1722** 12.50
**2SC1723** 14.50
**2SC1724** 16.50
**2SC1725** 18.50
**2SC1726** 20.50
**2SC1727** 22.50
**2SC1728** 24.50
**2SC1729** 26.50
**2SC1730** 28.50
**2SC1731** 30.50
**2SC1732** 32.50
**2SC1733** 34.50
**2SC1734** 36.50
**2SC1735** 38.50
**2SC1736** 40.50
**2SC1737** 42.50
**2SC1738** 44.50
**2SC1739** 46.50
**2SC1740** 48.50
**2SC1741** 50.50

### TERMS:

- C.O.D.: POSTAGE/PACKING: Add £1 to order under £50 value. VAT: All prices are excluding VAT, please add 15% to order and postage. GUARANTEE: All goods are of current production and sold with manufacturer's warranty. ENQUIRIES: Are welcomed for other types/brands of valves. Please send SAE.

---

**SERVICING THE TELECOMMUNICATIONS AND ELECTRONICS INDUSTRIES**

**102 PRIORY ROAD, SCRIBERS LANE, HALL GREEN, BIRMINGHAM B28 0TB**

TEL: 021-474 6000 TELEX 311033 CHACOM-G Attn: CROSAL

**VALVES - National, Varian, Mullard, RCA, ITT...**

---

**R. F. POWER TRANSISTORS**

- **2SC375** 11.93
- **2SC644** 0.25
- **2SC1717** 18.00
- **2SC1684** 2.70
- **2SC1685** 3.50
- **2SC1446** 17.50
- **2SC1416** 17.50
- **2SC1716** 3.39
- **2SC1717** 3.39
- **2SC1718** 4.90
- **2SC1719** 6.60
- **2SC1720** 8.60
- **2SC1721** 10.60
- **2SC1722** 12.50
- **2SC1723** 14.50
- **2SC1724** 16.50
- **2SC1725** 18.50
- **2SC1726** 20.50
- **2SC1727** 22.50
- **2SC1728** 24.50
- **2SC1729** 26.50
- **2SC1730** 28.50
- **2SC1731** 30.50
- **2SC1732** 32.50
- **2SC1733** 34.50
- **2SC1734** 36.50
- **2SC1735** 38.50
- **2SC1736** 40.50
- **2SC1737** 42.50
- **2SC1738** 44.50
- **2SC1739** 46.50
- **2SC1740** 48.50
- **2SC1741** 50.50

---

**CIRCLE 40 FOR FURTHER DETAILS.**
Music on the BBC Micro

Music 500

A virtually unlimited variety of waveforms and envelopes are available for playing on eight voices arranged over seven stereo positions in the Music 500, a synthesizer add-on for the BBC Microcomputer. The hardware comes in a metal cased box, roughly the same shape and size as a floppy disc drive. It contains its own power supply. It connects to the computer through a ribbon cable which plugs into the 1MHz-bus port and has itself a parallel socket for that bus. The audio output is from a 5-pin DIN socket and a stereo amplifier must be connected to make the output audible.

Supplied with the Music 500 is a cassette which includes AMPLE, a music programming language, some examples of preset waveforms and envelopes and a selection of music produced by the system. There is also a utility to enable the programs to be transferred to disc. Ample works rather like Fort. It enables commands to be defined in terms of existing words and these new words are used in turn within the definitions of other words. Eventually the whole program executes on the command of a single word — 'play'.

There are 16 channels of sound, normally used in pairs to allow a maximum of eight voices. More channels can be assigned to a particular voice at the expense of having fewer voices. Each channel in a pair can have its own waveform and the frequencies may be varied so that one channel will modulate the other.

Programming words are available for frequency modulation, ring modulation and synchronized waveforms. Harmonics up to the 16th can be assigned to a channel, each with its own amplitude. The wave is then converted to its geometrical form for storage; the geometrical form can also be defined directly, without harmonic analysis. A noise channel, to produce percussion sounds, is not directly available but can be simulated by introducing a random element into the waveform generation.

Envelopes for the notes can be defined in several ways from a simple attack-decay-sustain-release sequence to complex geometrical and pitch-bending envelopes. Waveforms and envelopes are assigned independently to sound channels and may be used in any combination.

Musically, notes are entered using their letter names, familiar to musicians. The sequence 'CDEFGABC' would play a C major scale. Sharps and flats are entered with a plus or minus sign before the note and key signatures may be defined at the beginning of a piece, after which only accidentals need to be entered. One convention that takes some getting used to is that upper-case letters are used for the next note above the current one but lower-case is used to descend. 'AG' would play A followed by the G above but Ab would be used to play A followed by the B below it.

Hence, if we were to enter 'cdefgabc' instead of getting a scale, each note would be followed by the one a seventh below and that sequence would descend about seven octaves!

The synthesizer has a pre-set pitch which may be altered to tune it to a different pitch. Numbers are assigned to relative note lengths and the speed of the music is governed by a 'tempo' instruction.

The language is very comprehensive and it is possible to reproduce almost any sound that can be imagined; but it is also quite difficult to learn and use. This is partly due to the lack of any graphics facilities. Music can only be entered as a computer program through the computer keyboard. Not, for example, as notes on a stave. There are limited facilities to actually hear the waveforms, envelopes or tunes being produced without writing a program and then running it. There is no list of specific waveforms or envelopes so that one could make the output sound like a trombone, a flute or an organ. The pre-programmed examples on the cassette have very computer-sounding noises, not too dissimilar to those available on the BBC's own internal sound generator, even when more than three voices and stereo positioning are used. So the synthesizer is not fully demonstrated except by one's own trial and error methods.

The sound output is of high quality and is best transmitted through a good hi-fi system but it could have been easy to install a low-power audio amplifier to give, for example, headphone output. My computer is in a different room from my stereo equipment and initially given the output on a portable stereo cassette player before being able to hear it. The negative aspects of this review might be of a temporary nature; there has been mention of a keyboard add-on for the Music 500. The present programming language and rather poorly printed handbook make no reference to this so both must be updated when the keyboard is issued. The keyboard will also allow the synthesizer to be played 'live'. Music 500 was developed for Acorn by Hybrid Technology Ltd., Acorn Computers Ltd., Fulbourn Road, Cherry Hinton, Cambridge CB1 4JN.

A system for music

By way of contrast, the Music System (TMS) includes no hardware and relies on the BBC's internal sound generator and computer keyboard. For £25 it offers two discs (also available on cassette) and a handbook. The programs are all inter-linked through a menu page and it is possible to use the Editor for entering music. The Synthesizer module for creating new sounds, the Keyboard programme for playing 'live' music. There is also a printer driver program to enable the printing of music scores and a 'linker' which allows separately programmed music to be strung together into longer compositions. Each section of the software is menu driven and uses an icon system similar to that of, say, the Apple Macintosh, so that there is hardly any need to type at the keyboard at all. Typically a cursor is used to point at an icon, or pictoral representation of the parameter to be altered.

Then two keys are used to increase or decrease the value of that parameter.

The Music Editor section of the software works rather like a word-processor for music. Entering a piece by positioning one cursor at the note value and then moving a second cursor to the note position on the stave. Key and time signatures are entered at the beginning of a piece and subsequent notes are automatically given the correct sharps and flats. As in Music 500 there is automatic bar checking to ensure that the note values given to each bar agree with the time signature. The music editor works on one voice at a time but may be switched instantly to either of the other voices. Music may be entered one voice at a time or in parallel, working on all voices together by rapidly switching between voices. One facility which illustrates the
thoroughness of the program is the provision for 'first time' and 'second time' bars in a repeated section. Notes may be sounded as they are entered and sections of a piece played at any time during their development.

The Synthesizer module is an envelope generator and again is programmed graphically with a representation of the envelope shape on the screen. Pitch and amplitude parameters can be easily changed at will and elements from one envelope can be transferred to another. Up to 30 envelopes can be stored either in a form to be replayed through the rest of TMS or to be incorporated into a Basic program.

The Keyboard module allows the computer to be used as a 'real time' instrument using the QWERTY keys to play the notes with envelopes previously defined in the Synthesizer module. It is even possible to 'record' one's efforts with a set of keys which will emulate a tape recorder so that it is possible to 'rewind' the memory and play-back or re-record a section. A metronome icon ticks away in the corner of the screen to preserve the tempo. A piece so recorded can be stored on tape or disc as a file. Finally the printout module will enable music programmed into the music editor to be printed out on a Epson or Star Delta dot-matrix printer. It is possible to print one voice at a time or all voices together and there is provision for a very high resolution print-out giving superb printed music or medium resolution which prints much faster. Treble and bass clefs, key and time signatures, accidentals and bar lines appear as they would on conventionally printed music.

All this is documented in the instruction manual which is very well laid out with all functions clearly illustrated. TMS also has its drawbacks; it only covers a range of four octaves and is restricted to the envelope commands available to the internal sound generator on the BBC computer. The cassette version has fewer facilities than the disc, especially in that it cannot use the fourth (percussion) channel. However the system is under constant revision and there is mention of the extension of the system with a music keyboard and a Midi synthesizer.

So we have two very contrasted systems; the Music 500 has superb but expensive hardware but the programming language without any graphics is quite difficult to use compounded by the poorly produced but, we hope, temporary manual. The Music System, at about £25, is at the opposite end of the scale with excellent software and a manual that is very easy to use but the system is restricted by the hardware available on the computer. Both systems are planned to be extended with live-performance keyboards and TMS may get an external synthesizer add-on. The Music System is based on programs orginally developed by System Software but has been extended and enhanced in cooperation with Island Logic. System, 12 Collegiate Crescent, Sheffield S10 2BA. EWW101

**INTERFACE FOR FIBRES**

One p.c.b. offers both transmission and reception of serial data along an optical fibre. Although primarily intended for RS232C links, the interface can also be used with t.t.i. levels and RS422/3. Full duplex facilities are available but the board may be used in simplex mode if a separate control signal is needed, such as the 'busy' signal from a printer. Fibres are connected to the board by S.M.A. connectors.

Fibres of the 200 micron glass graded index type give a transmission distance of at least 1km. The company can also provide the optical cables terminated at the required lengths or a termination kit for installation in the field, if required. Applications include installation in areas of high electrical interference, where optical cable can replace RS232C cables. Transmissions are unaffected by r.f.i. and are free from lightning damage and are therefore very suitable for installation in hazardous areas. Arthur Ford Ltd., Park Lane Works, Old Basford, Nottingham NG6 0EU. EWW204

**HIGH-SPEED OP-AMP**

With the precision necessary for high fidelity audio equipment as well as signal conditioning in instrumentation the Raytheon OP-47 is a low-noise device, available in a TO-99 metal can or an 8-pin plastic dip package and in military or commercial temperature ranges.

Power-supply rejection and common-mode rejection are typically 120dB with a spectral noise density of 3nV/Hz. Input bias and offset currents are as low as 10nA and offset voltage is guaranteed to be less than 60nV. The gain bandwidth product is 63MHz and the device is fully output short circuit protected. Typical applications include low impedance microphone amplifiers, professional quality audio amplifiers, spectrum analysers and precision instrumentation amplifiers. Raytheon Semiconductors, Ogilvie Road, High Wycombe, Bucks HP12 3D9. EWW200

---

**NEW PRODUCTS**

---

**ELECTRONICS & WIRELESS WORLD MARCH 1985**

---

79
NEW PRODUCTS

ETHERNET NODE ON A CHIPSET
All the logic, protocol and control functions needed to implement the interfacing of a processor to an Ethernet network are incorporated in three chips from AMD. The devices are: 8990 network controller, 7991A serial interface adaptor and 7995 Ethernet transceiver. At the data link level the set supports buffer management, data encapsulation, framing and package control, c.r.c. generation and checking, and serial/deserialization. At the physical level, there is 10Mbit/s data rate. carrier-sense multiple access with collision detection and transceiver interface compatibility. Dage (GB) Ltd, Eurosem Division, Rabans Lane, Aylesbury, Bucks HP12 3RG. EWW106

16 AMP P.C.B. RELAY
Using Silver Cadmium Oxide contacts for long life, the Zettler AZ735 relay is 28mm high and will switch 16A at 250V a.c. Normally supplied with one changeover contact, the relay can handle up to 415V 3500VA. 100 000 operations are claimed at 250V/16A a.c. with pick-up and drop-out times of 7ms and 2ms respectively. High isolation between coils and contact is provided. Direct coil voltages can be selected from a range between 5 and 76V. Normally open contacts can be supplied to special order. Sterling Components Ltd, Sterling Road, Slough, Berks. EWW107

MULTI-STANDARD TAPE RECORDER
Based on modular technology, the Stellavox TD9 tape recorder can cope with magnetic formats of 0.25in, 0.5in and 16mm film. All tape transport functions are controlled by a microprocessor with feedback data from opto-electronic tensiometers. The recorder is ergonomically designed to be easy to use and has claimed for it 'the highest sound quality'. It may be quickly adapted to the required format. Amongst its features are: Synchronization, with, or without time-code for film or video, a locator, pre-view facilities, computer control through an interface, line and/or battery supply, will accept reels up to the 14in. NAB standard, six tape speeds and a variation control, inside or outside oxide winding, a monitor speaker and it may be rack installed. There is a wide variety of accessories. Future Film Developments, 114 Wardour Street, London W1V 3LP. EWW108

FLEXIBLE STORAGE SYSTEM
A multipurpose data storage system is designed for use with the IBM-PC or other compatible computers. The Ram Tape-PC combines a 400Kbyte ram, organised as a 'silicon disc', with 13.5Mbytes of storage on a 1-in tape cartridge. The software configures the first part of the ram as a double-sided disc with direct access from the computer. The remaining ram is available to other disc images. More than 30 double-sided, double-density disc images can be stored on the tape cartridge, which can be loaded from the tape onto the electronic disc to provide access speeds up to 50 times faster than with flexible discs. The electronic disc may also be loaded from any other drive in the system to provide the same rapid access. The Ram Tape-PC has its own power supply, is provided with a host adaptor card and a disc containing the software drivers and utilities to access the various functions. Menu-driven software simplifies the operation for inexperienced users. Euro Electronics Ltd, Lancaster Gate House, 319 Pinner Road, Harrow, Middlesex HA1 4HF. EWW109

www.americanradiohistory.com
PAGED MESSAGES

A radiopager with the ability to display and store messages up to 70 characters long has been launched by British Telecom. Message Master can display names and addresses, telephone numbers, share prices or travel information, and up to ten messages with a total of up to 300 characters may be kept in the internal memory for reference. When a message has been received the pager will beep and flash a light, though it may be muted if the user so requires. Messages are transmitted to the pager directly through Telex or Datel, or by telephone to a central radiopaging bureau, which will forward the message through a computerized system. Various options are available depending on whether the user wishes to use the Message Master in a number of the 40 zones which make up the national system. It costs £75 a quarter and a further £9 to use the bureau. British Telecom Radiopaging, 4th Floor, 23 Howland Street, London W1P 6HQ. EWW208

64K EEPROM

Organized as an 8K byte device the HN58064P is an electrically erasable and programmable rom from Hitachi. It uses a single 5V supply. Latches are provided on-chip for addresses and data. Depending on the status of the chip enable, output enable and write enable lines, six different modes of operation can be selected: chip erase takes about 20ms, individual bytes can be written to or read from in 10ns conventional 'Read' mode is available as are a 'deselected' mode and a low powered 'standby'. Different versions of the device offer access times of 250, 300 or 450ns. The device is housed in a conventional 28-pin plastic package. It is specified to operate for over 10000 erase/write cycles. Hitachi Electronic Components (UK) Ltd., 221 Station Road, Harrow, Middlesex HA1 2XL. EWW 209

RESISTANCE BOXES

Two boxes offer decades of resistors selected by dial switches which also indicate the value chosen. The 1065 box offers power resistors over the range 0.1 to 120kΩ, while 1066 has precision wire-wound resistors for a range of 1 to 1.2MΩ decade and 0.01% for the others. The power resistors in the other box have an overall accuracy of 1% with the 0.1Ω decade at 5%. These are 10W power rated and the box has a maximum voltage of 500V d.c. whereas the precision box uses 350mW resistors with a maximum total voltage of 150V. Both are designed for laboratory, industrial and academic use. They are housed in metal cases and are easily transportable. Switch contact resistance has been kept to a minimum by the use of multi-wafer switches each with four parallel, silver-plated, self-wiping contacts. Time Electronics Ltd., Botany Industrial Estate, Tonbridge, Kent TN9 1RH. EWW203

PLUG-IN CIRCUIT BREAKER

Fitting a standard 13A socket and providing in turn a single 13A socket, the Power Breaker-20 incorporates an residual current circuit breaker (r.c.c.b.) to provide a high degree of protection against damage and electric shock. The device is built in accordance with the relevant British Standards. It has a 'power on' indicator light, a test button and will cut out automatically if plugged in to an incorrectly wired socket, for example if the live and neutral wires are reversed. It works on 220/240V a.c. mains, incorporates a 13A fuse and is slim enough to fit two side-by-side in a double socket. The Power Breaker is available at a number of retail shops and hardware stores and at electrical wholesalers. Suggested retail price is just under £20. B & R Electrical Products Ltd., Temple Fields, Harlow, Essex CM20 2BG. EWW205
**NEW PRODUCTS**

**IMAGE FRAME STORE FOR MICRO**

A high-resolution video frame store is provided by the Eltime Image III. The single p.c.b. may be used in conjunction with a BBC micro, to capture and display pictures in real time from any 625 or 525-line video source. The highest resolution is 512 by 512 pixels stored in a 64Kram dynamic ram. Every pixel can be accessed and altered by the assignment of up to 64 grey-scale levels. If a lower resolution is selected, the store can be partitioned to retain multiple pictures, e.g. for 256 by 256 resolution, four pictures can be stored. Pictures from the same or different sources can be compared.

A gated oscillator is used to synchronize incoming frames to the store, this is used in preference to a p.i.l. as the store is only locked to the incoming video for the duration of one field and this enables the device to capture a field from several different sources whose synch timings are not locked to each other and which may have different interface scans, or none at all.

Software is provided with details of how to configure the system for different resolutions, capture pictures and read or write to individual pixels. An additional board can provide a full frame, the equivalent of two fields. Three boards can be combined in parallel to give an RGB output. The board interfaces directly with any of the 6800 series of processors and occupies iK in the host processor's memory map. Additional circuitry is needed for use with other processors. Applications include robotic vision, medical imaging, factory security and surveillance. Additionally the store can be used to capture pictures which arrive slowly such as weather satellite pictures and ultrasonic scan images. Thus a display can be held steady without the need for a long-persistence c.r.t. As well as the BBC micro, versions are available for use with the Apple and IBM PC. Image III costs just under £2000. It was developed at the BT Research Laboratories and is manufactured under licence from BT by Eltime Ltd., Unit D29, Maldon Industrial Estate, Fullbridge, Maldon, Essex CM9 7LP. EWW EWW202

**COMMODORE MODEM**

A 300-Baud modem to plug directly into the user port of either a Commodore 64 or Vic 20 home computer has been developed by InterNet. It uses power drawn from the computer and requires no external supplies or batteries. Model 2074/V21 uses a 10-pole switched capacitor filter i.c. to remove noise from the line and frequencies are very stable as they are derived from crystal oscillators. It operates to CCITT V21 recommended tones for data communication at 300-Baud and may be used for inter-computer communication as well as commercial databases (Distel, Maplin, Estelle, for example) which operate the V21 standard. It is not compatible with the V23 standard of Prestel and Micronet. The modem has a plug to fit a BT telephone socket, though it is not BT approved, and includes a socket for the telephone which is used for dialling. It also has a jack for connection with an amateur radio transceiver or c.b. set for the radio transmission of data. Switches are provided to select local/on-line, Originate/answer, self test and full/half duplex. Leds indicate when the modem is on-line and whether it is receiving or transmitting. The modem is supplied with cassette software which can be adapted to select the character bit lengths, parity bits etc. as required. £19.50 inclusive from InterNet Ltd., Unit C2, Faircharm Trading Estate, Creekside, London SE8 3DX.

**DIGITAL THERMOMETER**

Claimed to be the smallest and cheapest hand-held electronic thermometer on the market, the Vixen is only 103mm long, costs less than £30 and is guaranteed for three years. It operates within a range of -120 to 820° with an accuracy of 0.2% and incorporates automatic cold-junction compensation. The thermometer uses NiCr/NiAl, type K, thermocouples through a standard miniature connector, enabling many standard thermocouples from a variety of sources to be used. The device has a battery life of 6000 hours which is claimed to be the equivalent of over four years normal service life. The display indicates low battery and open-circuit thermocouple. A Fahrenheit version is available. Vixen Hitech Ltd., 17 Amberley Road, Bostal Heath, London SE2 09G. EWW 201

**ELECTRONICS & WIRELESS WORLD**

82
The PC-16 16-bit computer provides PERFECT COMPATIBILITY with the IBM PC/XT range. The motherboard can be supplied in two versions for stereoscopic convenience. The 'N' version has no memory on board and the 'B' version with space for 64 to 256K RAM. Addition of the Memory Expansion Card provides a further 64 to 512K of RAM. BASIC FEATURES INCLUDE:

* 8088 CPU operating at 4.77 MHz
* Provision for 8087 Co-processor
* Four DMA channels
* Three TIMER channels on board
* 8 EXPANSION SLOTS

SYSTEM — 5 PC16 (B/3) — PRICE £1599 — Main computer employing 'B' board with 128K on board (upgradable to 256K on board) PLUS Colour/Graphics adaptor providing signal capable of running monochrome displays on RGB output for full colour. Multi I/O card, providing floppy drive controller for two drives, one parallel port, one serial port, one games port with battery backed clock/calander. RAM extension card for 512K. Two DS/DD floppy drives. 83-key keyboard. All complete, built & tested in case with power supply together with Concurrent (multisuer, multitasking)/CP/M,CCP/M manual, Basic manual and computer operations manual — ready to run!

MOTHERBOARD 'B', 8-slot, 128K
MOTHERBOARD 'N', 8-slot, MULTIFUNCTION card with 128K (expandable to 256K) one PL-port, one SER-port (2nd option) Clock/Calendar with backup MONOCHROME adaptor with printer port MULTIFUNCTION card — one port, one serial port, one games port, floppy drive controller, clock/calander with battery backup

14in RGB HI-RES MONITOR (640 dots x 300 lines) £389
12in HI-RES GREEN MON £89
64K RAM EXTEND MODULE £59
DS/DD FLOPPY DRIVE (500 KB unformatted) £175
WINCHESTER DRIVE CONTROLLER £425
512K RAM BOARD — comes with 128K RAM installed fully IBM compatible £299

WINCHESTER DRIVE 12/MB complete with controller £915
IBM COMPATIBLE KEYBOARD (B3 keyp.) £89
KEYTRONIC 5150 K/BOARD £175
KEYTRONIC 5151 K/BOARD £210
SWITCHING POWER SUPPLY £100
ADD SERIAL PORT KIT £23
FLOPPY DRIVE CONTROLLER £109

DRIVES — MEGABYTES FOR MICROPONDS!
5 1/4 Half height 500 KB £60 1/40 £119
5 1/4 Half height 1 MB 40/48 £125
5 1/4 Half height 1 MB 40/80 £159
5 1/4 Half height 2 MB 40/80 £199
5 1/4 Half height 4 MB £329
5 1/4 Half height 8 MB £449
8 FULL size 1 MB £309
8 FULL size 2 MB £429
MRS2 Half height 12.75 MB Hard Disk £492

Add 15% VAT to all prices given. Remember, VAT is also applicable on carriage at 15%. Terms CWO. DEALER ENQUIRIES WELCOME. FOREIGN enquirers if possible by telex please. However, French & German speaking staff at your disposal. MONEY BACK GUARANTEE. SEND £1 for our latest catalogue of over 3000 items: computers, peripherals, consumables, robotics, etc.

TEL: (0342) 313427-246311/2
TLX: 957547

CIRCLE 116 FOR FURTHER DETAILS.

There are better ways of measuring hum, ripple and other small signals

The Waugh Instruments Micro Amplifier extends the measurement capabilities of your oscilloscope to 100μV/div from DC—2MHz differential or single ended input. For details of this and other amplifiers contact:-

Peter Waugh at Waugh Instruments, Otter House Weston Underwood, Olney, Bucks, MK46 5JS (0234) 712445.

VIDEO TERMINAL BOARD

☆ 80 characters X 24 lines ☆

Requires ASCII encoded keyboard and monitor to make fully configurable intelligent terminal. Uses 6802 micro and 6845 controller. Program and character generator (7 x 9 matrix with descenders) in two 2716 EPROMs. Full scrolling at 9600 baud with 8 switch selectable rates. RS232 interface.

Bare board with 2 EPROMS and program listing £48 plus VAT. Assembled and tested — £118 Send for details or CWO to: AM Electronics Wood Farm, Leiston, Suffolk IP16 4HT Tel: 0728 831131

CIRCLE 53 FOR FURTHER DETAILS.

CIRCLE 38 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985

There are better ways of measuring hum, ripple and other small signals

The Waugh Instruments Micro Amplifier extends the measurement capabilities of your oscilloscope to 100μV/div from DC—2MHz differential or single ended input. For details of this and other amplifiers contact:-

Peter Waugh at Waugh Instruments, Otter House Weston Underwood, Olney, Bucks, MK46 5JS (0234) 712445.

CIRCLE 38 FOR FURTHER DETAILS.

CIRCLE 116 FOR FURTHER DETAILS.

CIRCLE 53 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985
<table>
<thead>
<tr>
<th>Component</th>
<th>Code</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistors</td>
<td>R101</td>
<td>0.01</td>
</tr>
<tr>
<td>Diodes</td>
<td>D101</td>
<td>0.02</td>
</tr>
<tr>
<td>Transistors</td>
<td>T101</td>
<td>0.03</td>
</tr>
<tr>
<td>Capacitors</td>
<td>C101</td>
<td>0.04</td>
</tr>
</tbody>
</table>

**Terms of business:** C.W.O. Postage and packing valves and semiconductors 50p per order. CRTs £1.50. Prices excluding VAT, add 15%.

Telephone 01-677 2424/7

**Open to callers Monday-Friday 9am-9pm**
THE ‘ALADDIN’S CAVE OF COMPUTER AND ELECTRONIC EQUIPMENT’

**1000'S OF BARGAINS FOR CALLERS**

**RECHARGEABLE BATTERIES**
Do-it-yourself maintenance FREE by Sunenscheck £8.95. Most sizes £3.95, including full UK Postage. Full 12 month guarantee. Orders over £75.00 - £1.00 off. 

**EX-STOCK INTEGRATED CIRCUITS**
- **74HCT40** £2.64, 74HCT404 £3.24, 74HCT408 £3.38, 74HCT409 £3.48, 74HCT40A £3.58, 74HCT40B £3.68, 74HCT40C £3.78, 74HCT40D £3.88, 74HCT40E £3.98, 74HCT40F £4.08.
- Orders under 25 items £4.50 x add 10%. 

**COOLING FANS**
Keep your PC in peak condition. Kraft plastic, 80x80 £1.50, 80x80mm £2.00, 90x90 £2.50, 90x90x20 £3.00. All 12 months guarantee. Also 120x120 mm £3.50, 140x140 £4.50, 150x150 £5.00. 

**EPROM COPYING**
The amazing SRTY 2 The Complete Tool Kit for copying, writing and erasing EPROMS of all types. Only £22.50 inc. Main carriage. A must for every hobbyist, as well as for students, clubs etc. 

**DATA MODEMS**
Join the communications revolution with our wide range of DATA MODEMS pairs with prices and types to suit all applications and usage requirements. Most modes are EX BRITISH TELECOM standard and most are suitable for the highest standard for continuous use and reliability. Requirements include 2400 BPS 10000 word, 1200 8000 word, 300 5000 word. Also various types of baud rates available as well as the standard RS232 serial interface. Add VAT £44.99. 

**SPECIAL 300 BAUD MODEM OFFER**
Another GIANTIC purchase from these EX BRITISH TELECOM, BRAND NEW or little used 28 data modems, all allows us to make the FINAL REDUCTION, and for YOU to join the exciting world of data communications at an UNHEARD of PRICE of ONLY £29.95. Made to the highest post OFFICE APPROVED spec at a cost of hundreds of pounds each, the 28 has all the standard requirements for data base, business or hobby communications. All this and more for £29.95.
- Full remote control 
- CUTT tone standards 
- Only £29.95. 
- Order now - while stocks last. 

**SPECIAL DOUBLES DEAL**
For an additional £25.00, we will supply a pair of these modems on a Short term lease. 

**COMPUTER 'CAR'**
All in one quality computer cabinet with integrated switch, panel layout, 240 volt, fan cooling. Originally made for the famous DEC PDQ computer, this cabinet may be used for two PDP-11's. Is capable of running 24 hours per day for 60 hours a week and capable of having up to 24 hours per day for 60 hours a week and capable of doing 1.5 megabyte operation. One full year of guarantees. £450.00. 

**RECHARGEABLE BATTERIES**
Available in all shapes and sizes for DEC PDP, PDP11, PDP8, PDP XT/80, PDP 18000, etc. with all types of guarantees and warranties. A must for all computer enthusiasts. 

**PRICE BARRIER SHATTERED ON 18'**
**RGB Cased Colour Monitors**
A scoop purchase from a major London wholesaler enables us to offer this special converted DECCA 100 COLOUR TV set at a super low price of £99.00!!! Low enough to suit any budget! Solid state modular construction, 16.9 high definition PLIF, which eliminates convergence problems and our own special modification results in a 80 column text definition and picture quality not seen on monitors costing three times as much. It is one of the most reliable and trouble-free products on the market, the quality has to be seen to be believed. Supplied complete and ready to plug in to a TV set and used for Computer. TV set. 

**BUDGET RANGE VIDEO MONITORS**
At a price you can afford, our range of EX BRITISH TELECOM 2400 BPS MODEMS are available. We have made the lowest price possible! 

**DEC CORNER**
- POP 110 System comprising of CPU 124K memory + MMU 16 line RS232 Interface plus 520 VDU etc inc. 
- **£450.00** 
- **£450.00** 
- **£450.00** 
- **£450.00** 
- **£450.00** 

**OLD SELLER Ray**
- **£125.00** 
- **£125.00** 
- **£175.00** 
- **£175.00** 
- **£175.00** 
- **£175.00** 
- **£175.00** 
- **£175.00** 

**NEW SELLER Ray**
- **£175.00** 
- **£175.00** 
- **£175.00** 
- **£175.00** 
- **£175.00** 
- **£175.00** 
- **£175.00** 
- **£175.00** 

**HUNDREDS OF PRINTERS**
**£175.00**
- **£175.00**

**DISK DRIVE SPARES**
- SIEMENS SPOD-1/100/500-40 track single sided EX new equipment tested, guaranteed working. Complete with data £75.00. 
- Sony SP-3500A 51/4' 15 track, single sided, EX equipment, guaranteed working £35.00. 
- HUGHART SABA0, SABA0 B's drive plus spares EX Stock call for price. 
- Hard disk drives. 

**ADD VAT TO ALL PRICES**
All prices quoted are for UK Mainland, paid cash with order in Pounds Sterling PLUS VAT. Minimum order value £20.00. Minimum Credit Card order £50.00. Minimum BONA FIDE account orders from Government Deps., Schools, Universities and established companies £20.00. 

CIRCLE 89 FOR FURTHER DETAILS.

www.americanradiohistory.com
The Archer-Single Board Computer

The SDS ARCHER — The Z80 based single board computer chosen by professionals and OEM users.

FEATURES
* High quality double sided plated through PCB
* 4 Bytewide memory sockets — upto 64k
* Power-fail and watchdog timer circuits
* 4 Parallel ports with handshaking
* Bus expansion connector
* CMOS battery back-up
* Counter-timer chip
* 2 serial ports
* 4 MHz. Z80A

Telephone or write for full technical description and price information.

OPTIONS
* SDS BASIC with autostart and "user program in ROM" facility
* SDS DEBUG MONITOR: a powerful 8k byte development aid
* On board 120/240 volt mains power supply
* Attractive two tone instrument case

Sherwood Data Systems Ltd
Sherwood House, The Avenue, Farnham Common, Slough SL2 3JX. Tel. 02814-5067

CIRCLE 43 FOR FURTHER DETAILS.

pantechnic

- design manufacture and supply
- POWER AMPLIFIERS
- HIGH POWER ASSEMBLIES
- CONTROL CIRCUITRY
- for application in
- INDUSTRY
- PUBLIC ADDRESS
- HI-
- available

OFF THE SHELF CUSTOMISED C A D DESIGNED

tel. 01.361.8715 132 High Road
telex 266 873 New Southgate
PANTEC G LONDON NW1 1PG.

CIRCLE 47 FOR FURTHER DETAILS.

COMPONENT PACKS

All Brand New except where marked
Price: £1 per pack
Order 12 you get one extra FREE
Please add £1 post if order under £20


Most items available in quantity at good discounts. Access & Barclay cards welcome

N.B. ELECTRONIC SUPPLIES
34 America Lane, Haywards Heath, Sussex RH16 3Q (24hr phone ordering 0444 454563)

CIRCLE 67 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD MARCH 1985

www.americanradiohistory.com
It's OUT — NOW!
it's the LATEST,
it's the LARGEST
and, it is the most COMPREHENSIVE CATALOGUE
of ELECTRONIC COMPONENTS and SERVICING EQUIPMENT
ever produced by
HRS
for YOUR COPY of the
HRS Spring 1985 Catalogue — call us on 021-771 2525

The stock range: aerial & audio equipment, batteries, cables, capacitors, cartridges & styls, cassette recorder spares & tapes (audio & video), cathode ray tubes, computer accessories, connectors, domestic appliance spares, etлектrodes, fuses, hardware, hobby kits, holders, indicators, integrated circuits, loudspeakers, multimeters, oscilloscopes, power supplies, production aids, recorder spares, remote control units, resistors, security equipment, semiconductors, service aids, signal generators, soldering equipment, sound equipment, storage systems, switches, tools, transformers, tv spares, valves, wound components.

HRS Electronics Limited
Great Barr St., BIRMINGHAM B9 4BB
Telephone: 021-771 2525 Telex 339992

CIRCLE 119 FOR FURTHER DETAILS.

12 CHANNEL GRAPHIC EQUALISER
kit No 242

The mother board contains the 2 slide pots (13.5 x 9cm) on which is plugged the circuit board (18 x 7.5cm). So the only cables used are those for power supply input signals! Both pcboards are connected with special connector/pins. All pots with pins for pcbboard insertion. So, no cables, no confusion...

Technical specification
Frequency resp.: 10 Hz - 100 kHz
Equalisation: 14 Hz, 28 Hz, 56 Hz, 100 Hz, 210 Hz, 500 Hz, 2 kHz, 4 kHz, 8 kHz, 16 kHz, 22 kHz.
Harmonic dist.: 0.02% Max. out signal: 7v rms Input res.: 47 kQ, PWR supply: ±15v DC, 100mA Master volume with isolation. Lcs used: (6x2) and one for input vol. output amp. Signal voltage easily adopted for any combination.

C & A ELECTRONIC O.E.
PO Box 25070 Athens 10026 GREECE Tel:5242867. Tlx:210798 CAGR

CIRCLE 16 FOR FURTHER DETAILS.
ELECTRONICS & WIRELESS WORLD MARCH 1985
ELECTRONICS & WIRELESS WORLD MARCH 1985

HART TRIPLE-PURPOSE TEST CASSETTE TC1
One inexpensive test cassette enables you to set up 9V level, head alignment and tape speed interchangeably when fitting new heads. Only £4.94 plus VAT and postage.

Tape Head Decal: Handy size means operated unit prevents build up of residual head magnetisation causing spill on playback. 
£0.34

 Cure-Pole Type for inaccessible heads. 
£0.95

Send for your free copy of our LIST. Overseas please send 2 IRCs to cover surface Post or 5 IRCs for Airmail. Please enclose correct postal address as follows:

INLAND

OVERSEAS

Orders £10.00+ £1.00

Orders £10.00+ £1.00

Surface or Air Post as required.

Earphone Jack Stack

-1000V AC/DC VOLTAGE
-10 AMPS AC/DC CURRENT
10 ohm—10M ohm RESISTANCE
BI-POLAR OUTPUT

50 ppm ACCURACY (20 ppm optional)

IEEE-488 INTERFACE

SELF-TEST FEATURE

AUTOCAL

5 ppm RESOLUTION

6 AC WAVEFORMS

25% OVER RANGE ON DC

ZERO OFFSET MODE

Multi-Function Calibrator 9822

IEEE-488

50 ppm ACCURACY (20 ppm optional)

IEEE-488 INTERFACE

SELF-TEST FEATURE

AUTOCAL

5 ppm RESOLUTION

6 AC WAVEFORMS

25% OVER RANGE ON DC

ZERO OFFSET MODE

Multi-Function Calibrator 9822

IEEE-488

50 ppm ACCURACY (20 ppm optional)

IEEE-488 INTERFACE

SELF-TEST FEATURE

AUTOCAL

5 ppm RESOLUTION

6 AC WAVEFORMS

25% OVER RANGE ON DC

ZERO OFFSET MODE

Multi-Function Calibrator 9822

IEEE-488

50 ppm ACCURACY (20 ppm optional)

IEEE-488 INTERFACE

SELF-TEST FEATURE

AUTOCAL

5 ppm RESOLUTION

6 AC WAVEFORMS

25% OVER RANGE ON DC

ZERO OFFSET MODE

Multi-Function Calibrator 9822

IEEE-488

50 ppm ACCURACY (20 ppm optional)

IEEE-488 INTERFACE

SELF-TEST FEATURE

AUTOCAL

5 ppm RESOLUTION

6 AC WAVEFORMS

25% OVER RANGE ON DC

ZERO OFFSET MODE
Advertisements accepted up to 12 noon Tuesday 5 March for April Issue

DISPLAYED APPOINTMENTS VACANT: £19 per single col. centimetre (min. 3cm).
LINE advertisements (run on): £4.00 per line, minimum £25 (prepayable).
BOX NUMBERS: £5 extra. ( Replies should be addressed to the Box Number in the advertisement, c/o Quadrant House, The Quadrant, Sutton, Surrey SM2 4AS).
PHONE: IAN FAUX, 01 661 3033 (DIRECT LINE).
Cheques and Postal Orders payable to BUSINESS PRESS INTERNATIONAL LTD. and crossed.

THE BEST APPROACH
£7,000-£30,000 + CAR
★ Where does your interest lie: Graphics; CAD; Robotics; Simulation; Image and Signal Processing; Medical; Automation; Avionics; Acoustics; Weapons; Comms, Radar; Opto and Laser?
★ Experienced in: VLSI: Microprocessor Hardware or Software; Digital and Analogue circuitry; RF and Microwave techniques?
★ There are hundreds of opportunities in: Design; Test; Sales and Service for Engineers and Managers
★ For free professional guidance: Call: 0638 742244 (till 8pm most evenings) or write (no stamp needed) to ELECTRONIC COMPUTER AND MANAGEMENT APPOINTMENTS LIMITED FREEPOST, The Maltings, Burwell, Cambridge. CB5 8BR.

At H.M. Government Communications Centre we're using the very latest ideas in electronics technology to design and develop sophisticated communications systems and installations for special Government needs at home and overseas. With full technical support facilities on hand, it's an environment where you can see your ideas progress from initial concepts through prototype construction, tests and evaluation, to the pre-production phase, with a chance to influence every stage. Working conditions are pleasant, the surroundings are attractive, and the career prospects are excellent.

Ideally we're looking for men and women who have studied electronics to degree level or equivalent and have had some experience of design, whether obtained at work or through hobby activities. Appointments will be made as Higher Scientific Officer (£7435-£10,039) or Scientific Officer (£5909-£8153) according to qualifications and experience.

For further details please write to the address given below. As our careful selection process takes some time, it would be particularly helpful if you could detail your qualifications, your personal fields of interest and practical experience, and describe the type of working environment most suited to your career plans.

The Recruitment Officer, HMGCC, Hanslope Park, Buckinghamshire MK19 4BH.

ELECTRONICS & WIRELESS WORLD MARCH 1985
UNIVERSITY OF LIVERPOOL
INSTITUTE OF MEDICAL AND DENTAL BIO-ENGINEERING

TECHNICIAN
GRADE 3 (ELECTRONICS)
To assist with circuit design, construction and maintenance of electronic control equipment in a medical research laboratory. Candidates must possess O.N.C., Intermediate T.E.C. or appropriate equivalent as minimum qualification plus three years experience which should include general workshop skills.

This post is available for two years.

Salary within range £5399 - £6325 per annum.

Application forms may be obtained from the Registrar, the University, P.O. Box 147, Liverpool, L69 3BX.

Quote Ref: RV/908/EWW (2487)

Senior Development Engineer

Granada houses and manages one of a number of small Technical Development Laboratories whose work is funded and directed jointly by all the Independent Television Companies. The function of these laboratories is to investigate new techniques, theories, and equipment in relation to broadcasting in its widest sense.

A vacancy exists for a Senior Development Engineer in the above laboratory. Suitable applicants require basic knowledge of colour television principles and some knowledge of any of the basic technologies encompassed within the general framework of broadcasting. These include colorimetry, optics, magnetic recording and digital and analogue circuit design. Work is undertaken in a purpose-built laboratory and applicants will be responsible for complete projects from specification to final documentation.

This is a specialised appointment providing freedom of expression for men or women of ability. Commencing salary is £12330, with the usual large company benefits including re-location assistance, contributory pension scheme and free Life Assurance.

Written applications including a full cv together with all other relevant information should be sent by 1st March to

Bob Connell,
Ref. A26,
Granada Television Ltd., Quay Street,
Manchester M50 9EA.

GRANADA TELEVISION
An equal opportunity employer (2479)

SALES ENGINEER


Write to: Radio Telephony Test Systems
Enterprise House
Central Way
North Feltham Trading Estate
Feltham Middlesex TW14 0RT
or telephone Mr G Varrall
Mr R Belcher 01-844 1811 (2500)

Analogue Engineers

Required for challenging work in
State of the Art Technology

AN OPPORTUNITY TO DEVELOP YOUR SKILLS

If you have high frequency circuit design experience relevant to one of the areas listed below, we would be most interested to hear from you.

★ WIDEBAND AMPLIFIERS
★ FAST ADC/DAC
★ SEMI/CUSTOM ANALOGUE
★ FAST PULSE CIRCUITS

We are located at Hainault which is on the edge of the Green Belt close to all the facilities of London. Gould designs and builds Europe's leading digital storage oscilloscopes. We offer good working conditions, competitive salary, flexible working hours and assistance with relocation.

Telephone: Mrs. Pat Lawson on
01-500 1000
GOULD INSTRUMENTS LTD.
Electronics (2465)

TELECO OILFIELD SERVICES LTD.
Barclayhill Place, Portlethen, Aberdeen AB1 4PF.
Agency enquiries are not requested.
Electronic Engineers – What you want, where you want!

TJB Electrotechnical Personnel Services is a specialised appointments service for electrical and electronic engineers. We have clients throughout the UK who urgently need technical staff at all levels from Junior Technician to Senior Management. Vacancies exist in all branches of electronics and allied disciplines - right through from design to marketing - at salary levels from around £6,000 – £20,000.

If you wish to make the most of your qualifications and experience and move another rung or two up the ladder we will be pleased to help you. All applications are treated in strict confidence and there is no danger of your present employer (or other companies you specify) being made aware of your application.

Please send me a TJB Appointments Registration form:

Name ........................................
Address ........................................

(24 Hour Answering Service)

THE UNIVERSITY OF SUSSEX
SCHOOL OF BIOLOGICAL SCIENCES
Electronics Technician
Grade 5

An electronics technician is required to work in the Experimental Psychology Group on an SERC research project on AI and speech recognition. The post is for two years in the first instance. The successful applicant will work with the Laboratory technical staff interfacing audio and digital devices to BBC micros and to a VAX 11/780. Experience with these machines would be an advantage, but some training will be given.

Salary within the scale for Technicians Grade 5 £6,581 – £7,884 per annum, depending on age and experience.

Closing date for applications 20th February 1985.

Applicants in writing to the
Laboratory Superintendent,
School of Biological Sciences,
University of Sussex, Falmer,
Brighton BN1 9QG.

EXPERIENCED AUDIO/ELECTRONIC ENGINEER

Experienced Audio Engineer required for progressive company specialising in P A, Studio Installations, Design & Servicing of Professional Audio Equipment. Digital experience an asset.

Phone 01-609 8282

Imperial Chemical Industries PLC
Agricultural Division: Billingham: Cleveland
Catalysts Group

Micromeritics Technologist

The Catalysts Group of Imperial Chemical Industries PLC, Agricultural Division, requires an Experimental Officer working on the provision and development of micromeritic services for the Division.

The job consists of operating and maintaining manual and automatic equipment for the measurement of surface areas, pore size distributions, mercury and helium densities of pellets and powders. Significant skills are required in the interpretation of the data obtained and in communicating these to the experimental and scientific staff of the Division.

The work will be in a laboratory environment and also involves the use of computers for control, calculation and data presentation.

The successful applicant must be self-motivated and capable of independent work. He/she should have a first degree in physics, physical chemistry or materials science and be interested in the utilisation of computers for improving the efficiency of the service provided. Interpretation of the results with respect to the particular material properties will be needed. Their relevance to the particular system being considered will need to be discussed with the customers of the micromeritics service. Previous experience with computers and electronics would be an advantage.

Remuneration will be commensurate with qualifications and experience. The Company operates house purchase, profit sharing and contributory pension schemes and offers financial assistance towards removal expenses.

Applications giving details of age, qualifications and experience should be sent as soon as possible to: Mr M A J W Pegg, Personnel Department, Imperial Chemical Industries PLC, Agricultural Division, PO Box No. 1, Billingham, Cleveland TS23 1LB.

94

ELECTRONICS & WIRELESS WORLD MARCH 1985
Dolby Laboratories

Dolby Laboratories manufacture a range of professional audio noise reduction equipment which is used by major recording companies, the cinema industry and broadcasting authorities throughout the world.

TEST DEPARTMENT SUPERVISOR

Reporting to the Production Manager the person appointed will be responsible for planning the flow of products through the department, providing technical support and ensuring high quality. The 17 staff test and trouble-shoot analogue circuits to component level, using ATE where appropriate. The position, which is both demanding and rewarding, would suit a graduate engineer aged 25—40 with supervisory experience in a similar environment.

PRODUCTION ENGINEER (ELECTRONICS)

The person appointed will join a small team which is responsible for technical support to the production department as well as interfacing with sales and design engineers on product improvement and new developments.

The successful applicant — aged between 25 and 35 — will be an electronics engineer with an enthusiastic, practical approach backed up a degree or HNC and several years experience in electronic equipment manufacturing. A keen interest in audio electronics and experience with ATE and CAM would be an advantage.

Salaries will be commensurate with qualifications and experience and assistance towards relocation is given in suitable cases.

The company operates a free life insurance and pension scheme.

For application form write or phone:
Sarah Kennedy, Dolby Laboratories Inc., 346 Clapham Road, London SW9 9AP. Tel: 01-720 1111

Electronic Engineers and Technicians

They're asking for you in Alexandria.

Voluntary Service Overseas is looking for experienced and qualified Electronic Engineers and Technicians to work with and help train members of third world communities in Egypt (University of Alexandria Research Centre) and in Sri Lanka (Chilaw Diocesan Industrial Centre).

Applicants should be aged between 20 and 65, without dependants and willing to accept no more than the 'local' rate of pay.

If you have the right qualities and experience and you're free to go, please believe you're needed urgently! (For more information, complete and return the coupon now.)

Electronic Engineers and Technicians

They're asking for you in Alexandria.

Voluntary Service Overseas is looking for experienced and qualified Electronic Engineers and Technicians to work with and help train members of third world communities in Egypt (University of Alexandria Research Centre) and in Sri Lanka (Chilaw Diocesan Industrial Centre).

Applicants should be aged between 20 and 65, without dependants and willing to accept no more than the 'local' rate of pay.

If you have the right qualities and experience and you're free to go, please believe you're needed urgently! (For more information, complete and return the coupon now.)

EIVW/3/85

Voluntary Service Overseas

Why not?

Post to: Enquiries Unit, Voluntary Service Overseas, 9 Belgrave Square, London SW1X 8FW (S A E appreciated) Charity No: 313757

Civil Aviation College (Gulf States) DOHA, QATAR

Required Soonest:

AVIATION ELECTRONICS INSTRUCTOR

1. University Degree in Electronics or Electrical Engineering or equivalent.
3. Minimum ten (10) years teaching experience in an ICAO recognized training centre.
4. Salary and allowance up to U.S. Dollars 3400 per month.

Applications to:

The Principal

Civil Aviation College (Gulf States)
P.O. Box 4080
DOHA
State of Qatar

(2489)
CAPITAL APPOINTMENTS LTD
THE UK's No. 1 ELECTRONICS AGENCY

If you have HNC/TEC or higher qualifications and are looking for a job in design, test, customer service, technical sales or similar fields, call us now for our free jobs list.

We have vacancies in all areas of the UK.

Salaries to £15,000 pa

01 808 3050 (24 hours)

CAPITAL APPOINTMENTS LTD
76 WILLOUGHBY LANE, LONDON N17 0SF

(291)

Your short circuit to a better career

We are now looking for highly professional Electronics Engineers who want 1985 to be the most challenging year of their careers. Waiting on our sophisticated database are vacancies all over the country, especially in high technology industries. And if you want to name your ideal position, our experienced advisers will even make discreet approaches on your behalf.

Joining Lansdowne Appointments Register is FREE and as simple as filling in this coupon or calling us. We will then send you one of our highly developed profile forms, which will enable us to accurately pinpoint the career move you seek.

Over the last 12 years, we have helped literally thousands of people to further their careers. In fact, we've been so successful at finding the right jobs and the right people that many companies talk to us before they even bother to advertise vacancies - many never do!

If you want to short circuit the system - contact us now, and join the people who have already found the fast route to a more successful career.

NOW SHORTLISTING:
Electronics Engineers with experience in:
- Design
- Development
- Applications
- Project Control
- Technical Management
- Test
- Quality Assurance
- Commissioning
- Field Service

01-743 6321

To Stuart Tait,
Lansdowne Appointments Register,
Park House, 207-211 The Vale,
LONDON W3 7QB

Please send me a Lansdowne Appointments Register job finding pack.

NAME
ADDRESS

All posts are open to men and women and our service is completely confidential for companies and job-seekers.

Lansdowne Appointments Register
Jobs for professionals: Professionals for jobs.

(2496)

ELECTRONICS & WIRELESS WORLD MARCH 1985
ELECTRONICS & WIRELESS WORLD MARCH 1985
Telecommunications Engineering Technicians

Openings in Servicing and Maintenance
Up to £8,873

Our business is to install and maintain the communications equipment used by the Police and Fire Brigades in England and Wales—some of the latest you will find in operation anywhere.

We have a number of vacancies at our Service Centres in various parts of the country, for Telecommunications Engineering Technicians with practical skills in locating and diagnosing faults in a wide range of equipment from computer-based data transmission to FM and AM radio systems.

The work provides excellent opportunities for extending your technical expertise, with specialised courses and training to keep you up to date on developments and new equipment. There are also opportunities for day release to gain higher qualifications.

Applicants, male or female, must be qualified to at least City & Guilds Intermediate Telecommunications standard and possess a current driving licence. Some travelling will normally be involved. Registered disabled persons can of course apply.

The Home Office is an equal opportunities employer.

Salary will be on a scale £6501 to £8873 a year with generous leave allowance and pension scheme.

Good prospects for promotion. If you are interested in working with us, please write for further details and application forms quoting reference WW/1 to Miss M Andrews, Home Office, Directorate of Telecommunications, Horseferry House, Dean Ryle Street, London SW1P 2AW.

Reading (0734) 875200

AMPEx is a company at the forefront of magnetic recording technology, which manufactures Professional Video Equipment, Instrumentation Recorders, Disk Drives, Terminals and Magnetic Media.

AMPEx INTERNATIONAL TRAINING, based in Reading, England, is currently expanding and there are several vacancies for Instructors to conduct quality maintenance courses on AMPEx products.

Applicants should be men or women who have experience in one or more of the following areas:

- Digital Processing, Professional Video Recording, Digital Magnetic Recording, Microprocessor Based Equipment.

Teaching experience is not essential, as appropriate training will be given.

An attractive salary is offered, together with the usual large company benefits.

For application forms, please contact:
Maureen Brake, Personnel Department, or John Watkinson, Training Manager.
First choice for job hunters

Component Development

High-technology market leaders, my clients' advanced systems incorporate the very latest component developments, created by themselves and in conjunction with major manufacturers.

Component Engineers

To advise designers on applications and evaluate new types. Electronics qualification, knowledge of component systems (BS8000, MIL, STDs), experience in electronics test, evaluation or defect analysis. Knowledge of hybrids, packaging, inter connections, material properties, HP4/IEEE bus programming, radiation hardness an advantage.

Team Leader - Component Evaluation

To head team dedicated to hybrid evaluation and defect analysis. Qualifications and expertise as for Component Engineer.

Section Leader - Electrical Standards

To head laboratory team responsible for calibration of all electrical/electronic instrumentation, development of new methods, and liaison with external calibration labs. Electrical/electronic apprenticeship, HNC/HTC plus knowledge of concepts of traceability and compliance with MOD/BCS requirements.

Test Equipment Engineers

To £8,900 Merseyside

Major new contracts at leading electronics manufacturer are creating new key appointments for Test Equipment Engineers. HNC or preferably degree-qualified in electrical/electronics engineering, you must have had experience of software and hardware application and procurement related to large-scale computer controlled equipment. Knowledge of circuit logic and ATE programming techniques including high level Machine Code and Assembler languages would be an advantage. The company offers the full range of benefits you would expect of a large, successful organisation, together with excellent working conditions. Generous relocation assistance will be available.

Test & Installation Engineers

Attractive package Cheshire

New technological era and expansion are creating key appointments with highly successful international leader in analytical instrumentation for earth sciences, nuclear industry, environmental pollution control, high purity metals and semiconductor industries. Role includes test, commissioning, installation and servicing of systems on-site in UK and overseas. HNC Electronic Engineering plus two years' experience as technician, installation engineer, test or electrical engineer or graduate in physics, chemistry or metallurgy with related experience. Knowledge of computer software/applications an asset.

Systems Engineers

Attractive salary Lake District area

Leader in design, development, testing and manufacture of advanced electronic systems needs additional Systems Engineers for multi-disciplined teams involved in all aspects of systems design and implementation, including move towards hypertechnology programmes. Degree or equivalent in relevant discipline plus two years' practical experience, ideally including top-down structured design. Major international group package, with relocation expenses.

Field Service Engineers

£13,000-£14,500 tax-free Iraq

World leader in hospital laboratory automation, producing broad range of scientific medical instrumentation for use in clinical pathology, needs additional Engineers to install systems, attend to routine/emergency maintenance and assist in training. A two year renewable contract on single status, it demands the expertise of experienced Engineers aged 25-35, qualified to HNC Electronics with a background in the servicing of computer-controlled equipment, ideally medical instrumentation. People with laboratory expertise in biochemistry or haematology and knowledge of electronics also considered. Tax-free salary, bonus, free furnished accommodation, car, medical and life insurance, two months' annual leave, air fares paid. Induction training in France.

High-Tech Expansion

Newcastle-upon-Tyne

Expansion, consolidation and major market initiative with innovative high-tech product range are together creating a number of new key appointments with this successful Tyneside company, part of a publicly quoted group, assembling electronic and electrical light current control and monitoring devices.

Senior Software Development Engineer

To update programs for requirements of computer remote control systems to MINOS standard. Qualifications: experience in real-time data programs using Coral 66, knowledge of peripherals an advantage. UK travel.

Microprocessor Hardware Engineer

To develop micro-based equipment for extreme environments. Qualifications: degree in electronics plus D + D or microprocessor equipment for mining industry. Experience of software writing for 8-bit processors an advantage.

Product Manager - Control & Monitoring Devices

To develop remote control and monitoring plant for use in hazardous environments, eg, mining and petroleum industries. Qualifications: degree in electronics plus experience in similar role, knowledge of microprocessor equipment development and applications, ideally including exposure to mining industry needs.

Negotiable salaries, pension, life assurance, generous holiday allowances, excellent prospects.

Phone Aidan Lymper, PER Newcastle, on (0632) 704585, for job description and application form.

Test & Installation Engineers

Attractive package Cheshire

New technological era and expansion are creating key appointments with highly successful international leader in analytical instrumentation for earth sciences, nuclear industry, environmental pollution control, high purity metals and semiconductor industries. Role includes test, commissioning, installation and servicing of systems on-site in UK and overseas. HNC Electronic Engineering plus two years' experience as technician, installation engineer, test or electrical engineer or graduate in physics, chemistry or metallurgy with related experience. Knowledge of computer software/applications an asset.

Send CV to Dorothy Thompson, PER, 75 Sankey Street, Warrington WA1 1SL.

ELECTRONICS & WIRELESS WORLD March 1985

99
Manager, Production Engineering Services

We have established a new management position in the Technical Operations Department at our Nottingham Production Centre - one of the most modern studios in the UK.

The person appointed will be responsible for the CAR, VT and Vision Control sections and for monitoring their technical performance.

We want someone who combines engineering competence with managerial ability - qualified to at least HND or equivalent with a minimum of five years engineering experience with a studio centre or an equipment manufacturer: experience at or above supervisory level is essential, with the skill to organise and control technical resources in a cost-effective manner. An understanding of TV production operations would be an asset. Candidates' likely age range will be 30-40.

The salary and benefits are attractive and reflect the ability and experience required for the position. If you have the necessary qualities, why not send us your CV?

Personnel Department, Central Independent Television plc, East Midlands Television Centre, Nottingham NG7 2NA.

An equal opportunities employer.

£20.00—P/HR.

1) Microwave Amplifier Design
2) High Frequency Trigger
3) RF Designers, M.O.D. Herts/

Phone or write: Roger Howard, C.Eng, M.I.E.E, M.I.E.R.E

CLIVEDEN CONSULTANTS
2 The Broadway, Bracknell, Berkshire
Tel: 0344 409408

THE UNIVERSITY OF LEEDS
ELECTRONICS TECHNICIAN

Dept. of Physiology
Required to assist in the construction of television electronic equipment associated with research and teaching of biological problems. Must be able to work from circuit diagrams and checks. Applicants should have a degree in electronic or equivalent qualifications and have 3 years relevant experience (including training period). Salary will be grade £11,000—£12,500 p.a. Applications stating age, qualifications and equal experience together with the name and address of 2 referees, should be addressed to Mr. S. Stammberg, Dept. of Physiology, Medical and Dental Building, University of Leeds, Leeds LS2 9LT.

BCS LABORATORY DEPUTY HEAD

Due to expansion we have a vacancy for an experienced standads engineer to carry out calibration on DC and LF instrumentation in our laboratory, which is approved by the British Calibration Service. This position would ideally suit someone in the calibration field wishing to further their career prospects. Experience in this type of environment is a necessity.

An attractive salary, pension and BUPA benefits will be offered, also relocation expenses where applicable.

Apply in writing giving details of employment to date:

Mr. J. Macalister
GMR Ltd., Unitig, Salisbury Square, Radford, Nottingham.

Bored?

Then change your job!

1) Test Engineer
To work on on-line active video systems and data acquisition equipment, Berks. To £10,500.

2) Field Service Engineers
To work on mobile radio communications, Berks. To £7,500.

3) Test Engineers
Working in an analogue digital control systems for radio and microprocessor equipment, Surrey. To £11,000.

4) Service Engineer
To work on computer peripheral equipment, Berks. To £2500.

5) Technical Author
Navel hardware systems, Surrey. To £11,000.

6) Junior Electronics Development
Involved in the design of colour and monochrome TV monitors. HNC/HTC+, Bucks. To £10,000.

7) Junior Electronics Development
and Computer peripherals to £12,500.

3) Test Engineers

SATELLITE RECEPTION RESEARCH ASSISTANTS
Monitoring Service

With the advent of satellite communications, broadcasting and news agency organisations are switching from conventional means to satellites for their transmissions. Satellite Reception Research Assistants will be involved in the Monitoring Service's work in this field.

Duties include frequency scanning and the compilation of transmission schedules. Extensive experience in communications with C and G Intermediate Telecommunications Technicians Certificate or equivalent qualification and a thorough grasp of satellite communications is essential. Knowledge of major broadcast systems, familiarity with news agency transmissions and the ability to recognise a range of languages an advantage.

Applicants will be required to take written tests and appointment will be subject to satisfactory hearing tests. Shift work involved.


Write or telephone immediately for application form (enclosing addressed, foolscap envelope and quote ref. 2037-WW), to Senior Personnel Officer, BBC Monitoring Service, Caversham Park, Reading, Berkshire RG4 8STZ. Tel: (0734) 472742. Ext. 212.

We are an equal opportunities employer.

SATELLITE RECEPTION RESEARCH ASSISTANTS
Monitoring Service

With the advent of satellite communications, broadcasting and news agency organisations are switching from conventional means to satellites for their transmissions. Satellite Reception Research Assistants will be involved in the Monitoring Service's work in this field.

Duties include frequency scanning and the compilation of transmission schedules. Extensive experience in communications with C and G Intermediate Telecommunications Technicians Certificate or equivalent qualification and a thorough grasp of satellite communications is essential. Knowledge of major broadcast systems, familiarity with news agency transmissions and the ability to recognise a range of languages an advantage.

Applicants will be required to take written tests and appointment will be subject to satisfactory hearing tests. Shift work involved.


Write or telephone immediately for application form (enclosing addressed, foolscap envelope and quote ref. 2037-WW), to Senior Personnel Officer, BBC Monitoring Service, Caversham Park, Reading, Berkshire RG4 8STZ. Tel: (0734) 472742. Ext. 212.

We are an equal opportunities employer.

SATELLITE RECEPTION RESEARCH ASSISTANTS
Monitoring Service

With the advent of satellite communications, broadcasting and news agency organisations are switching from conventional means to satellites for their transmissions. Satellite Reception Research Assistants will be involved in the Monitoring Service's work in this field.

Duties include frequency scanning and the compilation of transmission schedules. Extensive experience in communications with C and G Intermediate Telecommunications Technicians Certificate or equivalent qualification and a thorough grasp of satellite communications is essential. Knowledge of major broadcast systems, familiarity with news agency transmissions and the ability to recognise a range of languages an advantage.

Applicants will be required to take written tests and appointment will be subject to satisfactory hearing tests. Shift work involved.


Write or telephone immediately for application form (enclosing addressed, foolscap envelope and quote ref. 2037-WW), to Senior Personnel Officer, BBC Monitoring Service, Caversham Park, Reading, Berkshire RG4 8STZ. Tel: (0734) 472742. Ext. 212.

We are an equal opportunities employer.

SATELLITE RECEPTION RESEARCH ASSISTANTS
Monitoring Service

With the advent of satellite communications, broadcasting and news agency organisations are switching from conventional means to satellites for their transmissions. Satellite Reception Research Assistants will be involved in the Monitoring Service's work in this field.

Duties include frequency scanning and the compilation of transmission schedules. Extensive experience in communications with C and G Intermediate Telecommunications Technicians Certificate or equivalent qualification and a thorough grasp of satellite communications is essential. Knowledge of major broadcast systems, familiarity with news agency transmissions and the ability to recognise a range of languages an advantage.

Applicants will be required to take written tests and appointment will be subject to satisfactory hearing tests. Shift work involved.


Write or telephone immediately for application form (enclosing addressed, foolscap envelope and quote ref. 2037-WW), to Senior Personnel Officer, BBC Monitoring Service, Caversham Park, Reading, Berkshire RG4 8STZ. Tel: (0734) 472742. Ext. 212.

We are an equal opportunities employer.

SATELLITE RECEPTION RESEARCH ASSISTANTS
Monitoring Service

With the advent of satellite communications, broadcasting and news agency organisations are switching from conventional means to satellites for their transmissions. Satellite Reception Research Assistants will be involved in the Monitoring Service's work in this field.

Duties include frequency scanning and the compilation of transmission schedules. Extensive experience in communications with C and G Intermediate Telecommunications Technicians Certificate or equivalent qualification and a thorough grasp of satellite communications is essential. Knowledge of major broadcast systems, familiarity with news agency transmissions and the ability to recognise a range of languages an advantage.

Applicants will be required to take written tests and appointment will be subject to satisfactory hearing tests. Shift work involved.


Write or telephone immediately for application form (enclosing addressed, foolscap envelope and quote ref. 2037-WW), to Senior Personnel Officer, BBC Monitoring Service, Caversham Park, Reading, Berkshire RG4 8STZ. Tel: (0734) 472742. Ext. 212.

We are an equal opportunities employer.
THE SERVICES SOUND AND VISION CORPORATION
BROADCAST AND ELECTRONIC ENGINEERS

Required for Broadcast operations and engineering in the Services Sound and Vision Corporation which provides radio and television services to the British Forces and their dependants abroad. Candidates (preferably aged 22 - 35) should be educated to HND standard in electrical and electronic engineering and have work experience in the broadcasting or related industry.

The work, often overseas, includes the operation, maintenance and installation of the full range of professional radio studio equipment and Medium Wave and VHF broadcast transmitters.

Good salary and allowances paid together with fringe benefits. There are also prospects of promotion to higher grades and opportunities for training and transfer to Television and other departments of the SSVC.

Please apply in writing to:
Mrs Anna Sive, Personnel Officer
The Services Sound and Vision Corporation,
Chalnot Grove Narceet Lane, Gerrards Cross, Bucks SL9 8TN

BIO-ENGINEERING OPPORTUNITIES IN SAUDI ARABIA

General Arabian Medical and Allied Services Ltd. are management consultants and agents for the recruitment of staff to the Riyadh Al Khari Hospital Programme in Saudi Arabia. The programme comprises three hospitals including the 600 bed Riyadh Armed Forces Hospital and provides a very high standard of health care to members of the Armed Forces of Saudi Arabia and their families.

The Department of Medical Physics and Bio-Engineering has programme-wide responsibilities and with a mainly British staff of more than 40, is the largest department of its kind in the Middle East. A very wide range of clinical support and development work is undertaken by our well qualified professionals. Successful candidates will have the opportunity to widen their experience in a busy modern department with excellent facilities allowing them to achieve the high standard of work expected of them.

Further expansion of the department's activities, including a commitment to provide technical support for medical equipment on the kingdom's fleet of Lockheed C-130 Hercules 'flying hospitals' and air ambulances has created the need for additional qualified bio-engineering technicians.

MEDICAL ELECTRONICS TECHNICIANS
ANAESTHETIC EQUIPMENT MAINTENANCE TECHNICIANS

SALARY c. £16,230 - £18,234 pa tax free incl. bonus

The above posts are offered on the Medical Physics Technical Officer (Bio-Engineering) grade, equivalent to the NHS grade III MPT. Qualifications to OTEC or equivalent level is essential; HTEC and/or some year's experience is highly desirable.

There are also Locum positions available for medical physics technical officers for a period of not less than three weeks.

Benefits

Contracts are normally offered for a two-year initial term and include free fully furnished accommodation; four weeks leave after every six months service; free air fares (including leave flights); free health care and extensive recreational facilities. The bonus will be paid on completion of the contract.

Salaries for these single status positions are paid in Saudi Riyals and the sterling salaries quoted are calculated at the current rate of 4.1 Saudi Riyals = £1

For further information apply with a detailed C.V. or telephone for an application form.

Susan Griece, Recruitment Officer,
GAMA INTERNATIONAL LTD.,
6 Duke of York Street, London SW1Y 6LA.
Telephone: 01-839 6843.

DESIGN AND DEVELOPMENT ENGINEER

Experienced engineer required to join small electronics company involved in design and manufacture of telecommunications products for BT and other PTE authorities.

Applicants should have extensive experience in design and manufacturing of telecommunications products for BT and other PTE authorities.

Telephone: (032 24) 419 33

GAMA INTERNATIONAL LTD.,
6 Duke of York Street, London SW1Y 6LA.
Telephone: 01-839 6843.

Don't Forget!
for your classified adverts ring
Ian Faux
01 661 3033

When replying to classified advertisements, readers are recommended to take steps to protect their interests before sending money.

BUSINESS OPPORTUNITY

SOUTH SHROPSHIRE DISTRICT COUNCIL
SWITCHBOARD AND TELEPHONE INSTALLATION

The Council need to replace their present switchboard arrangements and telephone installation for the Council Offices, Stone House, Corve Street, Ludlow.

A specification giving details of the Council’s requirements and a form of tender is available from the undersigned.

Completed forms of tender must be received by not later than 12 noon on Monday 18th March 1985.

G. Koller, Chief Executive,
Stone House, Corve Street, Ludlow, Shropshire.
Tel: Ludlow 3033 Ext. 22.

ARTICLES FOR SALE

DRIOTWICH STANDARD FREQUENCY RECEIVER

Outputs: 1MHz, 10MHz
Phase locked crystal oscillator. Complete with ferrite rod aerial, usable throughout U.K. Now available in updated version £185.00.

R.C.S. Electronics, Welsey Road, Ashford, Middx. Phone 53661.
**ARTICLES FOR SALE**

**BRIDGES**


- (2732) 546656.

**QUINT CRystals Oscillators and Filters**

- Filters of all types. Large stocks of standard, special items. Specials supplied to order. Personal and expert service welcomed - N/A for last please OEM support. Nice design advice, prototype quotations, production schedules.

- Geogel Electronics: Merritt, Somer. 81266. Tel: 060-3711 (2732)

**ENCAPSULATING EQUIPMENT**

- For coils, transformers, components, desiring shielded, cables, clips, epoxy. Low wax casting for brains, bromine, silver, etc. Improving coils, transformers, components. Vacuum equipment, low cost, used and new. Also for CRT reconditioning metalising.

- Research Developments, Merey Road, Croydon CR2 0P. Tel: 0681-9974. (2676)

**MORSE READING PROGS**

- Work on clean signals without hardware interface. ZASR, UK. UNEXPERT FUNDORY. Translated code with word and line spaces for easy reading. Automatic scroll action. £7.15.

**OPTOELECTRONICS DATA BOOK 1984**

- Price: £58.00 by Texas £6.00.

**DIGITAL ELECTRONIC CIRCUIT & SYSTEMS**

- BY N.M. O'ROURKE. PRICE £5.45.

**MICROELECTRONICS**

- A PRACTICAL INTRODUCTION BY R.A. SPARKES. PRICE £8.50.

**SOLDERING IN ELECTRONICS**

- By R.N. Kien Wassen Vatassam. PRICE £8.00.

**OPTICAL FIBER COMMUNICATIONS**

- BY D. A. Kappel. PRICE £12.00.

**DIGITAL IMAGE ANALYSIS**

- By S. Levald. PRICE £26.00.

**SEMICONDUCTORS & SYSTEMS**

- INTRODUCTION TO MOS LS! DESIGN BY J. Mavor. PRICE £18.50.

**HANDBOOK OF BATTERIES**

- FUEL CELLS AND美しい電池 (2743) £16.00.

**THE DESIGN & DRAFTING OF PRINTED CIRCUITS**

- BY D. Lindsey. PRICE £16.50.

**SERVICES**

- PCB Fault Location and Repair. Jaccrow Systems Services, 103 Carrick Street, Croydon, Surrey CR9 1LX, Britain's leading maintenance company offers a fast and efficient diagnosis and repair service UK and overseas, using the latest ATARI. Ask for full details, without obligation Ring: 01-680 9191. Quote ref: EWS35 (2471)

- **PROFESSIONAL DESIGN SERVICE**

- Analog/RF circuit/System design. Specialising in microphone amplifier, mixer and network system. MOTOROLA 664658056 series microprocessor development design/capability. All work carried out to a high standard by experienced professional engineers. Through Electronic Design Services Ltd., Unit 85. Bristol Road Industrial Centre, Bristol. BS5 8ED. Tel: 0592-28951 (2475)

- **TURN YOUR SURPLUS**

- to transistors etc. into cash, immediate satisfaction. We also welcome the opportunity to quote for complete factory clearances. Contact Cullis HARDING & Co., 125 South Brook, Wembley. W3 5RJ. Tel: 099 584588.

- **DESIGN AND DEVELOPMENT SERVICES**


- **IMPROVE YOUR PROSPECTS**

- with skills that employers want – learn the easy way with modern home study courses.

- **MODERN ELECTRONICS**

- Train for success in the fastest ever courses.

- **COMPUTER PROGRAMMING**

- The demand for Programmers is increasing! Enrol your computer course now! For free booklet write today to (2747)

- **IDEAL SCHOOLS**

- E.E. McGregor, 2nd Floor Flat. 263 Queensway. Glasgow G11 1UK. Tel: 041-244 5200

**SMALL SELECTION ONLY LISTED USING US FOR YOUR REQUIREMENTS WHICH MAY BE IN STOCK**

**MICROCOMPUTERS**

- **FIRMWARE**

- **INSTRUMENTATION**

- For fastest, best CASH offer, phone,

- **COMPUTER APPRECIATION**

- Oxford (0865) 55163

- Mexico 53573.

**WANTED**

- **SURPLUS ELECTRONIC COMPONENTS AND EQUIPMENT**

- We also welcome the opportunity to quote for complete factory clearances.

- B. BANDERM ELEKTRONIK

- S. KATION STREET, LITTLEPORT, CAMBS. Phone: Ely 09265 8199 (2493)

**ARTICLES FOR SALE**

- **Eurocard Power Supplies**

- 5v @ 1A, 1.5A, 3A, and 5A

- Options: 5v @ 12v & 100mA for RS232, Crabwell, 12 or 15v main output.

- Front Panel with EEC mains skt.

- Prices from £15 for IA kSt (224) + VAT for details contact:

- Stevenson Ltd., Dept. W.W. P.O. Box 512, Windsor, Berks SL4.4NU.

- (2501)

- **654024 CMS MICROCONTROLLER**

- Uses BBC Computer as host. Build stand-alone controllers simply quickly. Bare boards or built & tested. Large n.a. for details or technical manual £2 50: Nixan Electronics Ltd. 25 Suffolk Drive, Lacey Green, Winslow, Cheshfr. SKN 49J (2512)

**VINTAGE VALVE SPARES**


**CALLUM FLAT**

- Bed flat 8" x 6" ex ministry here been used since with conditions. All cables and all beds daylight £1-57. 2000 e/w. £49 1049. (2513)

**WAVEGUIDE**

- Flags and dishes. All standard sizes and always have material only from stock. Special sizes to order. Earth Stations. 61-228. 976, 212 Howard Street. London SW1 (1999).
CIRCOLEC
THE COMPLETE ELECTRONIC SERVICE
Artwork, Circuit Design, PCB Assembly, Test & Repair Service, O.A. Consultancy, Prototypes, Final Assembly. Full PCB Flow Soldering Service. Quality workmanship by professionals at economic prices. Please telephone 01-646 5686 for advice or further details.

E C COMPONENTS
We buy large and small parcels of surplus I/C, transistors, capasitors and related electronic stock immediate settlement. Tel: 01-208 0766 Telex: 8814996

SURPLUS
We offer good prices for test equipment, components, redundant computers, PCB's, connectors. Immediate settlement.

TIMEBASE
94 Alliston Gardens
Shelling, Southampton SO2 8FU
Telephone: (0703) 431 323

STEWART OF READING
110 WYKEHAM ROAD
READING RG6 1PL
TEL NO : 0734 68041
TOP PRICES PAID FOR ALL TYPES OF SURPLUS TEST EQUIPMENT, COMPUTER EQUIPMENT, COMPONENTS, ANY QUANTITY.

TO MANUFACTURERS, WHOLESALERS
BULK BUYERS, ETC.
LARGE QUANTITIES OF RADIO, TV AND ELECTRONIC COMPONENTS FOR DISPOSAL
SEMICONDUCTORS, all types, INTEGRATED CIRCUITS, TRANSISTORS, DIODES, RECTIFIERS, THYRISTORS, etc. RESISTORS, C/F, M/F, W/W, etc. CAPACITORS, SILVER MICA, POLYSTYRENE, C280, C296, DISC CERAMICS, PLATE CERAMICS, etc.
ELECTROLYTIC CONDENSERS, SPEAKERS, CONNECTING WIRE, CABLES, SCREWED WIRE, SCREWS, NUTS, CHOKES, TRANSFORMERS, etc.
ALL AT KNOCKOUT PRICES - Come and pay us a visit ALADDIN'S CAVE
TELEPHONE: 445 0798/445 2713
R. HENSON LTD.
21 Lodge Lane, North Finchley, London, N.12
(5 minutes from Tally Ho Corner)

THE Publishers take all reasonable care to ensure that classified advertisements are genuine, but readers must satisfy themselves that they will be obtaining what they require before entering into transactions, particularly if they involve large sums of money.

FREE P.T.T. PROTOTYPE of the finest quality with EVEREST P.C.B. artwork designed by us. Competitive hourly rates, and high standard of work. BAILESTON DESIGNS LIMITED, St. Hugh St., BAILEY, Essex. Tel: (0787) 477684/47554.

TW ELECTRONICS LTD
THE PCB ASSEMBLERS
More and more companies are investigating the advantages of using a professional subcontractor. Such an undertaking requires certain assurances. TW are able to satisfy all of them - quality, competitive pricing, firm delivery and close co-operation with the customer.

For further details, contact us at our new works.
Blenheim Industrial Park
Bury St. Edmunds
Suffolk IP33 3UT
Telephone: 0284 33551

FREEMARKET VENDORS
1,000 types. List 15p.

WANTED:
Ex. RAF Air - publications, manuals, etc., from 1938 onwards relating to transistors - receivers - equipment and radar. Excellent price paid. M. Gee 29 Stratford House, Aston Street. London E14 7NL. Telephone: 01-254 9083 evenings.

ELECTRONICS & WIRELESS WORLD MARCH 1985

103
CIRCLE 92 FOR FURTHER DETAILS.

OVERSEAS ADVERTISEMENT AGENTS
France and Belgium: Pierre Mussard, 18 - 20 Place de la Madeleine, Paris 75008.
Hungary: Ms Edith Bajusz, Hungexpo Advertising Agency, Budapest XIV, Vaszilagt,
Telephone: (01) 723-2508 - Telefax: Budapest 22-1450. INFORCE
Italy: Sig C. Cepi, Elisa-Kompass, S.p.a. - Servizio Editoriale, Via Marchese 20, 20122 Milan,
Telephone: 347651 - Telex: 37342 Kompass.

Japan: M. Itohitsuji, Trade Media - IBP (Japan), B. 2112 Arozu Tsurumi, 15, 13-10 Tokyo 106,
Telephone: (03) 855 0581.
United States of America: Jay Kleinman, Business Press International, 200 East 42nd Street,
Jack Fierly Jr., The Fleck Co. Suite 1801, 36 East Walker Drive, Chicago, Illinois 60601 -
Telephone: (312) 630-9200 - Telefax: 312-637-8300.
Vince A. Lauta, Elmarax International, P.O. Box 34679, Los Angeles, Calif. 90034, USA -
Telephone: (213) 921-9581 - Telex: 18-1059.

INDEX TO ADVERTISERS

Appointments Vacant Advertisements appear on pages 92 - 103

ELECTRONICS & WIRELESS WORLD

16 Walton Street, Oxford OX1 2HQ
Tel: Oxford (0865) 55163 Telex: 838750
IBM PERSONAL COMPUTER Model XT, with single floppy & 10MB Winchester AS NEW
UNITRON Model 220 microcomputer, APPLE IIe & CP/M compatible machine with 6625 &
780 processors, 128Kb memory, detached keyboard with numeric pad and floppy disk interface
BRAND NEW & BOXED

CONFORM plus IBM PC compatible portable computer with 10MB hard disk, single floppy
disc 640 bytes, processor, comprehensive use of software as NEW
ROCKWELL AIM 65/40 single board 6502 development system with display, keyboard, power
supply and complete software
PHILIPS P2600 SYSTEM comprising, 48K 286 processor, twin 51 floppy drives, HONEYWELL MODEL 12120 processor twin printers, RADIOPHONIC
OLYMPIA BOSS MICROCOMPUTER, small 250 based business system with 90 s display, 64k
memory twin 51 floppy disc drives, HONEYWELL MODEL 12120 processor twin printers, RADIOPHONIC
MANNE&MANTUALLY Model 860MC matrix printer. With microprocessor control, 2000 bit-
broadcasting, popular for TEL and LSL case work, small. Compact but heavy duty machine. BRAND NEW &
BOXED

CENTRONICS Model 730 2 matrix printer
CENTRONICS Model 720 matrix printer, 120 col 165cps, bidirectional printing with self test in
good as demo condition.
DEC Index Printers various models available (BA11M, SBA1A, BA11 XL etc) with 2211
addressing or easily modified & various optional processors etc

Farnell Instruments Inside front cover
Field Electric Ltd
Fyde Electronics
Gemini Microcomputers
Gould Instruments
GNC Electronics
Granda Ltd
Greenwood Electronics
Hameg Oscilloscopes
Hamron Haris
Hart Electronics
Henry/Audio Electronics
Hi-tech
HIS Electronics
HW International
Henson Ltd
ILP Electronics
IMS Electronics
Industrial Auctions Ltd
Interface Terminals
Irvin Business Systems

Kentley Instruments
Kerom Ltd
Kimberly Ltd
Labcron Supplies
Martin Locations
Midwich Computer Co
Monolith Electronics
Newland Instruments Case's
Northern Amateur Radio Society Association
Number One Systems

OMITI Model 260 TELEFAX facsimile transmitter/receiver, Microprocessor controlled (8085) CCITT
Group 2 machine for transmitting documents over an ordinary phone line. BRAND NEW &
BOXED

Tektronix Model 6411 high density strip for 400 screens graphics terminals
Tektronix Model 611 graphics storage display. For use with any DAC computer output
FACIT Model 4020 high speed paper tape reader. Parallel ITIL interface
FACIT Model 5020 high speed paper tape reader. Parallel ITIL interface
CALCOMP Model 563 DX drum plotter. 0.1mm step size
CALCOMP Model 563DX drum plotter. As above, but high speed
CALCOMP Model 1036 AG graph printer. High speed 3 colour printer with Type 915 magnetic
ink unit for on demand on line use. Suitable for 2/floor, 800 x 600 ppi etc P.O.A.
C.I.L Model 6620/2 pen A6 high speed printer, P.O.A.
HEWLETT-PACKARD Model 90 portable computer
HEWLETT-PACKARD Model 95 desk top computer with integrated graphics display printer & use
HEWLETT-PACKARD Model 9800 matrix printer RADIOPHONIC

GOULD-BRYANS Model 5500 graph plotter 300mm x 280mm printing area with 0.1mm resolu-
tion and vector printing speed of 250mm/sec. With intelligent controller providing 12 character set &
4 programming routines RADIOPHONIC
HEWLETT-PACKARD Model 41C calculator with printer P.O.A.
GENERAL DATACOMM Model TD1240 line printer multi-plexer as used above with optional
GANG 2400/2000, Manufactured. Provided. Originally £2,900.00
SOUTH AFRICA: Central News Agency
Budapest 22-4525

Gordon & McConaghy, Business Press International, 1440 Maple Drive N.E., Atlanta,
Georgia 30320, USA

Japan: Mark Hart, Trade Media - IBP (Japan), B. 2112 Arozu Tsurumi, 15, 13-10 Tokyo 106,
Telephone: (03) 855 0581.
United States of America: Jay Kleinman, Business Press International, 200 East 42nd Street,
Jack Fierly Jr., The Fleck Co. Suite 1801, 36 East Walker Drive, Chicago, Illinois 60601 -
Telephone: (312) 630-9200 - Telefax: 312-637-8300.
Vince A. Lauta, Elmarax International, P.O. Box 34679, Los Angeles, Calif. 90034, USA -
Telephone: (213) 921-9581 - Telex: 18-1059.

Mark Jantzen, The Fleck Co. Suite 650, Rana Building, Cleveland, Ohio 44119 - Telephone (216) 621 1916
Ray Rickles, Ray & Rickles & Co., P.O. Box 2928, Miami Beach, Florida 33145 - Telephone: (305) 532 7241
Tim Parks, Ray & Rickles & Co., 3116 Maple Drive N.E., Atlanta, Georgia 30320, Telephone: (404) 772-8500,
Mike Loughlin Business Press International, 15055, memorial Ste 205, Houston, Texas - Telephone (713) 783 8673
Canada: Colin H. MacCallum, International Advertising Consultants Ltd., 915 Carlton Tower, 2 Carlton Street, Toronto 2 -
Telephone (416) 317 3324.

*Subscription agencies

Printed in Great Britain for Index Printers Ltd., Old Street, and again for Legendary Suppliers, South Street for the companies, Heinemann International, Updated Mos, The Quality, Soteria MAE, ©
Ray & Rickles Press International.94. Reprint World being the only source from the following: AUSTRALIA and NEW ZEALAND, Gouda & Gouda Ltd. Index, A. H. Wooder & Co. CANADA, The West European Subsidiary Service Ltd, Gordon & Gour Ltd. SOUTH AFRICA: Grecia News Agency Ltd, William Davison & Sons (S.A.) Ltd. UNITED STATES: Eastern News Distribution Inc., 711 Fourth, Zihlgo, Chicago, 9, Ill. 3001.

www.americanradiohistory.com
ANTEX
a world of soldering

Tomorrows Soldering Technology Today.

ANTEX has a worldwide reputation for quality & service & for many years has been one of the best known & most popular names in soldering. Always at the forefront of technology, ANTEX is continually researching new and better ways of achieving more accurate, reliable, and cost effective soldering. On ANTEX Soldering Irons, the advanced design of the interface between the element & the bit allows more efficient heat transfer to the bit and improved stability of the temperature at the point of contact with the work. Indeed, experiments have shown that an XS25 watt iron can be used for tasks where a 40 watt iron would normally have been required.

ANTEX Soldering Irons exhibit exceptionally low leakage currents & hence are suitable for use on Static Sensitive Devices. Sophisticated Temperature control soldering units have recently been added to the ANTEX range.

Model C
Model XS
Model XS-BP
- 25 Watts. 240 volts, fitted with British Plug.
Model CS

SKS Soldering Kit: Contains model CS240 volt iron, an ST4 Stand and solder.
SKS-BP and SK6-BP: Soldering Kits as above with British Plug.

Model CX-3P
- 17 Watts. 240 volts, fitted with British Plug.

TCSU1
- Very versatile temperature controlled soldering unit with 30 watt (XSTC) or 40 watt (XSTC) miniature iron, range 65°C to 420°C. Accuracy ±5°C.

Model TCSU-D
- Elegant Temperature Controlled Soldering Unit with 50 watt iron (XSTC) and built around FERRANTI custom-made LLSA Range 65°C to 450°C. Accuracy ±3°C. Zero crossover switching. Detachable sponge tray.

CIRCLE FOR FURTHER INFORMATION

www.americanradiohistory.com
CIRCUIT BOARD DESIGN
WITHOUT THE TEDIOUS

smARTWORK lets the design engineer create and revise printed-circuit-board artwork on the IBM PC or compatibles.

Forget tape, forget ruling to get waiting for a technician, draftsman, or the CAD department to get to your project. smARTWORK software turns your IBM PC or compatible into a professional, high quality drafting tool. It gives you complete control over your circuit-board-design — from start to finish.

What makes smARTWORK so smart is that it understands electrical connections. Conductor spacing is always correct, lines do not become too narrow, and connecting lines do not intersect other conductors. smARTWORK can automatically find and draw the shortest route between two conductors. Or you can specify the route.

smARTWORK is the only lowcost printed-circuit-board artwork editor with all these important advantages:

- Complete interactive control over placement and routing
- Quick correction and revision
- Production-quality 2x artwork from pen-and-ink plotter
- Prototype-quality 2x artwork from dot-matrix printer
- Easy to learn and operate, yet capable of sophisticated layouts
- Single-sided and double-sided printed-circuit boards up to 10x16 inches
- Multicolour or black and white display
- 32 user selectable colour combinations; coincident points may be displayed in contrasting colours
- Can use optional Microsoft Mouse as pointing device

System Requirements

- IBM PC, XT or compatible with 192K RAM, 2 disk drives and DOS 2.0
- IBM Colour/Graphics Adapter with RGB monitor or B&W monitor
- Epson MX-80/MX-100 or FX-80/FX-100 dot-matrix printer
- Houston Instruments DMP-41 pen-and-ink plotter (optional)
- Microsoft Mouse (optional)

The Smart Buy

At £895 (+VAT) smARTWORK is exceptional value, particularly when compared to conventional engineering workstation costs.

Write to the address below or use the enquiry card for more information on smARTWORK. Or call Richard Lambert on 0524 381423 to arrange a FREE demonstration or to discuss your requirements.

Starter kit comprising of: SAM, 200i PC, monochrome monitor, FX-100 dot matrix printer, DOS 2.0, smARTWORK, 1 Year on-site maintenance and much more. £3995.00

Starter kit plus 10M hard disk drive. £4995.00

Colour monitor. £395.00

Microsoft Mouse. £149.00

Pen and ink plotters from. £1795.00

smARTWORK. £895.00

smARTWORK Demo disk. £10.00

10% Discount on all Orders processed and paid for before 28th February 1985.

Note: All prices exclude VAT and are subject to change without notice.

Terms: Strictly CASH WITH ORDER.

Conguin Software, 20 Morecambe Road, Lancaster LA1 5JA
Phone: 0524 381423