ELECTRONICS &

Wireless world

November 1984 85p

Norway	Nkr	29.20
Singapore	M$	5.50
Spain	Pts	340.00
Switzerland	SFr.	7.00
U.S.A.	$	3.75

Intelligent eprom programmer

Real-time tape timer

Digital test gear

The PSG520H

a small, lightweight synthesized signal generator for field or bench use

Colour brochure available.
Send for yours now.

100kHz to 520MHz

Runs from clip-on NiCd battery pack, external 12Vd.c. (vehicle battery via cigar lighter socket) or, from any standard a.c. mains supply

Reverse power protection to 50W (standard)

Excellent specification and features

from Farnell

FARNELL INSTRUMENTS LIMITED · WETHERBY · WEST YORKSHIRE LS22 4DH · TELEPHONE (0937) 61961 · TELEX 55478 FARINT G

REGIONAL OFFICE (SOUTH) · DAVENPORT HOUSE · BOWERS WAY · HARPENDEN · HERTS. AL5 4HX · TEL. (05827) 69071 · TELEX 826307

WW–001 FOR FURTHER DETAILS

CIRCLE 11 FOR FURTHER DETAILS.

CIRCLE 27 FOR FURTHER DETAILS.

ELECTRONICS &
Wireless world

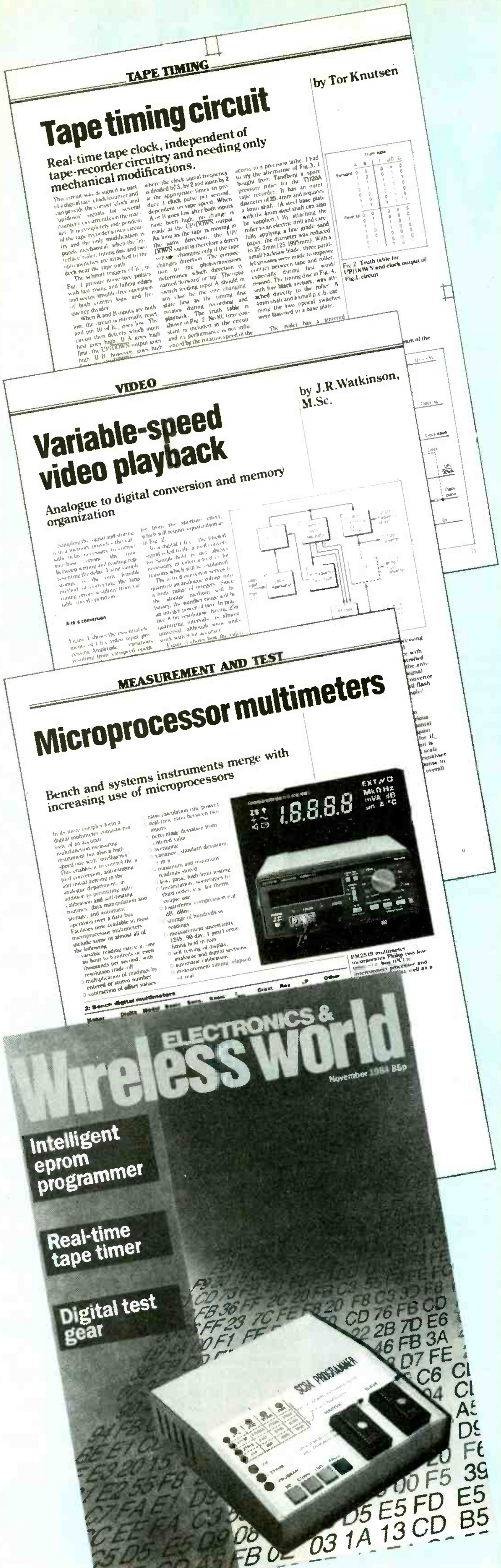
over 70 years in independent electronics publishing

November 1984 Volume 90 number 1585

CONTENTS

FEATURES

REGULARS

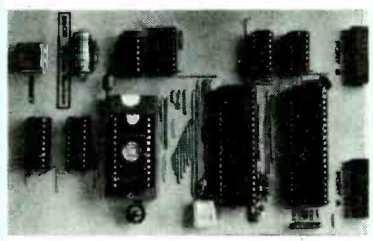


Designer Richard Newport's front cover is the intelligent eprom programmer appropriately superimposed on electronically-typeset machine code from the SC84 microcomputer monitor.

NEXT MONTH

Dr Baert of Ghent University describes a method of transformer design that improves on conventional methods as well as touching on some little-known facts.

Hand-held multimeters are analysed in our final table of digital multimeter specifications being a listing of those models currently available in the UK.



Peter Nicholls of the MEP describes his minicontroller – a 6502 - based general-purpose controller that runs software developed on the BBC microcomputer and emulates its i/o.

Current issue price 85p, back issues (if available) £1.06, at Retail and Trade Counter, Units 1 & 2, Bankside Industrial Centre, Hopton Street, London SE1. Available on microfilm; please contact editor. By post, current issue £1.30, back issues (if available) £1.40, order and payments to EEP Sundry Sales Dept., Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Tel.: 01-661 3378.

Editorial & Advertising offices: Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

Telephones: Editorial 01-661 3614. Advertising 01-661 3130. See leader page.

Telex: 892084 BISPRS G (EEP)

Subscription rates: 1 years £15 UK and £19 outside UK.

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

Distribution: Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Telephone 01-661 3248.

Subscriptions: Oakfield House, Perrymount Road, Haywards heath, Sussex RH16 3DH. Telephone: 04444 59188. Please notify a change of address.

USA: $49.40 surface mail, $102.60 airmail. Business Press International (USA). Subscriptions Office, 205 E. 42nd Street, NY 10017.

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.

ISBN 0043 6062.

Editor
PHILIP DARRINGTON
01-661 3128

Deputy Editor
GEOFFREY SHORTER, B.Sc.
01-661 8639

Technical Editor
MARTIN ECCLES
01-661 8638

Projects Editor
RICHARD LAMBLEY
01-661 3039

News Editor
DAVID SCOBIE
01-661 8632

Drawing Office Manager
ROGER GOODMAN
01-661 8690

Technical Illustrator
BETTY PALMER

Advertisement Manager
BOB NIBBS, A.C.I.I.
01-661 3130

MICHAEL DOWNING
01-661 8640

ASHLEY WALLIS
01-661 8641

Northern Sales
HARRY AIKEN
061-872 8861

Midland Sales
BASIL McGOWAN
021-356 4838

Classified Manager
BRIAN DURRANT
01-661 3106

IAN FAUX
01-661 3033

Production
BRIAN BANNISTER
(Make-up and copy)
01-661 8648

Publishing Director
DAVID MONTGOMERY
01-661 3241

International Agents and the Advertisers Index appear at the back of this issue.

bigger and better.

Nicad Batteries & Chargers

High quality nickel cadmium rechargeable batteries. Equivalent in size with popular Dry Cell sizes e.g. HP7 (AA), HP11 (C), and HP2 (D). Minimum life 600 (300 PP3 size) full charge/discharge cycles. Batteries must be charged from a constant current source only. All batteries are supplied only with a residual charge and should be charged before used.

DATA & PRICES

Type	V(nom)	Capacity	Stock No.	1-9	10-49
AA	1.2V	500mAH	01-12004	0.80	0.74
C	1.2V	1.2AH	01-12024	2.35	1.99
D	1.2V	1.2AH	01-12044	2.00	2.00
PP3	8.4V	110mAH	01-84054	3.70	3.50

CH/4/50
To recharge up to 4 AA size NiCads.
Size; 112 x 71 x 37mm 01-00409 4.95

CH1/22
To charge PP3 type NiCads.
Size; 70 x 50 x 32mm 01-00159 4.30

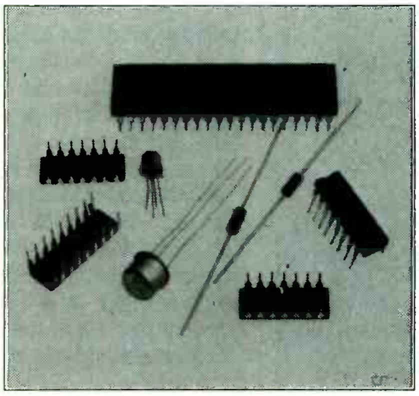
CH8/RX
Will recharge AA, C, D and PP3 size cells with automatic voltage selection. Will recharge following combinations: 4xD, 4xAA, 4xC, 2xPP3, 2xD + 2xC, 2xD + 2xAA. 2xD + 1xPP3, 2xC + 2xAA, 2xC + 1xPP3, 2xAA + 1xPP3. Charge rate: 11mA for PP3, 45mA for AA size, 120mA for C and D size, for 16 hrs. Power: 240V 50Hz. Output Voltage: 2.9V for AA, C and D size, 11.0V for PP3 size. Weight: 0.475kg. Size: 199 x 109 x 55mm.
01-02204 9.45

HT320

High quality, high specification meter at a reasonable price. In addition to the usual ranges, facilities are provided for measuring transistor parameters such as Iceo and Hfe.
Meter movement fully protected against overloads. 3-colour mirrored scale in robust case. Supplied complete with comprehensive instructions, test leads, transistor test leads and batteries (2 x HP-7, 1 x PP3).
DC Volts: 0.1V, 0.5V, 2.5V, 10V, 50V, 250V, 1kV (20kΩ/V). AC Volts: 10V, 50V, 250V, 1kV (18kΩ/V). DC current: 50μA, 2.5mA, 25mA, 250mA. Resistance: 2k, 20k, 2M, 20Mz. AF Output: −10dB to +22dB for 10VAC (0dB 0.775V, 600Ω). Leakage (Iceo) 15μA, 15mA, 150mA. Hfe: 0-1000 (Lc/Tb). Weight: 410gms.
56-83201 14.00

RF Generator LSG17

A stable wide-range generator for the hobbyist, service technician, schools, colleges, etc. Frequency range: A/100kHz-300kHz, B/300kHz to 1MHz (Harmonics 96-450MHz) C/1MHz-3.5MHz, D/3.0MHz-11MHz, E/10MHz-35MHz, F/32MHz-150MHz. Accuracy: k1.5%. Output greater than 100mV (no load). Ext. xtal osc for 1 to 15MHz crytal. Power required: AC100, 115 or 230V 3VA. Size & Weight: 150(H) x 238(W) x 130(D)mm, 2.5Kg approx.
56-90017 115.00



Linear ICs

		Stock No.	Price
LF351	Bi-FET op amp	61-03510	0.49
LF353	Dual version of LF351	61-03530	0.81
LM380N	1W AF power amp	61-00380	1.45
LM381	Stereo pre-amp IC	61-00381	3.27
NE544	14 pin DIL servo driver IC	61-00544	1.80
NE555N	Multi-purpose low cost timer	61-05550	0.21
uA741CN	DIL low cost op-amp	61-07411	0.42
TDA1062	RF oscillator and mixer system for 1-200MHz	61-01062	1.95
TDA1083	Portable radio AM/FM audio in one IC	61-01083	1.95
HA1388	18W PA from 14V	61-01388	2.75
MC1496P	Double balanced mixer/ modulator	61-01496	1.25
TDA2002	8W into 2 ohms power amp	61-02002	1.25
ULN2283	1W max 3-12V power amp	61-02283	1.00
CA3089	FM IF amp, detector, mute, AFC, AGC system	61-03089	2.84
CA3130E	BIMOS op amp	61-31300	0.80
CA3140E	BIMOS version of 741	61-31400	0.46
MC3359	Low current dual conversion NBFM IF and det	61-03859	2.95
LM3900	Quad norton amp	61-39000	1.20
LM3909N	8-pin DIL LED flasher	61-39090	0.68
KB4412	Two balanced mixers IF amp with AGC for AM/SSB	61-04412	1.95
ICM7555	Low power CMOS version of 55 timer	61-75550	0.98
HA11225	Low noise FM IF	61-11225	1.45
HA12017	83dB S/N phono preamp 0.001% THD	61-12017	0.80
MC14412	300 baud MODEM controller (Euro/US specs)	61-14412	6.85

Selected Lines

PB2720	80dB Piezo Buzzer	43-27201	0.55
10M15A	10.7 Filter	20-10152	2.10
10M08AA	10.695 Filter	20-11152	3.49
FC177	LCD Freq. Meter	39-17700	20.00
CM161	Min LCD Clock	40-80161	8.25
BBC to Centronics Cable		03-10019	7.25
Dragon,to Centronics Connect Cable		03-10017	7.25
C12 Computer Cassette Tape		21-00012	0.55
8 x 0.3"	IC socket	28-00800	0.12
14 x 0.3"	IC socket	28-14000	0.13
16 x 0.3"	IC socket	28-16000	0.13
6V	KUIT-A Relay	46-80000	0.48
9V	KUIT-A Relay	46-80001	0.48
12V	KUIT-A Relay	46-80002	0.48
CX120P	COAX Relay	46-90120	11.96
CX520D	COAX Relay	46-90520	26.98
CX540D	COAX Relay (BNC)	46-90540	26.98

Books

Beginners Guide to Amateur Radio	02-11262	4.50
Beginners Guide to Electronics	02-04134	4.50
Active Filter Cookbook	02-21168	12.70
CMOS Cookbook	02-21398	11.85
TTL Cookbook	02-10358	11.00
Design of Active Filters	02-21539	10.15
Design of Op-amp Circuits with experiments	02-21537	9.30
Effectively Using the Oscilloscope	02-21794	9.30
The ZX Spectrum	02-00100	5.95
Practical Design of Digital Circuits	02-11831	10.45
Electronic Projects for Home Security	02-05351	3.80
Electronic Telephone Projects	02-21618	7.60
55 Timer Applications Sourcebook	02-21538	6.40
Television Engineers Pocket Book 7th Ed	02-21313	8.50
Electronics Pocket Book	02-21309	7.50
99 Practical Electronic Projects	02-21635	5.90
More Electronic Projects in the Home	02-21307	3.80
The Radio Amateurs Question and Answer Reference Manual	02-02157	5.95
Basic Programming on the BBC Microcomputer	02-06640	5.95
Using Microprocessors and Microcomputers: The 6800 Family	02-98728	11.05
Z-80 Microcomputer Design Projects	02-21682	12.70
Z8000 Microprocessor: A Design Handbook	02-37345	16.10

68000: Principles and Programming	02-21853	12.70
8085A Cookbook	02-21697	13.55
Handbook of Electronic Tables Formulas	02-21532	11.00
Popular Circuits: Ready Reference	02-04585	13.95
Semiconductor Data Book 11th Edition	02-04797	9.00

CIRCLE 26 FOR FURTHER DETAILS.

Calculating leaps.

In panic at the signs of economic decline towards the end of the '70s, Britain's main error was to put aside its reputation for individuality, eccentricity and quality. Instead we regeared our industry to compete with countries already efficiently producing mechanical/electrical/electronic goods in high volume and of acceptable quality, the best example of which is Japan. Something obviously had to be done, but to try and emulate countries with healthy economies was an oversimplified solution, certainly in the long term.

Our workforce's complex mentality — potentially a great asset — should have been a main factor in devising a solution to economic decline. But this factor, apparently complex and unpredictable, was misjudged. Mentality could, conceivably, have been ignored, but it is more likely that Government decided upon a material solution to combat economic decline and considered that the remainder of the problem was simply a matter of conveying the urgency of the problem to those responsible for implementing the solution.

Much of our mainstay, a core of highly skilled craftsmen, professional engineers and scientists, disappeared during this phase; remember the brain drain? On many counts we appear to be just about keeping our heads above water in productivity, on others we have failed disastrously. But now, the relatively sudden switch of emphasis (further panic?) to 'high technology' is causing greater problems. Trained, imaginative and intelligent workers required for the new fields are scarce, so much so that recruitment advertisements for UK high-technology employees are appearing as far afield as New Zealand, despite our own unemployment problems.

To illustrate why the decision to compete directly was a mistake, Japanese people, obviously capable of producing goods at a very high rate, work together. Each member of the team works to benefit the team rather than the individual — and is capable of working to inflexible schedules. Nothing short of self glorification suits the equivalent British worker, who is trained to try and do more than is asked for in a given time rather than to simply reach a goal before a deadline. In our education system, initiative, a term closely related to inventiveness, is all important. Tight deadlines may increase productivity in the short term, but they also inhibit creativity over a longer period. Frequent tight schedules cause the British worker, not trained to be content with being a cog in a well oiled machine, to lose will, to become resentful and eventually counter productive. Not so workers in countries renowned for productivity.

Our intrinsic desire for self glorification obviously has to be tamed but it has its advantages, especially in exploiting new concepts, as should have been clear from our now waning recognition as leaders in software and applications development. As a country faced with the prospects of economic decline, we should have put our resources into this business much earlier, rather than trying to compete with highly productive countries. We can build the machines to compete but we cannot so easily reprogram our workforce to blindly operate these machines. Short of reconditioning a large proportion of the population within a few months, we now have no alternative but to recognize and use this desire for self glorification and inventiveness which, after all, has served us well in the past.

But are we already too late again? Our prowess in software and applications development was clear all along but Government has had to wait to see other countries exploiting these resources before it decided to make a move with its belated rush into new technology. Let us hope that inventiveness suppressed in the high-productivity phase can be recovered, and more importantly that jobs created by and for new technology don't turn out to be as soul destroying as their counterparts in our production industry.

Computer for Swedish schools

A new computer, designed specifically for them, has come into use in schools in Sweden and it is expected in other nordic countries as well. Computers in School (Compis) is the Swedish equivalent of the British Micros in Schools Project but, with nordic thoroughness, they have not selected any commercially available computer but have developed one to specification drafted by the Swedish Board for Technical Development. The tender selected was submitted by Esselte Stadium, a supplier of educational materials, and is manufactured by Teli AB, the industrial division of the Swedish Telecommunication Administration, who have formed a new company for the development and marketing of the computer.

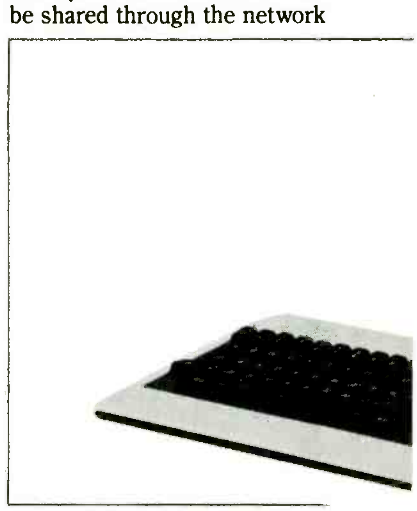
The result is the Compis, which has an impressive specification. A 16-bit computer based on the Intel iAPX 186, it can be used as a stand-alone but has been designed for multi-user networking. The eprom operating system is controlled by a separate processor. Another processor controls the graphics, independantly of the central processor. In the basic version the computer has a 128Kbyte primary memory (ram), a separate 128Kbyte video memory, 16K and 64Kbytes of eprom for system software and 16Kbytes of rom for the operating system. Total memory capacity is 1MByte and in the basic version memory is arranged as a "solid-state disc" for the storage of files without the need to access external memory. When a disc drive is fitted this section is automatically returned to normal use.

The operation system selected for school use is CP/M 86, a 16-bit version of CP/M 80. This is provided on the eprom incorporated into the 80130 (third) processor. It has the advantage of a vast supply of ready-made software. Many other operating systems can be downloaded from disc and the computer is compatible with a side range including PC—DOS, MS—DOS, Unix and Xenix, and UCSD-p which is also offered as an alternative resident operating system. UCSD-p is claimed to be a more advanced operating system primarily intended for use with the Pascal programming language but without such an extensibe base of available software as CP/M.

An interesting choice has been made for the resident computing language, Comal. It uses many of the same words and functions as Basic, but in a structured fashion similar to Pascal. It thus offers a bridge between Basic and Pascal. Comal is included in rom and is therefore instantly available. A wide range of other languages may be downloaded from disc.

All this is available to Swedish schools at a price of 10 000 Krone, equivalent to $1200US or, even at the current rate of exchange under £1000. At that price and with that specification we doubt that it will stay within Sweden for long. Norway are planning to supply it to their schools and sales are expected to other nordic nations. It is possible that it could reach a Europe-wide or even a world market.

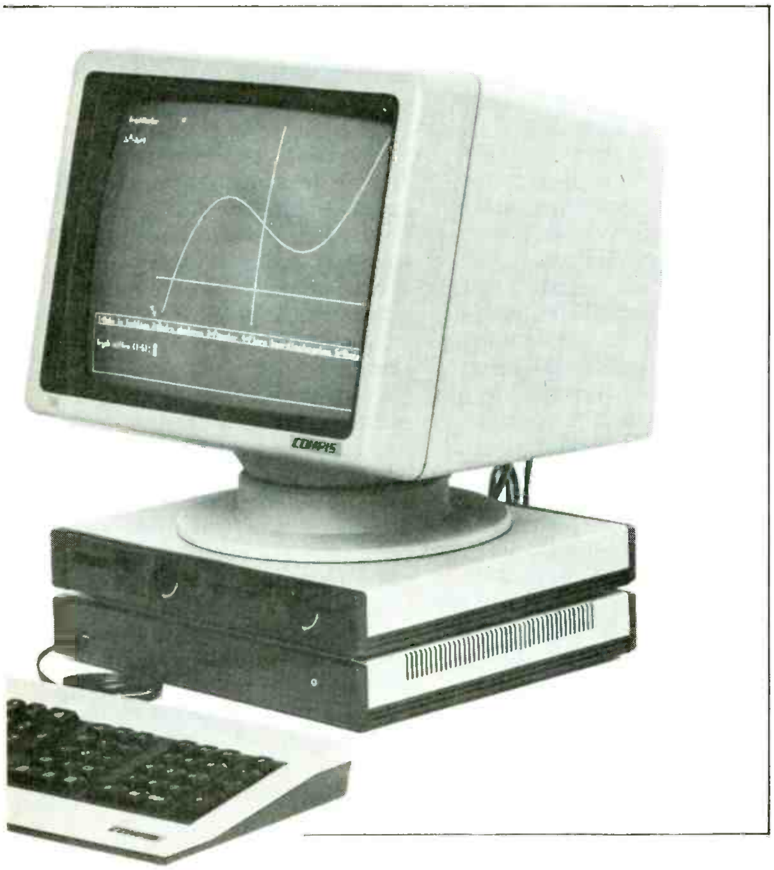
External memory can be provided on 5.25in. floppy disc, up to two double-sided double density drives, or by hard disc with 10Mbytes, expandable to 30Mbytes. This can, of course be shared through the network



system. Communication both to the outside world and to peripheral equipment is well catered for. There is an optical interface for a multi-user network system with a data transmission rate programmable up to 880Kbit/s; two V24 (RS232) interfaces, one for a serial printer and the other for a modem; a Centronics parallel printer interface; two analogue interfaces, one for a tape recorder and the other for analogue measuring devices; and connections for the disc drives.

The Intel iAPX186 processor is one of a new generation which incorporates functions that would normally fill a large p.c.b. Not content with an improved version of the 8086 processor there is also an 8MHz clock generator; two independent direct memory access (d.m.a.) channels; A communications channel operating at 880Kbit/s; programmable interrupt controls; three programmable timers; programmable logic for memory selection which can also detect the peripheral units connected and adapt the processor signalling patterns accordingly; logic to control the internal 7Mbyte/s bus; and an expansion output for co-processors, graphics and mathematics. The clock frequency of the processor is 8MHz and a real time clock is incorporated to record year, month, day, hour, minute and second with battery back-up to maintain it.

The central proessor is supported by an 82270 graphics processor which can provide colour graphics and high or ultra-high resolution monochrome graphics memory it is possible to shuttle screen images between that and the main computer memory and create high-speed animation. Each of 128 characters is displayed in a 8 by 16 or 8 by 8 dots matrix. 25 or 50 lines may be displayed and, in the ultra-high resolution mode, it is possible to show 100 lines of 160 characters; they are not very legible but the function is useful in checking the layout of a document. Text and graphics may be magnified from two to sixteen times and the magnified image can be moved in any direction with a panning function. Graphics functions include lines, arcs, circles, rectangles etc. Text and graphics may be freely mixed and the text can be written on the screen in eight different directions.



Electronic mail

A rise in postal charges has bumped up once again the cost of keeping in touch with friends and business colleagues. And even those of us who've been dozing at the back of the class are beginning to wake up, somewhat belatedly, to the possibilities of that latest wonder of the information age, electronic mail.

At the recent Personal Computer World show, Cable and Wireless treated us to a smoothly efficient demonstration of their Easylink service. "But what happens", I asked, still taking it all in, "if the people I want to talk to are not on Easylink, but on some other electronic mail system instead — Telecom Gold, for instance?"

The temperature fell noticeably. "Well, said the demonstrator, "I'm sure you'll be able to, eventually." [Inspiration!] "When they get the computer standards sorted out."

We'd always imagined that the aim of a mail service was that you could communicate with *anyone*. Other outfits seem to manage: British Telecom and Mercury Communications have had no problems of compatability, not as far as technical matters are concerned. And with the new cellular radio systems, people who buy 'phones from Racal or their rival Securicor will be free to use them over either network. So why the difficulty with electronic mail?

The history of technology is full of good ideas which might have been twice as good for a bit of standardization. And now, if you'll excuse us, this writer is going out for a book of stamps.

Oftel born out of POUNC

When BT became a public limited company a new watchdog body was formed, the Office of Telecommunications or Oftel, which has taken over the duties of the Post Office Users National Council (POUNC) in so far as they relate to telecommunications. It is a Government department established under a Director-General, who is independent of ministerial control and free, it is said, from political pressures. The first Director-General, Professor Bryan Carsberg, is an economist and accountant. He was appointed by the Secretary of State for Trade and Industry, whom he had previously advised on the liberalization of the telecommunication industry and the privatization of BT.

Professor Carsberg said recently that he would persue an active and vigilant campaign to promote the development of the telecomms industry and "enhance the effectiveness of contribution to the UK economy. I intend to be active in looking for indications of compliance with licence conditions rather than passively waiting for problems to become visible."

"In the field of consumer protection, the most effective weapon is competition. However until competition has had time to develop, we have some specific responsibilities to protect the interests of customers. We are ready to consider any dispute between BT (or any other operator) and its customers, and unlike POUNC we can take strong action to resolve an issue if the circumstances warrant it."

"Special conditions exist to protect the interests of the elderly and disabled, to prevent discrimination against rural customers, and to limit the closure of public call boxes. I expect that BT will respond to these and other conditions in positive spirit, recognising the importance of good performance to their public image; but I intend to be energetic in enforcing the conditions if necessary."

Licence- exemption proposals

Some low-power radio equipment is likely to receive exemption from radio-transmission licences according to a consultative document published by the DTI. In 1980 radio-controlled models and metal detectors were exempted, later cordless telephones. Now four other areas are to be considered; Telemetry and telecontrol for general purposes, some speech communications equipment, Doppler and field disturbance devices, and emergency alarms for the elderly.

The first category includes remote control by radio (e.g. for opening garage doors), remote relaying of measurements, non-speech communication and devices incorporating transponders, such as animal tracking devices.

Low power speech communications include radio-microphones for use in lectures and in entertainment, radio aids for the deaf and all speech devices using induction systems (e.g. for paging and for simultaneous translation at international conferences). However talk-back paging at 161MHz would still need licencing.

The third category encompasses devices which detect the presence, movement, speed or passage of people or object. These include intruder alarms, production-line counters and traffic controls, or which detect the presence of resonant circuits as are used in anti-shoplifting tags and to access control equipment.

In most cases the equipment would still be subject to Government type approval, and it is proposed that there should be a standard mark to indicate that the type approval requirements had been met and to incorporate the approval number.

The Government would also retain the right to inspect the equipment to ensure that it is correctly used and maintained, that it complies with radio regulatory specifications and to close it down in the case of undue interference.

Copies of the booklet are available from the DTI Radio Regulatory Division, Room 613 (LPD), Waterloo Bridge House, Waterloo Road, London SE1 8UA.

Simple solutions to complex problems

It may be that in some areas of endeavour, when we are looking for a complex solution to some problem, the answer is staring us in the face all the time.

Take the local area network. T.T. Farrow of Software Sciences suggested at conference that in comparison with various ring and star systems, the humble p.b.x used to switch both voice and data signals through the office extension system is as good as any. Connecting a terminal to a telephone extension through a small data/voice unit, permits both to be used and transmitted simultaneously in analogue form down the existing pairs of wires. At the p.b.x the two are separated by a similar device, with the data being routed to the host computer and the voice transmissions allowed to enter the exchange as usual. All the systems have the disadvantage of needing re-cabling.

Such a simple and elegant solution 'feels' right. It makes one wonder how often we might be looking too hard to find a simple answer.

New licence schedule

A new schedule to the amateur radio licence has been introduced, resulting from discussions between the DTI and the RSGB. The schedule is the technical supplement to the licence which lists the frequencies amateurs may use. It has now been produced in a single format to cover both Class A and Class B licencees and has been made easier to understand. Operators can see easily the frequencies they may use and their status (i.e. primary/secondary), the maximum power and the type of transmission permitted. There have been a couple of minor changes in the licence; the first reflects the transfer to the Radio Interference Service to the DTI from British Telecom, the other removes the clause referring to RTTY transmissions as these are referred to elsewhere in the schedule.

Licences are available to those who have passed the Radio Amateur Examination, Class B permits transmissions at frequencies above 144MHz. To get Class A, the operator must also pass a morse test and can then transmit on any amateur band.

In brief

A coals-to-Newcastle story is provided by the sale of power semiconductors to the Japanese Meidensha Electric Manufacturing company who are constructing a rapid-transit electric railway in Singapore. The rectifiers and thyristors to be used in the system's substations are manufactured by Westcode Semiconductors, in Chippenham, Wilts.

- The end of an era has been marked by the decision of the M-O Valve Company to cease manufacture of the Golden Lion KT88 tetrode valve. The KT77 will also be "phased out". The valves have been extensively used for many years in high-quality valve amplifiers.
- Siliconix are building a new factory in Silicon Valley for the fabrication of 6in silicon wafers. The production line will use many new techniques in the manufacture of mos i.cs including steppers to gibe accurate registration of masks, ion implantation and plasma etching. This is expected to give a much lower rejection rate and thus a higher yield.
- A new and revised edition of the *Handbook for Television Subtitlers*, prepared by the IBA Engineering Division jointly with Oracle Teletext Ltd, and the University of Southampton. About 12 hours of subtitles are available to ITV viewers each week and the book has expanded on previous editions in the light of further research and practical experience. The text has been extended with particular reference to subtitling for deaf children and to incorporate the results of experiments in the difficult area of real-time subtitling of 'live' programmes. The book is available free to broadcast organizations and to those actively concerned with film or educational applications of captions, from IBA Engineering Information Service, Crawley Court, Winchester Hants.
- BT's Research Laboratories at Martlesham Heath are involved in 14 projects which have been awarded £21m by the Alvey Directorate as part of its programme to promote new integrated-circuit technology. One goal is the production of microchips with the equivalent of a million components on each. The overall programme has been designed to research the new materials and processing techniques needed to reduce the size of individual components in i.cs and develop techniques for their interconnection on the chip. Among the methods used in getting things even smaller and consequently faster is multilevel interconnect, like a multilayer p.c.b. but of electron-microscopic size.

INDUSTRY STANDARD

Modem Filters

New Low Prices in OEM Quantities From Stock

R5630 Full-duplex 300 baud, **103** compatible filter in 16 pin DIP.

R5631 Full-duplex 200/300 baud, **V.21** CCITT compatible filter in 16 pin DIP, pin-for-pin compatible with R5630.

R5632 Full-duplex 1200 baud, **212/V.22** combo filter.

R5633 General purpose programmable filter array for full-duplex 103, V.21, DTMF and **Videotex.**

R5626 Mask programmable to your specification.

Reticon also provides a wide variety of other standard and specialised custom filters and signal processing devices using Reticon's proven NMOS Switched-Capacitor Technology.

Contact us on your needs at Chicago (312) 640-7713; Boston (617) 745-7400; Japan 03-343-4411; England (0734) 788666; Germany (089) 928-060.

EG&G RETICON®

34/35 MARKET PLACE, WOKINGHAM, BERKSHIRE RG11 2PP
Telephone: Wokingham (0734) 788666 Telex: 847510 EGGUK

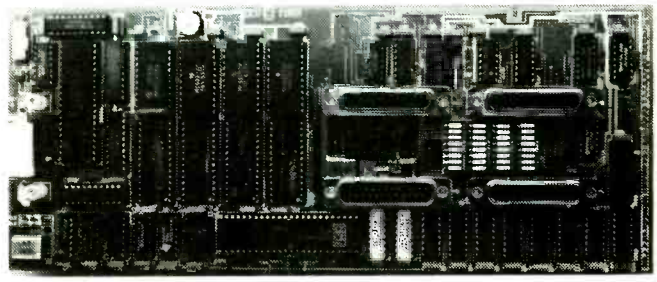
CIRCLE 71 FOR FURTHER DETAILS.

TWO NEW BOARDS FROM seed

Introducing the CB 69 and DCB 69 two new microprocessor boards

CB69

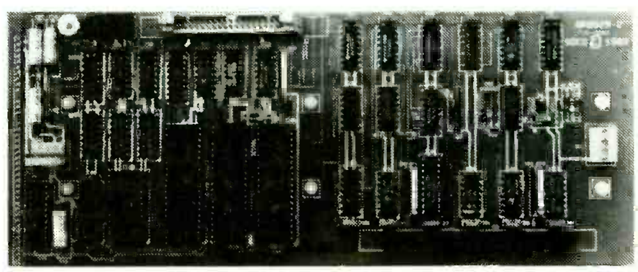
A single board microcomputer for a variety of applications.



Features include:-
6809 Microprocessor
Three serial communication ports
Real Time Clock
64K Dynamic RAM
Battery Back-up on RTC
2 Mhz Operation

DCB 69

Single board disk controller



Features include:-
Support for 4 5" Mini Floppy drives
Single or Double density
Single or Double Sided
S.A.S.I. Interface for Winchesters
Parallel interface

Software support includes:-

OS9 Level One

Editor, Assembler, Debugger
Word Processor, Basic 09, Pascal
C, Electronic Spreadsheet etc.

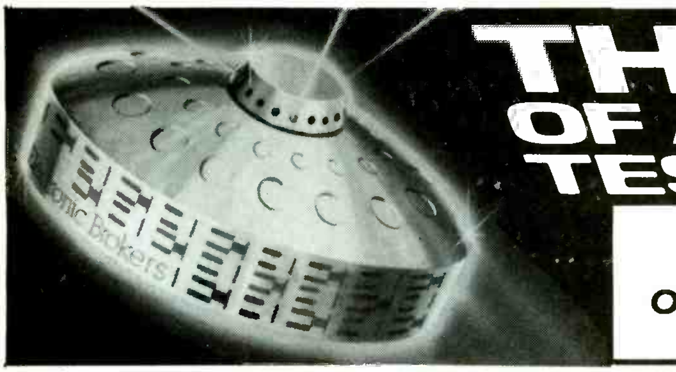
DOS 69

Editor, Assembler, Basic

The CB 69 and DCB 69 can be plugged together to form a small compact unit for under £500

For further information contact:-
SEED
Portland House
Coppice Side
Brownhills
Walsall
West Midlands WS8 7EX

CIRCLE 50 FOR FURTHER DETAILS.



THE SOURCE OF ALL GOOD USED TEST EQUIPMENT

SAVE up to 50%

ON SUPERLATIVE USED TEST EQUIPMENT

Calibrated to Original Specs

OSCILLOSCOPES

TEKTRONIX 7000 SERIES

7104 1GHz Oscilloscope Mainframe 10mV/div 350ps Risetime (MLP ~~£21,135~~) **£16,500**

7313 opt 01 25MHz Bistable Storage Oscilloscope Mainframe 4,9cm/μs Stored Writing Speed (MLP ~~£4,932~~) **£2,225**

7603 100MHz Oscilloscope Mainframe (MLP ~~£2,712~~) **£1,950**

7633 100MHz Storage Mainframe (MLP ~~£7,794~~) **£4,950**

7704A 200MHz Oscilloscope Mainframe (MLP ~~£4,278~~) **£2,950**

7834 400MHz Fast Multimode Storage Oscilloscope Mainframe 2500cm/μs Stored Writing Speed (MLP ~~£12,273~~) **£9,850**

7904 500MHz Oscilloscope Mainframe (MLP 7904A ~~£8,709~~) **£6,950**

7000 SERIES PLUG INS

7A11 Fet 250MHz Amp (MLP ~~£2,669~~) **£1,600**

7A19 600MHz S T Amplifer (MLP ~~£2,422~~) **£1,600**

7A26 200MHz D T Amplifier (MLP ~~£1,917~~) **£1,325**

7B53A 0.05μS D Timebase (MLP ~~£1,434~~) **£985**

7B80 10nS Timebase (MLP ~~£1,405~~) **£960**

7B85 10nS Delay Timebase (MLP ~~£1,609~~) **£925**

7B92A 0.5nS D Timebase (MLP ~~£3,327~~) **£2,000**

HEWLETT PACKARD

1715A-01 200 MHz Oscilloscope (MLP ~~£3,568~~) **£2,450**

1740A 100MHz Oscilloscope (MLP ~~£2,028~~) **£1,450**

1741A 100MHz Storage Oscilloscope (MLP ~~£4,878~~) **£3,250**

1744A 100MHz Storage Oscilloscope (MLP ~~£5,677~~) **£3,000**

PHILIPS

PM3232 10MHz True Dual Beam Oscilloscope **£495**

PM3244 50MHz 4 Trace Oscilloscope **£1,500**

TEKTRONIX

212 Miniature 500KHz D T Battery Oscilloscope (MLP ~~£1,746~~) **£850**

434 opt 01 25MHz D T Storage Oscilloscope (MLP ~~£5,459~~) **£2,350**

464 DMM44-04-05 100MHz Storage (Unused) (MLP ~~£5,916~~) **£4,650**

475 200MHz D T Oscilloscope (MLP ~~£4,104~~) **£2,650**

475A 250MHz D T Oscilloscope (MLP ~~£4,453~~) **£3,300**

LOGIC ANALYSERS

FLUKE

3010A Programmable PCB Logic Tester (MLP ~~£19,153~~) **£8,000**

HEWLETT PACKARD

1611A Microprocessor Logic Analyser **£2,950**

A80 Personality Module for 8080 Microprocessors (for use with 1611A) **£950**

TEKTRONIX

7D02 opt 01 Microprocessor Analyser Up to 52 Channels (MLP ~~£7,144~~) **£3,950**

DAS 9103 opt 01 & 02 Logic Analyser 32 Channels at 25MHz or 8 Channels at 100MHz with 16 Channels Pattern Generator (MLP ~~£18,018~~) **£7,500**

SIGNAL ANALYSERS

HEWLETT PACKARD

141T + 8552B + 8555A Spectrum Analyser 10MHz-18GHz (MLP £16,562) **£12,750**

3580A Spectrum Analyser 5Hz-50KHz **£3,250**

TEKTRONIX

7L5 opt 25 and L3-01 20Hz-5MHz Spectrum Analyser with Tracking Generator (MLP ~~£13,071~~) **£7,800**

TR502 Tracking Generator for 7L12, 7L13, 7L14 (MLP ~~£6,332~~) **£3,000**

TR503 Tracking Generator for 492 or 496 (MLP ~~£6,332~~) **£4,250**

TEKTRONIX TM500 & TM5000 SERIES

DC5009 Programmable counter/timer identical to DC509 + GPIB (MLP ~~£2,014~~) **£1,500**

DD501 Digital Delay Delay to 99,999 events (MLP ~~£1,155~~) **£775**

FG501 Low Frequency Function Generatar, 0.001Hz to 1MHz sine, square, triangle, pulse and ramp **£375**

FG502 Function Generator 0.1Hz to 11MHz sine, square, triangle. Pulse and ramp to 1.1MHz (MLP ~~£773~~) **£565**

FG503 Function Generator 0.1Hz to 3MHz sine, square and triangle (MLP ~~£528~~) **£400**

PG501 Pulse Generator 5Hz to 50MHz 20nsec to msec pulse period (MLP ~~£639~~) **£300**

PG505 Pulse Generotor 10Hz to 100KHz pulse width 5 nsec to 0.5 sec (MLP ~~£864~~) **£450**

PG507 Dual Output Pulse Generator 5Hz to 50MHz (MLP ~~£1,936~~) **£1,200**

PG508 Pulse Generator 5Hz to 50MHz pulse width 10 nsec to msec (MLP ~~£1,904~~) **£1,250**

RG501 Ramp Generator 10μs to 10s ramp duration 10V gate out, TTL compatible **£400**

SC501 5MHz Single Channel Plug-in Oscilloscope 10mV sensitivity, occupies single TM500 series compartment (MLP ~~£1,166~~) **£500**

SC502 15MHz Dual Channel Plug-in Oscilloscope 1mV/div sensitivity, 20ns/div calibrated sweep Occupies two TM500 series compartments (MLP ~~£2,131~~) **£900**

SC504 80MHz Dual Channel Plug-in Oscilloscope 5mV/div sensitivity, 5ns/div calibrated sweep, true X-Y capability (MLP ~~£2,690~~) **£995**

SG502 Low Distortion Signal Generator 5Hz-500KHz (MLP ~~£776~~) **£525**

SG503 Signal Generator, 250KHz to 250MHz with 3 digit counter (MLP ~~£1,916~~) **£1,250**

SG504 Signal Generator 245MHz-105MHz (MLP ~~£3,197~~) **£1,250**

SG505 Oscillator 10Hz to 100KHz sinewave Ultra-low distortion — 0.0008% THD (MLP ~~£696~~) **£400**

TG501 opt 01 Time Mark Generator (MLP ~~£2,213~~) **£1,450**

TEKTRONIX TV TEST EQUIPMENT

R148/148 PAL Insertion Test Signal Generator (MLP ~~£6,266~~) **£4,400**

DISPLAYS

HEWLETT PACKARD

1332A High Resolution X-Y Display 9.6 x 11.9cm Display Area option 216 (TTL Blanking and Analog Z Mod) and option 330 (covers Feet etc. to Medical Standards) (MLP ~~£2,190~~) **£1,250**

SIGNAL SOURCES

HEWLETT PACKARD

214A Pulse Generator to 1MHz Double Pulse Mode 100V, 200 watts output **£950**

612A UHF Signal Generator 450-1250MHz **£1,100**

618C SHF Signal Generator 3.8-7.6GHz (NEW CONDITION) (MLP ~~£8,405~~) **£4,000**

8004A Pulse Generator 20MHz **£450**

8011A opt 001 Pulse Generator 20MHz with Pulse Burst 16V output (MLP ~~£1,079~~) **£695**

8013B Pulse Generator 50MHz with variable Transition Time (MLP ~~£1,238~~) **£750**

8403A Modulator with option 004 8732B Pin Modulator 1.8-4.5GHz (MLP ~~£1,902~~) **£1,000**

8620C Sweeper Mainframe (MLP ~~£3,076~~) **£2,100**

86240B Sweeper Plug In 2-8.4GHz (MLP ~~£6,152~~) **£4,200**

86260A Sweeper Plug In 12.4-18GHz (MLP ~~£4,195~~) **£3,600**

8640A AM/FM Signal Generator 0.5-512MHz (MLP ~~£7,191~~) **£2,750**

8690B Sweeper Mainframe **£2,000**

8698B Sweeper Plug In 0.4-110MHz **£1,000**

8601A Sweeper 100KHz-110MHz **£1,950**

MARCONI

TF2015 AM/FM 10-520MHz (MLP ~~£2,175~~) **£1,450**

TF2015/2 AM/FM 10-520MHz (NEW CONDITION) (MLP ~~£2,175~~) **£1,350**

TF2120 Waveform Generator Sine, Square, Triangular and Ramp o/p Waveforms 0.0008Hz-100KHz **£850**

TF2169 Pulse Modulator 10-520MHz for use with TF2015, TF2016 and other generators **£200**

TF2170B Synchronizer for TF2002B **£500**

TF2171 Synchronizer for TF2015 (NEW CONDITION) (MLP ~~£1,540~~) **£975**

TF2173 Synchronizer for TF2016 **£600**

6058 Signal Generator 7-12.5GHz **£850**

TEKTRONIX

284 70pS Pulse Generator (MLP ~~£1,977~~) **£950**

GENERAL EQUIPMENT

AVO

Model 8 (various versions) **£80-£85**

BIRD

4311 Peok Power Meter (MLP ~~£540~~) **£300**

BRYANS SOUTHERN

29300 A4 Size
X-Y Ranges: 0.25mV to 10V/cm in 10 Ranges
Slew Speed: 70cm/second
Timebase: 0.1 to 50sec/cm in 9 Ranges
(MLP ~~£1,637~~) **£1,000**

26001 with 2 x 26116 Amplifiers and 26201 Timebase.
A4 Size
X-Y Ranges: 50μV to 10V/cm in 17 Ranges
Slew Speed: 150cm/second
Timebase: 0.05 to 50sec/cm in 9 Ranges
(MLP ~~£2,661~~) **£1,400**

26001 with 2 x 26116 Amplifers and 26202 Power Unit instead of Timebase (MLP ~~£2,443~~) **£1,250**

FLUKE

887AB AC/DC Differential Voltmeter (MLP ~~£3,044~~) **£1,950**

8921A DVM Wideband, autoranging True RMS Readout in volts or dB. Bandwidth 10Hz-20Mhz (MLP ~~£1,326~~) **£695**

893A AC/DC Differential Voltmeter **£750**

931B Differential Voltmeter. TRUE RMS **£1,000**

HEWLETT PACKARD

427A Analogue AC/DC/Ohm Meter (MLP ~~£810~~) **£495**

467A Power Amplifer DC-1MHz **£725**

4815A RF Vector Impedance Meter **£3,850**

7040A X-Y Recarder 1V/Inch (MLP ~~£1,882~~) **£850**

HEWLETT PACKARD MICROWAVE ACCESSORIES

P382A Attenuator 12.4-18.0GHz (MLP ~~£1,100~~) **£425**

X382A Attenuator 8.2-12.4GHz (MLP ~~£1,100~~) **£425**

423B Crystal Detector 0.01-12.4GHz (MLP ~~£219~~) **£165**

J752C Directional Coupler 5.85-8.2GHz **£600**

J910A Termination 5.3-8.2GHz **£175**

11692D Dual-Directional Coupler 2-18GHz (MLP ~~£2,025~~) **£1,500**

11720A Pulse Modulator 2-18GHz (MLP ~~£2,650~~) **£1,950**

MARCONI

CT596 (6460/1) Wattmeter 10MHz-18GHz. 0.3μW-10mW. Extended to 1W with 6534/4. 20db attenuator **£1,500**

TF1313A LCR Bridge 0.1% (MLP ~~£1,470~~) **£775**

TF2333 MF Trans Test Set **£850**

2438 Counter/Timer DC-520MHz (MLP ~~£908~~) **£795**

RACAL

Store 4DS FM Taperecorder **£3,950**

Store 7DS FM Taperecorder **£6,150**

9919 opt 04A Counter. 8 digit, 10Hz-1.1GHz (MLP ~~£870~~) **£525**

TEKTRONIX

1503 TDR Cable Tester (MLP ~~£4,931~~) **£3,000**

1503 Option 04 TDR Cable Tester with Recorder (MLP ~~£5,987~~) **£3,500**

2701 Attenuator 50Ω 0.79db in 1 db steps (MLP ~~£590~~) **£295**

OF150 Fibre Optic TDR. CRT display and built in recorder. Resolution to 0.1dB/Meter (MLP ~~£15,545~~) **£12,000**

ADD 15% VAT TO ALL PRICES
Carriage and Packing extra
Trading Conditions Available on request

Electronic Brokers Ltd., 140/146 Camden Street, London NW1. Tel 01-267 7070

CIRCLE 78 FOR FURTHER DETAILS.

Anglia Industrial Auctions

Specialist Auctioneers to the Radio and Electronic Industry

NEXT SALE OF OVER 700 LOTS WILL BE HELD ON OCT. 17th 1984
THE LOTS BELOW WILL BE OFFERED FOR SALE UNLESS PREVIOUSLY SOLD

NEXT SALE OF OVER 700 LOTS WILL BE HELD ON NOV. 21st 1984
THE LOTS BELOW WILL BE OFFERED FOR SALE

Including: 35 Tektronix Oscilloscopes Type RM45, 130 Valves Type 4CX300A with Bases, 6 Tektronix Oscilloscopes Type 545, 50 Tektronix Plug-ins, 6 Tektronix Oscilloscopes Type 585, 7 Tektronix Oscilloscopes Type 551, 7 Telequipment Oscilloscopes Type S 54 B, Tektronix Storage Display Unit Type 661, Tektronix Hard Copy Unit Type 4601, 5 Roband Oscilloscopes Type R050A, 16 Tektronix Calculators Type 31, 12 Airmec Modulation Meters Type 210, 6 Radiometer AM/FM Signal Generators Type MS27g, 3 Marconi FM Signal Generators Type TF 1066B, 4 Marconi RC Oscillators Type TF1101, Eddystone Receiver Type 770 S, 7 Electrohome Video Monitors, 5 Pye Base Stations Type F27 AM, 42 Pye Vanguards Type AM25, 15 Pye UHF Signal Generators, 8 19" Video Monitors, 8 Marconi Signal Generators Type TF 995 B/5, 30 Marconi Signal Generators Type TF 995 A/5, 27 Pye Aerial Tuner Units Type ATU 4, 38 Marconi Signal Generators Type TF 1064, 20 Marconi Tx & Tx Output test Sets Type TF 1065, 60 Grundig Stenorettes, 350 Pye PF1 UHF Receivers, 350 Garrard Car Cassette Player Mechanisms, 450 2ft. Dexion Shelves, Rank Xerox 1385 Photocopier Camera with spares & Service Manuals (This is the original Xerox Machine), 500 Kg Scrap Printed Circuit Boards (Gold Plated).

5 STATION ROAD, LITTLEPORT, CAMBS. CB6 1QE. Phone ELY (0353) 860185

CIRCLE 46 FOR FURTHER DETAILS.

COMPUTER APPRECIATION

16 Walton Street, Oxford OX1 2HQ -
Tel: Oxford (0865) 55163

IBM PERSONAL COMPUTER Model XT. With single floppy & 10MB Winchester. AS NEW £2950.00

UNITRON Model 2200 microcomputer. APPLE II/e & CP/M compatible machine with 6502 & Z80 processors, 64kbyte memory, detached keyboard with numeric pad & floppy disc interface. BRAND NEW & BOXED £350.00

SHARP Model PC3201 MICROCOMPUTER SYSTEM comprising, 8085-based processor with 64bytes, monitor, dual 5¼" disc drives, Model CE322P (Epsom) printer & operating system £650.00

MICRO V Model Microstar I microcomputer system. 8085 based with 64 kbytes, dual double sided, double density 8in disc drives, 3 serial interfaces & LEAR SIEGLER Model ADM 31 VDU £550.00

ROCKWELL AIM 65/40 single board 6502 development system with display, keyboard, power supply & cassette recorder £525.00

FACIT Model 4070 PAPER TAPE PUNCH. BRAND NEW £350.00

PERTEC Model PCC2000 COMPUTER/WORD PROCESSING SYSTEM. Comprising, 64kbyte 8085 based processor with green 24 × 80 display, detached keyboard with numeric & function keypads, twin 8" double or single density floppy disc drives (IBM compatible), RS232 & Centronics interfaces, NEC Model 5500 Spinwriter (55cps daisy wheel printer). Software included in the price — CP/M, WORDSTAR, BASIC, DATASTAR etc. BRAND NEW £1,100.00

DICOLL LSI11 SYSTEM comprising, processor with 64bytes, BA11 backplane & PSU (DEC manufactured), DLV11J quad serial interface, dual PERTEC double density floppy disc drives. Contained in compact, attractive portable box. Software includes RT-11 & many interesting bits & pieces £750.00

OLYMPIA BOSS MICROCOMPUTER. Small Z80 based business system with 80 col. screen, 64kbyte memory, twin 5¼" floppy disc drives, HONEYWELL Model L32 120cps matrix printer £550.00

TRANSAM 'TUSCAN' S100 MICROCOMPUTER Z80 based machine with 64kbytes of static RAM, twin 5¼" floppy disc drives, NEC green phosphor monitor, RS232 & 8 bit parallel interfaces. S100 software includes CP/M etc. £750.00

VISUAL Model 200 VDU. 24 × 80, 9600 Baud etc. with slow scrolling. Externally accessible switches configure for VT52, ADM3A, ADD S520 or HAZELTINE 1500 compatibility. Currently listed at £850 .... £250.00

PHILIPS Model P2121 daisy wheel printer (TEC 'Starwriter'). RS232 interface, DIABLO compatibility, 25cps bidirectional printing. In good ex-demo condition. £250.00

CBM Model 8027 daisy wheel printer (Olympia 'Scripta') for PET. 25cps, IEEE interface. BRAND NEW £250.00

CBM Model 8024 high speed matrix printer (Tally 1200) for PET. IEEE interface. BRAND NEW £250.00

MANNESMANN/TALLY Model M80MC matrix printer. With microprocessor control, 200cps bidirectional printing with U/L case, self test. Compact but heavy duty machine. BRAND NEW & BOXED £125.00

CENTRONICS Model 730-2 matrix printer £95.00

CENTRONICS Model 702 matrix printer. 132col. 165cps. bidirectional printing with self test. In good ex-demo condition. £225.00

CENTRONICS Model 779 matrix printer. Similar to above but 80 col. £95.00

DEC boxes & power supplies. Various models available (BA11MF, SB11AA, BA11LX) all with 22 bit addressing or easily modified & with various optional processors etc. .... P.O.A.

ITT Model 3510 TELEFAX Facsimile transmitter/receiver. Microprocessor controlled (8085) CCITT Group 2 machine for transmitting documents over an ordinary phone line. BRAND NEW & BOXED .... £350.00 or £600.00 per pair

IBM Golfball printer with Z80 controlled IEEE interface for PET. 15cps & takes standard range of heads. (Complete with head) £120.00

TEKTRONIX Model T932A 35MHz double beam portable oscilloscope. £275.00

TEKTRONIX Model 4601 hard copy unit for 400 series graphics terminals £95.00

TEKTRONIX Model 611 graphics storage display. For use with any DAC computer output £150.00

FACIT Model 4020 high speed paper tape reader. Parallel TTL interface £225.00

Please note: • VAT & Carriage extra on all items • Visitors by appointment, please. • Technical manuals are available from us for many items stocked.

CIRCLE 70 FOR FURTHER DETAILS.

VIDEO TERMINAL BOARD

★ 80 characters × 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 × 9 matrix with descenders) in two 2716 EPROMs. Full scrolling at 9600 baud with 8 switch selectable rates. RS232 interface.

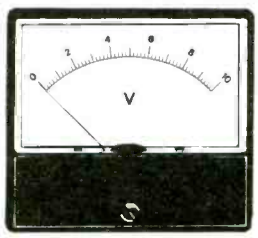
Bare board with 2 EPROMS and program listing — £48 plus VAT. Assembled and tested — £118 Send for details or CWO to:

AM ELECTRONICS

A M Electronics
Wood Farm, Leiston, Suffolk IP16 4HT
Tel: 0728 831131

CIRCLE 38 FOR FURTHER DETAILS.

METER PROBLEMS?



137 Standard Ranges in a variety of sizes and stylings 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 9 FOR FURTHER DETAILS.

Microcomputer-controlled cassette recorder

by A.J. Ewins

The series concludes with two articles describing software structure

In this part, I propose to outline the overall structure of the software developed to control the solenoid-operated cassette deck. I have developed a machine-code program to run on my own 6502 based computer. Using a number of new Basic words the routines of my m/c program are accessed and carried out, always returning to Basic upon completion of the routine. In addition to describing the overall program in general terms I shall discuss, in detail, a number of the subroutines designed to control the mechanical operation of the cassette deck.

My UK101 microcomputer has been considerably modified and augmented, using various enhancements produced by Premier Publications. In particular it uses their CIGMON X monitor chip, improved versions of the Basic 1, 3 and 4 chips and their new Basic 5. Most importantly, from their 6502 assimbler disassembler chip, ENCODER, which enables me to write m/c programs in a form of simplified assembly language, greatly simplifying the compilation of a m/c program, The various subroutines presented are written in ENCODER'S assembly language There are differences fro the more normal type of assembly language and where these need explanation I do so.

Interfacing the program to Basic

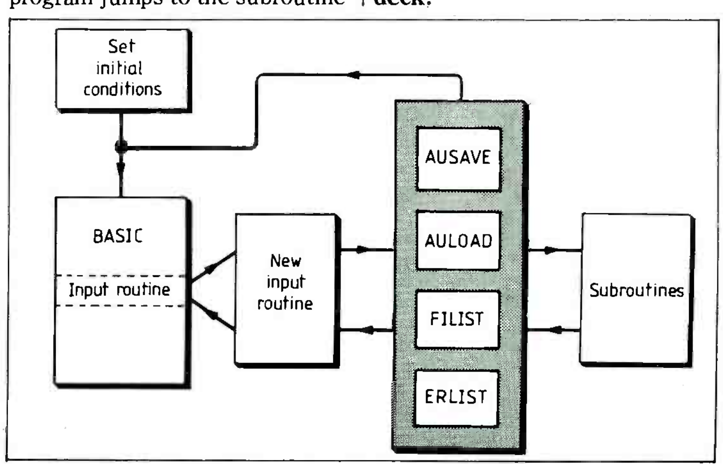
The ease with which the operation of the cassette deck can be controlled by the microcomputer depends very much upon how the Basic list of command words can be extended. Fortunately, in the UK101, all inputs from the keyboard are handled by the Basic interpreter through an input routine which is accessed via a vectored address held in ram. The input routine is peculiar to the type of computer and is therefore handled by the Monitor chip. However, instead of jumping from Basic direct to the Monitor chip, the instruction given is an indirect one, i.e. JUMP to the address location stored at *another* address location. In the UK101, the instruction given is JMP ($0218), where $0218 is a location in ram which, together with the next memory address, $0219, normally contains the address of the Monitor chip's input routine $FB46. Because the address of the input routine is contained in a ram address the computer programmer is quite at liberty to modify the values contained at those locations, substituting the address of his *own* 'input' routine. Using this technique I can arrange for the computer to look and check for four new Basic words, AUSAVE, AULOAD, FILIST, and ERLIST when a Basic command is typed-in from the keyboard. If none are found, the control is handed back to Basic interpreter which then checks its own list of command names. If, however, one of the new words is found, then the computer jumps to a routine to handle that command.

The overall structure of the program is shown in Fig. 1. An initial m/c routine is accessed, which sets up initial conditions and includes writing the address of the 'new input routine' at the input vector addresses. The initial routine then exists to Basic (UK101, warm start). Subsequent keyboafe entries from Basic are handled by the 'new input routine'. Upon receipt of a carriage-return the 'new input routine' looks for one of the four new Basic words, accessing one of the four new routines, if found. Each of the four has access to various subroutines which control the mechanical functions of the cassette deck among other things. Each may 'return' to Basic through the new input routine, or 'jump' directly back to Basic.

New input routine

I have listed, in ENCODER's assembly form, the m/c program of the new input routine (:INPR) and its subroutine 'Find' (:FIND). The old input routine at $FB46 is a subroutine which accepts the character written from the keyboard and stores it in the Basic buffer line, and also retains it in the accumulator (the A-register) of the 6502. The new input routine thus first uses the old routine, then checking whether the character stored in the accumulator is a carriage-return. If not, it returns the program control to the Basic interpreter which awaits another character to be input from the keyboard, If the character is a carriage-return, then the value of the X-register is temporarily stored at address $02FF and a 'space' character is added to the end of the Basic buffer line which, in the UK101, starts at $13 and is indexed by the X-register. The value of X is thus an indication of the length of the buffer line and the program jumps to the subroutine

Fig.1. **Block diagram of program to control cassette deck.**

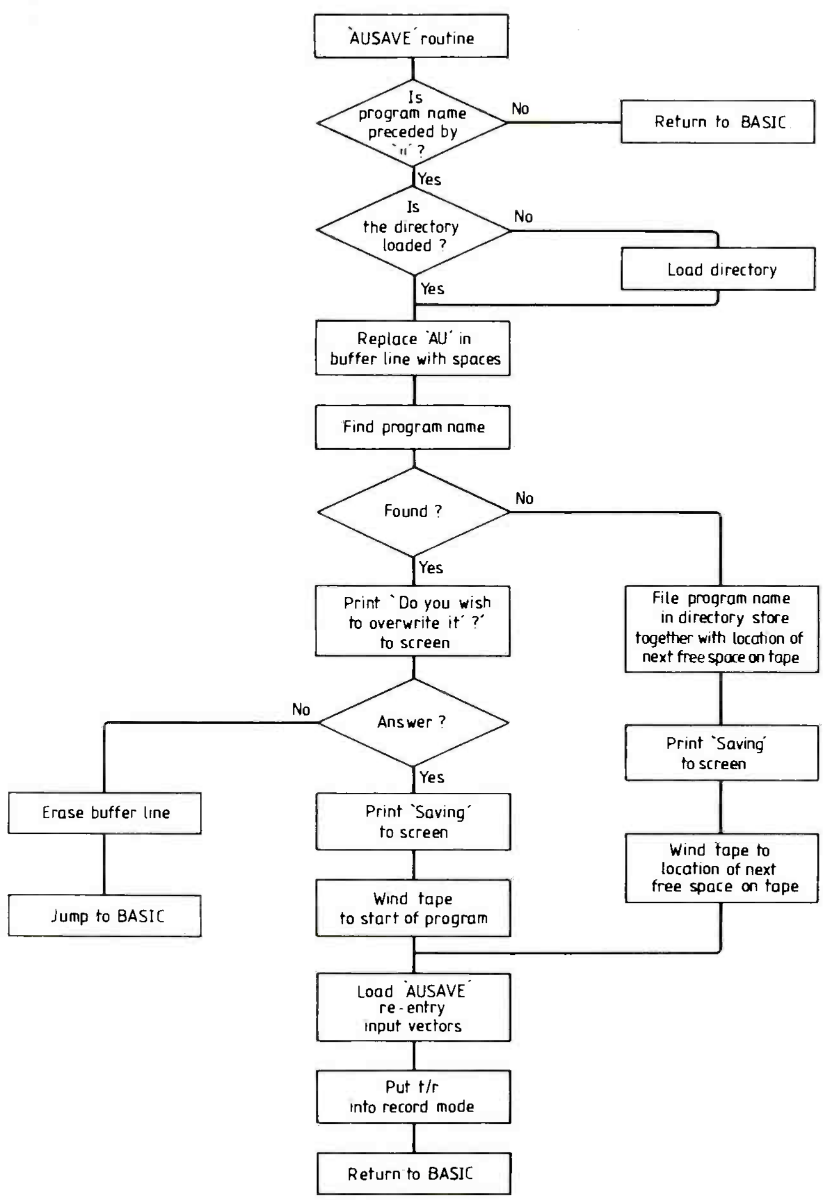


:FIND. Upon returning from :FIND the temporarily stored value of X is returned to the X-register, the accumulator reloaded with carriage-return and the program returned to the Basic interpreter.

The subroutine :FIND compares the word in Basic's buffer line with a list of new words stored in the subroutine :FIND at the location labeled :WORD. Inverted commas are used to indicate to ENCODER to, 'sore the ASCII values of the following text in the immediately following memory locations'. The address locations of the four routines associated with the four new words are stored in the routine starting at the location labelled :JUMP. To the ENCODER, #:LOAD means, 'store the address of the routine labelled ':JUMP; list *must* be in the same order as the new BASIC words separated from the next by the 'asterisk' character and the list is terminated by the 'hash' character. The list may contain any number of words of any length (up to that of the buffer line!) and the list of :JUMP addresses may be added-to, but, remember, there *must* be a :JUMP address for *every* new word.

The subroutine :FIND works by comparing the word stored in Basic's buffer line with the list of new words, starting at the beginning. A 'jump index' is given the initial value of zero and is incremented by two every time a new word 'fails' the comparison. If a comparison is found then the 'jump index' is transferred to the X-register. The JUMP address of the routine selected is determined by indexing the list of JUMP addresses from the :JUMP label with the X-register. The high and low bytes of the JUMP address are transferred to zero-page addresses, $EE & $EF, and the routine is finally accessed by the statement JMP ($EE).

Fig.2. **AUSAVE routine logic flow-chart**



New routines

The four routines, AUSAVE, AULOAD, FILIST and ERLIST are shown only as flow-diagrams in Figs 2 to 5. In the UK101, using the new Basic 4 chip supplied by Premier Publications, it is possible to SAVE and LOAD named files using the following formats:

1. SAVE
2. SAVE "program name"
3. SAVE"
4. LOAD
5. LOAD "program name
6. LOAD "program name"
7. LOAD""
8. LOAD"
9. LOAD?"

1 Formats 1 and 4 are the same as normal SAVE and LOAD commands; they are not used in the automatic mode;
2 saves the program to tape with the specified program name, which may be up to 32 characters long;
3 saves the program in a format designed to prevent illegal use by another computer user (it can only be loaded using the syntax LOAD"");
5 loads, but does not automatically run the named program from tape;
6 loads *and* automatically runs named program from tape;
7 loads and runs the first program found;
8 loads but does not run the first program found;
9 compares a program on tape with that currently in the computer's memory. The resident program is retained. The command is used to verify a program on tape directly after it has been saved.

In writing routines to handle the new words AUSAVE and AULOAD, I have allowed only some of the above formats:

AUSAVE "program name"
AULOAD "program name"
AULOAD "program name"
AULOAD?
AULOAD""

If AUSAVE, AULOAD, AUSAVE" or AULOAD" are typed, the new routines have been designed to return a syntax error. However, in the case of AUSAVE "program name", it does not seem to matter whether the last set of inverted commas are included or not.

Although the length of the program name, using the UK101's new Basic 4 chip, may be as long as 32 characters, under automatic control I have limited it to 6 characters. This results in a much tidier format when the directory (or File List) is displayed on the screen.

Apart from AUSAVE and AULOAD, two other Basic words are used in the control program, FILIST and ERLIST. The FILIST command is used to display the directory on the screen so that the list of programs (held in the directory) may be viewed. The format produced by the FILIST command is a row of four program names (together with electronic counter values indicating their location on the tape cassette) with each row separated by a blank row. ERLIST is similar to the FILIST command in that it also display the list of stored programs, but in this case the format is simply a column of program names. Having listed out the program names, the operator is invited to, 'Erase last Program?'. Any reply other than 'Y' from the keyboard exists from the routine back to the Basic interpreter. If 'Y' is typed, the programs are relisted as before but with the last program erased from the list. The invitation to 'Erase last Program?' is repeated. The program whose name has been erased from the list is not irrecoverably lost until the directory is saved anew on the tape. Reloading the directory, stored at the beginning of the cassette tape, will reinstate the 'erased' program or programs. All that the ERLIST command does is to reassign the position of the 'next free space' on the tape to the position immeniately before the 'erased' program. Using this technique, the last recorded program may be effectively erased from the directory and a new one recorded in its place.

To be able to save and load programs to and from a tape cassette automatically, it is essential to know what programs are stored on the tape. The information is held in the directory which is always stored at the beginning of the cassette. In order that the directory can be loaded from and saved to the tape cassette without interfering with the Basic program held in the computer's memory, I have written a special m/c routine. When loaded from the tape, the directory is placed in a reserved area of ram not used by the computer's program. Ten characters are required to store a program name, together with its electronic counter value. Thus 512 bytes of ram can hold up to 51 program details, which should be more than enough record space for a C60 cassette.

No specific command is required to load the directory when a new cassette placed in the tape deck. By linking the 'cassette-in-position' microswitch on the tape deck to the CB1 input of a 6522 v.i.a. chip (see Fig.2 of first part of the article), the computer is able to determine when a cassette is removed and a new one placed into the tape deck. When either of the four new basic commands are entered from the keyboard, each of the four routines checks to see whether the directory has been loaded. If it has not, it is immediately loaded into its reserved ram location. Unless the cassette is subsequently removed or replaced with another, there is no further need to reload it.

Ausave

Figure 2 is a flow-diagram of the logic of the AUSAVE routine. The command AUSAVE 'program name' enters the routine as previously described, the first check merely establishing the correct syntax to ensure that the program name is read correctly. The next check determines whether the directory is already loaded or not and loads it if not. The characters 'AU' are now from the command held in Basic's buffer line, so that

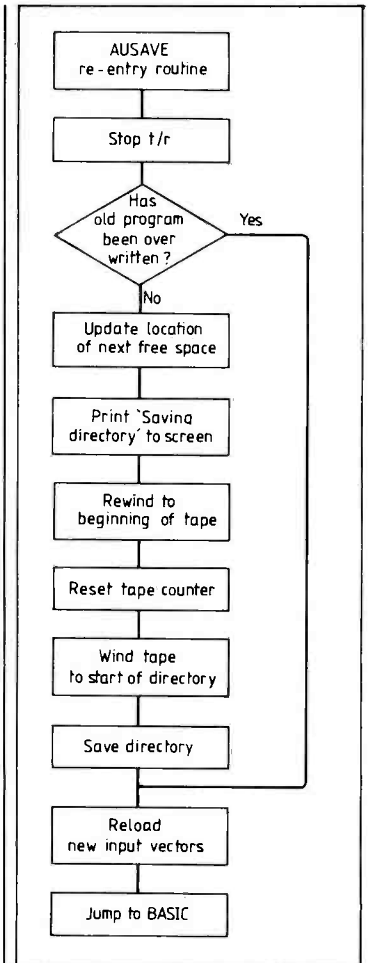
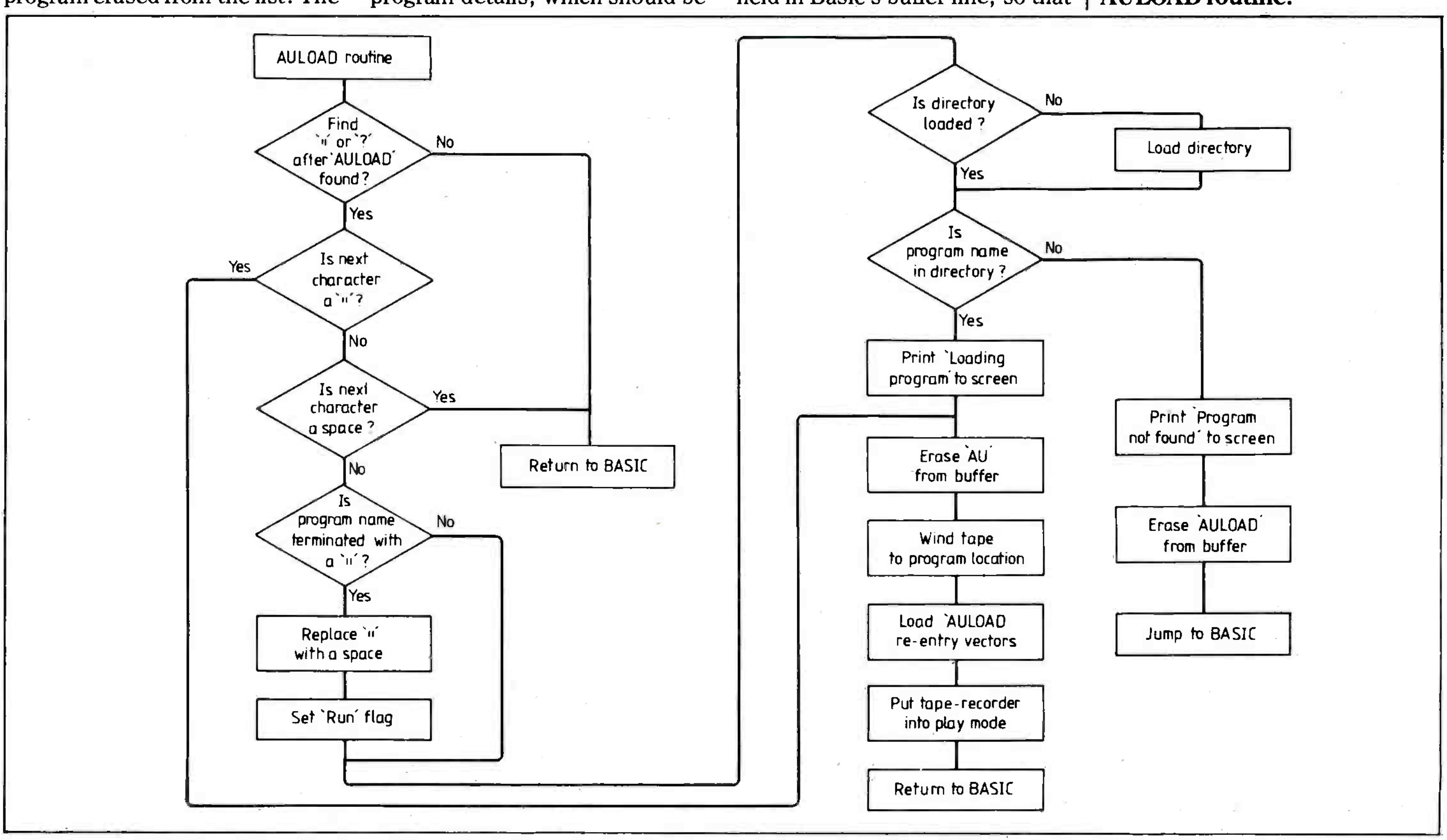


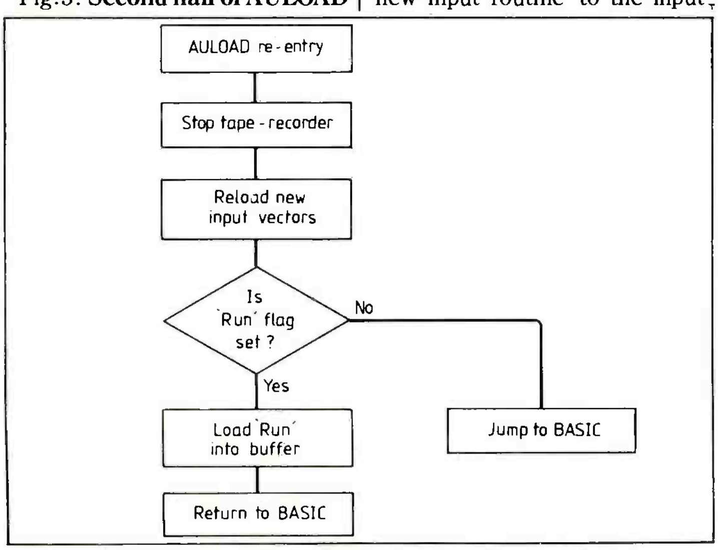
Fig.3. **Second half of AUSAVE routine hand back to Basic when deck is in record mode.**
Fig.4. **Flow-diagram of AULOAD routine.**



when control is handed back to the interpreter, Basic sees the command, SAVE 'program name' in the buffer line. When SAVEing a program under automatic control it is obviously important not to use the same name twice. The next check prevents this from happening. However, if the program name has already been used, the opportunity is given to overwrite the existing program (no matter where it is located) by the new one of the same name. This technique can be useful in updating an old program, but care must be taken to ensure that the length of the new program is not greater than the old one, or the program following it on the tape may be corrupted. If the program name has not been used before, then it is added to the directory together with the electronic counter value of the 'next free space' on tape: the tape is then wound to this position.

Before placing the tape deck into its RECORD mode the address of the start of the second half of the AUSAVE routine shown in Fig.3 is placed into the input routines vector location. With the tape-recorder running in its RECORD mode, this half of the AUSAVE routine hands control back to the basic interpreter, which sees the command SAVE 'program name' in its buffer line and therefore SAVEs the named program in the normal way. Once the program has been saved the Basic interpreter returns to its 'input routine'. As a result, it is immediately vectored to the second half of the AUSAVE routine. The first function of this half is to stop the tape-recorder. If an old program has been overwritten, then there is nothing more to do but reassign the address of the 'new input routine' to the input routine vectors and return to the Basic interpreter. If, however, a new program has been SAVEd then the 'next free space' value must be updated. This is done by reading the current value of the electronic counter and adding a little to its value so as to clear the end of the last program by a comfortable margin. The details of the directory stored on tape must also be updated as follows.

Fig.5. **Second half of AULOAD**



The tape is rewound to the beginning, the tape counter reset and the tape advanced to the start of the directory location. The directory is then saved anew, overwriting the old, but with the additional information concerning the new program. By always rewinding to the beginning of the tape and resetting the tape counter, before advancing to the beginning of the directory, the 'load directory' routine is designed to exit from its program after the tape has incremented beyond the expected directory start location by a reasonable amount. In my program I have arranged for the words, 'Directory Not Found' and to wait for confirmation from the operator via the keyboard, since a misread of the directory will produce the same result and an immediate attempt to SAVE the required program could result in a disastrous corrupting of the existing programs.

AULOAD routine

The flow-diagram of the AULOAD routine is shown in Fig. 4 In the case of AULOAD there are a number of syntaxes to support as described earlier and the first four checks sort out the various possibilities, exiting from the routine if none of the four allowed are found. In such an event, upon return to Basic, a syntax error will be indicated. The first check determines whether the first character after the command, AULOAD, (other than a 'space' character) is a set of inverted commas or a question mark, the next one determining whether the second character is a set of inverted commas, or not. If it is, the program jumps to the steps prior to exiting the routine. This procedure is designed to handle the AULOAD?" syntax. If immediately prior to this command AUSAVE "program name" has been carried out, then appropriate temporary stores contain information about the start location of the SAVEd program. The tape is thus wound to this position and the SAVEd program compared with the program remaining in the computer's memory. The previously SAVEd program can thus be verified. The syntax, AULOAD"", will produce a similar result: however, in this case, the program recently SAVEd is LOADed into the computer, erasing that held in memory.

If the second character is not a set of inverted commas, then it should be the start of the program name, 'spaces' not being allowed: the third step performs this check. The fourth check determines whether the program name is terminated with inverted commas. If it is, then the program is required to be RUN immediately after LOADing. However, the RUN command must not be carried out until the second half of the AULOAD routine has been performed. The second set of inverted commas are thus replaced with a 'space' character and a RUN flag set for subsequent attention by the second half of the routine.

With the directory loaded, the next step searches the directory for the desired program in order to determine where it may be found on tape. If the program name is not found the routine is exited. The reason for 'jumping' to Basic this time, rather than 'returning' through the :FIND and :INPR routine is really for nicety. To avoid a 'syntax error' being printed to the screen, the buffer line is erased (i.e. replaced with 'space' characters). Jumping, then, to warm start Basic produces the 'READY' comment, whereas returning does not. (Remember, when JUMPing rather than RETURNing to Basic, the unused 'return from subroutine 'addresses must be pulled off the stack by two PLA statements.)

Having found the desired program, the characters 'AU' are replaced with 'space' characters to leave the command LOAD "program name" in the buffer line. The address of the start of the second half of the AULOAD routine is loaded into the 'input routine' vectors after having wound the tape to the location of the start of the program. The taperecorder is then put into its PLAY mode and the first half of the routine exited. The BASIC interpreter now sees the command LOAD "program name" and therefore loads the program in the normal way. Once loading is complete, the basic interpreter

Continued on page 58

01-208 1177 TECHNOMATIC LTD 01-208 1177

BBC Micro Computer System
BBC Computer & Econet Referral Centre
BBC Computers:

Model B: **£320 (a)** B+DFS: **£409(a)**
Model B+NFS: **£389(a)** B+NFS+DFS **£450(a)**
ACORN 2nd Processors: 6502: **£175(a)** Z80: **£352(a)**
TORCH UNICORN: Z80 Card: **£299(a)** Z80 Disc Pack: **£699(a)**
UNICOMM Communications Package: £160(b)
20 Mbyte Hard Disc+400K Floppy: £1995(a)

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

DISC DRIVES

These drives, fitted with high quality Japanese mechanisms are supplied in attractive steel cases painted in BBC colour. The drives are fully Suggart A400 compatible. All dual drives are supplied with integral power supply whilst singles are supplied with or without power supply. All drives come complete with data & power cables, manual and BBC formatting disc.

1×100K (250KDD unformatted)	40TSS TS55A TEAC	**£100**(a)
1×200K (.5MbDD unformatted)	80TSS TS55E TEAC 40/80	**£145**(a)
1×400K (1MbDD unformatted)	80TDS TS55F TEAC 40/80	**£155**(a)
2×100K (.5MbDD unformatted)	40TSS TD55A TEAC	**£280**(a)
2×200K (1MbDD unformatted)	80TSS TD55E TEAC 40/80	**£360**(a)
2×400K (2MbDD unformatted)	80TDS TD55F TEAC 40/80	**£420**(a)

CS100 TEC with psu	**£135**(a)	40/80T Switch Module	**£30**(c)
CS200 TEC with psu	**£165**(a)	3" Hitachi 100K 40T	**£115**(b)
CS400 MITS with psu	**£195**(a)	TD55M Mitsubishi	**£400**(a)

SCOTCH 3M DISCS

This month we are offering these high performance 5.25" discs at a bumper bargain price for a limited period. The prices will be valid for orders received before 15th October. These industry standard discs have been manufactured with advanced techniques are of such high quality that their error free performance is guaranteed for life. If ever there is a disc failure, the disc is replaced without question.
Discs in packs of 10:

40 Track SSDD **£12.50(c)** 40 Track DSDD **£17(c)**
80 Track SSDD **£21(c)** 80 Track DSDD **£22(c)**

PRINTERS

EPSON: RX80FT **£225** (a); FX80 **£318** (a);
FX 100 **£460** (a):
KAGA TAXAN:KP 810**£249**(a);
BROTHER: HR15 **£350** (a); EP44 **£199** (a):
JUKI 6100 **£359** (a)

DRIVE ACCESSORIES

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

Single Disc Cable **£6**(d) Dual Disc Cable **£8.50**(d)
10 Disc Library Case **£1.95**(c) 30 Disc Storage **Box £6**(c)
30/40 Disc Lockable **Box £14**(c) 70/80 Disc Lockable **Box £19**(b)

ACCESSORIES

EPSON Serial Interface: 8143 **£35** (b); 8148 with 2K buffer **£50** (b).
EPSON Paper Roll Holder **£17** (b); FX80 Tractor Attach **£37** (b); RX/FX80 Dust Cover **£4.50** (d).
EPSON Ribbons: MX/RX/FX80 **£6.50;** MX/RX/FX100 **£12.50** (d).
JUKI: Serial Interface **£60** (a); Tractor Attach. **£99** (a); Sheet Feeder **£199** (a); Ribbon **£2.50** (a).
BROTHER HR15: Sheet Feed **£199**; Ribbons — Carbonor Nylon **£3**; Multistrike **£5.50** (d); 2000 Sheets Fanfold with extra fine perf. 9.5" — **£13.50**; 15" **£17.50** (b).
BBC Parallel Lead **£8**; Serial Lead **£7** (d).

MONITORS

MICROVITEC 14" RGB
1431 Std Res **£195** (a); 1431Ap std Res PAL/Audio **£215** (a);
1451 Med Res **£295** (a); 1441 Hi Res **£399** (a);
2031 20" Std Res **£360** (a); Plinth for 14" Monitors **£8.50.**
Microvitec Monitors with TTL/Linear Inputs also available.

KAGA VISION III
Hi Res 12" RGB **£358** (a);
Green Screens: KAGA 12G **£106** (a); SANYO DM811 112CX **£99** (a);
Swivel Stand for Kaga Green **£22.50** (b);
BBC Leads: KAGA RGB **£5** Microvitec **£3.50**; Monochrome **£3.50** (d)

MODEMS

Our range of modems include: TELEMOD-2, a BT approved V23 1200/75 and 1200/1200 modem, ideal for PRESTEL use. **£65**(b). BBC cable **£3-50.** BUZZ-BOX, a very compact BT approved V21 300/300 Baud, battery operated modem ideal for inter-computer communication, bulletin boards etc. **£65**(c). BBC lead **£3.50.** External PSU **£8.** MINOR MIRACLES WS-2000- the ultimate multi-standard modem, covering all common BELL and CCITT standards up to 1200 baud. The optional 'auto-answer' and 'auto-dial' boards gives this modem the greatest potential of all- **£129.** Please phone for details of accessories and our comprehensive range of communication software.

SOFTY II

This low cost intelligent eprom programmer can program 2716, 2516, 2532, 2732, and with an adaptor, 2564 and 2764. Displays 512 byte page on TV — has a serial and parallel I/0 routines. Can be used as an emulator, cassette interface.
Softy II .... **£195.00(b)**
Adaptor for 2764/2564 .... **£25.00**

UV ERASERS

UV1T Eraser with built-in timer and mains indicator.
Built-in safety interlock to avoid accidental exposure to the harmful UV rays.
It can handle up to 5 eproms at a time with an average erasing time of about 20 mins. **£59 + £2 p&p.**
UV1 as above but without the timer. **£47 + £2 p&p.**
For Industrial Users, we offer UV140 & UV141 erasers with handling capacity of 14 eproms. UV141 has a built in timer. Bother offer full built in safety features UV140 **£61,** UV141 **£79, p&p £2.50.**

PRINTER BUFFER

This printer sharer/buffer provides a simple way to upgrade a multiple computer system by providing greater utilisation of available resources. The buffer offers a storage of 64K. Data from three computers can be loaded into the buffer which will continue accepting data until it is full. The buffer will automatically switch from one computer to next as soon as that computer has dumped all its data. The computer then is available for other uses. LED bargraph indicates memory usage. Simple push button control provides REPEAT, PAUSE and RESET functions. Integral power supply. £245 (a).

ATTENTION

All prices in this double page advertisment are subject to change without notice.
ALL PRICES EXCLUDE VAT
Please add carriage 50p unless indicated as follows:
(a) £8 (b) £2.50 (c) £1.50 (d) £1.00

ACORN IEEE 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 a network of up to 14 other compatible devices, and would typically link several items of test equipment allowing them to run with the optimum of efficiency. The IEEE Filing System ROM is supplied **£282.**

INDUSTRIAL PROGRAMMER

EP8000.
This CPU controlled Emulator Programmer is a powerful tool for both Eprom programming and development work. EP8000 can emulate and program all eproms up to 8KX8 bytes, can be used as stand alone unit for editing and duplicating EPROMS, as a slave programmer or as an eprom emulator **£695**(a)

CONNECTOR SYSTEMS

I.D. CONNECTORS

(Speedblock Type)

No of ways	Header Plug	Receptacle	Edge Conn.
10	90p	85p	120p
20	145p	125p	195p
26	175p	150p	240p
34	200p	160p	320p
40	220p	190p	340p
50	235p	200p	390p

D CONNECTORS

No. of ways

	9	15	25	37
MALE				
Solder	80p	105p	160p	250p
Angled	150p	210p	250p	365p
FEMALE				
Solder	105p	160p	200p	335p
Angled	165p	215p	290p	440p
Hoods	90p	85p	90p	100p

IDC 25-way plug 385p. Socket 450p.

TEXTOOL ZIF

SOCKETS 24-pin £5.75
28-pin £8.00 40-pin £9.75

DIL SWITCHES

4-way	90p	6-way	105p
8-way	120p	10-way	150p

EDGE CONNECTORS

	0.1"	0.156"
2 × 6-way (commodore)	—	300p
2 × 10-way	150p	—
2 × 12-way (vic 20)	—	350p
2 × 18-way	—	140p
2 × 23-way (ZX81)	175p	220p
2 × 25-way	225p	220p
2 × 28-way (Spectrum)	200p	—
2 × 36-way	250p	—
1 × 43-way	260p	—
2 × 22-way	190p	—
2 × 43-way	395p	—
1 × 77 way	400p	500p
2 × 50-way(S100conn)	600p	—

EURO CONNECTORS

DIN 41612

2 × 32 way St Pin	230p	275p
2 × 32 way Ang Pin	275p	320p
3 × 32 way St Pin	260p	300p
3 × 32 way Ang Pin	375p	400p
IDC Skt A + B	275p	
IDC Skt A + C	350p	

For 2 × 32 way please specify spacing (A + B, A + C).

AMPHENOL CONNECTORS

36-way plug Centronics Parallel | Solder £5.25 IDC £5.25
36-way socket Centronics Parallel | Solder £5.50 IDC £5.50
24-way plug IEEE Solder £5 IDC £4.75
24-way socket IEEE Solder £5 IDC £4.75

PCB Mtg Skt
Any Pin 24 way Solder 600p
36 way ZOC 650p

RS 232 JUMPERS

(25 way D)

24" Single end Male	£5.00
24" Single end Female	£5.25
24" Female Female	£10.00
24" Male Male	£9.50
24" Male Female	£9.50

TEST CLIPS

14-pin 375p 16-pin 400p
40-pin £10.30

RIBBON CABLE

(grey/metre)

10-way	40p
16-way	60p
20-way	85p
26-way	120p
34-way	160p
40-way	180p
50-way	200p
64-way	280p

DIL HEADERS

	Solder	IDC
14 pin	40p	100p
16 pin	50p	110p
24 pin	100p	150p
28 pin	200p	—
40 pin	200p	225p

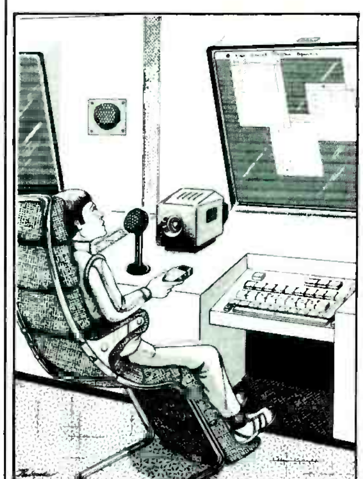
CIRCLE 42 FOR FURTHER DETAILS.

The Information Society—3

by A. E. Cawkell

Telecommunications: techno-commercial politics, protocols and standards

Present problems will partly be resolved by network unification, but it will still be necessary to arrange for one machine to 'talk' to another without the intervention of compatibility problems for their users.



The big users whose traffic justifies a nationwide or international private telecommunications network can employ managers responsible for ensuring reliable service. These people lease lines, purchase equipment, organise software etc., and can control the whole system and purchase equipment in such a way that protocol and equipment incompatibility problems are avoided. These are the people who use the 'private networks' of Fig.1 (May issue) for intra-organisational communications and who are likely also to use the facilities offered by v.a.n. vendors on 'commercial networks'. However, when it comes to inter-organisation or inter-person communications they are no better off than the rest of us.

A coalescence of networks transparent to the user — that is which enable him to send and receive data on any machine as easily as he now direct dials and talks to a friend in Hong Kong, may well be 20 years away. Incidentally the politics, technicalities, and investment needed to establish direct dial communications between users with one simple standard instrument — the telephone — took many years to complete.

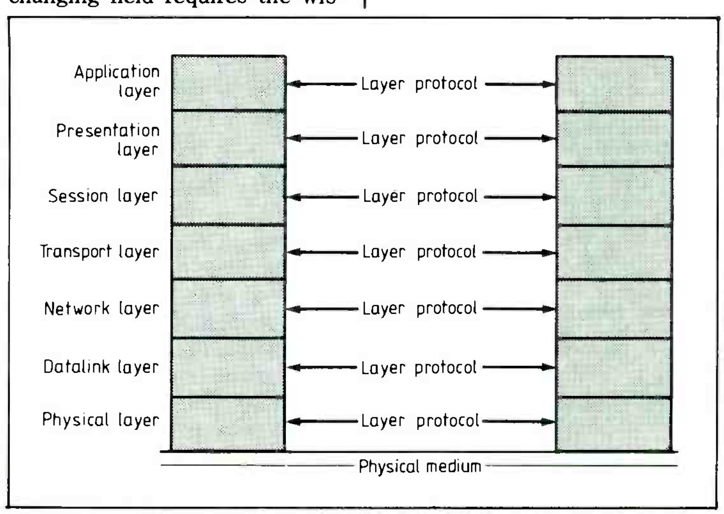
Communication between machines brings in another team of players — the commercial suppliers — active in the techno-commercial political arena which is somewhat different from the 'higher level' politics discussed in the previous section. Each player is trying to so well establish his own rules (protocols) for running a system using machines of his own manufacture that other suppliers will have to play by those rules if they want to join the game (a *de facto* standard). At the same time he co-operates with his competitiors in hammering out a consensus standard for the general benefit of the community, but without trying too hard.

Commercial suppliers have less inertia than PTTs and some are more enterprising than others. If one supplier jumps in with a system while the PTTs are still thinking about it, penetrates the market, and the system is seen to work, he can hope that the others won't re-invent the wheel and will adjust to his *fait accompli*. Other suppliers and PTTs can, of course, think of all kinds of reasons for ignoring this pushiness. The system may be geared to the proposer's own data processing equipment, it may be considered to be too complex or already out of date, it may give the proposer an unacceptable commercial advantage, or it may be incompatible with such standards as already exist.

The development of machines for inputting, storing, processing, and retrieving information, and methods for transferring data from one machine to another has been carried out in a very short time in a highly competitive environment with the larger companies introducing major advanced systems incompatible with others. The sale of a number of systems is followed by the introduction of add-on compatible bits and pieces, the whole being controlled by proprietary software. faced with the option of writing off their first investment and starting afresh with another supplier, or buying and using the new compatible offerings from the same supplier more or less painlessly, suppliers hope that customers will choose the second course.

After briefly introducing the subject of protocols the author of a useful booklet[43] continues 'Topic understood — but why should I switch off my yawns about it?'. The answer is that once established, standard protocols will enable you to buy the most suitable items of equipment from different sources knowing that they will work together and with other people's equipment, systems will be able to communicate with each other, numbers of devices needed will be reduced, obsolescence will be minimized because up-grading will be easier, and costs will come down — always assuming, of course, that the 'right' standard is adopted in the first place.

Standardization in a rapidly changing field requires the wis-



dom of Solomon. What may seem sensible today may be obsolete tomorrow. However, the general chaos has prompted the OSI seven-layer reference model agreement, arrived at under the auspices of the International Standards Organisation (ISO), Comite Consultatif Internationale de Telegraphie et Telephone (CCITT), the Institute of Electrical and Electronics Engineers (IEEE), the European Computer Manufacturers Association (ECMA) and others.

The OSI model brings together certain existing and proposed CCITT standards in an orderly and logical manager in contrast to present piecemeal useage. The majority of CCITT members are from the PTTs, so the standards are backed by the power of these monopolies seeking to maximize the use of their enormous investment in cables and equipment. CCITT includes some computer/data processing manufacturer members and the operation of most of the equipment made by industry follows CCITT recommendations. IBM goes its own way.

The problem which the OSI model seeks to solve is this. Mr Dupont has an MBI machine connected to a local area network (lan) and he wants to send some information to Mr Singh, say, in another country — for example the message 'Gone to lunch; back at 2pm GMT'. Mr Singh has a Faxo machine, accessible via a telephone line with its own number. Dupont types Singh's address on the message and the system is required to transmit, route, and present the message to Singh exactly as Dupont typed it.

To do this, a set of instructions must be automatically appended to Dupont's message to establish a path through a complex set of networks to Singh's machine, and to ensure that the arriving bit stream is presented on a screen or on paper, exactly as composed, regardless of the different characteristics of the sending and receiving machines. Various devices en route will read that part of the instructions intended for them and will act to carry out these functions.

A very large body of mainly incomprehensible literature exists about the OSI model. A major article appeared[44] at an early stage which is heavy going perhaps because it is aimed at the already knowledgeable, and its title is a misnomer. Another equally authoritative article appeared later which also fails to provide a picture[45]. A selection of articles, mainly with self-evident titles, are listed in references 46-49.

The OSI model is usually presented as an abstraction in the form shown in Fig.3. Seven functions are recognized in the model. Dupont's message will require instructions so that each function can be performed en route, once a set of standards devised to deal with these functions are complete. For instance the 'application layer' box will only recognise and execute 'application' instructions. Dupont's message — an 'electronic mail' application, will have a mail code attached by the application layer at the sending end. The remote application layer box will recognise mail and know that it must be read into a file called mail in Singh's machine.

At another level, say the transport layer — the layer responsible for selecting a route of the required quality for the information being conveyed and checking and correcting it — a device installed somewhere along the way, triggered by the appropriate code will be standardized with a set of "transport expectations". In other words it will be able to take action only by reference to a set of codes, any one of which it may receive, to take care of a designated sub-function. For example, if it receives an error checking code that is wrong it will automatically ask for the retransmission of a block of message symbols.

Until the OSI model starts to be implemented, attempts to establish *de facto* standards will continue. This approach more or less succeeded in another area — microcomputer operating systems (CP/M). It came somewhere near to succeeding in telecommunications when IBM introduced Binary Synchronous Communications and then Systems Network Architecture in 1974. This was an advanced concept, since further developed, with application programs running on host computers and remote terminals or complete devices. Other IBM 'document interchange' software enables the exchange of files between all devices. Once adopted, a customer would probably be locked-in to IBM for future requirements.

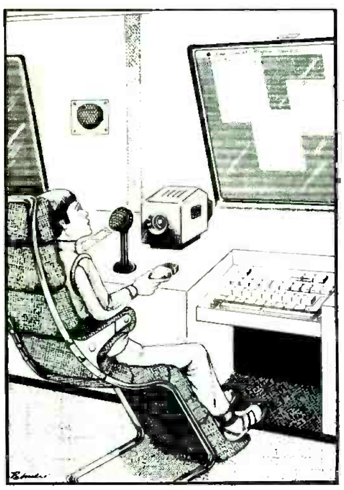
Of course there are many other communication requirements besides inter-computer and distributed processing; moreover many IBM users have stayed with BSC because of the cost of installing SNA. SNA required all messages to embody a nine byte code — the instructions to the en route devices to take the necessary action, as will be required when OSI is in place. On the other hand, the apparent success of the IBM Personal Computer, obviously also seen by IBM as the intelligent terminal for use with its mainframes, the existence of companies making IBM-like equipment to deal with the special communications problems of IBM users, and IBM's juggernaut approach with SNA used in its DIOSS office system coupled to high-powered advertising, indicated that SNA is a long way from being displaced by thoughts of OSI.

Currently IBM is placing full page SNA advertisements containing diagrams which look like the OSI model, claiming 10,000 large system installations. Closer inspection reveals that the seven layers are there with different names. IBM has been forced to acknowledge the existence of the PTT-sponsored X25 interface to public and other networks and now advertises the fact that an SNA network can be connected to them. This means that there is SNA-to-other-network compatibility by standardization at the bottom three layers of the OSI model concerned with interconnection and the reliable transport of data — but that is all. The way in which the data is handled in terms of encypherment, flow control, formatting, and file interchange is another matter.

It is probably true to say that the OSI model owes a good deal to SNA, but the standards finally adopted for the component parts of the model require to look sufficiently different for it to be evident that IBM is not calling the tune. IBM will presumably pursue an opportunist policy according to the relative success of SNA and its successors, and competitive OSI-compatible offerings.

Anticipating that OSI or something very like it, will be adopted the UK National Computer Centre, acting on behalf of the Department of Industry, have announced an 'Intercept Strategy'[50].

Further articles review telecommunication techniques and discuss social aspects of the Information Society.



REFERENCES

43. User View of Communications Standards, 2nd edition March 1983, published by NCC Ltd., Oxford Road, Manchester M1 7ED, England, (On behalf of the IT Standards Committee for Private Users, Depatment of Industry).

44. Pouzin, Louis; Zimmerman, H. *Proceedings of the IEEE* vol.66, November 1978, pp.1346-70.
A tutorial on protocols.

45. Tanenbaum, Andrew S. *Computing Surveys*, vol.13, December 1981, pp.453-89.
Network protocols.

46. Schindler, S. *Computer Networks* vol.6, 1982, pp.291-8.
The new ISO standards for communcations and office automation.

47. Mier, Edwin E. *Data Communications*, July 1982, pp.71-101.
High-level protocols, standards, and the OSI reference model.

48. Jones, Thomas C. *Data Communications*, July 1982, pp.123-31.
Paving the way for universal document interchange.

49. von Studnitz, Peter. *Computer Networks*, vol.7, 1983, pp.27-35.
Transport protocols: their performance and status in international standardization (July 1982).

50. Focus IT Information Sheet, Issue 1, April 1983. IT Standards Unit, DOI, 66-77 Victoria St., London SW1E 6SJ. Intercept strategy announcement.

emco

Clearance Sale of Display Monitors

• New & Demonstration Units • Monochrome & Colour

Model	Description	Price (Exc. VAT)
	Monochrome Monitors	
X6	6" P4 metal case 2 x BNC	£79.50*
X9A	9" P31 metal case 2 x BNC	£44.00*
X9B	2 x 9" twin rack mounted P4 front controls	£139.00*
X9C	9" P31 TTL for Apple	£44.00*
X12A	12" P4 metal case	£44.00*
X12B	12" P4 TTL input, metal case, 2 x BNC	£49.00*
X12C	12" P4 metal case 2 x BNC	£47.00*
X12D	12" rack mounted P4 front controls	£74.00*
X12E	12" P4 plastic case	£44.00*
X12F	12" P31 plastic case	£54.00*
X12G	12" P31 blue plastic case	£44.00*
X12H	12" P31 TTL for Apple	£44.00*
X12J	12" P31 for IBM PC	£74.00*
X12K	12" Amber	£35.00
X17	17" P31 plastic case	£60.00
X20A	20" P31 metal case	£69.00
X24A	24" P4 std res, teak cabinet with silver bezel	£60.00*
X24B	24" P31 professional non-glare panelled CRT 2 x BNC	£260.00*
	Colour Monitors	
X14A	14" colour std res (.65mm) RGB	£98.00
X14B	14" colour std res composite video	£95.00
X14C	14" colour std res NTSC composite video	£89.00
X14D	14" colour med res RGB	£149.00
X14E	14" colour high res RGB	£199.00
X20B	20" colour std res RGB	£198.00*
	Colour Graphics Terminal	
X14F	14" high res VTC8001	£490.00
	Kits	
K1	9"/12" scan card & deflection coil (with CRT +£13)	£16.00
K2	9" P31 open-frame 12V non-glare comp video	£20.00
K3	9" scan card & deflection coil (with CRT +£13) TTL	£20.00
K4	9" scan card & deflection coil (with CRT +£13) comp video	£20.00
K5	12" scan card & deflection coil (with CRT +£13) TTL	£20.00
K6	12" scan card & deflection coil (with CRT +£13) comp video	£20.00
K7	15" scan card & deflection coil (with CRT +£19) TTL	£20.00
K8	15" scan card & deflection coil (with CRT +£19) comp video	£20.00
	Leads	
L1	BNC/6-pin DIN lead	£1.90
L2	Phono/phono coax lead (1m)	£1.25
L3	BNC/UHF lead (1m)	£1.90
L4	Coaxial cable (100m)	£19.00

– subject to availability.
All products are with composite video input except where otherwise stated. P4 phosphor is white, P31 is green. Minimum order £10. A delivery charge of £5 + 50p per monitor will be added to all orders.

* Includes 1 year labour and parts warranty. Other products are sold in working order but *without* warranty.

emco

Britain's largest suppliers of data CRT's

Emco Electronics Ltd., 129/131 Coldharbour Lane, London SE5 9NY Telephone: 01-737 3333

CIRCLE 14 FOR FURTHER DETAILS.

SUPER HY LIGHT STROBE KIT

Designed for Disco Theatrical uses, etc

Approx 16 joules Adjustable speed Price **£45.** + £2 p&p (Total inc. VAT **£54.05.** Case and reflector price **£15** + £2 p&p (total VAT **£19.95**): Foolscap SAE for further details including Hy-Lyght and industrial Strobe Kits.

ULTRA VIOLET BLACK LIGHT FLUORESCENT TUBES

4ft 40 watt **£10.44** (12.00 inc. VAT)
2ft 20 watt **£7.44** + £1.25 p&p (£9.99 inc VAT)
18in 15 watt **£5.00** + 75p p&p (£6.61 inc VAT)
13in 10 watt **£4.00** + 75p p&p (£5.46 inc VAT)
12in 8 watt **£3.60** + 50p p&p (£4.71 inc VAT)
9in 6 watt **£3.00** + 50p p&p (£4.02 inc VAT)
6in 4 watt **£3.00** + 50p p&p (£4.02 inc VAT)
230V AC Ballast Kit for either 6in, 9in or 12in tubes **£5.50** p&p 55p (£6.96 inc VAT)
For 13in & 18in Tubes **£6** p&p 75p (£7.76 inc VAT)
For 12V DC op 12in & 13in tubes only **£5.50** p&p 75p (£7.18 inc VAT)
175 WATT SELF-BALLASTED MERCURY BULBS Available for either B.C. or E.S. fitting, price **£10.80** + p&p £1.25 (total inc VAT £13.65)
L.T. TRANSFORMERS
"**Special Offer** 6.3 V 0.63V at 10 Amp (12V 010 Amp or 6V at 20 Amp) **Price £9.00.** p&p £2.00 — inclusive of VAT £11.50 N.M.S.

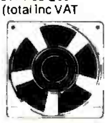
ROBOT ENTHUSIASTS

The following two Motors are ideally suited for Experimenters in this field:

1. ESCAP precision Swiss-made ironless rotor, 6V. DC. geared Motor with 70—1 gearbox. 6V. DC — 16 rpm 3V. — 8 rpm. Amazing power, no load current — only 10 ma. approx. Size: 4×2½ cm. Ex-equipment, tested and guaranteed. ONLY **£4.50** + 50p. p.&p. (incl. Total £5.75).
2. 12/24V D.C. Reversible Precision-built Motor. mf. ESCAP. Will operate from 24V. down to 2V. D.C. — current consumption negligible. A range of speeds between 2 to 36 rpm obtainable. 6V. DC — 9 rpm N/L 6MA. 12V. DC — 18 rpm N/L 10MA. 24V. DC — 36 rpm N/L 18MA. Total length of motor and gearbox 90 mm. Max. dia. 42 mm. Shaft length 15 mm. Shaft dia. 6 mm. Approx. half manufacturer's price: **£15.00** + £2.00 p.&p. (total incl. VAT £19.55). NMS.

VORTEX BLOWER & SUCTION UNIT

Powerful multi-stage dynamically balanced, totally enclosed 9½ dia. Rotators, 3,500 rpm. 1½" I.D. inlet and outlet 110V A.C. Price **£30** Suitable transformer for 240V A.C. **£10** + £4.50 p&p (total inc VAT **£51.18**) N.M.S.



COOLING or EXTRACTOR FAN Quiet smooth running Size 4¾×4¾×1½ Supplied for 240V a.c. operation. Price **£4.75** £1 p&p (total inc VAT **£6.62**) N.M.S.

240V A.C. SOLENOID VALVE

Designed for Air/Gas at 0-7, water 5psi. Inlet/outlet ⅜". Forged brass body. manuf. Dewraswitch Asco. Price **£5.50** + £1 p&p (**£7.48** inc VAT) N.M.S.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230, 240V a.c. 50/60 OUTPUT 0-260V

200W 1A Max	£15.00
0.5K VA 2½A Max	£19.00
1KVA 5A Max	£27.00
2KVA 10A Max	£41.00
3KVA 15A Max	£54.00
5KVA 50A Max	£101.00
10KVA 50A Max	£101.00
15KVA 75A Max	£275.00

3-PHASE VARIABLE VOLTAGE TRANSFORMERS

Dual input 200-240V or 380 415V Star connected

3KVA 5amp per phhase max	£113.40	All V.V.Ts plus carriage and VAT
6KVA 10 amp per phase max	£170.10	
10KVA 16 amp per phase max	£345.45	

Comprehensive range of TRANSFORMERS L.T. ISOLATION & AUTO (110-240V). Either cased with American socket and mains lead or open frame type available for immediate delivery. Leaflet on request.

12V.D.C. BILGE PUMPS

400 G.P.H. 15ft head, 3amp **£8.00** + £1.00 p&p (**£10.35** inc VAT)
700 G.P.H. 10ft head. 35amp. **£11.50** + £1.50 p&p (**£14.95** inc VAT).
1750 G.P.H. 15ft head. 9amp. **£15.00** + £1.75 p&p (**£19.26** inc VAT).

SINGLE DIAPHRAGM COMPRESSOR

Max 20 PSi. One CFM approx 240 volts A.C. **£18** + £2 p&p (**£23** inc VAT) N.M.S.

EPROM ERASURE KIT

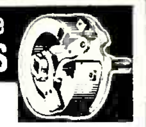
Why waste money? Build your own EPROM ERASURE for a fraction of the price of a made-up unit. Complete kit of parts less case to include 12, 8 watt 2537 Angst Tube, Ballast unit, pair of bi pin leads, Neon indicator, safety microswitch, on/off switch and circuit
LESS CASE: Price **£13.60** + 75p p&p (Total incl. VAT **£16.50**)
Warning. Tube used in this circuit is highly dangerous to the eyes. Unit must be fitted in suitable case

FROM STOCK AT PRICES THAT DEFY COMPETITION!

AC GEARED MOTORS
DC MOTORS
MICROSWITCHES
RELAYS
REED SWITCHES
SOLENOIDS A.C. or D.C.
PROGRAMME TIMERS
C.F. BLOWERS
AC CAPACITORS
STROBE KITS
FLASHTUBES
CONTACTORS
SYNCHRONOUS MOTORS

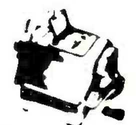
Phone in your enquiries

Superior Quality Precision Made NEW POWER RHEOSTATS



New ceramic construction, heavy duty brush asembly, continuously rated.
25 watt 5/10/25/50/100/150/250/300/500/1kΩ 1.5KΩ **£3.80** + 30p p&p (**£4.71** inc VAT)
50 WATT 250Ω **£5.50** + 50p p&p (**£6.90** inc VAT)
100 WATT 1/5/10/25/50/100/250/500 1kΩ/1.5kΩ/2.5kΩ/3.5kΩ **£9.50** + 75p p&p (**£11.78** inc VAT).
Black Silver Skirted Knob calibrated in Nos 1.9 1½in. dia brass bush ideal for above Rheostats **30p ea** + VAT

INSULATED TESTERS *NEW!*



Test to I.E.E. Spec Rugged metal construction suitable for bench or field work, constant speed clutch. Size L 8in. W 4in H 6in. weight 6lb **500V.** 300 megohms **£49.** p&p £2 (**£58.56** incl VAT) 1000V 1000MΩ **£55** p&p £2 (**£65.55** inc VAT) SAE for leaflet

SPECIAL OFFER

AUTO TRANSFORMER tapped 90 260V 3.5KVA 1 phase totally enclosed in metal case. mf. Wooden Price **£60.00** + carriage at cost + VAT. N.M.S.

GEARED MOTORS

5 rpm 240V AC Mf by Carter **£6.05** £1 p&p (**£8.11** inc VAT) N.M.S. **28 rpm** torque 20lb in. reversible 1/80th h.p. 110V AC. Price **£9.50** + p&p £1.80 (total incl. VAT **£12.99**).
Suitable **TRANSFORMER** for 230 240V AC operation. Price **£5.20** + p&p £1.40 (total incl. VAT **£7.59**) N.M.S.
38.3 rpm GEARED MOTOR. Torque 35lb in reversible 115V AC inc. start capacity. Price **£11.55** + p&p (total inc. VAT **£15.58**) N.M.S. Suitable **TRANSFORMER** 230V AC operation. Price **£4.50** + 50p p&p (total incl VAT **£5.75**)
CROWN 37 rpm 2000lb in approx 110V AC. reversible geared motor. Price **£35** p&p £4.50 (**£45.42** incl. VAT) NMS.
Suitable **TRANSFORMER** for above **£10** p&p £1.50 (**£13.22** inc VAT). **71 rpm** torque 10lb in reversible 1/70th h.p. 110V AC motor. Price **£9.50** + £1.80 p&p (total incl. VAT **£12.99**)
Suitable **TRANSFORMER** for 230 240V AC operation. Price **£5.20** + p&p £1.40 (total incl. VAT **£7.95**) N.M.S.

57 RPM 240V 1/22 hp continuously rated REVERSIBLE 50 lb in manuf. by Wynstruments. New. Ideal for garage doors, curtains etc. ONLY £12.00 + £2.00 p.&p. (incl. VAT £16.10) inclusive capacitor.

CHECK METER

200-240V A.C. 50amp fully reconditioned **£7.50.** + £1.75 p&p (total incl VAT **£10.64**)

SANGAMO WESTON TIME SWITCH

Type S251 200/250 A.C. 2 on/2 off every 24 hours 20 amps contacts with override switch. Diameter 4 × 3 price **£9.50** + £1.50 p&p (**£12.65** inc VAT & p&p) Also available with Solar dia R&T.
Other types available from stock.
N.M.S. New Manufacturers Surplus
R&T Reconditioned and tested.

Goods normally despatched within 7 days

Ample parking space
Showroom open
Monday-Friday

BARCLAYCARD VISA

SERVICE TRADING CO

57 BRIDGMAN ROAD, CHISWICK, LONDON W4 5BB. 01-995 1560
ACCOUNT CUSTOMERS MIN. ORDER £10

Personal callers only *Open Saturdays*

9 Little Newport Street
London WC2H 7JJ
Tel: 01-437 0576

CIRCLE 7 FOR FURTHER DETAILS.

BERG LOW PROFILE 14 PIN DUAL IN LINE I.C. SOCKET manufactured from glass filled polyester to UL94V-0. £7 for 100, £31 for 500, £56 for 1000, £256 for 5000, £460 for 10,000, £2100 for 50,000, £2,700 for 100,000. Sample 10 sent for £1.20 + 30p p&p (£1.73 inc VAT)
BERG LOW PROFILE 16 PIN DUAL IN LINE I.C. SOCKET as above £8 100, £36 for 500, £65 for 1000, £295 for 5000, £530 for 10,000, £2390 for 50,000, £4300 for 100,000. Sample 10 sent for £1.40 + 30p p&p (£1.96 inc VAT).

WIRE CUTTER AND STRIPPER Tempered steel blades spring loaded with moulded red P.V.C. handles. Cutting and stripping adjustable up to 6.0mm². Overall length 135mm, weight 64 grms, 10 for £15, 25 for £34, 50 for £63 100 for £116, 500 for £525, 1000 for £1000. Sample pair sent for £1.75 + 25p p&p (£2.5 inc VAT)
METAL FILM RESISTORS FZ4 manufactured by C.G.S. semi-precision with a standard tolerance of +−2% and a temperature co-efficient of better than 100 ppm/oc. We have a full range in stock from 100R to 1MO. All bandoliered. £2.50 per 1000 any one value.
WIRE WOUND RESISTORS. manufactured by E.R.G. Type 16 ES with a standard tolerance +−5% of nominal resistance value. All values in stock.
3 watt series £3.50 per 100 any one value + £1 p&p (£5.17 inc VAT)
6 watt series £6.50 per 100 any one value + £ p&p (£8.63 inc VAT)
10 watt series £10.50 per any one value + £1 p&p (£13.23 inc VAT)
ALUMINIUM FOIL CAPACITORS manufactured by Iskra 2.25 MRD 385V A.C. WKG axial tupe. Body length 40mm × 23mm £25 per 100 pcs, £115 per 500 pcs. £212 per 100 pcs, £980 per 5000 pcs, £1800 per 10,000 pcs, £4,165 per 25,000 pcs. Sample 10 sent for £3.00 + £1 p&p (£4.60 inc VAT)
BRITISH MADE TRANSFORMER. input 240V at 50HA, output 12V-0-12V 1/2 amp with built in thermal overload circuit. P.C. mounting £25 for 10 + VAT £115 for 50 + VAT £210 for 100 + VAT £950 for 500 + VAT £1700 for 1000 + VAT. Sample sent for £3 + 75p p&p (£4.31 inc VAT).
PAIR OF MATCHED SPEAKERS 4 ohm 3 watts in teak finish cabinets with black/chrome facia 7 1/2" × 12" × 5" depth — 1 sample pack (2 spks) £10.00 + £2 p&p (£13.80 inc VAT) 10 packs £9.00 each + £2 p&p (£12.65 inc VAT)
12" VIDEO DISPLAY UNIT (green) complete with frame and P.C.B. incorporating time bases/EHT, etc but minus case and simple power supply unit. Originally designed to be basically compatible with BBC Micro and Commodore computers. Circuit diagram supplied. Price per sample unit £60.00 + £3 p&p (£72.45 inc VAT) Quantity prices on application.
OPEN FRAME AND SHADED POLE MOTORS by well known manufacturers, 240 volt a/c — many uses — Price per sample £1.50 + 75p p&p (£2.59 inc VAT). Price per 10 motors £1.25 + 75p p&p (£2.30 inc VAT) each.
ULTRASONIC BURGLAR ALAM — portable — wooden finish with internal alarm — easily installed — mains/battery option — provision for window contacts and pressure mat — extended horn and bell unit.
Sample units £39.00 + £2 p&p = £47.15 inc VAT each, 5 units £35.00 + £2 p&p = £42.55 inc VAT each, 10 units £33.00 + £2 p&p = £40.25 inc VAT each.
EXTERNAL HORN Sample £7.50 + £1 p&p = £10.35 inc VAT each, 5 units £6.75 + £1.50 p&p = £9.49 inc VAT each, 10 units £6.37 + £1.50 p&p = £9.05 inc VAT each.

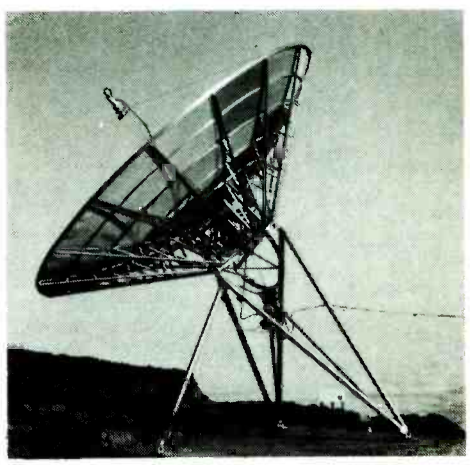
TERMS C.W.O. export enquiries welcome. We find it impossible to advertise all we stock. Please telephone, write or telex for further enquiries. Personal callers always welcome.

ELECTRONIC EQUIPMENT Co.

SPRINGFIELD HOUSE,
TYSSEN STREET,
LONDON E.8. 2ND
TEL NO. 01-249-5217
TLX: 8953906 EECO G

CIRCLE 47 FOR FURTHER DETAILS.

SATELLITE RECEIVING EQUIPMENT



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

Complete systems installed anywhere in the world.

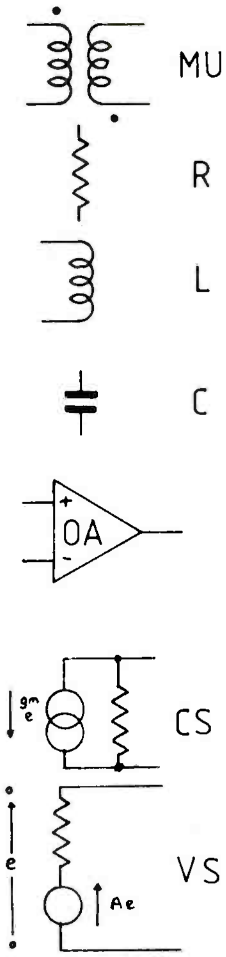
A full report on reception feasibilities at any location is available — price £25.00.

Please state Longitude and Latitude.

For further details contact: Harrison Electronics, 22 Milton Road, Westcliff-on-Sea, Essex SS0 7JX. Telephone: Southend (0702) 332338.

CIRCLE 76 FOR FURTHER DETAILS.

CIRCUIT MODELLER for CP/M



by Harcourt Systems

An engineering package for CP/M and MS DOS* microcomputers to carry out accurate, fast designs of linear circuits.*

CIRCUIT MODELLER can find voltage gain, phase shift, Z_{in} and Z_{out} for most linear electrical and electronic circuits. The limits of capacity are set by the microcomputer RAM, which must be at least 60 KBytes. This gives a capacity of 32 nodes, 101 resistors, 101 capacitors, 101 inductors, 31 mutual inductors, 31 simple operational amplifiers and 31 controlled sources.

Features include:

ADD & EDIT	to construct and alter circuit
LOAD & SAVE	to save and recover circuit from disk
GAIN	to display gain and phase
ZIN	to display input and output impedances
BW	to find centre frequency and −3dB Av points of circuit
SEARCH	to find frequency corresponding to given gain
PRINT	to print synopsis of circuit diagram sufficient for its precise reproduction.

Operating Speed

CIRCUIT MODELLER is an all-compiled package with seven overlays in which the inner two loops of pivotal condensation are written in Z80 assembler. This means that whereas microcomputer CAD is usually slow, **CIRCUIT MODELLER** can solve a four hybrid-pi amplifier in a few seconds.

Graphics

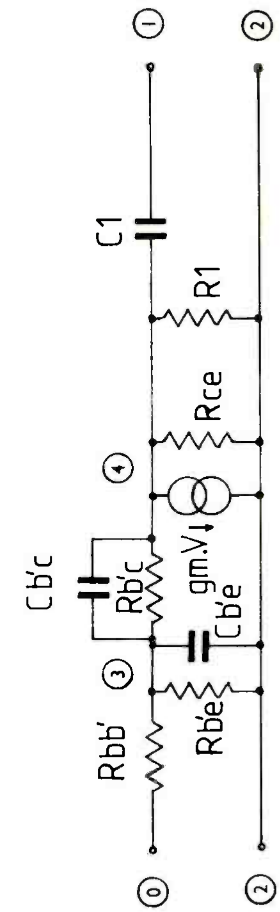
PLOT is an extension to **CIRCUIT MODELLER** enabling an ordinary 132 column printer to plot both dB gain and phase angle against frequency for the circuit. A log/log plot is obtained with automatic axis scaling.

Themselves designers of high performance electronic equipment, Seasim Controls have recognised the importance of **CIRCUIT MODELLER** which they are making available in association with Harcourt Systems. **CIRCUIT MODELLER** is priced at £160+VAT. Prices for MS DOS on application.

Order, or send for more details from

SEASIM CONTROLS LIMITED
The Paddocks, Frith Lane, Mill Hill, London NW7 1PS
Telephone: (01) 346 9271 – Telex: 21189

*CP/M is a trademark of Digital Research
*MS DOS is a trade mark of Microsoft



CIRCLE 52 FOR FURTHER DETAILS.

LOOK!
UNBEATABLE VALUE

TANDON 5¼"THINLINE FLOPPY DISK DRIVES
SINGLE SIDED DOUBLE DENSITY £100
DOUBLE SIDED DOUBLE DENSITY £130
BRAND NEW.

DON'T DELAY— ORDER TODAY!

H.P. SPECTRUM ANALYSER 8551A 10MHZ - 12.4GHZ with 851B display ..... P.O.A.
TEK455 Dual Trace 50MHZ Delay Sweep £650
GOULD OS 3500 Dual Trace 60MHZ Delay Sweep £600

OSCILLOSCOPES

2 TEK 454 Dual Trace 150 MHZ Delay Sweep £700
6 TELEQUIPMENT D83 Dual Trace 50MHZ Delay Sweep £400
7 Tel 453 Dual Trace 50MHZ Delay Sweep £375
9 COSSOR 4100 Dual Trace 75MHZ Delay Sweep £375
10 SOLARTRON CD1740 Dual Trace 50MHZ Dual TB £250
14 TEK 585A Dual Trace 85MHZ Dual TB Delay Sweep £200
15 COSSOR CDU 150 Dual Trace 35NHZ Delay TB £200
17 SELABS SM111 Dual Trace 20MHZ £200
23 SOLARTRON CD1400 Dual Beam 15MHZ £100

STORAGE OSCILLOSCOPES

35 TELEQUIPMENT DM64 Dual Trace 10MHZ £350
36 TEK 564 Dual Trace 10MHZ Delay Sweep £275
37 TEK Spectrum Analyser 50HZ-1MHZ. 547 Mainframe with 1L5 Plug-in Unit £700
40 TELEQUIPMENT CT71 CURVE TRACER £400
42 H.P. SHF SIG GEN 620B 7-11GHZ £350
46 H.P. UHF SIG GEN 612A 450-1230MHZ £200
50 MARCONI AM/FM Sig Gen TF2008 10KH-510MHZ £1,250
52 MARCONI AM/FM Sig Gen TF10668/6 10-470 MHZ £325
59 MARCONI AM/FM Sig Gen TF995A/21.5-220MHZ £250
62 MARCONI VHF Sig Gen TF10648/5M 68-108; 118-185; 450-470MHZ £110
63 MARCONI OUTPUT TEST SET TF 1065 for use with TF1064 & TF995 range Sig Gens £75
66 ADVANCE AM Sig Gen E2 100KHZ-100MHZ £40
72 TEK Constant Amplitude Sig Gen 190B 350KHZ/50MHZ. £100
74 MARCONI WIDE RANGE OSC TF1370A £/MHZ (Square wave to 100KHZ) £95
80 WAYNE KERR AF Sig Gen S121 10HZ-120KHZ £40
87 H P Pulse Gen 214A 10HZ-1MHZ £250
89 EH PULSE GEN 139L 1KHZ-20MHZ Single/Double Pulse £200
99 TEK TIME MARK GEN 180 ..... £40
102 BONTOON Q METER 260A 50KHZ-50MHZ £250
104 MARCONI Q METER TF329G 50KHZ-50MHZ £150
106 MARCONI UNIVERSAL BRIDGE TF1313 0.25% £200
108 MARCONI INSITU UNIVERSAL BRIDGE TF2701. Battery Operated £300
109 Wayne Kerr Autobalance Component Bridge 8421 ..... £250
114 Wayne Kerr Component Bridge B521 (CT375) L 100uH-500kH; C1pF-5F; R1 milliohm-1000Mohm £35
117 Wayne Kerr VHF Admittance Bridge B801 with Source S161 & Detector R161 ..... £400
119 MARCONI AM/FM Mod Meter TF2300S 2-100MHZ £375
123 AIRMEC MOD METER AM/FM type 210 3-300MHZ £95
124 MARCONI RF MILLIVOLTMETER TF2603 50KHZ-1500MHZ 1mV-3VFSO £375
125 MARCONI ELECTRONIC VOLTMETER TF260420HZ-1500MHZ AC/DC/Ohms AC300mV-300V FSD: DC 200mV-1KV FSD £175
144 AVO MULTIMETER Model 7 P&P £7 ..... £20
146 AVO MULTIMETER Model 8 P&P £7 ..... £45
152 MULTIMETER U4324 33 switched ranges 20K Ohm per volt Comple with leads & battery. Brand New. One year guarantee P&P £4 ..... £16
160 FARNELL STAB PSU TSV30/5 0-30V 5A. Current limiting Metered £65
161 FARNELL STAB PSU TSV30/2 0-30V 2A Current limiting metered £50
163 ROBAND VARECO PSU type 33-2 0-33V 2A Current limiting metered (in current production) £100
169 KINGSHILL STAB PSU Model 500 0-60V 0.5A. Current limiting Metered P&P £7 ..... £40
180 BRANDENBURGH PHOTOMULTIPLIER PSU 47R 10-2100V 5mA Metered £200
190 VOLTEX PSU Model 82-635 +/– 5V; +12V; -24V High current un-used £15
191 AC/DC ELECTRONICS PSU MODULE 251 5V 2A +/–12V 0.4A Un-used P&P £3 ..... £15
206 B&K LEVEL RECORDER 2305 ..... £400
209 B&K MEASURING AMPLIFIER 2606 2HZ-200KHZ £600
210 B&K BAND PASS FILTER SET Octave & 3rd Octave Weighing Networks ABCO £550
211 B&K DIGITAL EVENT RECORDER 7502 ..... £1,500
225 DAWE OCTAVE BAND SOUND LEVEL METER type 6419c £150
281 H P LOGICSTATIC ANALYSER 1602A £450
286 AVO VALUE CHARACTERISTIC METER VCM 163 ..... £275
293 MARCONI AF POWER METER TF893A £75
297 MARCONI DIFFERENTIAL DC VOLTMETER TF2606 0-1100V £225
300 R&S POLYSKOP SWOB1 BN 4244/2/50 ..... £350

Also in stock NEW OSCILLOSCOPES, MULTIMETERS etc.

THIS IS A VERY SMALL SAMPLE OF STOCK, SAE or Telephone for **LISTS**
Please check availability before ordering. Carriage all units £10 VAT to be added to Total of Goods & Carriage.

STEWART OF READING
110 WYKEHAM ROAD, READING, BERKS RG6 1PL
Telephone: 0734 68041

Callers welcome 9 a.m. to 5.30 p.m. Monday to Saturday inclusive

CIRCLE 75 FOR FURTHER DETAILS.

MITSUBISHI

GaAs FETs

MGF-1400
MGF-1402
MGF-1412

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 45 FOR FURTHER DETAILS.

Lynwood GD1 VDUs: Intelligent Green micro controlled, RS232, printer port, 101 key k/b. Full Video enhancements. ....ONLY **£149**+£15 P&P(S/H)

Burroughs MT686/7/TD710: Intelligent Green 12" VDU with 3 micros and 64K store. RS232. Programmable... Only **£199** new or £149 S/H + £15 P&P

Videcom Apollo VDUs: Stylish 15" Green Z80 controlled VDU with printer port and lots of very advanced features. .... Only **£399** new or £249 S/H £15 P&P

Centronics 306 Line printers: Professional fast (120 cps), superb quality 80 column printer. Parallel i/f..... ONLY **£99**+ £15.00 P&P

Computhink Act 800 Computer system. Dual floppies (2.4Mb) and lots of business software .... ONLY **£1200**
Diablo 630 Daisywheel printer. OEM i/f................. NEW **£599**+£15 P&P
Diablo Hitype 2 Daisywheel, Tractor unit,................ S/H **£399**+£15 P&P
Calcomp 565 Drum Plotter, 10thou steps. .... ONLY **£450**+£10 P&P

BECKENHAM PERIPHERALS LTD

Callers welcome by appointment

01-466 5582
34 Rodway Road, Bromley
Kent BR1 3JL

SAE for LIST and enquiries

CIRCLE 36 FOR FURTHER DETAILS.

Variable-speed video playback

by J.R.Watkinson, M.Sc.

Analogue to digital conversion and memory organization

Sampling the signal and storing it in a memory provides the varialbe delay necessary to correct timebase errors, the time between writing and reading representing the delay. Using sample storage is the only feasible method of correcting the large timing errors resulting from variable speed operation.

A-to-d conversion

Figure 1 shows the essential elements of t.b.c.video input processing. Amplitude variations resulting from varispeed operation have been described, and prior to entering the convertor proper, the signal amplitude has to be returned to normal. Since the playback signal level is proportional to offtape line rate, a frequency-to-voltage convertor running from offtape H-sync. can be used to control a v.c.a. in the video signal path: the level will now be independent of speed. For the broadcastable speed range (typically −1× to +3×) the amplitude range is so small that the v.c.a. can be bypassed or omitted. For speeds between around −10× and +10×, the signal spectrum is sufficiently similar to normal that the standard anti-aliasing filter can be used. Beyond these speeds, the sampling rate changes so much that different cut-off frequencies are needed, one of about 7MHz for high forward speed, and one of about 2MHz for high reverse. Filter selection is done by comparing offtape H-rate with references.

In a c.c.d. based t.b.c., the filtered signal requires a sample/hold circuit to take a near-instantaneous voltage sample and hold it for transfer to the storage device. As the c.c.d. is analogue, it will exhibit no quantizing error, but the sampling process will suffer from the aperture effect, which will require equalization as in Fig. 2.

In a digital t.b.c., the filtered signal is fed to the a-to-d convertor. Sample-hold is not always necessary in video a-to-d cs for reasons which will be explained.

The a-to-d convertor serves to quantize an analogue voltage into a finite range of integers. Since the storage medium will be binary, the number range will be an integer power of two. In practice 8 bit resolution, having 256 quantizing intervals, is almost universal, although some units work with 9 bit accuracy.

Figure 3 shows how the video signal, in this case colour bars, is embraced by an 8 bit quantizing structure. The fact that sync. tip goes below zero is of no consequence provided that new syncs will be applied after timing correction. Two precautions are necessary to keep the video within the convertor range: firstly, the input will be pedestal-clamped to prevent level shift due to picture content changes; and secondly, the input level is above or below standard. A manual gain adjustment is provided for use in conjunction with these level lights.

The a-to-d convertor is a critical component of the t.b.c. because of the high operating speed needed. Many of the well known a-to-d techniques, such as ramp conversion and successive approximation, are ruled out because they cannot run fast enough. The preferred approach is the flash convertor which can work at very high speeds owing to its inherent simplicity. Figure 4 shows that each quantizing level has its own binary comparator. A resistor chain and current source produce one reference voltage for every quantizing level. The input signal is fed to the other input of the comparators: there will thus be one binary output for every quantizing level, and a priority encoder is necessary to give a digital output. No sample-hold is

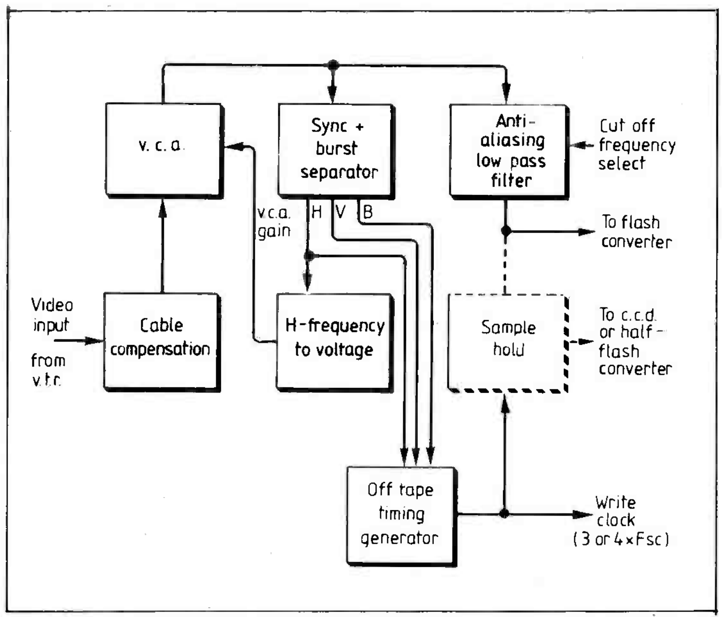


Fig.1. **Input video processing system returns signal amplitude to reference with H-locked Voltage Controlled Amplifier. Following the anti-aliasing filter, video signal can be sent to flash convertor directly. CCDs and half-flash converter require sample/hold (see text).**

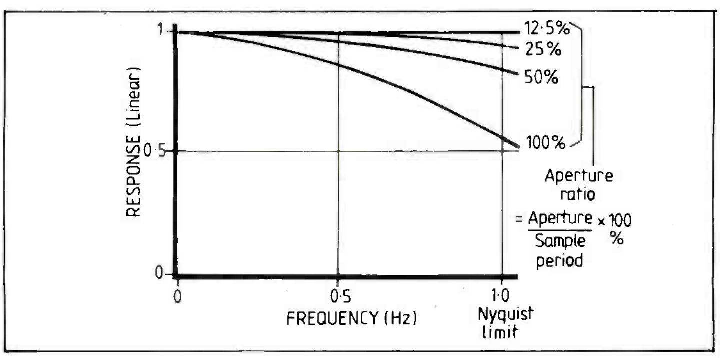


Fig2. **Response due to aperture effect for various aperture ratios. Horizontal axis is fraction of Nyquist limit frequency, e.g. for $4f_{sc}$ sampling, Nyquist limit is $2f_{sc}$, hence horizontal scale would be $0\text{-}2f_{sc}$. The equaliser needs an inverse response to the above to give flat overall response.**

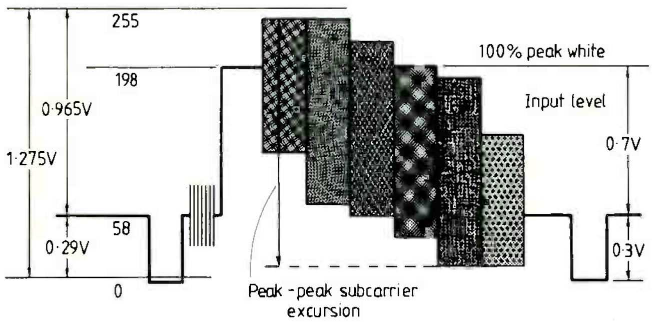


Fig.3. **How the composite video signal fits the quantizing structure. The important range is the total excursion of subcarrier. One quantizing interval is 5mV in this example.**

necessary with such an approach, since all the comparators see the input at the same time.

The simplicity of the flash convertor is offset by the need for one comparator for each quantizing interval, 256 being needed in an 8 bit system. This is a natural application for an integrated circuit, and single chip flash convertors are available. Figure 5 shows the TRW device used in the Ampex TBC-2.

A 256 level flash convertor in discrete component or s.s.i. form is not practicable, and before the single chip device became available, a variation on the flash convertor was used. In the half-flash convertor of the Sony BVT-2000 shown in Figure 6, the input signal is fed to a 16 level flash convertor, which produces a 4 bit resolution output. This is fed to a d-to-a convertor which produces a 4 bit, accurate analogue output. The d-to-a output is subtracted in the analogue domain from the input signal, to produce the quantizing error due to 4 bit conversion. This error is sent to a further 4 bit flash convertor, whose output is appended to the original 4 bits to produce an 8 bit output. Note that there are only 32 comparators, as opposed to 256, which makes the approach feasible with discrete components.

Drawbacks of the half-flash convertor are that the two-stage conversion requires sample hold, with consequent compensation for aperture effect, and that careful adjustment is necessary to minimize non-monotonicity at 16 level intervals.

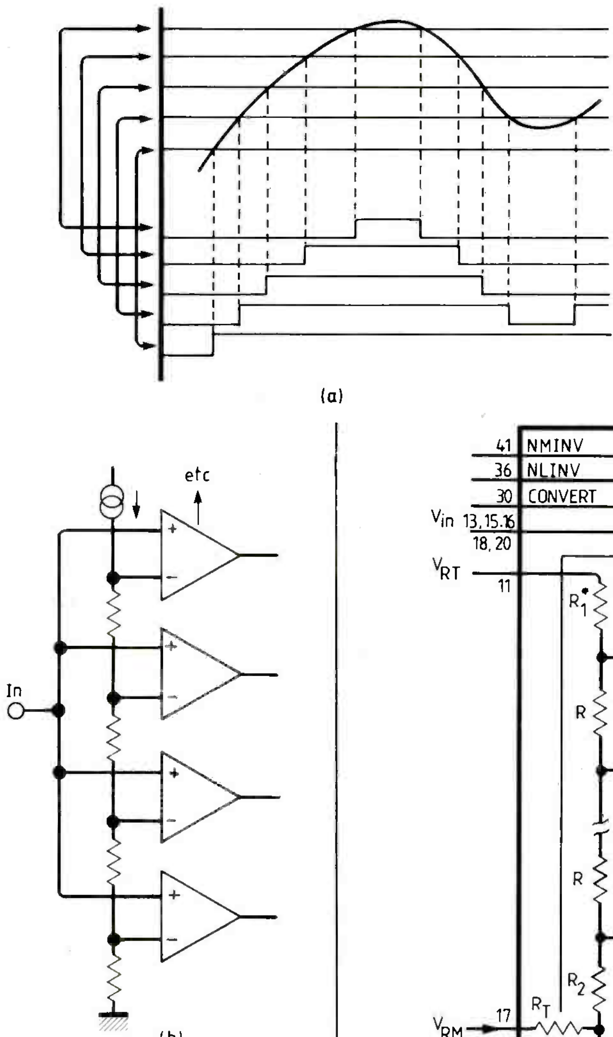


Fig.4. **Flash convertor has one reference voltage for ach quantizing level with which the input signal is compared. Representative waveforms (a), typical circuit.**

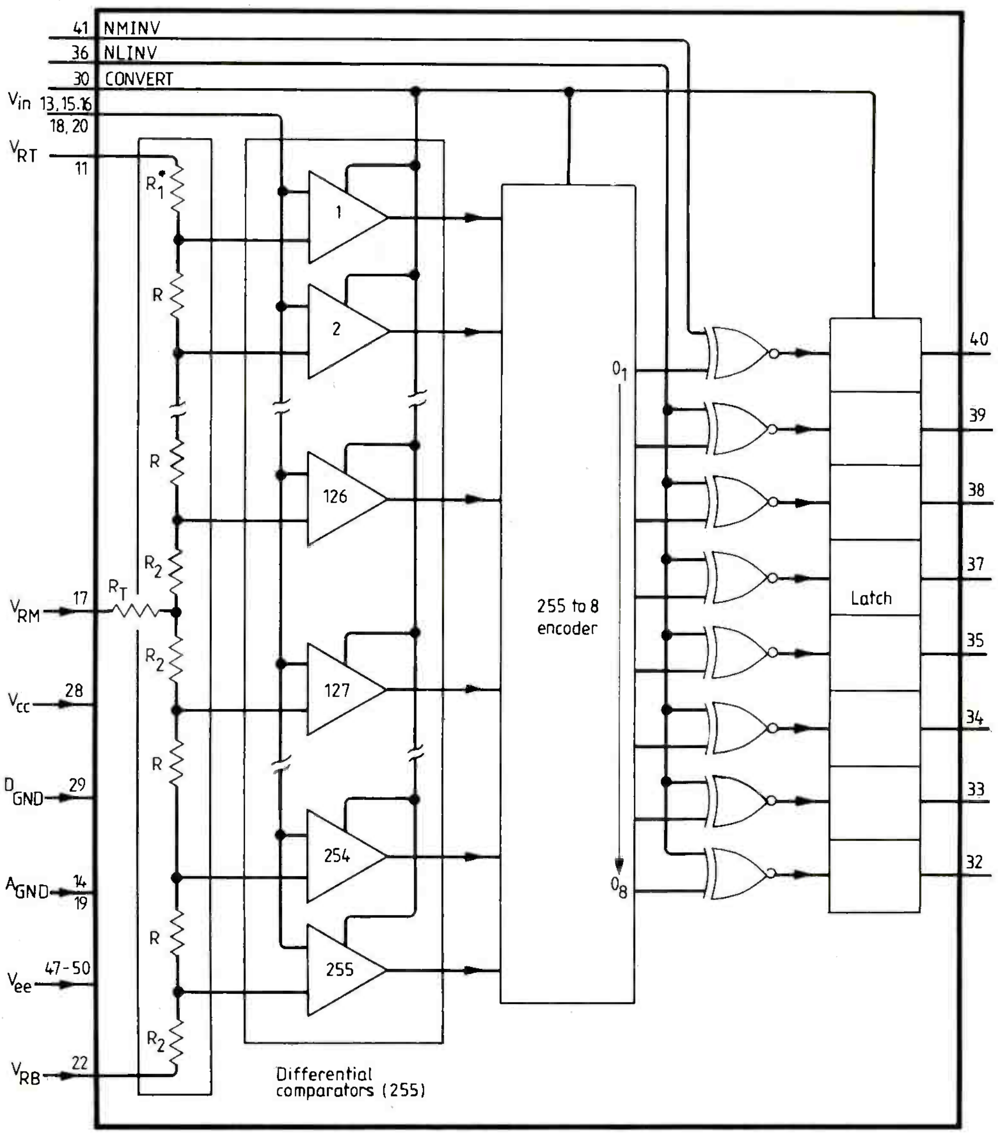


Fig.5. **In monolithic flash convertor, exclusive-or gates facilitate generation of complemented output for some applications. Device shown in TRW1007.**

Memory. The memory can take the form of either RAM or shift registers. As c.c.ds are analogue relatives of the shift register, the description of the latter will serve both.

Memory addressing is split into two distinct subsystems, one controlling the sample address within the line, and one controlling the line address within the available memory.

Owing to the high sampling rates used, interleaving is necessary to permit available memory devices to work within their speed specifications. The degree of interleaving is affected by the chosen sampling rate. Figure 7 shows two examples of current practice: in the Ampex TBC-2, bipolar shift registers are used with $3\times f_{SC}$ sampling, requiring 6 way interleaving whereas the Sony BVT-2000 uses r.a.m. and $4\times f_{SC}$ sampling, requiring an 8 way interleave. Individual storage chips are thus working at the same speed in these two machines.

Since all available chips have capacities which are a power of two, interleaving can also be used to increase the choice of the number of samples stored in a line without sacrificing elegant addressing methods or wasting chip capacity. For example, the six-way interleave of Figure 7(a) stores 768 samples per line (6×128), which at $3\times f_{SC}$ (75ns) stores 768×75 ns = 57.6 microseconds from each line. Clearly the $4\times f_{SC}$ device will need 1K samples to store the same portion of a line. The full 64 microseconds is not needed since syncs are replaced.

A counter is needed for both shift register and r.a.m. storage. In the case of r.a.m. the counter generates the r.a.m. address, whereas with shift registers, the counter determines the correct number of clocks needed to shift data in and out. When memory is written, the counter can vary, whereas when the memory is read, the clock will come from reference, and the only variation will be due to the action of the velocity compensator. A selector is needed for the appropriate clock, and clearly write and read cannot be simultaneous.

Memory line addressing. The functions of the memory line addressing system can be summarised as follows:

a) updates write line address at offtape H-rate, and read line address at reference H-rate.

b) ensures that the four kinds of PAL line* are never interchanged.

c) ensures that the first line of an offtape field becomes the first line of a reference field irrespective of the time difference between these events. This is known as verticle locking.

d) caters for other modes of the v.t.r. such as E-E and confidence playback.

Figure 8 shows that the memory address overflows from the highest back to zero, giving the memory the structure of a ring. The addresses are combined into stes of four to preserve the PAL four line sequence. For this reason PAL C-format t.b.cs always have a line capacity which is a multiple of four. The two least significant bits of the memory address, 2^0, which determines the state of Vswitch at 7.8kHz and 2^1, which determines normal or inverted burst at 3.9kHz are controlled independently of the other address bits. At normal speeds, the correct four line sequence will be assured by resetting these bits during the vertical interval once every four frames, when a colour frame pulse will appear in the VTR control track. This follows from the fact that the 4 line sequence reaches the same phase after four frames since 4 does not divide 625.

At variable speeds, the track jumps executed by the track following head will break the 4 line sequence. However, it is possible

*See Appendix on PAL system

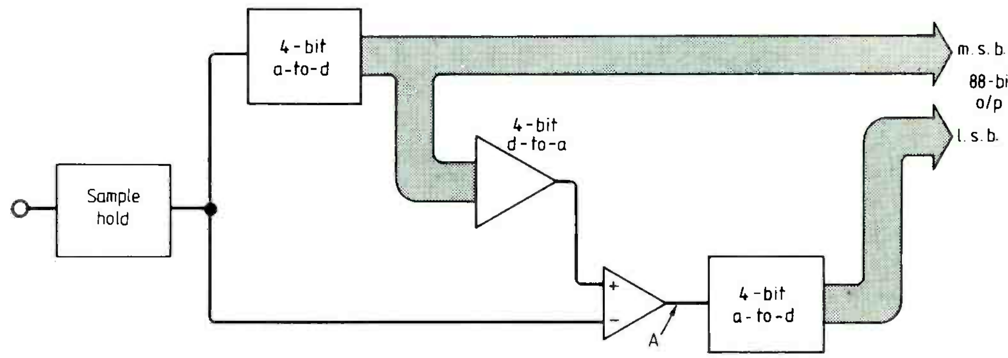


Fig.6. **In the half flash convetor, the input is quantised to 4 bits accuracy, then reconverted to analog and subtracted from the input. The signal at A cannot exceed 16 levels in amplitude for the high order A/D would increment, subtracting a further 16 levels. Signal at A can thus be quantised by a futher 4 bit A/D to give overall 8 bit signal. Sample/Hold is necessary because signal A cannot be determined until after A/D and D/A have operated.**

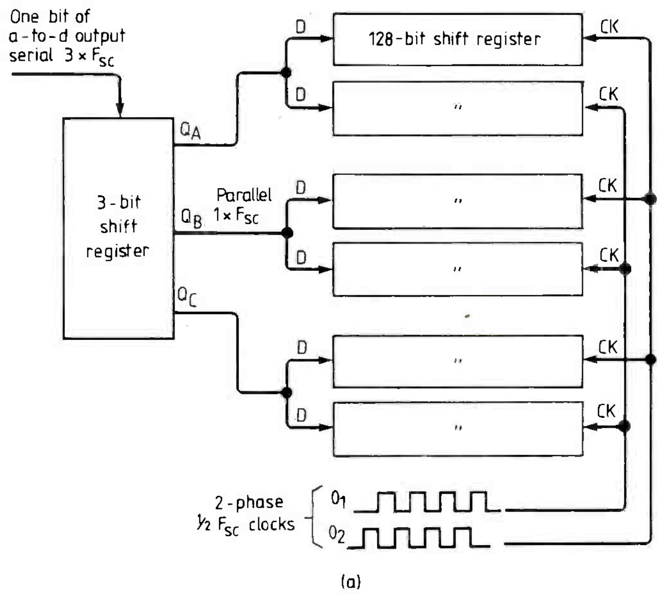


Fig.7a. **Shift register memory of Ampex TBC-2 was 3 to 1 bit rate reduction in shift register and further 2 to 1 reduction by interleaving dual register with two phase clock.**

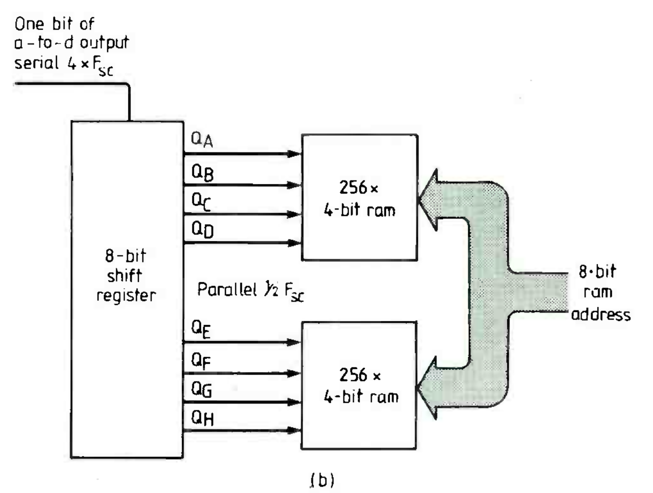


Fig.7b **RAM memory of Sony BVT-2000 uses one stage 8 to 1 bit rate reduction. 256 location RAMs store bits for a pair of lines — good for storage density, but has a side effect of making the window smaller. Note that a and b are repeated 8 times to store 8 bit A/D output.**

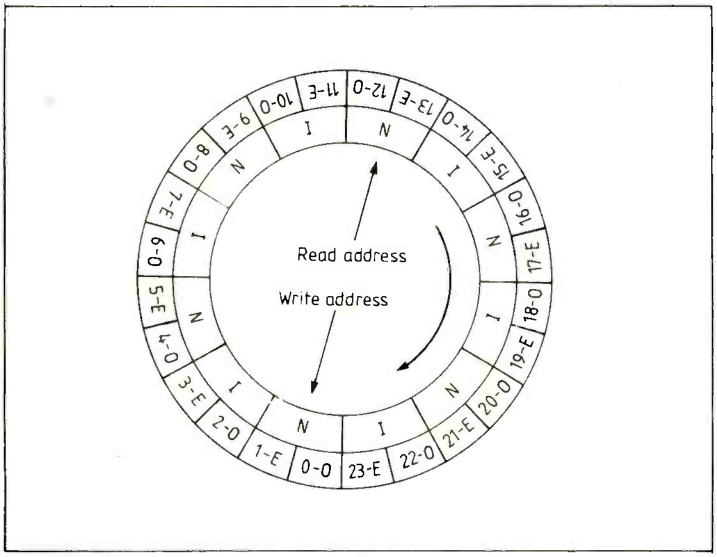


Fig.8. **Ring memory structure of 24 line TBC. Note the subdivision into 4 line blocks in order to cater for the PAL 4 line sequence. N=Normal Burst I=Inverted Burst (3.9KHz) O/E=odd/Even V switch. (7.8KHz).**

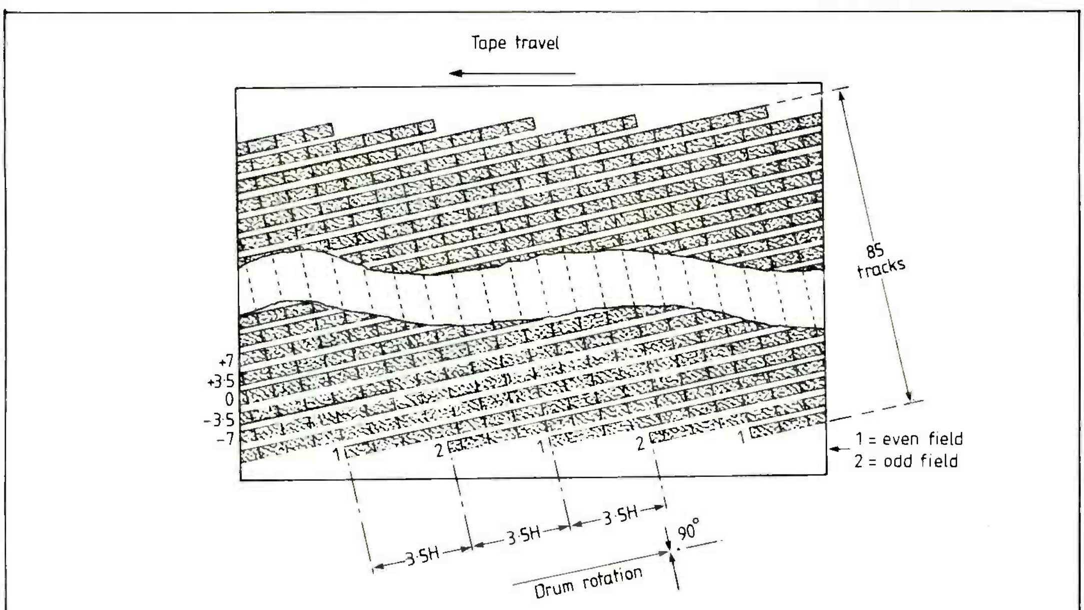
Fig.9. **PAL C-Format tape has 85 parallel tracks at any one perpendicular, with a 3.5H timing shift between each. The 0.5H term cancels the effect of interlace and H pulses in all tracks are aligned. The timing error in variable speed will be obtained by multiplying the head deflection (in tracks) by 3.5H. Eg. +½ track deflection = 1.75H advance.**

to calculate the discontinuity from the number of tracks jumped, and the direction, so the VTR sends this information to the TBC in addition to the video. These precautions are necessary because losing the phase of the four line sequence prevents any subsequent colour difference decoding.

As stated, the read address and write address increment at different rates in varispeed. To quantify this phenomenon, it is necessary to return to the fundamentals of the C-format which are responsible for it. Figure 9 shows a view across a C-format tape. Owing to the chosen geometry, a line perpendicular to the tracks will intersect precisely 85 tracks at points which are successively 3½ lines further along. Upward movement of the track following head is the equivalent of an advance, and downward movement is the equivalent of a delay, relative to drum phase, which the VTR will hold constant relative to reference. When the tape is moving at non-normal speed, the head must follow a ramp in order to stay on track, which causes a steady growth in timing error, until a jump takes place, causing a step timing shift. Clearly the step caused by jumping must be equal and opposite to the gradual timing change caused by deflecting the head to stay on track.

To take some examples, at just below normal speed, the head will repeat one field occasionally by performing a one track reverse jump. This has the effect of suddenly advancing offtape video by 3½ lines relative to drum (and thus relative to reference) timing. Over the next few fields, the slow tape speed will cause timing to slip back gradually until it is again corrected by a jump. Conversely at just above normal speed, a field will be skipped occasionally, and in this case the 3½ line step delay will balance the gradual advance caused by the increased tape speed. In both cases the timing errors stay within 3½ lines, giving an indication of the amount of memory required for correction.

To be continued.



EVENTS

October 30 to November 1
Itame
International test and measurement exhibition, Olympia 2, London. Network Events Ltd. 0280 815226

October 30
Applying the 68000 Family.
Conference at the City Conference Centre, London. Organised by Microprocessors and Microsystems, 0483 31261, ex. 258.

November 1 to 2
Fibre optic gyroscopes
and monomode optional components, University of Strathclyde colloquim at Scottish Business School, Glasgow. Details from IEE 01-836 3357.

November 6
Magnetic thin-film coating
for the recording media. Meeting at the Institute of Physics, 01-235 6111.

November 6
Tolerance design and electronic circuits.
IEE seminar at the Cafe Royal, London. 01-246 1871 ex. 308.

November 6
Systems aspects of robotics.
IEE colloquium. As above.

November 6 to 8
Custom electronics and design show.
Exhibition, Heathrow Penta Hotel. Prodox Ltd, 0890 30664.

November 6 to 7
Custom v.l.s.i.
for control IERE/IEE Conference, IERE 01-388 3071.

November 7
Next revolution in electronics,
GaAs chips, IEE Lecture, as above

November 8
Communications systems for Band III,
IEE Colloquium, as above.

November 8 to 11
Leisuretronics,
home entertainment exhibition, Horticultural Hall, London, Trident 0822 46711.

November 9
CCITT assembly review.
IEE Colloquium, as above

November 13
Opto-electronics
and high-speed devices. IEE colloquium, as above.

November 13 to 16
Compec 84
Professional computer exhibition. Olympia 2, London. Reed Exhibitions 01-643 8040.

November 13 to 17
Electronica 84. Electronics trade fair, Munich. Details from Montbuilt 01-486 1951.

November 15
Comms Satellites
on-board processing. IEE colloquim, as above.

Non-linear systems. IEE control theory colloquium, as above.

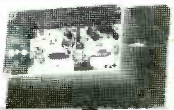
TYPE 9051

TYPE 9046

VMOS WIDEBAND LINEAR POWER AMPLIFIERS. 4W/10W/20 watts RF output. Without tuning. Power gain 10dB. 24V. + supply.

TYPE 9046 100KHz.-100MHz. 4 watts .... £84.50+£3.50 p&p
TYPE 9051 15MHz.-200MHz. 4 watts .... £84.50+£3.50 p&p
TYPE 9171 15MHz.-200MHz. 10 watts .... £140.00+£8.00 p&p
TYPE 9172 As above with integral power supply unit .... £200.00+£15.00 p&p
TYPE 9174 15MHz.-200MHz. 20 watts .... £180.00+£8.00 p&p
TYPE 9175 As above with integral mains power supply unit .... £240.00+£15.00 p&p

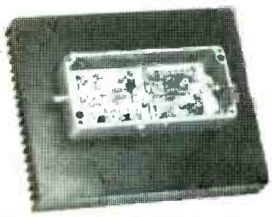
TYPE 9152



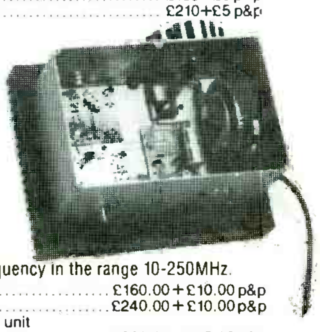
TYPE 9159

TELEVISION LINEAR POWER AMPLIFIERS. Tuned to your specified channels in bands IV or V. (or 400-900MHz).

TYPE 9061 150mV. input, 10mW. output .... £140+£5 p&p
TYPE 9152 10mW. input, 50mW. output .... £180+£5 p&p
TYPE 9159 500mW. input, 5 watts output .... £210+£5 p&p



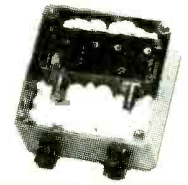
TYPE 9155



TYPE 9157

RF POWER AMPLIFIERS. Tuned to your specified frequency in the range 10-250MHz.

TYPE 9105 10 mW. input, 3 watts output .... £160.00+£10.00 p&p
TYPE 9155 3 watts input, 30 watts output .... £240.00+£10.00 p&p
TYPE 9156 As above with integral mains power supply unit .... £320.00+£15.00 p&p
TYPE 9106 100 mW. input, 10 watts output .... £180.00+£10.00 p&p
TYPE 9158 10 watts input, 80 watts output .... £320.00+£10 p&p
TYPE 9157 As above with integral mains power supply unit .... £400.00+£15 p&p

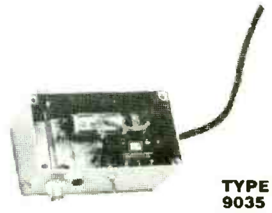


TYPE 9010

TWO STAGE GASFET STRIPLINE PREAMPLIFIERS
Tuned to your specified channels in bands IV or V

TYPE 9002 Two stage Gasfet preamplifier. N.F. 0.7dB. Gain 25dB. High Q filter .. £85+£2 p&p
TYPE 9004 UHF two stage Gasfet preamplifier. N.F. 0.6dB. Gain 25dB. Aligned to your specified frequency in the range 250-500MHz. High Q filter .... £85+£2 p&p
TYPE 9012 Gasfet preamplifier mains power supply unit .... £24.50+£3 p&p
TYPE 9010 Masthead weatherproof unit .... £6.50+£2 p&p

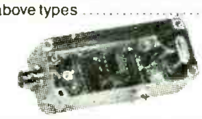
TYPE 9006



TYPE 9035

GASFET RF PREAMPLIFIERS. Aligned to your specified frequency in the range 30-250MHz. Masthead or local use.

TYPE 9006 N.F. 0.6dB. Gain 10-40dB. variable .... £65.00+£2 p&p
TYPE 9006FM As above. Band II 88-108MHz .... £65.00+£2 p&p
TYPE 9035 Mains power supply unit for above types .... £24.50+£3 p&p



TYPE 8034

TYPE 8034 PHASE LOCKED SIGNAL SOURCE using low frequency reference crystal. Specify output in the range 1-600MHz. Output 10mW.+10dBm .... £84.50+£2 p&p
TYPE 9113 TELEVISION FREQUENCY CONVERTER. Changes channels in the range 40-1000MHz .... £242+£5 p&p
TYPE 9056 1500MHz PRESCALER. Divides 100-1500MHz by 10 .... £79.50+£2 p&p
TYPE 9086 FM TRANSMITTER 88-108MHz. 50 watts RF output. 24V + supply. Complete modular system .... £480+£30 p&p
TYPE 9087 As above with integral mains power supply unit .... £540+£40 p&p

RESEARCH COMMUNICATIONS LTD.

UNIT 3, DANE JOHN WORKS, GORDON ROAD, CANTERBURY, KENT CT1 3PP
TELEPHONE: CANTERBURY (0227) 56489

PLEASE ADD 15% V.A.T. ON TOTAL

CIRCLE 28 FOR FURTHER DETAILS.

Happy Memories

Part type	1 off	25-99	100 up
4116 200ns	1.25	1.15	1.10
4164 200ns Not Texas	4.75	4.25	4.10
2016 150ns	4.75	4.25	4.10
6116 200ns Low power	7.75	Call	Call
6264 150ns Low power	31.50	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	6.65	Call	Call
27128 300ns Suit BBC	18.95	Call	Call

Z80A-CPU...£3.75 Z80A-PIO...£4.20 Z80A-CTC...£4.85

Low profile IC sockets:									
	Pins	8	14	16	18	20	24	28	40
	Pence	12	13	14	16	18	24	27	38

Soft-sectored floppy discs per 10 in plastic library case:
5 inch SSSD £17.00 5 inch SSDD £19.25 5 inch DSDD £21.00
5 inch SSQD £23.95 5 inch DSQD £26.35

74LS series TTL, wide stocks at low prices with DIY discounts starting at a mix of just 25 pieces. Write or 'phone for list.

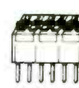
Please add 50p post & packing to orders under £15 and VAT to total
Access & Visa welcome, 24hr 'phone service on (054 422) 618
Non-Military Government & Educational orders welcome, £15 minimum.

HAPPY MEMORIES (WW)
Gladestry, Kington
Herefordshire HR5 3NY
Tel: (054 422) 618 or 628

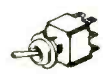
CIRCLE 48 FOR FURTHER DETAILS.

ELECTROVALUE

Your SPECIALIST SUPPLIERS for SWITCHES



Out of a very wide range of types, we show some of the more popularly demanded ones. The full range currently stocked will be found in our latest free A-Z price & products list. Please mention this journal when contacting Electrovalue.



MINIATURE TOGGLES, 7000 Series 250V/2A, 120 V/5A. Single, double, three and four pole configurations inc. Centre Off/On and biased.

CK WAVECHANGE with adjustable stops. 1P/12 way, 2P/6W, 3P/4W, 4P/3W, 6P/2W.

SWITCH KITS
RA Shaft Assemblies up to 6 wafers. DP Mains switch. Screens; Spacers.

PUSH BUTTON
Miniature
Single and Double Pole Changeover
Standard
Latching and momentary

SLIDERS
Miniature & Standard. SP and DP in 1, 2 or 3 positions.
Many other types such as for timing and other special applications.

BRITAIN'S LEADING QUALITY COMPONENT SUPPLIERS - SEND FOR FREE 40 PAGE A-Z LIST
ATTRACTIVE DISCOUNTS-FREE POSTAGE-GOOD SERVICE & DELIVERY

ELECTROVALUE LTD 28 St. Jude's Road, Englefield Green, Egham, Surrey TW20 0HB

Tel: (0784) 33603. Telex: 264475. *North:* 680 Burnage Lane, Manchester (061-432 4945). *EV Computing Shop,* 700 Burnage Lane, Manchester (061-431 4866).

ACCESS AND BARCLAYCARD Phoned Orders Welcome

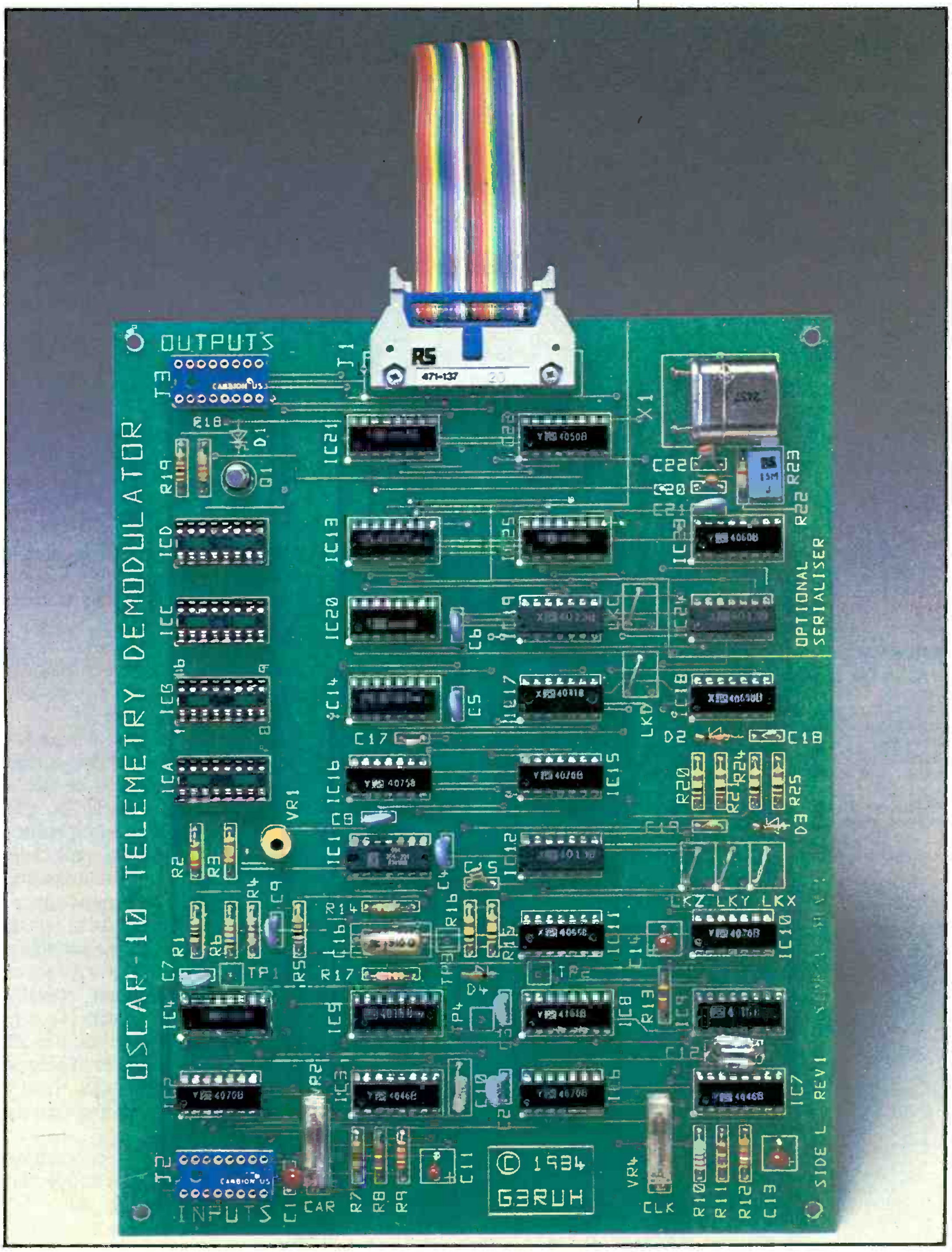
2

CIRCLE 82 FOR FURTHER DETAILS.

Telemetry decoder for Oscar-10

by J. R. Miller, B. Sc.

James Miller concludes his desigh with a look at the software requirements and an alternative decoding technique



Once the system has been adjusted it may be checked out live or with a test tape. The waveforms obtained should be as shown in Figs.6, 7 and 8 (October issue). A number of features of the satellite data make this easier. The padding character hex 50 and <space> both occur in longish bursts. In addition, the sync code tester will obviously not work unless everything else is going properly, and so illumination of the 'block' led once every 14 seconds for 10 seconds provides a quick, comprehensive overall check.

The design of the software to decode and display the data is straightforward enough, but it is outside the scope of this article to present it in full.

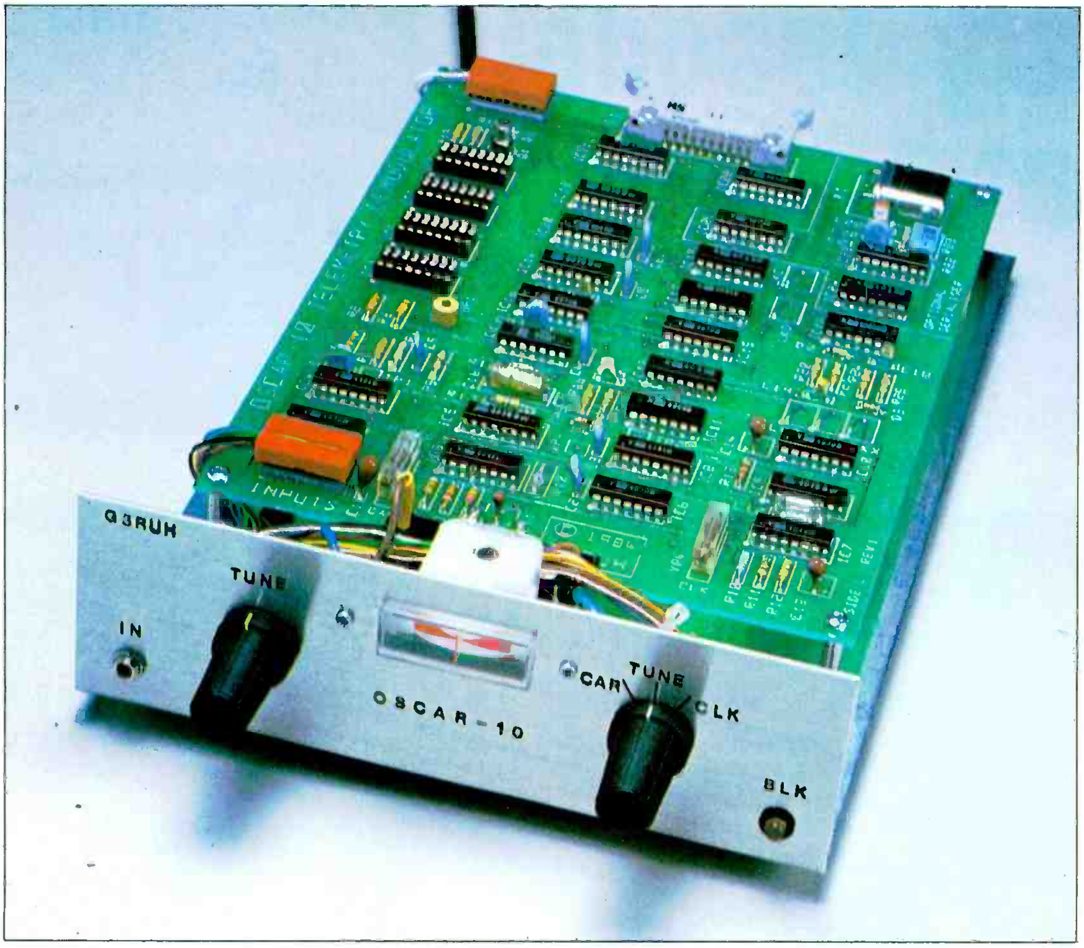
The computer should examine the block flag until it is asserted, then wait for a byte strobe. It should then read in the byte, place it into a 512-byte buffer and await the next strobe. Alternatively, bits may read in serially and packed away.

When all 512 bytes have been read, decoding can begin. In real-time there are four seconds in which to do this. Check that first two bytes are recognisable identifiers, e.g. Q <space>. Then all that remains is to pick out the items of interest such as volts, amperes and temperatures and to display them on a printer or screen in an appropriate format.

Alternatively it is possible to dump the lot, or selected bytes, to storage for later processing, perhaps to monitor specific parameters or to plot graphs.

A simple program for display using the BBC microcomputer is available from Amsat-UK[1], and is suitable as a basis for experimentation.

A useful indicator of performance is given by the bit error rate.



If we define a reasonable rate as less than 1 in 10 000 bits, i.e. an average of one error every other block, the theoretical channel signal-to-noise ratio (s.n.r.) should be 2.4dB in 1600Hz bandwidth. Allowing for the signal amplitude modulation and the limiter, the practical figure is actually about 6.2dB, peak signal power to noise power, or 2:1 in voltage. With care this can be verified experimentally — the signal sounds and looks pretty ragged.

An s.n.r. of 6.2dB is represented in the lab by the surprisingly small figure of 52nV (—133dBm) at the input of a receiver having a 3dB noise figure. Now, the 2m general beacon transmits about 1W (+30dBm); the space loss over a 40 000km path is 168dB, so the received signal at a unit gain antenna is roughly —138dBm. Thus an antenna gain of 138 — 133 = +5dBi is needed, plus a margin for fading, cable losses, wider bandwidth, higher receiver noise figure and so on.

In practice this means that for satisfactory reception a modest Yagi or equivalent is needed, pointed at the satellite.

It is worth noting that it is typical of optimal demodulators that they exhibit a marked performance threshold effect. In our '6.2dB' example above, a reduction in the s.n.r. of only 1dB results in a dramatic tenfold error rate increase. This is most apparent where there is a rapid fading (usually induced by the satellite's 50 rev/min spin): what appears to be a healthy signal actually results in bursts of errors at s.n.r. minima. Spin fading occurs most strongly a few hours each side of apogee, when the spacecraft's antennas are not pointing directly towards Earth.

Another point concerning errors: because of the differential decoding scheme, a single bit error leaving the integrate-and-dump section results in two adjacent bit errors at the system output. This should be remembered if any software error checking is to be attempted.

A further decoding method

Finally, there is another method of decoding the signals. There is a distinctive relationship between the message bits (as opposed to data bits), and the encoded stream D*Clk signal with missing inter-bit transitions, whereas a message 0 does not (see Fig.3, October issue).

So an alternative decoding method is to treat D*Clk as a stream of 800bit/s half-bits, grouped in pairs. Two similar successive half-bits are decoded to a logic 1 output, and two differing half-bits to a 0.

This can be implemented most simply by feeding the integrator with D*Clk, clocking the integrate-and-dump and differential decoder with I:800, and inverting the data output sense! Links X, Y and Z are provided to enable experimenters to evaluate this.

The error properties of this arrangement are interesting:

- because the signal energy per dump decision has halved, the half-bits' intrinsic error rate is much higher than a whole bit's, but
- it is now possible for single message bits to be corrupted.
- The presence of a mid half-bit-pair transition for zeros implies that the carrier energy per bit for a 0 is about two-thirds of that of a 1. So message 0s are more easily corrupted than 1s.
- This contrasts with the whole-bit decoder, where 0 or 1 data bit errors are equally likely but *two* message bits are always corrupted together (though less frequently).

REFERENCES

1. Amsat-UK, London E12 5EQ, England. Oscar-10 Operating Manual, £3; The Satellite Experimenter's Handbook £9.90 (members £8.50); Oscar-10 telemetry test data tape, £6 (members £5); telemetry decoding software for the BBC microcomputer, on cassette £6 (members £5); p.c.b. £15. Prices include packing and UK postage; overseas postage costs extra. A stamped addressed envelope should accompany *all* enquiries. Amsat-UK depends on donations.

Table A. connection details

J_2 — inputs		J_3 — outputs	
1 Audio in	16 +12V	1 +5V in/out	16 +12V
2 0V	15 TP1	2 0V	15 Led+
3 Car. lock } to S_1	14 TP2	3 Block	14 Led—
4 Tune } to S_1	13 TP3	4 Ser.data	13 —
5 Clk lock } to S_1	12 Tuning, VR_3	5 Ser.clock	12 —
6 Meter amp.	11 Tuning, VR_3	6 —	11 —
7 TP4/Clk	10 Meter—	7 —	10 —
8 0V	9 Meter+	8 0V	9 —

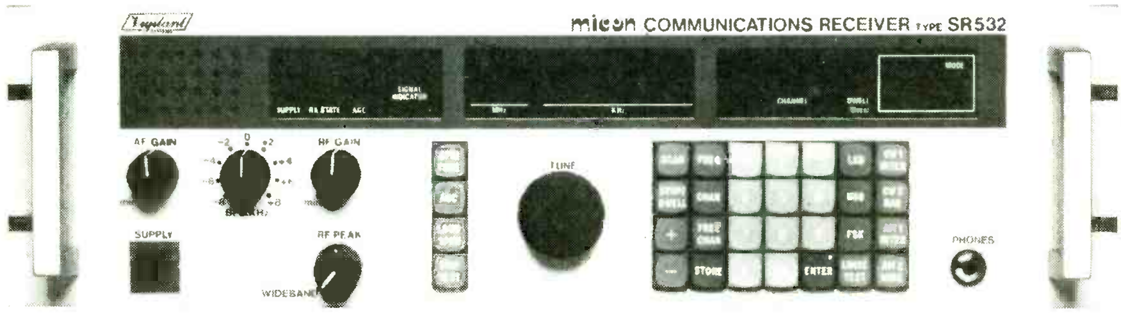
Acknowledgements

My thanks are due to friends Trevor Stockill for encouragement, p.c.b. layout facilities, instant hardware and BBC computer software advice; Philip Howarth for criticism of the manuscript; Andy Kerr for being the constructors' guinea-pig; to Ron Broadbent of Amsat-UK; Janet for letting me hog our home computer, and to Cambridge Consultants Ltd for the free use of facilities.

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 10^7/°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
Dwell	: Variable from Keypad 1 to 9 seconds

KEYPAD FUNCTIONS INDICATED BY DISPLAYS

NOW AVAILABLE AT HIGHLY COMPETITIVE PRICES

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

CIRCLE 20 FOR FURTHER DETAILS.

KONTAKT

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 spray residues. No compressed airline needed. With plug-in nozzle even blows around corners. Ready for use in the service kit.

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

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

Spray Wash WL
A rapid cleaner 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, K88 Oil Spray, K701 Vaseline Spray, K90 Video Spray, K33 Graphite Spray, K100 Antistatic Spray, K101 Fluid Spray and, of course, Positiv 20 positive photo resist for printed circuits.

Details from:

Special Products Distributors Ltd.
81 Piccadilly, London W1V 0HL
Tel: 01-629 9556. Telex: 26500 (answerback RACEN)
Cables: Speciprod, London W1

CIRCLE 23 FOR FURTHER DETAILS.

AEL AT SPEED

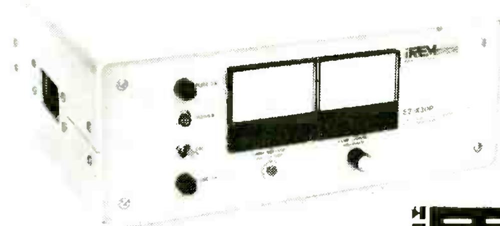
TO BE CRYSTAL CLEAR
Tel. 029-34-5353 Telex 87116 Aero G
MOD approved CAA approved

CIRCLE 37 FOR FURTHER DETAILS.

ELECTRONIC POWER UNITS

FOR XENON ARC AND MERCURY ARC LAMPS
UNITS AVAILABLE FOR LAMPS RANGING FROM 75 TO 6500 WATTS.

Lamp housings and lens systems manufactured as standard off the shelf models or to specific design.



iREM

K. T. Manners Design Ltd.
P.O. Box 936, London, W4 4NW Telephone: 01-994 7155. Telex: 28604

CIRCLE 15 FOR FURTHER DETAILS.

Intelligent eprom programmer

On its own, this microprocessor-controlled programmer can copy a range of eproms up to the 27512 and send contents to a serial printer — under computer control it can do much more,including the programming of single-chip microcomputers. 'Intelligent' algorithms are used to greatly reduce programming time.

by J.H. Adams, M.Sc.

The gamut of eprom programmers available today ranges from simple extensions for a specific computer to completely independent units which are effectively computers in their own right. Simple ones don't even offer verification. Complex ones are often bulky, very expensive and, even when they cost thousands of pounds, need another computer for loading data from a disc file into an eprom — typically the last step in producing eprom firmware.

This eprom programmer designed for SC84* is a general-purpose unit which may be operated by any computer through an RS232 link. When acting as a computer peripheral it can be used to check eproms, load their contents into a disc file, program the contents of a disc file into an eprom and directly copy eproms. On its own the programmer can copy eproms, check their erasure and send the contents of an eprom to a printer in formatted hexadecimal and ascii. Printing eprom content is useful for identifying an eprom, checking an erasure or just listing device content. Four common serial printers data rates are selectable on the programmer front panel.

All currently available single-supply 27-type eproms, from the 2716 to the 27512, can be programmed by the instrument as can proposed 12.5V A-series devices. Where applicable, the programmer makes use of 'intelligent' or 'interactive' programming algorithms devised by eprom manufacturers to speed up the programming of larger devices. This, together with some built-in features, typically reduces the nominal programming time for such devices by 75% — and all for under £100.

One of my daily tasks is designing embedded microprocessor systems using so-called one-chip microcomputers. With this in mind, the solution to this quite complicated specification seemed obvious — use a microcomputer. Probably the most popular one-chip microcomputer family is the 8048 series by by Intel, Philips and many Japanese manufacturers. These processors are primarily intended as 'one-chip' systems, the microcomputer containing program rom, read/write memory, clock generator and input/output facilities. Not widely known though is that there are versions for use with an external program rom, and with such devices powerful 'three-chip' systems can be made. While the program addressing capability may seem limited and the instruction set rather small, what instructions there are are very effective when the microcomputer is being used in a system like this one with many control lines.

The programmer requires 43 control lines, some input, some output and some bidirectional, which is beyond even the 40-pin 8048 processors, but special i.cs called i/o expanders are available for just such requirements. These i.cs offer between 12 and 16 extra individual i/o lines each and are specifically designed for use with the 8048 which has a set of instructions for addressing external expanders. There are various members of the 8048 family, the differences being in the amount and type of internal memory. The one chosen for this programmer is the simplest, the 8035. This processor has no internal rom, an external addressing range of 4Kbytes of program rom and 32bytes of

*SC84 was described in the May, June, July, September and October issues of *E&WW*

Programmer specification

Eprom types programmed	2716, 2732, 3732A, 2764, 2764A, 27128, 27128A, 27256, 27512, 8741, 8748, 8749
Modes	Computer peripheral Programmer-control functions and eprom data i/o through 9600 baud serial link. Eprom reading, copying and programming under computer control. Disc-file to eprom and *vice versa*, sum-check master or slave and copy master to slave using SC84 software. Manual controls are inhibited. Stand alone Manual controls, verified by sounder, for eprom copying, erasure verificationand sending contents of eprom to a serial printer, etc, in formatted hexadecimal and ascii form at one of four data rates.
Interface	RS232C bidirectional with hardware handshake Eight-bit data, , l.s.b. first, no parity, two stop bits send, one or two stop bits receive.
Printer data rates	9600, 2400, 1200 and 300 baud
Controls	Four push controls, PROG — programs selected master to slave eprom LIST — lists master eprom via RS232 port UP — increment selection pointer DOWN — decrement selection pointer
Processor	8048 microprocessor with i/o extenders controls above functions and uses 'intelligent' programming algorithms where applicable to reduce programming time by at least 75%.

internal general-purpose read/write memory. Together with two 8243 i/o expanders, the program eprom, a latch to catch the eprom address, a counter to generate the programming address, RS232 buffers, relays, switches, leds, and p.s.u., it makes a powerful and versatile program.

The problem with eproms is that their manufacturers implement an eprom, such as the 2704, in a 24-pin package and then immediately start work on the next device. As each new eprom is introduced, its doubled memory capacity demands an extra address pin — the 2732's 24-pin package is bursting at the seams. Data and address pins cannot be omitted and as a result, the number of control pins decreases and hence their use gets more complicated. When the 2732's successor was introduced, it had to be in a larger 28-pin package and this gave the luxury of three separate control lines (chip-enable, data-output enable and program), a separate programming-voltage pin and one to spare. The spare pin disappeared in the 27128 and by the time the 27512 was designed, the eprom was back in the same straitjacket. What will happen next, according to one maker at least, is a 30-pin i.c.

Running concurrently with the development of 27-series eproms has been the 25 series with a different pin configuration, which mercifully died out at the 2564 level, and the odd maverick such as a 24-pin version of the 2764 from Motorola. The standard is now the 27 series and, learning from mistakes made with 24-pin devices, the pin configuration of 28-pin devices was agreed and registered with JEDEC early on, resulting in easier circuit design and later expansion.

The only headache left is for the eprom programmer designer. High voltage needed to program 27-type eproms has proliferated from the original 25V to include 21 and 12.5V. Also, 'intelligent' programming algorithms introduced to reduce programming times of larger devices involve such unorthodoxies as stepping V_{cc} from 5 to 6V and using modes specified to function only between 20 and 30°C.

Intelligent programming

Intelligent or interactive programming algorithms are techniques which eprom manufacturers have developed to speed up the programming of eproms without compromising data integrity. The programming technique in use since the introduction of the first single-supply eproms has been to apply the specified programming address and data and then to apply a 50ms programming pulse. This was brute-force programming to a certain extent, the pulse length being long enough to definitely program eproms whatever their characteristics. Using short pulses, the problem has been in checking that an eprom location is programmed sufficiently to retain data on a long-term basis and not just enough to scrape through a verificiation. Pulse shortening is necessary though — it would take about an hour to program 27512 using 50ms pulses.

The solution adopted by manufacturers (with slight variations) is to raise the supply by 1V during programming and verification. Increased sensing thresholds within the eprom mean that even a marginal verification at 6V will ensure correct operation at 5V. In outline, the algorithm repeatedly programs the eprom with 1ms pulses and checks it during an interactive period. Next an extra programming section is carried out for safety and finally the eprom is checked at a 5V supply. Typical programming times are reduced by a factor of four or five using this algorithm. Further increase in speed in this and conventional programming (for 24-pin devices) is achieved by checking whether or not a location actually needs programming before attempting to program it. After erasure, an eprom contains all FF bytes (hexadecimal) so for speedy programming, all unused data bytes to be sent to the eprom should be set to this value (hence FILL and NEW commands in MCOS). To illustrate the advantage of this technique, the programming time for a 2764 is reduced from seven minutes to just one.

Programmer hardware

Most of the design effort went into the 8035 control program and the SC84 program for controlling the programmer as a peripheral. These will be described later — first the circuit.

All devices in the 8048 family can all be forced to access external memory by wiring a specific pin to +5V. This even applies to the preprogrammed variety so the 8048 and 8049 are suitable. At least one supplier of 8035 i.cs is supplying 8048 devices to overcome the present shortages. In its 'one-chip mode', the 8048 offers three eight-bit ports.

When external program storage is used, port zero forms a multiplexed data and lower-address bus and the lower four lines of port two form the upper four address lines. An address-latching signal ALE (address-latch enable) and a rom-enabling signal PSEN (program-source) are used to control the fetching of instructions. As data regularly appears on these 12 lines, the three-chip solution restricts the use of ports zero and two compared with a true one-chip circuit. However, port zero may still be used as a conventional data bus. The 8048 has Z80-like read and write signals which can be used to access i/o devices connected to port zero or, in conjunction with the latched address and special MOVX (move external) instructions in the processor, external read/write memory.

To compensate for the loss of i/o capability, the lower four lines of port two, as well as providing rom addresses, act in conjuncton with another control line called PROG to pass data between the processor and i/o expander i.cs. A typical three-chip solution — the one used here — would therefore use port zero to access the program rom, half of port two to supply rom addresses and the expander interface and the other half of port two to provide general i/o or, when more than one expander is fitted, act as an expander selector. Port one becomes an uncommitted eight-bit port.

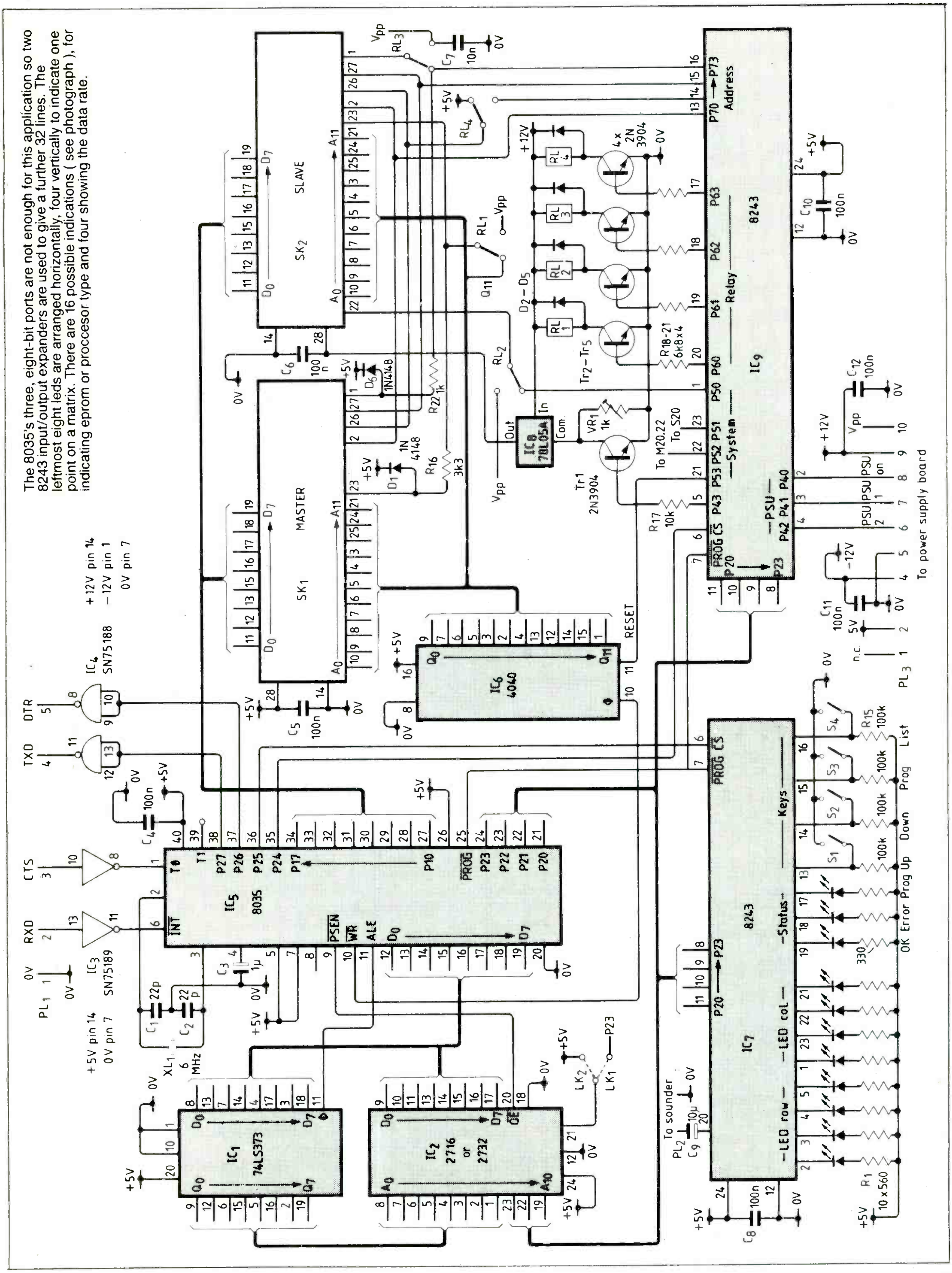
As suggested above, the 8048 can only address one expander at a time. To simplify the software design it is important that the system does not keep switching between expanders and so the allocation of lines has been split so that one expander, EXP0, is concerned with the programmer's controls and display and the second, EXP1, with control of the programming process. Each expander consists of four, four-bit ports. These ports may all be used for both input and output although all four lines each port must be either inputs or outputs. As well as being able to transfer data between the processor accumulator and the ports, the processor can AND and OR patterns into the ports to set individual lines high or low.

The ports are numbered four to seven in the processor instruction set. In expander zero, ports four and five are used for the led display, port six to drive the three status leds and an optional sounder which gives an audible indication of keypad use, and port seven to sense the four keys. In expander one, port four controls V_{cc} and V_{pp} supplies, port five provides control signals for the eproms and address counter, port six energises relays used for power control and port seven controls those eprom lines which can act as higher-order address lines.

Expander zero is activated while the programmer is being set up, either from the key-pad or the computer. Once given a command, expander one is selected, the lines are set to suit the selected eprom and the command is executed. The only exception to this is during the list operation when the processor switches back to expander zero after each printed line to make sure that you are not trying to interrupt the listing by pressing one of the keys.

Serial i/o is performed through lines on the microcomputer as, under computer control, the system must be able to sue serial i/o at all points in the program. The asynchronous receiver/transmitter for reception and transmission of serial data is all in software, the data format being eight bit with no parity, with one start bit and two stop bits on send, one or two stop bits on receive. When listing an eprom the most significant bit is alway zero. Data rates of 300, 1200, 2400 and 9600 baud are provided for the listing port so that the programmer may be used with a variety of printers, electronic and mechanical. The data rate for the computer link is set at 9600 baud, which is also the default rate for the listing port. Other data rates are easily established by modifying the control eprom. The RS232 lines are buffered directly in and out of the processor. The two output lines (data and handshake) come from the two spare lines of port two; the two inputs feed in through one of the 8048 T (test) inputs and the external interrupt line. This leaves port one as the bi-directional eprom data bus.

The lower 12 address bits are produced by a 4040 cmos counter, this being a cheaper solution for providing another 12 i/o lines than fitting another i/o expander. This i.c. is cleared by a control line from expander one but, as



The 8035's three, eight-bit ports are not enough for this application so two 8243 input/output expanders are used to give a further 32 lines. The leftmost eight leds are arranged horizontally, four vertically to indicate one point on a matrix. There are 16 possible indications (see photograph), for indicating eprom or processor type and four showing the data rate.

there are no other lines to spare on this expander, it is clocked using the 8048 WR signal, this and RD being general-purpose strobes when there is only program memory on port zero.

Using the programmer

When the system is switched on or reset, the indicator leds point to 2716 (i.e. 2716 programming is selected), the high-voltage supply is turned off, a printer rate of 9600 baud is selected and the link to the computer is enabled. The system then loops, waiting for either a press of one of the four keys on the programmer or for a character from the computer. If a command key is pressed, the link to the computer is disabled until the selected operation, list or program, is completed. If a byte is received over the link first, the system is placed under computer control and keys on the programmer are ignored until a command has been received and executed.

While in stand-alone mode, repeated pressing of the up or down keys moves the led pointer through the various eprom types and data rates. When the led pointer is in the eprom area of the selection table, pressing PROG initiates programming and LIST listing of the indicated eprom type. When the pointer is in the data rate area of the table, pressing prog has no effect but pressing LIST selects the indicated rate for the printer interface. The programmer acknowleges valid key presses by a single 'beep' and valid commands by a double one. Note that if an eprom which doesn't match the type selected is put into the slave socket, you may damage both the eprom and the programmer (depending on how the eprom fails) when you operate the programmer. No damage will occur to an eprom in the master socket (providing it is not put into the socket the wrong way around), nor are there any programming voltages present on the master socket. As the behaviour of the programmer is uncertain at the moment of switch-on or off, it should not be turned on or off with an eprom in the slave socket.

In listing mode, the eprom is listed as for the SC84 MCOS LIST command, i.e. the address of the first byte on line followed by the contents of 16 consecutive eprom locations in spaced hexadecimal, grouped in clumps or four bytes. At the end of the line, the same 16 bytes are repeated as either their ascii representations if they are valid ascii characters, or as periods. Note that, to save i/o lines, the lower 12 address lines for the eprom addresses are generated by a 12-bit ripple counter. As this address cannot be stepped backwards, as would be possible with a software address counter, the 16 bytes are stored in the 8035 internal memory as they are accessed for hexadecimal listing so that they are available for the ascii section of the listing. Listing mode can be interrupted by holding down either the up or down key.

In programming mode, a 16-bit address counter is maintained in parallel with the external counter so that the system can decide when the programming operation is complete and, when larger eproms are being programmed, set up the higher-order address lines as required. A 24-bit data sum check is maintained for each eprom. The least-significant byte of each sum check is compared during programming operations after each byte is programmed and the operation terminated if they are found to differ. At the end of the programming session, one of the status leds is set, OK or ERROR. If the programming is under computer control, an eight byte result frame consisting of the programming address value, the master sum check and the slave sum check is sent back to the computer. From this information the computer is able to deduce if the programming was successful and if not, at which address the error occurred and which bit(s) in the slave eprom failed to program. When under computer control the progress of the operation is indicated by the steady conversion of the last message displayed into reverse video. Do not expect the programming to take place at a steady rate, especially when a 2764 or larger eprom is being used as the programming algorithm is data-dependent.

The circuit, as with much modern digital equipment, is just a collection of interconnected i.cs. The originality is really in the software. The resistor and diode arrangement feeding pins 1 and 23 of the master eprom socket allow the slave and master pins to be driven from the same source. Depending on the eprom type these pins may be address lines or programming voltage pins. In the latter mode the slave socket will need to receive the programming voltage and the master socket +5V at between 5 and 15mA depending upon the eprom. As a cmos device cannot supply this current without some voltage-drop, the master socket is not permanently driven by the relevant signal line set high but is driven from the high-voltage supply to the matching slave pin with a diode to clamp the voltage to no more than one diode drop above 5V, and a resistor to limit current. Pin one is V_{pp} on 2764, 27128 and 27256 devices, but A_{15} on the 27512s. Pin 23 is A_{11} on all eproms except for the 2716 where it is V_{pp}. In fact, both of the pins on the master socket could be set to their respective V_{pp} levels and the master eprom read normally as this is the mode described as program verify in the data sheet. I decided for safety's sake however to keep all voltage over +5V off the master socket though so that should the wrong eprom for the selection made be put into the master socket there would be no chance of it being damaged or reprogrammed. Naturally, when an address line is supplied to this and the slave's pin 1 or 23, the diode stays off and the extremely high input impedance of the eprom makes the resistor's effect negligible.

Relays were used to switch eprom pins which alternate between signal and power pins depending on the eprom (pins 1, 22, 23 and 26) for simplicity and to avoid variable voltage drops which could affect the programming voltage. Levels of V_{pp} are critical during intelligent programming, where using a 2764 as an example, a V_{pp} of 20 completely negates the potential speed up while a potential of over 22V will destroy the device. Power to pin 28 of the slave eprom is switched electronically between +5 and +6V.

The power supply provides unregulated lines at approximately +12V and —12V for the slave power, relays and the RS232 interface, and a regulated 5V rail for the logic. It also provides a programmable high-voltage supply which the programmer can set to zero and up to three other voltages up to 30V at up to 50mA.

To be continued

Power supply and setting-up procedures are subjects of the next article. Software and an adaptor for programming eprom versions of the 8048 microprocessor will be described later. Components and software are available from John Adams at 5 The Close, Radlett, Hertfordshire, telephone Radlett 5723. Printed circuit boards, currently under manufacture, will be available from Combe Martin Electronics, King Street, Combe Martin, North Devon EX34 0AD.
An enhanced version of SciDOS — the CP/M2.2-compatible disk operating system for SC84 — has recently been introduced. Users of SciDOS can obtain an updated disk for £5 including postage. Details of this can be obtained from John Adams by sending an s.a.e.
A hexadecimal listing of the programmer software can be obtained from our editorial offices at Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Again, please send an s.a.e.

Fast, reliable and low-cost EPROM programming

Our new EPROM/EEPROM programmers give you unmatched efficiency and value for money. They're designed to handle the latest high-density devices, and offer simple and reliable operation. Look at the features:

Production programming:
For production applications, there are three models in the 9000 series, all offering:

- programs up to 8 devices simultaneously
- devices to 512-kbit density
- all major fast-programming algorithms
- software selection – no adapters
- 16-character alphanumeric display
- auto self-test and fault detection
- simple menu-driven operation
- simple keys for operation/editing

And these options:

- powerful editor with 8/16-bit programming
- serial and parallel interfaces
- label printing, codelock, remote control
- add-on emulation

You can buy our model P9010 duplicator for just £795 or opt for some sophisticated extra facilities:
P9020 provides a high speed RS232C interface, capable of operating to 19.2 kbaud with 16 built-in I/O formats and costs £995.
The £1295 model P9030 offers both serial and parallel interfaces. Using its printing facility you can produce labels on UV-opaque foil. It also provides a sophisticated editor plus a RAM buffer of up to 32 kbytes. All are available ex-stock.

General-purpose use:
For lab and general-purpose use, the XP640 emulator/ programmer provides all you need for the latest devices:

- 512-kbits RAM buffer
- EPROMs/EEPROMs to 512-kbit density
- multipage video output and line display
- all major fast-programming algorithms
- software selection – no adapters
- supports JEDEC electronic identifiers
- auto self-test and fault detection
- powerful editing for 8/16-bit operation
- handles single-chip microcomputers
- serial and parallel interfaces
- add-on emulation system
- remote control

Our XP640 provides all the flexibility you need for design and development EPROM/EEPROM programming. Its unique video output and 16-character display enhance the built-in editing facilities. The RS232C interface supports 16 formats with transmission rates to 19.2 kbaud. You can expand the system to handle both Intel and NEC single-chip micros, or add on 128-, 256-or 512-kbit emulation modules. The XP640 costs just £795; the XA64 single-chip microcomputer programming option adds £225, emulation modules start at £395 for 128-kbits. Ex-stock delivery.

CIRCLE 41 FOR FURTHER DETAILS.

GP Industrial

GP Industrial Electronics Ltd
Unit E, Huxley Close
Newnham Industrial Estate
Plympton, Plymouth PL7 4JN
Tel: (0752) 342961 Telex: 42513

PHONE 0474 813225 3 LINES

P. M. COMPONENTS LTD

SELECTRON HOUSE, WROTHAM ROAD
MEOPHAM GREEN, MEOPHAM, KENT DA13 0QY

TELEX 966371 PM COMP

INTEGRATED CIRCUITS

AN124	2.50
AN214Q	2.50
AN240P	2.80
AN612	2.15
AN7140	3.50
AN7145	3.50
AN7150	2.95
BA521	3.35
CA1352E	1.75
CA3086	0.46
CA3123E	1.50
ETT6016	2.50
HA1377	3.50
HA1156W	1.50
HA1339A	2.95
HA1551	2.95
LA1230	1.15
LA4031P	1.95
LA4102	2.95
LA4140	2.95
LA4250	2.95
LA4400	4.15
LA4420	1.95
LA4422	2.50
LA4430	2.50
LC7120	3.25
LC7130	3.50
LC7131	5.50
LC7137	5.50
LM324N	0.45
LM380N	0.95
LM383T	2.95
M51513L	2.30
M51515L	2.95
M51521L	1.50
MB3712	2.00
MC1307P	1.00
MC1310P	1.50
MC1327	0.95
MC1327Q	0.95
MC1330P	1.10
MC1349P	1.20
MC1351P	1.50
MC1351P	1.50
MC1357	2.35
MC1358	1.58
MC1495	3.00
MC1496	1.25
MC145106P	7.95
MC1723	0.50
MC3357	2.75
ML231B	1.75
ML232B	2.50
MSM5807	8.75
PLL02A	5.75
SAA500A	3.50
SAA1025	7.25
SAA5010	6.35
SAS560S	1.75
SAS570S	1.75
SAS580	2.85
SL901B	4.85
SL917B	6.65
SL1310	1.80
SL1327	1.10
SL1327Q	1.10
SN76003N	1.95
SN76013N	1.95
SN76023N	1.95
SN76033N	1.95
SN76110N	0.89
SN76115N	1.25
SN76131N	1.30
SN76226DN	2.95
SN76227N	1.05
SN76533N	1.65
SN76544N	1.95
SN76570N	1.00
SN76650N	1.15
SN76660N	0.80
STK014	7.95
STK015	5.95
STK043	9.50
STK415	7.95
STK433	5.95
STK435	7.95
STK437	7.95
STK439	7.95
STK461	11.50
TA7061AP	3.95
TA7108P	1.50
TA7120P	1.65
TA7130P	1.50
TA7146	3.95
TA7176AP	2.95
TA7203	2.95
TA7204P	2.15
TA7205AP	1.15
TA7222AP	1.80
TA7227P	4.25
TA7310P	1.80
TA7313AP	2.95
TA7321P	2.25
TA7609P	3.15
TA7611AP	2.95
TAA550	0.25
TAA570	1.95
TAA661B	1.20
TAA700	1.70
TBA120AS/B/C/SA/SB/T/U	1.00
TBA231	1.25
TBA395	1.50
TBA396	0.75
TBA440N	2.55
TBA480Q	1.25
TBA510	2.50
TBA510Q	2.50
TBA520	1.10
TBA520Q	1.10
TBA530	1.10
TBA530Q	1.10
TBA540	1.25
TBA540Q	1.35
TBA550Q	1.95
TBA560C	1.45
TBA560C	1.45
TBA560CQ	1.45
TBA570	1.00
TBA641A12	2.50
TBA651R	2.50
TBA720A	2.45
TBA750Q	2.65
TBA800	0.89
TBA810AS	1.65
TBA810P	1.65
TBA820M	0.75
TBA820Q	1.45
TBA890	2.50
TBA920	1.65
TBA950/2X	2.35
TBA970	2.95
TBA990	1.49
TBA1441	2.15
TCA270	1.10
TCA270SQ	1.10
TCA650	2.50
TCA940	1.65
TDA440	2.20
TDA1001	1.95
TDA1004A	3.25
TDA1006A	2.50
TDA1010	2.15
TDA1035	2.50
TDA1037	1.95
TDA1170	1.95
TDA1190	2.15
TDA1270Q	3.95
TDA1327	1.70
TDA2002	1.95
TDA2020	2.95
TDA2030	2.80
TDA2522	1.95
TDA2523	2.95
TDA2524	1.95
TDA2530	1.95
TDA2532	1.95
TDA2540	1.95
TDA2541	2.15
TDA2560	2.15
TDA2571	2.95
TDA2581	2.25
TDA2593	2.95
TDA2600	5.50
TDA2610	2.50
TDA2611A	1.95
TDA2640	2.60
TDA2680A	2.75
TDA2690	2.45
TDA3310	2.95
TDA3560	5.50
UPC566H	2.95
UPC575C2	2.75
UPC1025H	1.95
UPC1028H	1.95
UPC1032H	1.50
UPC1156H	2.75
UPC1158H	0.75
UPC1167C2	1.15
UPC1181H	1.25
UPC1182H	2.95
UPC1185H	3.95
UPC1191V	1.50
UPC1350C	2.95
UPC1353C	2.45
UPC1365C	3.95
UPC2002H	1.95
555	0.35
556	0.42
723	0.50
741	0.35
747	0.50
748	0.35
7805	0.65
7808	0.60
7815	0.65

SEMICONDUCTORS

AAY12	0.25
AC126	0.45
AC127	0.20
AC128	0.28
AC128K	0.32
AC141	0.28
AC141K	0.34
AC142K	0.30
AC176	0.22
AC176K	0.31
AC187	0.25
AC187K	0.28
AC188	0.25
AC188K	0.37
AD142	0.79
AD143	0.82
AD149	0.70
AD161	0.39
AD162	0.39
AD161/2	0.90
AF106	0.50
AF114	1.95
AF121	0.60
AF124	0.65
AF125	0.35
AF126	0.32
AF127	0.40
AF139	0.40
AF150	0.60
AF178	1.95
AF239	0.42
AU107	3.50
AU106	3.25
AU110	4.50
BC107A	0.11
BC107B	0.11
BC108	0.10
BC108A	0.11
BC108B	0.12
BC109	0.10
BC109B	0.12
BC109C	0.12
BC114	0.11
BC116A	0.15
BC117	0.19
BC119	0.24
BC125	0.25
BC139	0.20
BC140	0.31
BC141	0.25
BC142	0.21
BC143	0.24
BC147	0.09
BC147B	0.09
BC148A	0.09
BC148B	0.09
BC149	0.09
BC157	0.12
BC158	0.09
BC159	0.09
BC160	0.28
BC161	0.28
BC170B	0.15
BC171	0.09
BC171A	0.10
BC171B	0.10
BC172	0.10
BC172B	0.10
BC172C	0.10
BC173B	0.10
BC174	0.09
BC174A	0.09
BC177	0.15
BC178	0.15
BC182	0.10
BC182LB	0.10
BC183	0.10
BC183L	0.09
BC184LB	0.09
BC204	0.10
BC207B	0.13
BC208B	0.13
BC212	0.09
BC212L	0.09
BC212LA	0.09
BC213	0.09
BC213L	0.09
BC214	0.09
BC214C	0.09
BC214L	0.09
BC237B	0.09
BC238	0.09
BC239	0.12
BC251A	0.12
BC252A	0.15
BC258	0.25
BC258A	0.39
BC284	0.30
BC300	0.30
BC301	0.30
BC303	0.26
BC307B	0.09
BC327	0.10
BC328	0.10
BC337	0.10
BC338	0.09
BC347A	0.13
BC461	0.35
BC478	0.20
BC527	0.20
BC547	0.10
BC548	0.10
BC549A	0.10
BC550	0.14
BC557	0.08
BC557B	0.08
BC558	0.10
BCY33A	1.60
BD115	0.30
BD116	0.60
BD124P	0.59
BD131	0.42
BD132	0.42
BD133	0.40
BD135	0.30
BD137	0.32
BD138	0.30
BD139	0.32
BDD140	0.30
BD144	1.10
BD150C	0.29
BD159	0.65
BD160	1.50
BD166	0.55
BD179	0.72
BD182	0.70
BD201	0.83
BD202	0.65
BD203	0.78
BD204	0.70
BD222	0.46
BD223	0.59
BD225	0.48
BC232	0.35
BD233	0.35
BD234	0.35
BD236	0.49
BD237	0.40
BD238	0.40
BD242	0.65
BD246	0.75
BD376	0.32
BD410	0.65
BD434	0.65
BD437	0.75
BD438	0.75
BD520	0.65
BD538	0.65
BD597	0.95
BD701	1.25
BD702	1.25
BD707	0.90
BDX32	1.50
BDY57	1.65
BF115	0.35
BF119	0.65
BF127	0.39
BF154	0.20
BF158	0.22
BF160	0.27
BF167	0.27
BF173	0.22
BF177	0.38
BF178	0.26
BF179	0.34
BF180	0.29
BF181	0.29
BF182	0.29
BF183	0.29
BF184	0.28
BF185	0.28
BF194	0.11
BF195	0.11
BF196	0.11
BF197	0.11
BF198	0.16
BF199	0.14
BF200	0.40
BF241	0.15
BF245	0.30
BF259	0.28
BF257	0.28
BF258	0.28
BF259	0.28
BF271	0.26
BF273	0.18
BF336	0.34
BF337	0.29
BF338	0.32
BF355	0.37
BF362	0.38
BF363	0.65
BF371	0.25
BF394	0.19
BF422	0.32
BF457	0.32
BF458	0.36
BF459	0.36
BF467	0.68
BF595	0.23
BF597	0.25
BFR39	0.23
BFR40	0.23
BFR41	0.28
BFR81	0.25
BFR88	0.30
BFR90	1.50
BFR91	1.75
BFT42	0.35
BFT43	0.35
BFW92	0.85
BFX29	0.30
BFX84	0.26
BFX85	0.32
BFX86	0.30
BFX88	0.25
BFY50	0.21
BFY51	0.21
BFY52	0.25
BFY90	0.77
BLY48	1.75
BR100	0.26
BR101	0.49
BR103	0.55
BRC4443	1.15
BT100A/02	0.85
BT106	1.49
BT116	1.20
BT119	3.15
BT120	1.65
BU105	1.22
BU108	1.69
BU124	1.25
BU125	1.25
BU126	1.60
BU204	1.55
BU205	1.30
BU208	1.39
BU208A	1.52
BU208D	1.85
BU326	1.20
BU407	1.24
BU500	2.25
BU526	1.90
BU80Y	2.25
BUY69B	1.70
MJ3000	1.98
MJE340	0.40
MJE520	0.48
MPSA13	0.29
MPSA92	0.30
MRF237	3.45
MRF450A	12.50
MRF453	17.50
MRF454	23.50
MRF455	17.50
MRF475	2.50
MRF477	10.00
OC16W	2.50
OC23	1.50
OC42	0.55
OC44	0.75
OC45	0.55
OC70	0.45
OC71	0.55
OC81	0.50
R2008B	1.45
R2010B	1.45
R2322	0.58
R2323	0.66
R2540	2.48
RCA16334	0.90
RCA16335	0.80
SKE5F	1.45
TIP29	0.40
TIP29C	0.42
TIP30C	0.43
TIP31C	0.55
TIP32C	0.42
TIP33B	0.75
TIP34B	0.75
TIP41A	0.45
TIP41C	0.45
TIP42C	0.47
TIP47	0.65
TIP120	0.60
TIP125	0.65
TIP142	1.75
TIP161	2.95
TIP2955	0.80
TIP3055	0.55
TIS91	0.20
TV106/2	1.50
2N2110	4.50
2N2219	0.28
2N2905	0.40
2N3053	0.40
2N3054	0.59
2N3055	0.52
2N3702	0.12
2N3703	0.12
2N3704	0.12
2N3075	0.12
2N3706	0.12
2M3708	0.12
2N3733	9.50
2N3773	2.75
2N3792	1.35
2N4427	1.50
2N4444	1.15
2N5294	0.42
2N5296	0.48
2N5298	0.60
2N5496	0.65
2SA715	0.60
2SC495	0.80
2SC496	0.80
2SC1096	0.80
2SC1106	2.50
2SC1172Y	2.20
2SC1173	1.15
2SC1306	1.00
2SC1307	1.50
2SC1364	0.50
2SC1449	0.80
2SC1678	1.25
2SC1909	1.45
2SC1945	2.65
2SC1953	0.95
2SC1957	0.80
2SC1969	1.95
2SC2028	1.15
2SC2029	1.95
2SC2078	1.45
2SC2091	0.85
2SC2098	2.50
2SC2166	1.95
2SC2314	0.80
2SC2371	0.36
2SD234	0.50
3N211	1.95
3SK45	0.70
3SK88	0.55

DIODES

AA119	0.08
BA115	0.13
BA145	0.16
BA148	0.17
BA154	0.06
BA156	0.15
BA157	0.30
BAX13	0.04
BAX16	0.06
BB105B	0.30
BT151	0.79
BY126	0.10
BY127	0.11
BY133	0.15
BY164	0.45
BY176	1.20
BY179	0.63
BT182	0.55
BY184	0.35
BY199	0.40
BY206	0.14
BY208-800	0.33
BY210-800	0.33
BY223	0.90
BY298-400	0.22
BY299-800	0.22
BYX10	0.20
BYX36-150R	0.20
BYX38-600R	0.60
BYX55-600	0.30
BYX71-600	1.10
BZY95C30	0.35
CS4B	4.50
CS10B	8.45
OA47	0.09
OA90	0.05
OA91	0.06
OA95	0.06
OA202	0.10
IN21DR	2.95
IN23B	2.95
IN23C	2.95
IN23ER	2.95
IN23WE	2.95
IN4001	0.04
IN4003	0.04
IN4004	0.05
IN4005	0.05
IN4006	0.06
IN4007	0.06
IN4148	0.02
IN4448	0.10
IN5401	0.12
IN5402	0.14
IN5403	0.12
IN5406	0.13
IN5407	0.16
IN5408	0.16
ITT44	0.04
ITT923	0.15
ITT2002	0.10

ZENER DIODES

BZX61 Series	0.15
BZY88 Series	0.10

NEW BRANDED CATHODE RAY TUBES

A1865/20	65.00
AW36.11	25.00
CME822W	19.00
CME822GH	25.00
CME1428GH	45.00
CME1428W	39.00
CME1523GA	39.00
CME1523W	39.00
CME1431GH	39.00
CME1431W	39.00
CME202GH	45.00
CME2024W	45.00
CME2325W	45.00
CME3126GH	45.00
CME3128GH	45.00
CME3128W	45.00
CME3132GH	45.00
CME3155W	45.00
CRE1400	25.00
CV429	89.00
CV1450	35.00
CV1526	19.00
CV2185	15.00
CV2191	19.00
CV2193	15.00
CV2328	65.00
CV5119	85.00
CV5320	85.00
CVX389	55.00
D9-110GH	39.50
D9-120	45.00
D10-210GH	45.00
D10-210GH68B	65.00
D10-210GH72	65.00
D10-230GH	35.00
D10-230GM	35.00
D10-293GY/90	55.00
D13-27GH	49.50
D13-30GH	49.50
D13-33GM	49.00
D13-47GH/26	55.00
D13-47GH/34	55.00
D13-51GL/26	85.00
D13-51GM/26	85.00
D13-450GH/01	55.00
D13-471GH/26	55.00
D13-550GH	65.00
D13-600GM	59.00
D13-610GH	59.00
D13-610GM	59.00
D13-611GH	59.00
D13-611GM	59.00
D13-630GH	59.00
D14-120GH08	65.00
D14-150GH	75.00
D14-150GM	75.00
D14-172GH/84	59.00
D14-172GR	59.00
D14-172GV	55.00
D14-173GH	55.00
D14-173GM	53.00
D14-173GR	55.00
D14-181GH/62	65.00
D14-181GH/98	65.00
D14-181GJ	55.00
D14-181GM	53.00
D14-181GM50	59.00
D14-181W	55.00
D14-182GH	59.00
D14-182GM/98	65.00
D14-200BE	89.00
D14-200GA/50	85.00
D14-200GM	75.00
D14-210GH	75.00
D14-270GH/50	75.00
D14-310W	110.00
D14-320GH	85.00
D14-320GH/82	85.00
D14-340GH/KM	45.00
D14-340KA	45.00
D16-100GH	65.00
D16-100GH/65	69.00
D16-100GH/67	65.00
D16-100GH67A	75.00
D16-100GH/79	69.00
D16-100GH/79A	75.00
D16-100GH97	65.00
D18-130GH	65.00
D18-160GH	69.00
D21-10GH	65.00
D21-10GJ	69.00
D21-10LD	69.00
DB7.6	35.00
DB7-36	45.00
DG7.32	45.00
DG13.2	45.00
DH7.11	95.00
DH7.91	45.00
DP7.5	35.00
DP7.6	35.00
DP7.11	45.00
DN13.78	35.00
F15.101LC	49.00
F16-101GM	55.00
F16-101LD	55.00
F21-130GR	55.00
F21-130LC	55.00
F21-131GR	79.00
F31-10GM	65.00
F31-10GR	65.00
F31-10LC	65.00
F31.10LD	65.00
F31-12LC	65.00
F31-12LD	65.00
F31-13GR	65.00
F31.13LD	65.00
F31-13LG	65.00
F41-123LC	160.00
F41-141LG	160.00
F41-142LC	185.00
M7-120W	19.00
M14-100GM	45.00
M14-100KA	55.00
M14-100LC	45.00
M17-151GVR	175.00
M17-151GR	175.00
M19-100GY	55.00
M19-100W	45.00
M19-101GR	55.00
M19-103W	55.00
M23-110GH	55.00
M23-111W	55.00
M23-111GH	55.00
M23-111LD	55.00
M23-112GM	55.00
M23-112GV	55.00
M23-112GW	55.00
M23-112KA	55.00
M23-112LD	55.00
M23-112W	55.00
M24-120GM	59.00
M24-120GR	59.00
M24-120LC	59.00
M24-120WAR	59.00
M24-121GH	55.00
M24-121LC	59.00
M24-121WA	59.00
M28-11LA	49.00
M28-12GH	55.00
M28-12LC	55.00
M28-13LC	49.00
M28-13LG	49.00
M28-13GR	49.00
M28-13WA	49.00
M28-131GR	55.00
M28-132GM	55.00
M28-133GH	55.00
M31-100GH	55.00
M31-101GH	55.00
M31-182GR	55.00
M31-182GV	53.00
M31-183W	55.00
M31-184W	65.00
M31-184GH	65.00
M31-184P31	65.00
M31-185GH/VR	69.00
M31-186W	69.00
M31-190GH	55.00
M31-190GR	55.00
M31-190LA	55.00
M31-190W	59.00
M31-191GH	59.00
M31-191GR	59.00
M31-191GV	55.00
M31-191W	59.00
M31-192W	59.00
M31-195GH	59.00
M31-210GH	59.00
M31-220W	59.00
M31-270GY	65.00
M31-271P31	65.00
M31-271GW	65.00
M31-271W	65.00
M36-12W	75.00
M36-141LA	75.00
M36-141LG	75.00
M36-141W	75.00
M36-170LG	75.00
M38-100GR	65.00
M38-101GH	65.00
M38-103GR	65.00
M38-113GH	65.00
M38-120W	65.00
M38-120WA	65.00
M38-121GR	65.00
M38-121GHR	65.00
M38-121LA	65.00
M38-121WA	65.00
M38-122GH	65.00
M38-122GW	65.00
M38-140LA	65.00
M38-141LA	65.00
M38-142GR	65.00
M38-142LA	65.00
M38-340P31	65.00
M38-341GR	65.00
M38-341P31	65.00
M38-344P39	65.00
M40-120W	59.00
M43-12GM/01	65.00
M43-12LG/01	65.00
M44-120LC	65.00
M44-120GR	65.00
M47-25GR/22	65.00
M50-120GH	65.00
M50-120GR	65.00
M50-120GV	65.00
M50-120LC	65.00
M61-120LC	75.00
M61-120W	75.00
S6AB	45.00
SE4/D/P7	45.00
SE42BP31AL	55.00
SE42BP31	55.00
SE52AP31AL	55.00
SE5FP31	55.00
T937	65.00
T948N	65.00
T948H	65.00
V3191	59.00
V4150LC	55.00
V4254B	65.00
V4274GH	65.00
V4283W	65.00
V5002LD	65.00
V5004GR	59.00
V5004LD	59.00
V6001GH	65.00
V6006GH	65.00
V6007DP31	59.00
V6007GW	65.00
V6008GW	59.00
V6008W	65.00
V6034WA	59.00
V6048CLA	59.00
V6048F	65.00
V6048J	49.00
V6052GH	65.00
V6052GR	65.00
V6064BLA	65.00
V6064BP31	55.00
V6064CLA	55.00
V6069GH	55.00
V6070P31	49.00
V7016A	65.00
V7030	59.00
V7031GH	59.00
V7031/67A	59.00
V7035A	49.00
V7037GH	45.00
V8004GR	65.00
V8006GH	65.00
V8010A	65.00
2BP1	9.00
3BP1	13.50
4EP1	30.00
3H/0BM	55.00
5BP1	9.00
5BHP1	30.00
5BHP1FF	30.00
5BHP31	30.00
5CP1	10.00
6EP7/S	39.00
13BP1	13.50
13BP4	17.50
17DWP4	25.00
32J/1085	69.00
88D/89B/89D/89L	15.00
1273	39.00
1564	39.00
1844	45.00
9442E1	80.00
95447GM	75.00
95449GM	75.00
7709631	78.50

ELECTRO-OPTICAL

95025	25.00
9558B	25.00
9677M	22.00
P4231BAM	19.00

WIREWOUND RESISTORS

4 Watt	5R6-10K	0.20
7 Watt	R47-22K	0.20
11 Watt	1R5-15K	0.25
17 Watt	1R-15K	0.30

VALVE AND CRT BASES

B5D	5.50
B7G	0.15
B7G SKTD	0.25
B8G	0.70
B8H	0.70
B9A	0.25
B9A SKT	0.40
B9G	0.75
B10B	0.20
B13B	0.50
B14A	3.00
12PIN CRT	0.95
NUVISTOR	2.95
OCTAL	0.35
SK610	35.00
UX5	1.75
UX7	1.75
CANS	0.30

LINE OUTPUT TRANSFORMERS

DECCA 100	7.95
DECCA 1700 MONO	9.95
DECCA 1730	8.95
DECCA 2230	8.25
GEC 2040	8.95
GRUNDIG 1500	15.45
GRUNDIG 5010-6010, 2222-5011-6011	13.45
ITT CVC20	8.20
ITT CVC30	8.25
PHILIPS G8	8.50
PHILIPS G9	8.99
PHILIPS G11	13.39
PYE 725	10.95
RBM T20A	12.40
TANDBERGE 90°	11.15
TELEFUNKEN 711A	11.15
THORN 1590	9.50
THORN 8000	9.20
THORN 9000	9.95
THORN 9800	22.40
THORN MAIN TRANSFORMER 3000/3500	9.70

EHT MULTIPLIERS

ITT CVC20	6.35
ITT CVC30	6.35
PHILIPS G8 550	6.96
RANK T20A	6.91
THORN 3000/3500	7.57
THORN 8500	5.80
THORN 9000	8.00
UNIVERSAL TRIPLER	5.45

REPLACEMENT ELECTROLYTIC CAPACITORS

DECCA 30 (400-400/350V)	2.85
DECCA 80/100 (400/350V)	2.99
DECCA 1700 (200-200-400-350V)	3.55
GEC 2110 (600/300V)	2.25
ITT CVC20 (200/400V)	1.80
PHILIPS G8 (600/300V)	2.25
PHILIPS G9 (2200/63V)	1.19
PHILIPS G11 (470/250V)	2.35

VARICAP TUNERS

ELC1043/05 MULLARD	8.65
ELC1043/06 MULLARD	8.65
U321	8.25
U322	8.25

POTENTIOMETERS

STANDARD VERTICAL POTS	0.12
MIN. VERTICAL POTS	0.12
SANDARD HORIZONTAL POTS	0.12
MIN. HORIZONTAL POTS	0.12
CONVERGENCE PRE-SETS	0.30
SLIDERS LOG	0.48
SLIDERS LINEAR	0.48

PUSH BUTTON UNITS

DECCA, ITT, CVC20 6WAY	7.95
ITT CVC5 7 WAY	10.19
PHILIPS G8 (550) 6 WAY	14.49

20MM QUICK BLOW FUSES

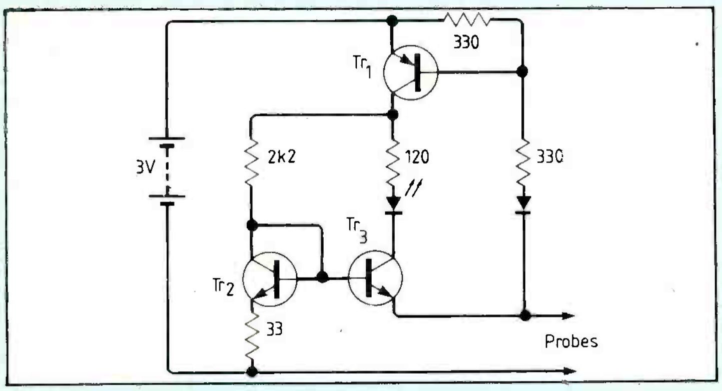
100MA	8p each
200MA — 5AMP	5p each

20MM ANTI SURGE FUSES

100MA — 800MA	15p each
1A — 5AMP	12p each

SPARES & AIDS

FOAM CLEANSER	0.79
FREEZE IT	0.82
SOLDA MOP	0.64
SWITCH CLEANER	0.79
WD40	1.25
PUSH PULL MAINS SWITCH (DECCA, GFC, RANK, THORN ETC.)	1.02
PYE IF GAIN MODULE	6.99
ANODE CAP (27kV)	0.69

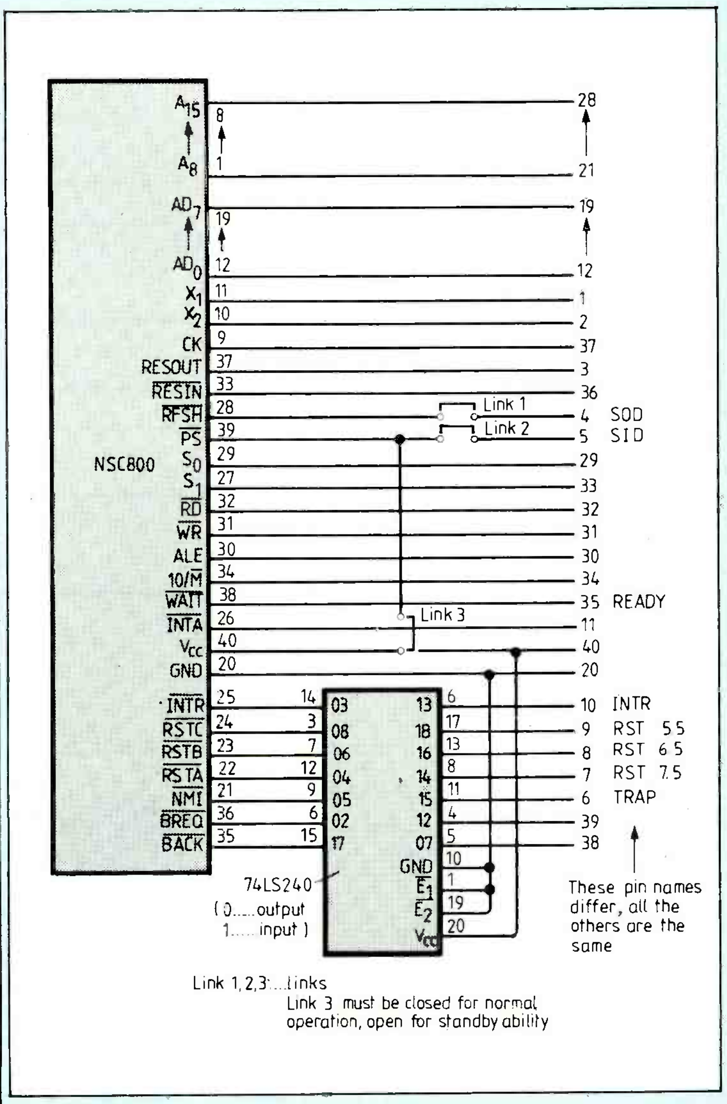


Continuity indicator

This circuit indicates impedances lower than 20Ω between the probes by lighting a led — and from a 3V supply. When built using E-line transistors, miniature resistors and HP17-type batteries, it is small enough to fit inside a pen-sized probe.

Low leakage is important for Tr_1 as it acts as a power switch. The two 330Ω resistors are selected to ensure that this transistor doesn't turn on until probe resistance is less than a few hundred ohms. The left-hand transistor acts as a voltage-reference source which inhibits Tr_3 until the probe voltage is higher than about 50mV. This means that diode junctions will not indicate continuity.

K. Wood
Ipswich
Suffolk



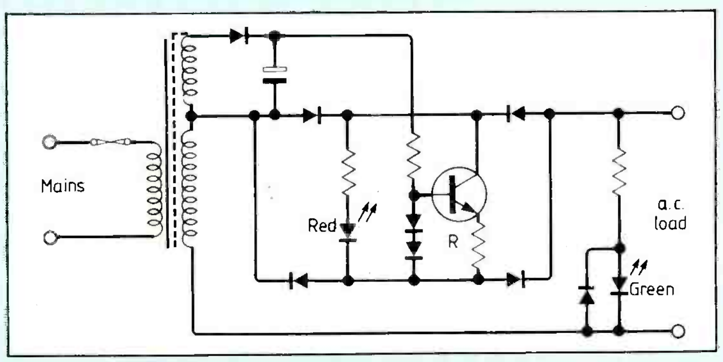
8085 systems run Z80 software

Many users of 8085-based microcomputers are unhappy about the processor's limited instruction set. Because of this I developed an easy to use adaptor which replaces this processor by an NSC800 (National Semiconductor). The NSC800 instruction set is fully compatible with the Z80's so this modification allows you to use Z80 software on 8085 systems.

My adaptor, which fits into the 8085 socket, simply crosses a few pins and inverts one or two inputs and outputs. Internally, the NSC800 (cmos) is very similar to the Z80, but its bus structure is similar to that of the 8085, the only main differences being that STD and SOD (serial input/output data) are not available. In applications where SID and SOD are required by your system, this modification cannot be used.

One or two points worth noting are that the 8085 non-maskable interrupt (TRAP) causes a jump to location 0024_{16} and the NSC800 NMI causes a jump to 0066; however, both processors address input/output ports in the same manner and divide the crystal-clock frequency by two. On the NSC800, the interrupt-control register is located at address BB (on-chip) and this address must be free. Execution times of the two processors also differ so watch out when using software delay loops. One version of the NSC800 runs at 4MHz.

Franz Braunschmid
Vienna

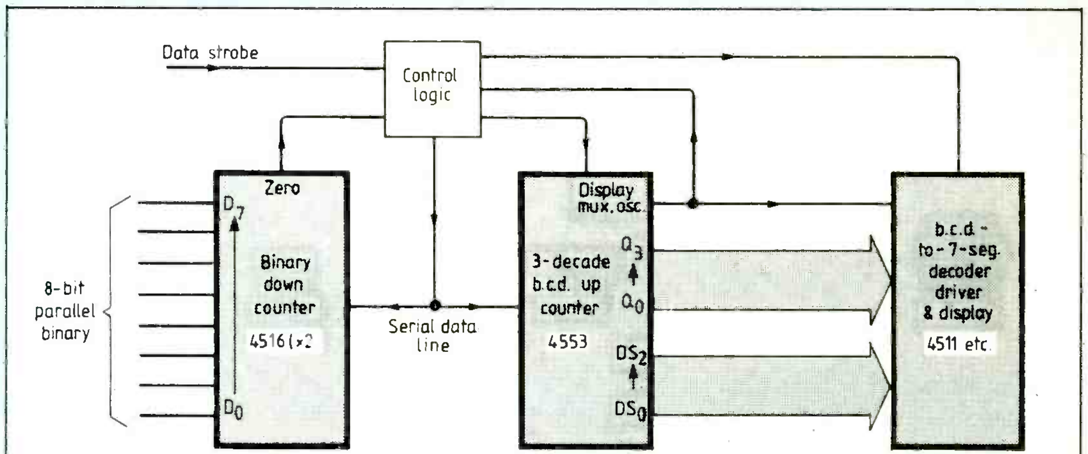


Protection for a.c. loads

Transformer short circuit protection is given by this circuiit designed for an application where tv distribution amplifiers were driven through coaxial cable. The top transformer winding biases the transistor (with heatsink) and resistor R sets the current limit. Green and red leds indicate normal operation and short circuit respectively and the primary fuse is a slow one.

Salvador Espin
Balearic Islands
Spain

Dynamic binary-to-b.c.d. converter and display

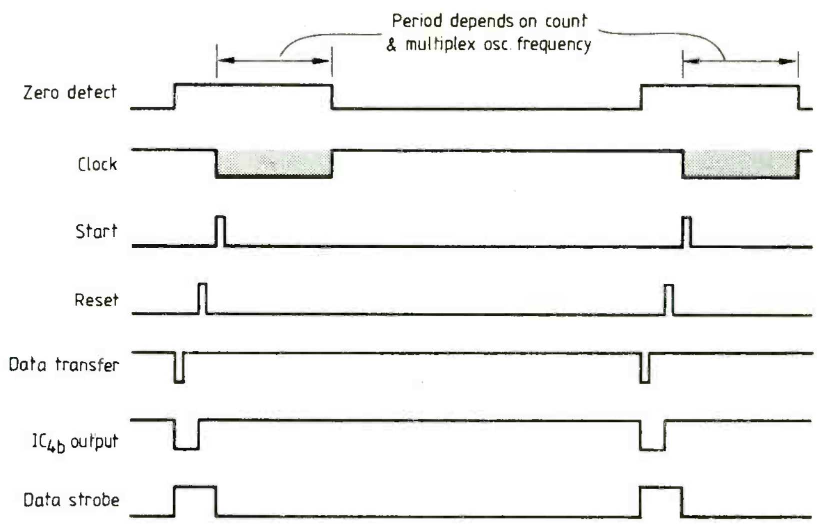


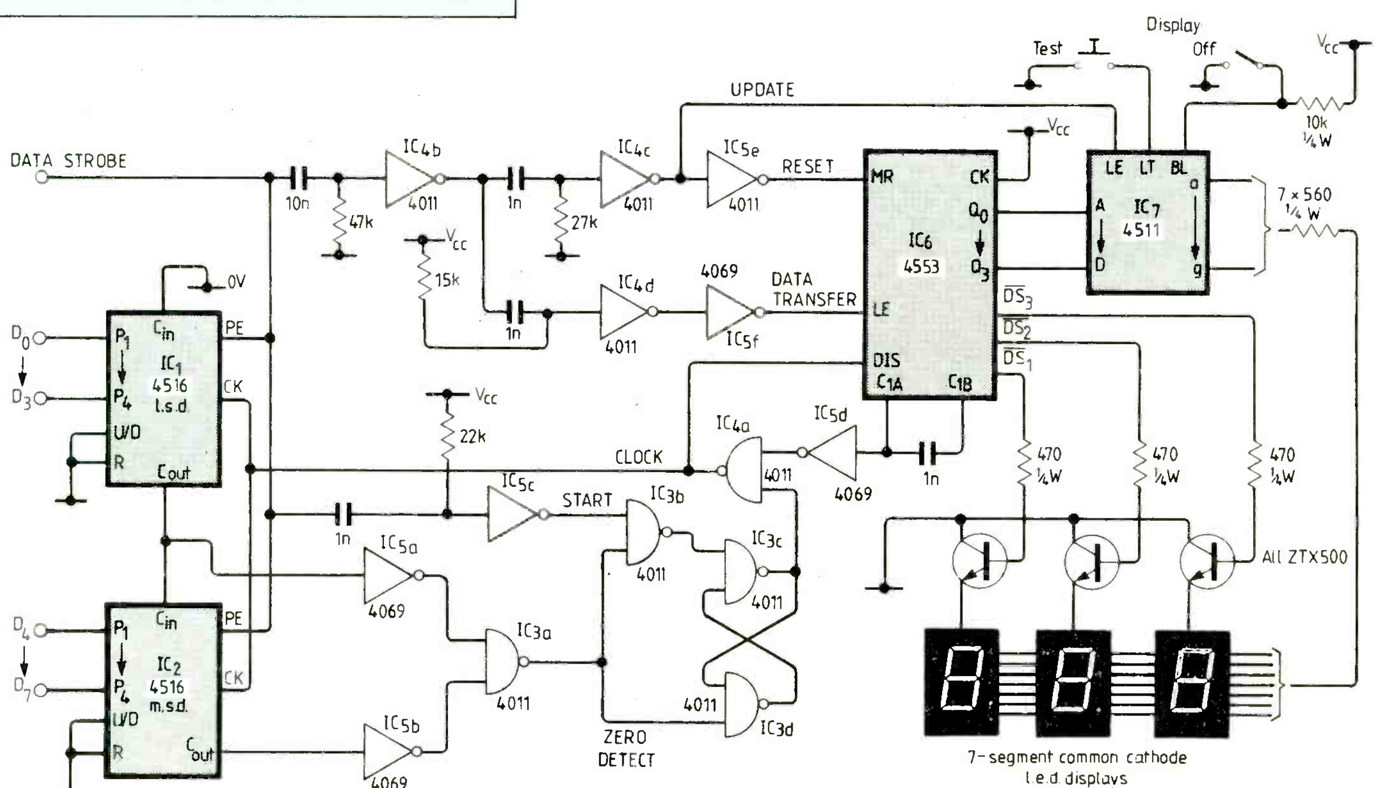
This circuit converts eight-bit binary data for a decimal display without using static decoders. Parallel data at D_{0-7} is loaded into up/down counters $IC_{1,2}$ by DATA STROBE. This signal also produces control pulses at gates $IC_{4c,4d,5c}$. Content of the b.c.d. counter IC_6 is latched at the device's output by DATA TRANSFER, RESET clears the counter section of IC_6 to zero, UPDATE causes the output of IC_6 to be latched into b.c.d. seven-segment decoder IC_4 and START sets the bistable circuit formed by $IC_{3c,d}$.

Pulses from the display-multiplex oscillator (in IC_6) are now used to simultaneously increment IC_6 and decrement $IC_{1,2}$. When $IC_{1,2}$ reach zero, clock pulses are inhibited by gates $IC_{5a,b,3a}$ and bistable circuit $IC_{3c,d}$. The sequence repeats on each DATA STROBE pulse.

Addition of uarts and current-loop signalling allows the circuit to provide a remote indication and since conversion is carried out in the remote unit the uarts need only continuously transmit one eight-bit word.

D.W. Cooper
Rochester
Kent





Stage lighting system—2

by Ian Kemp, M.A.

More circuitry and some practical advice

In the September issue, the equipment was described in outline, with some circuit details. The rest of the circuit information follows, and the article concludes with constructional information.

Control desk power supply. This is a relatively standard circuit, and is shown in Fig. 9. The mains input is filtered in the same way as the power box supply, and the rectified output is smoothed by two 4700µF capacitors and then fed via a 2.5A fuse to three 5V regulators. This system was adopted in preference to a single 3A, 5V regulator so that there would be greater isolation between the various sub-sections. Outputs were monitored by three 5V6 Zener diodes connected to the base of a TIP3055: any excess voltage is reduced if it is a pulse, or if a regulator fails, the fuse blows.

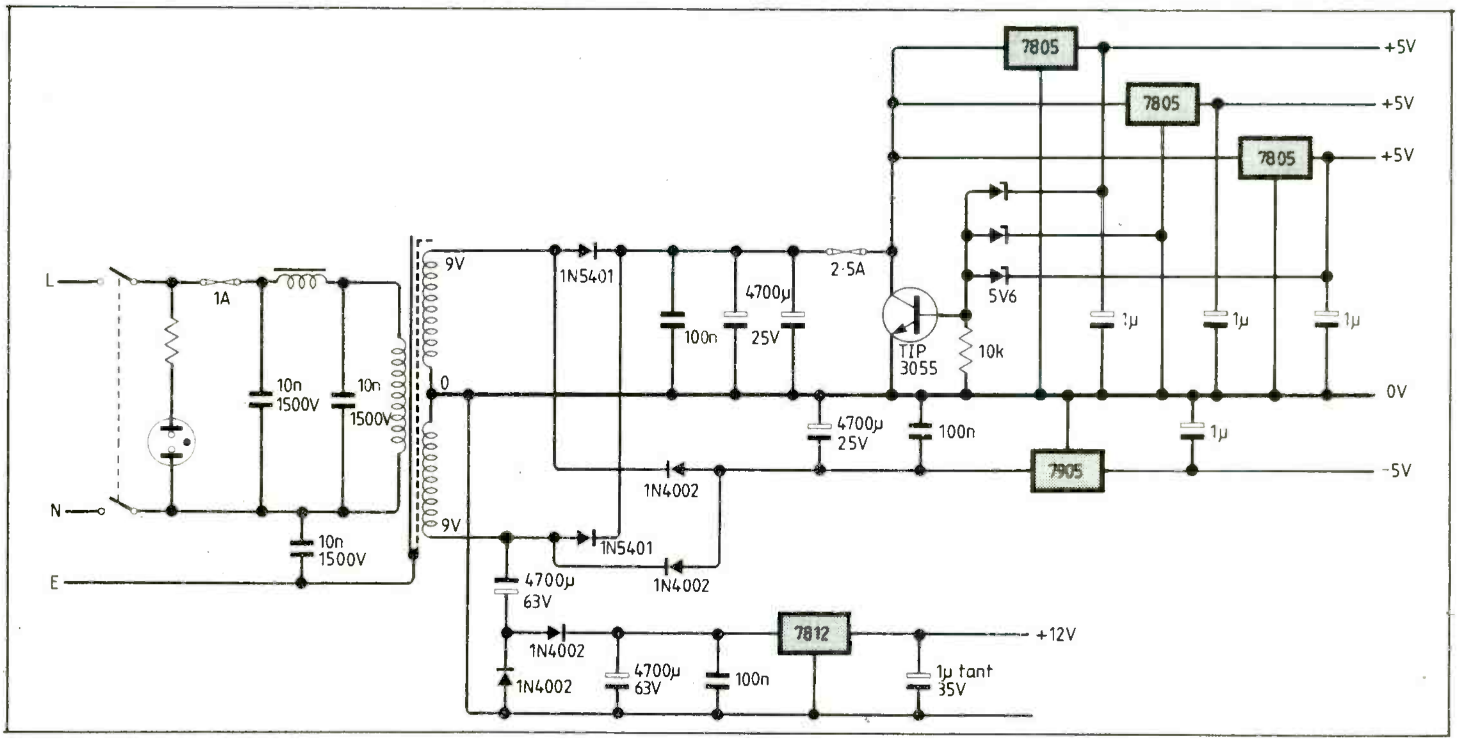
The negative 5V regulator is standard and provides bias for the a/d convertors. Originally, 2708 eproms were used and this supply provided these memory chips with bias. The positive 12v supply is obtained from a voltage doubler and powers the modulator and the original 2708 eproms. The 0V line is connected to the mains earth and the control desk case.

Control desk keyboard. The keyboard is a hexadecimal key pad and the electronics, shown in Fig. 10, was designed and built by pupils. A diode matrix provides 16-to-4-line encoding and a separate key is used to control whether the first or second digit is entered. The information is stored in two 74LS75 latches and is connected to the data bus via two 74LS367 buffers. The buffer is enabled on input port 01H.

Microprocessor board. A separate microprocessor was used rather than a commercial computer so that it could handle the very fast and frequent interrupts from the uart and also to give pupils the opportunity to program a microprocessor rather than a computer. In Fig. 11, of the relevant I/0 lines of the m.p.u. are buffered and the clock is provided by another tv crystal. The software is stored in a 2k eprom (2716) and ram is provided by a 6116. This memory chip was used so that battery back-up could be provided at some time in the future. Reset is provided by two push switches wired in series, so that the system could not be reset accidently.

V.d.u. and modulator. The simple v.d.u. gives a display of 32 characters by 16 lines — an adaptation of the v.d.u. used in the WW computer which was published some years ago. In Fig. 12; there are essentially three divider chains running from a 4MHz crystal oscillator (8MHz divided by two). The first divider chain, consisting of two 74LS93s, produces the line sync. pulses. Each line is 64µs long and is divided

Fig. 9. **Control-desk power supply.**



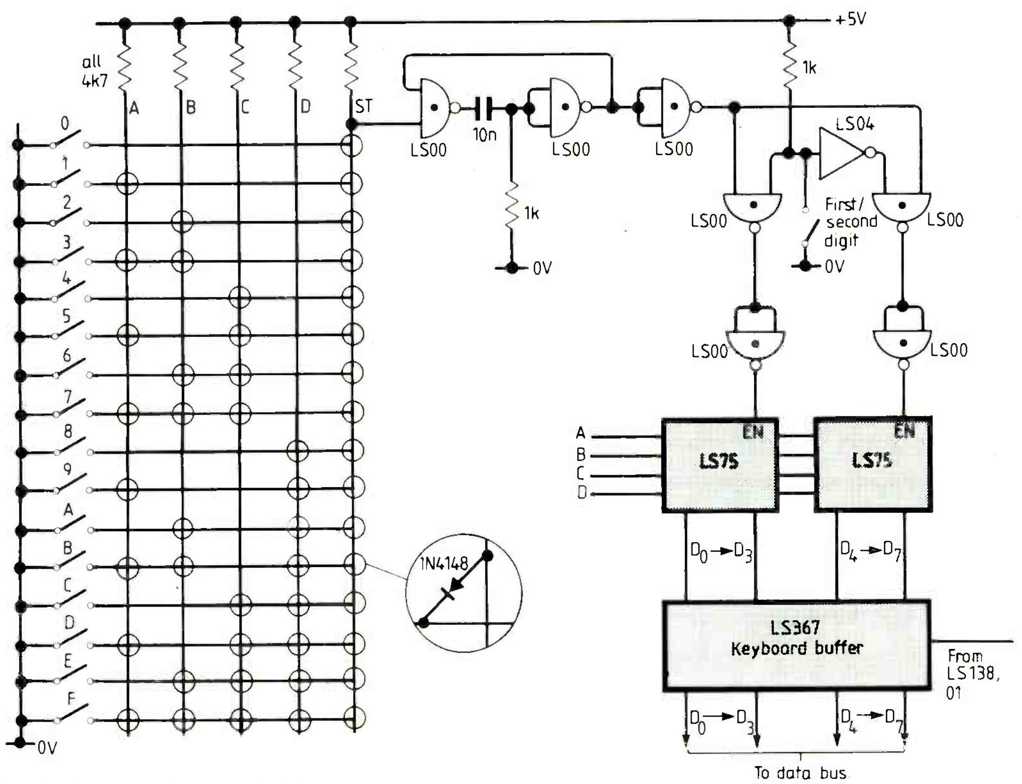


Fig.10. **Control-desk keyboard circuit.**

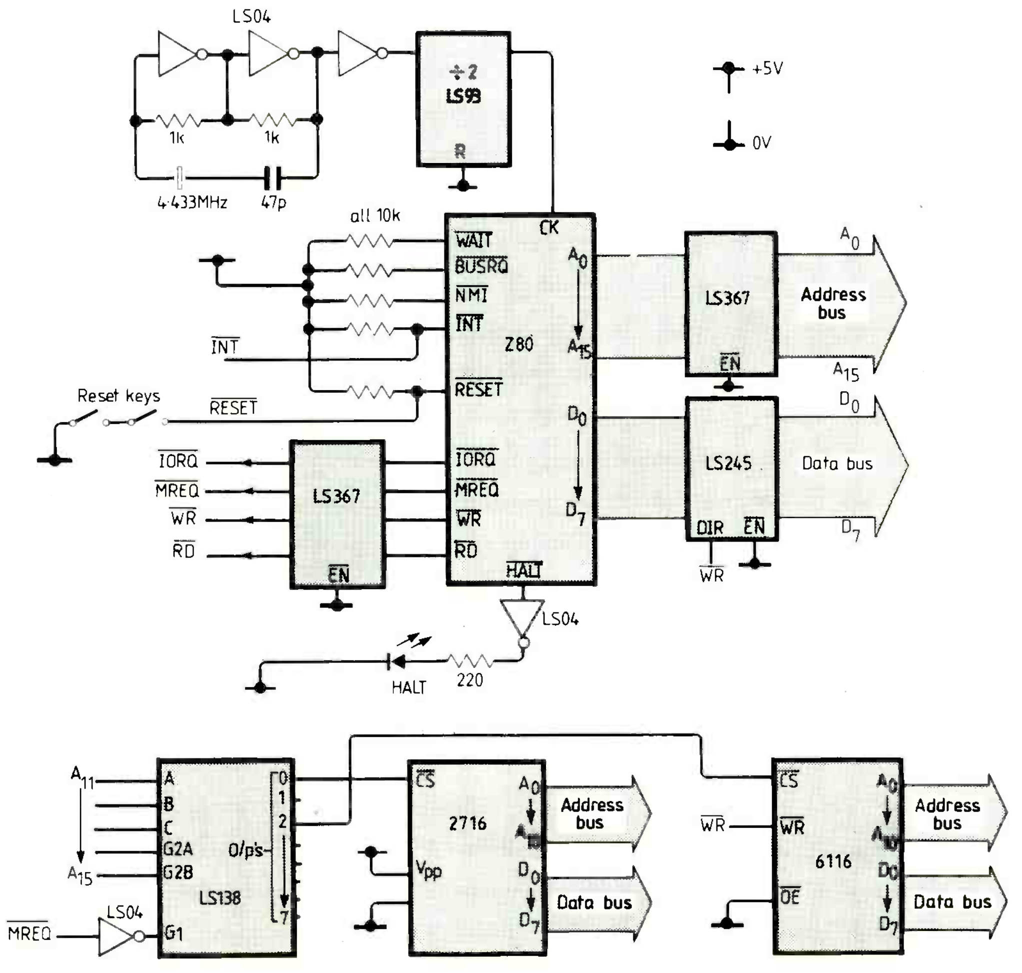


Fig.11. **Control-desk microprocessor board.**

into a 48μs display, a 8μa pause, a 4μs sync. pulse and a further 4μs pause, as in the original design.

Each character is 6 pixels wide and the second divider chain performs character line count. It consists of a divide-by-six counter (74LS92) followed by a divide by 32 counter (2×74LS93), which are only enabled during the 48μs display. The output of these counters is fed to the video ram (7×2102) via two-way selectors (74LS157). Line count is performed by the third divider chain of two 74LS93s. Each character consists of eight pixels down, each pixel consisting of two lines: the outputs of the first 74LS93 feed the row-select inputs of the character generator and the outputs of the second 74LS93 are fed to the video ram, via the two-way selectors.

This uses a total of 256 lines out of a possible 312½ lines. The others are blanked out by a monostable (74121) which also provides the frame sync. pulse. A 74S262 teletext character generator was used because one was available: other character generators would be suitable. The video information is changed into serial form by the 74LS165, which is mixed with the video blanking (during synchronization) and then fed to the modulator.

The video ram is simply decoded to appear at 8000H of the computer memory. Some noise on the display is experienced, but since the up-date rate of the v.d.u. is user-controllable (via software) a satisfactory compromise between noise/up-date rate can be achieved. The modulator was adapted from a video game published some years ago and could probably be replaced, with advantage, by a commercial modulator. However, the circuit did provide useful experience to some pupils in u.h.f. work (i.e. the need for short wires!).

Uart, master a/d, enter latch. The uart for transmitting the information to the power box controls the microprocessor via the INT line as shown in Fig. 13, and is serviced as soon as the INT line is taken low, i.e. when the uart transmitter buffer register is empty. The uart is clocked by another tv crystal, suitably divided to produce a clock rate of approximately 140kHz. The output from the uart is taken to the transistor complementary Darlington amplifier before being sent to the power box.

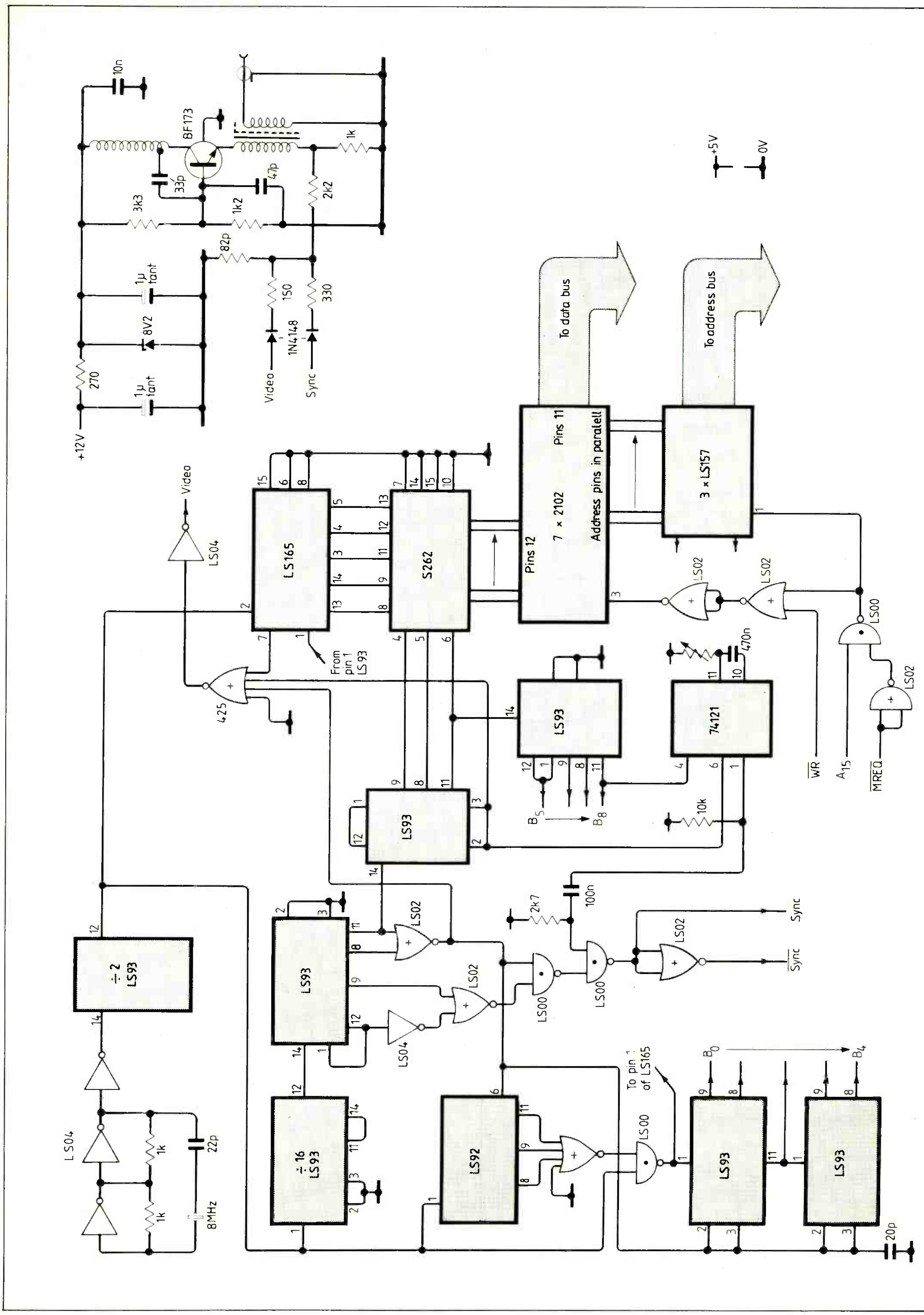


Fig. 12. Video display and u.h.f. modulator.

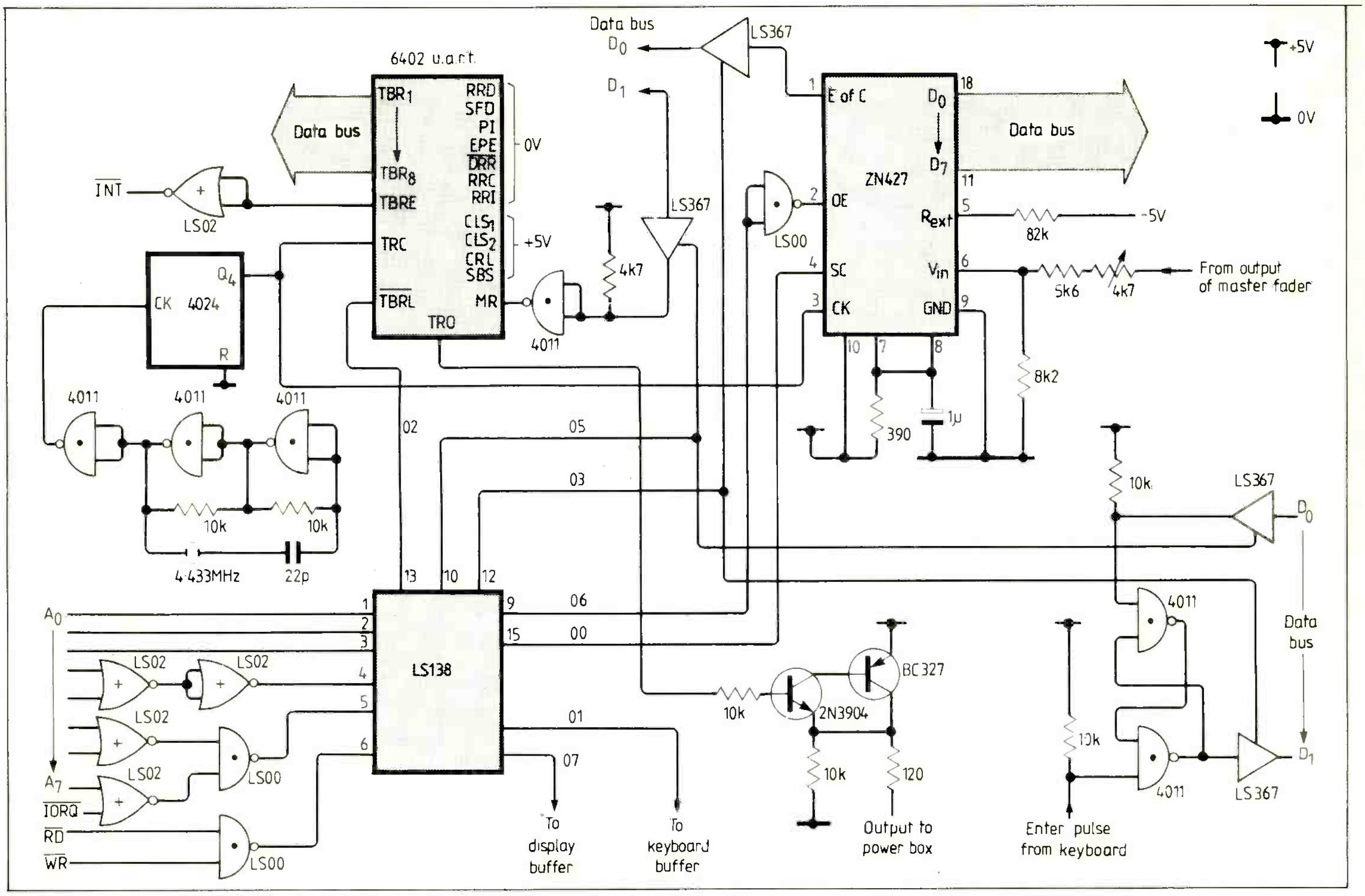


Fig.13. **Control-desk uart, a/d converter and enter latch.**

The master fader has its own a/d convertor (ZN427) which is frequently interrogated by the microprocessor. The circuitry is based on the ZN427 data sheet.

When a keyboard entry is required, the Enter key is pressed, which sets a bistable (4011). When the uart has been serviced, a check is made to see if a keyboard entry has occured, before returning to the main program. Full details of this and the I/0 ports used will be in the software section.

Faders and relay unit. The design of the system required that the faders could be plugged directly into the dimmers. Since power box 0V is neutral-referenced and the computer 0V is earth-referenced, care had to be taken to ensure that these 0V lines could not be connected together. This is achieved by the circuit of Fig. 14.

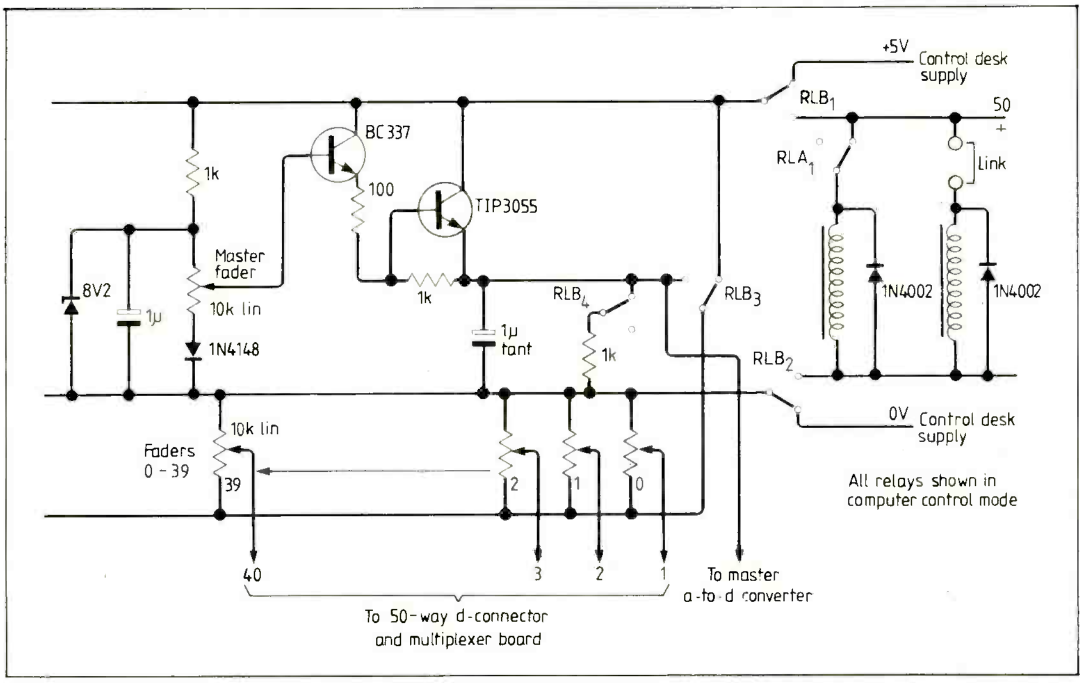
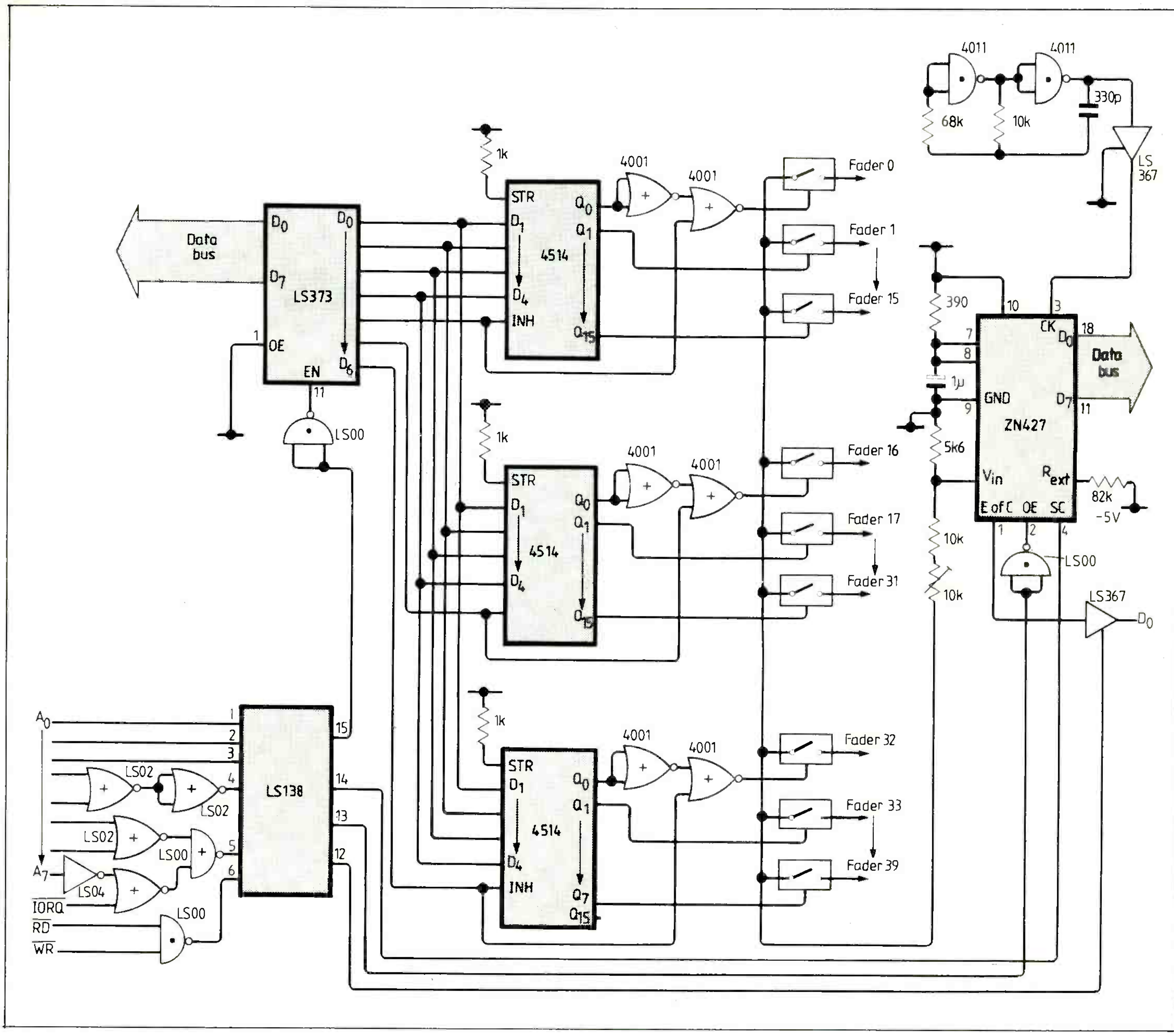


Fig.14. **Control-desk fader and relay unit.**

When used without the computer, the faders are powered from the power box power supply via a 50-way cable, which is only connected to the faders if the multiplexer and uart circuit boards are removed from their edge connectors. There are also wire links on these boards which make relay A operate, so ensuring that the supply remains disconnected. With these boards removed, relay B operates and connects the supply to the master fader circuit, which in turn supplies power to all the faders. This ensures that the master fader still controls the brightness of all of the lamps. The master fader circuit essentially consists of an emitter follower. The diode at the 0V end of the master fader offsets some of the base emitter voltage drop of the emitter follower.

Multiplexer and fader a/d. The circuit in Fig. 15 stores the number of the fader to be converted in the 74LS373 octal latch. Num-



bers 0-15 are stored as 60H—6FH, 16—31 as 50H—5FH, and 32—39 as 30H—37H. Input/output port decoding is achieved using the 74LS138, the decoded ports being 80H-87H. The output from the octal latch is fed to the 7-to-40 line decoder, consisting of three 4514s, whose outputs operate the 40 analogue switches (4016), so enabling the output of each fader to be connected to the a/d convertor (ZN427). The circuit of this a/d convertor is the same as the master a/d convertor.

Construction

The lighting system was built in many modules to enable as many pupils as possible to work on the project. Many of the circuits were fabricated on Veroboard, using traditional wiring techniques.

Control desk. The circuits for the control desk were built on veroboard, with 43-way edge connectors. Four of these boards were used and the circuits were divided up as follows: V.d.u.; microprocessor and memory; general input/output including uart and master a/d converter; fader multiplexer and a/d converter. The remaining circuits (modulator, p.s.u. keyboard, etc) were built on ordinary pieces of Veroboard.

The four edge-connectors were soldered onto the copper strips of another piece of Veroboard. The fader multiplexer and a/d converter board was double sided, which enabled one side of the edge-connector to be joined to the 'computer bus' while the other side was used to carry the inputs from the faders to the analogue switches. The remaining terminals on this side of the connector were used to arrange the switching of the safety relays for when the power box is connected directly to the control desk.

Power box. The circuits for the power box, with the exception of the dimmer boards, were constructed on Veroboard, and were divided into the following modules: power supply and mains filter; regulators for the dimmer boards and the ramp generator; demultiplexer and d/a converter. Each of these modules was housed in its own die cast box and the three boxes were stacked together at the right hand end of the power box.

The mother boards for the two dimmer racks were made from Veroboard again, reinforced by a metal and wood frame. The copper strips only carry the low-voltage supplies to the dimmer

Fig.15. **Multiplexer and fader a/d converter.**

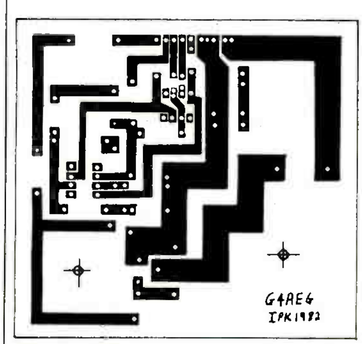


Fig.16. **Dimmer printed circuit board.**

Details of the software and operating procedure and the eprom listing are too extensive to reproduce here. Interested readers can obtain them from this office by sending a stamped, addressed envelope, marked 'stage lighting'.

board: They were broken either side of the dimmer board plug for the live and 0V line., i.e. mains neutral, and 6A wire was used to connect to the main neutral wire for each mother board, which was a piece of 6mm square brass bar, carefully insulted on Perspex supports. The mains live wire was also treated in a similar way, being distributed on each mother board by a 6mm brass bar. Connections are made to each lighting circuit by 6A terminal blocks at the rear of each mother board.

Since the dimmer boards had to be mass produced (a total of 40 were required) it was decided to make printed circuit boards. The component lay out and foil pattern are shown in the diagrams and photographs. To make these boards, a mask was cut out of a piece of thin s.r.b.p. board, held in place over the cleaned copper board and sprayed with ordinary car paint. Two or three thin layers of paint made an effective etch resist. Since Iron (III) Chloride was not plentiful, the circuit boards were first electrolysed in copper sulphate, the circuit board being made the anode and another piece of copper the cathode. This removed much of the copper and the remainder was removed in Iron (III) Chloride solution. The paint, after etching, was then removed with a suitable solvent.

R.S. 10-way circuit-board plugs and sockets were used for the dimmer board connectors, rated at 250V a.c. 2.5 A per way. Three ways were paralleled together for the neutral/0V line and two were used for the connection to the lamp circuit.

Safety. Obviously, safety is very important when dealing with a 100A mains supply. I was very conscious of this during the whole project and so carried out many tests on all the mains connected parts of the circuits to satisfy myself of their reliability. All of the mains wiring has been deliberately overloaded for both current and voltage and it survived satisfactorily. In normal use the whole of the power box remains cool during operation, even after many hours of operation.

The power box enclosure was made from square section steel tubing, brazed together to form a frame, which was then covered in Aluminium sheeting. The dimmer boards and all live connections are normally behind aluminium mesh, although this has been removed for the photograph of the box. When in normal use there is a lockable door enclosing all the electronics and a small panel to the right gives access to the input sockets. This ensures that no unauthorized person has opportunity to gain access to the mains circuits.

Acknowledgement. I am indebted to many people for their assistance and encouragement during this project. In particular I owe thanks to the following people:—
A very tolerant wife.
Malvern Hall Parents' Association who financed the project.
Mr H.K. Greenhalgh, Headmaster.
Mr A. Martin and Mr K. Hickinbottom who built the enclosures and cases. G. Tomkins, A. Perkins, K. Sollis and R. Manton., pupils of the school.

CASSETTE RECORDER *continued from page 20*

returns to its 'input routine' and is immediately vectored to the second half of the AULOAD routine in Fig. 5. The recorder is stopped, the addresses of the new input routine reloaded into the input vectors, and the RUN flag checked. If not 'set', the routine is exited via a JUMP statement to 'warm start' Basic. If the flag is 'set', the command RUN is written into Basic's buffer line, the X-register set to three (the number of characters in the word RUN) and the A-register loaded with 'CR'. The routine is then exited via an RTS statement with the result that the Basic interpreter acts upon the RUN command and runs the program previously loaded.

FILIST and ERLIST routines

The FILIST and ERLIST routines perform functions as previously described, the flow-diagram being shown in Fig. 6. Both routines are simply housekeeping routines which allow details of the programs held in the Directory to be displayed on the screen. The routines are exited via a JUMP to 'warm start' Basic after first erasing the FILIST or ERLIST command from the Basic buffer line.

to be concluded

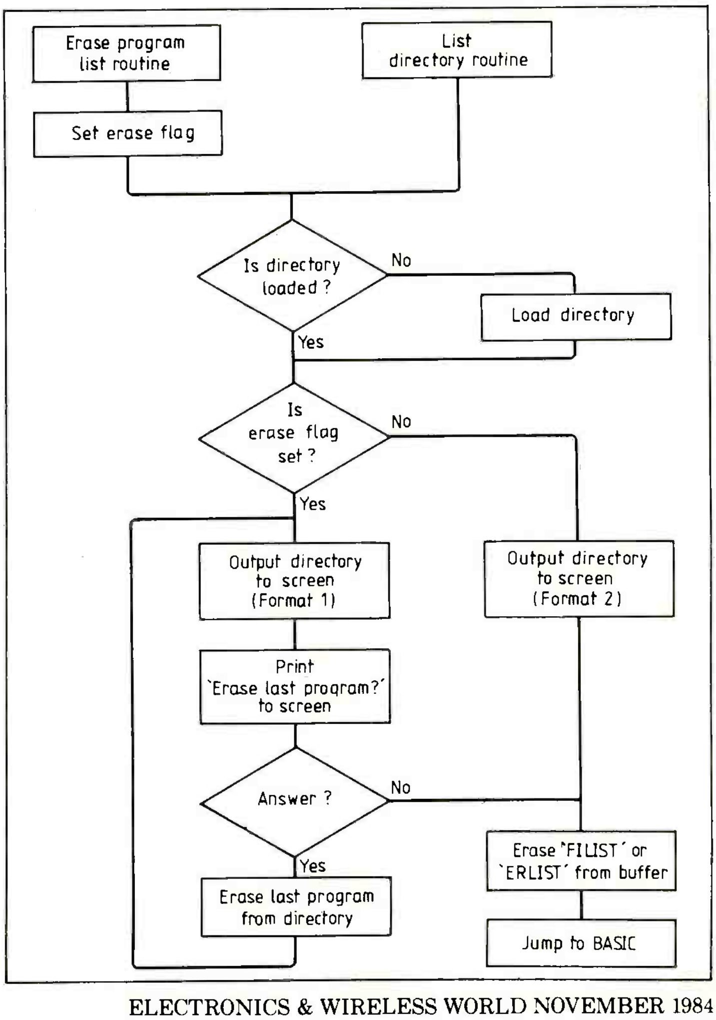


Fig.6. **FILIST and ERLIST routines to display list of stored programs — the directory.**

Microprocessor multimeters

Bench and systems instruments merge with increasing use of microprocessors

In its more complex form a digital multimeter consists not only of an accurate multifunction measuring instrument but also a high speed one with 'intelligence'. This enables it to control the a-to-d conversion, autoranging and initial zeroing in the analogue department, in addition to permitting auto-calibration and self-testing routines, data manipulation and storage, and automatic operation over a data bus. Facilities now available in most microprocessor multimeters include some or almost all of the following

- variable reading rate e.g. one an hour to hundreds or even thousands per second, with resolution trade-off.
- multiplication of readings by entered or stored number
- subtraction of offset values
- ratio calculation (inc power)
- real-time ratio between two inputs
- percentage deviation from entered value
- averaging
- variance, standard deviation, r.m.s.
- maximum and minimum readings stored
- low, pass, high-limit testing
- linearization, sometimes to third order, e.g. for therm-couple use
- logarithmic compression e.g. dB, dBm,
- storage of hundreds of readings
- measurement uncertainty (24h, 90 day, 1 year) error limits held in rom
- self-testing of display, analogue and digital sections
- automatic calibration
- measurement timing, elapsed or real

PM2519 multimeter incorporates Philip two-line inter—i.c. bus (i²C) to interconnect processor and peripheral chips as well as a GPIB adapter.

2: Bench digital multimeters

Maker	Digits (A=bar)	Model	Basic price	Sens. d.v.	Basic error(1)	f_{max} a.v.(2)	Crest factor	Res note3	µP note4	Other features
Beckman Industrial	3½	3050	179	100µV	0.1%+1	100kHz	—	✓		diode &
		3060	275	100	0.1%+1	20	5	✓		cont.test
Brown Boveri (HI,JMI)	3½	2030	116	100µV	0.1%	5kHz	—			cmos
		2031	143	as above				hi/lo		book-
		2032	162	as above			7	hi/lo		style
	4¾	2110	550	10µV	.05'6+1	20k	7			G,R,dBC
Data Precision (Farnell)	3½	1351	180	100µV	0.1%+1	10kHz	—	✓		
		175	210	as above		50	—	hi/lo		battery
	4½	255	270	10	0.03%+2	1	—	✓		battery
		258	285	10	0.05%+1	20	5	✓		(model
		2+80R	270	10	0.03%+2	50	5	✓		248 led)
		3400	.720B	10	.007%+1	20	5	4		G£690
	5½	2590R	640	1	.007%+2	20	5	✓		l.e.d.
		3500	990B	1	.005%		—	4		ratio
		3600	655	1	.007%+2	100	7	(4)	10	G£165
Datatech (Telonic)	3½	30	177	100µV	0.1%+1	10kHz	—	✓		led(lcd)
Farnell	4½	141	345	10µV	0.63%+2	20kHz	5			B£80
Fluke	3½	8010	218	100µV	0.1%+1	200kHz	3	✓		hold,batt
		8012	291	as 8010 but 2Ω resistance range						
	4½	8050	328	10	.003%+2	200	3			dB,batt
	5½	8840	570	1	.005%	100	£123	4	1	G£123
		8860	1295	1	0.01%+3	3				µC:£477
Hewlett Packard	3½	3435	534	10µV	0.1%+1	100kHz	—	✓		
		3466	798	1	0.03%+1	100	4	✓		diode test
		3468	664	1	.018%+2	100	4	4		HPIL
Griffin & George	3½	'GIPSI'	180		1%±4		—	✓		RS423
	Dual input. Program modules allow many variables.									
Iwatsu	4½	7501	2750	1µV	0.03%	100kHz	3	—	2,4,5, 12 chanl	7,12,13G

Thurlby's 1905 5½ digit microprocessor-controlled multimeter offers exceptance value for money at £325, as the chart on page 73, October issue, indicated.

A multimeter can thus be set up manually using the relevant feature at a suitable reading rate and then left to complete the test cycle. And if the instrument is of the 'systems' type — one that is programmable by a separate controller over a two-way data bus — it may be done completely remotely. Although the general purpose interface bus is now by far the most common form of instrument link some dmms have the serial RS232 or a parallel binary interface as an option.
A few bench-type instruments have only a transmit mode and so are not programmable.

A less expensive route to programmability than a full GPIB system is through a wired hand-held controller such as Fluke introduced to their 8860 a few years ago. As well as increasing computational power this can also control output to printer and at the same time leave the front panel relatively uncluttered.

The programming concept has been taken a stage further in Hewlett Packard's interface loop, which is a lower cost serial interface bus primarily aimed at the small-system user. On the loop, which supports a controller and a number of transmitter and receivers, messages are sent in eleven-bit groups at ±1.5V levels along two wires which can be up to 10 metres long (or 100m using a shielded twisted pair). The controller could be a microcomputer but typically

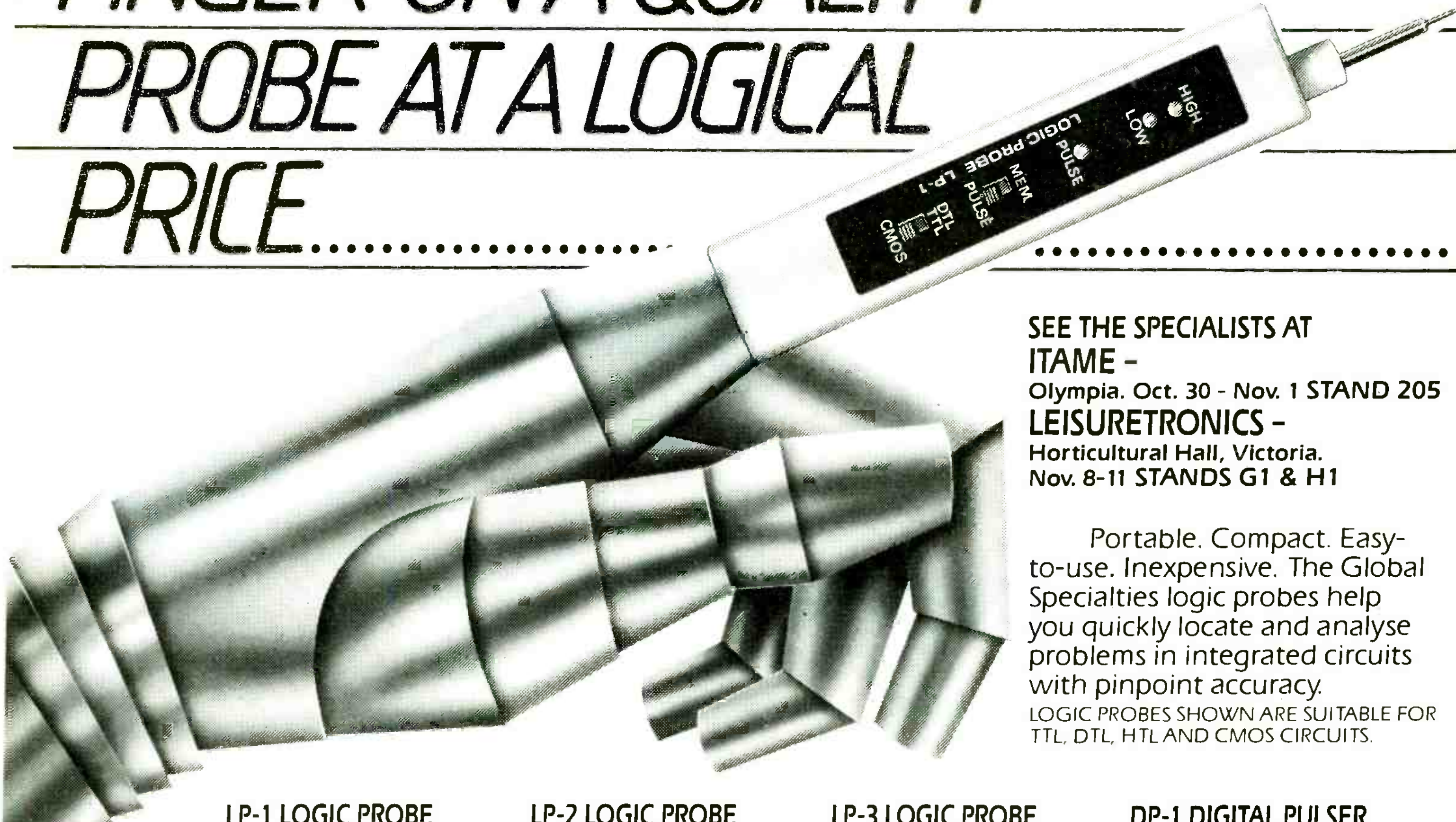
2: Bench digital multimeters

Keithley	3½	169	195	100μV	0.25%+1	5kHz	—	✓		battery
	4½	175	385	10	0.03%+1	100	3	✓	1,4,6,7,13	G£195
		177	545	1	0.031+1	20	3	✓		
		179	395	10	0.04%+1	10	3	hi/lo		G£345
	5½	191	775	1	.007%+3	100	3	4	✓	no current
		195	895	100n	0.02%+8	50	3	4	1,4,6,10	degC, Ginc
		197	495	1	.013%+2	100^+	3	4	1,4,6,7,13	G£195
Kikusui	3½	1502	149	100μV	0.1%+1	5kHz	—	hi/lo		
(Telonic)	4½	1400	245	10	.03+.01%	1	—			
Metrix, ITT	4¾	580	1190	10μV	.025%+4_6	100kHz	4	4	2,3,4,8,9,12	freq.to1MHz
(Sifam)		1458	with built-in printer							
Norma	3½	3210	177	100μV	0.2%+1_{24}	5kHz	7→	✓		(t:£77)
(Cropico)	4¾	3745	497	10	0.03%+3	5	2	✓	2-4,6,7,11	6:£190
Philips	A4½	2518	165	100μV	.1+.02%	50kHz	2/9	✓		dB
(Pye Unicam,	A4½	2519	285	10	.1+02%	20^+	2/9	✓	1,7,10,13	G£210;f
Electronic		2521	365	10	.03%+2	100	2	✓	7,12,13	freq.to 10M
Brokers)	5½	2528	1295	1	.01%+1	500	4.5	4	8	G
		2544	855							
	3½	5002	1735	10μV	.5+.5%	20M†	12	—	1,2,6,7,13	G,nol ratio
Racal	4½	4002	399	10μV	0.4%+1	20kHz	hi/lo			G_0£345
Dana		4003	529	1	.04%+1	20	3	—		B_0£204
	5½	4008		185 similar to Thurlby 1504						
		4009		325 similar to Thurlby 1905						
		5001	793	1	.01%+6_6	20	4	4	1,2,5,6,10,13	G:£275
		5003/4	1492	1	.01%+6_6	20	4	4	1-6,11	G,no I
		5005/6	2181	1	.01%+6_6	300	7	4	11,13	G, ratio
Rohde &	5½	URE	1584	50μV	.05%	20MHz	5	—	1—3,7,10	G£163
Schwarz		UD55	1050	1	.14%+1	20M†	12	—	1,2,6,7,13	G,nol ratio
Sifam	3½	2500	87	100μV	0.3%+2	700Hz				
Siemens	3½	VMG3	250	100μV	.1+.05%$_{24}$	100kHz	2.5→			(£282)
	A3½	1030-3	345	100	.1+.05%	20	3			(A:£440)
		1034	208	similar to Norma 3210						
	4½	1040	534	10	.03+.015%	10	—			hold,B
	4¾	1042	800	similar to Norma 3745						
		1045	1303	10	.015+.005%	100	13			G
Solartron	5½	7045	440	1μV	.02%+1	10kHz	—			Auto,T
	6½	7150	695	1	.01%+2	100	✓	4	1,13	Ginc
Soar	3½	5025	199	similar to hand-held 3025						
(HI)		5030	129	similar to hand-held 3030						
Thandar	3½	351	115	100μV	0.1%+1	1kHz	—			
		355(6)	85	100	.25%+1	1	—			led(lcd)
	4½	451	160	10	.03%+2	1	—			
Thurlby	4¾	1503	159	19V	.05%	10kHz				.03%+£16
		1504	185	10	.05%	20				
	5½	1905	325	10	.015%	5/20				G£145
Trio	3½	705	115	1mV	.5+.5%	1kHz	—			
(HI)		706	219	100n	.1+.15%	15	—			
	4½	720	329	100n	.03+.02%	2C	—			

1. Figures are d.v. ± (reading % + digits) or ±(rg%+f.s.%) for 12 months, with only one or two noted exceptions.
2. Level limit may vary
3. 4: four-wire measurement, hi/lo: high and low test voltages
4. Microprocessor programs 1: Digital calibration, 2: compute (offset, scale, % dev.), 3: ratio, 4: max and min hold, high, pass, low limits, 5: averaging, 6: results store, 7: dB, 8: linearizing for temperature, 9: statistics (van. , rms), 10: self test 11: timer, 13: null facility
5. G: GPIB interface, B: bcd/parallel interface (G_0 output only).

Digital multimeter glossery
Absolute accuracy. Degree of traceability of a measurement to a national standard.
Accuracy. Measurements are 100% accurate if there are no errors; often, inaccurately, taken to mean inaccuracy or error limits.
Autozero. Residual zero voltage, current or resistance error, automatically detected and compensated.
Common-mode rejection. Ratio of common-mode voltage, i.e. in both inputs relative to chassis, and amount converted to normal mode voltage.
Crest factor. Ratio of peak value to r.m.s. value. Large values require true-r.m.s. converters.
Effective common-mode rejection. Combined effect of simple c.m.r. and guard.
Four-terminal measurement. Elimination of lead resistance by separating current source and voltage measurement terminals.
Guard. Electrostatic shield to reduce common-mode currents.
Linearity. Ability to convert analogue to digital quantities up to full scale.
Repeatability. Ability to reproduce identical measurements.
Resolution. Degree to which a quantity can be subdivided, usually given in parts per million.
Sensitivity. Smallest amount of a quantity, usually voltage, that can be detected.
Stability. Repeatability.

IF YOU CAN'T PUT YOUR FINGER ON A QUALITY PROBE AT A LOGICAL PRICE........



SEE THE SPECIALISTS AT
ITAME -
Olympia. Oct. 30 - Nov. 1 STAND 205
LEISURETRONICS -
Horticultural Hall, Victoria.
Nov. 8-11 STANDS G1 & H1

Portable. Compact. Easy-to-use. Inexpensive. The Global Specialties logic probes help you quickly locate and analyse problems in integrated circuits with pinpoint accuracy.

LOGIC PROBES SHOWN ARE SUITABLE FOR TTL, DTL, HTL AND CMOS CIRCUITS.

LP-1 LOGIC PROBE

The LP-1 detects high speed pulse trains or one shot events and stores pulse or level transitions. This simple handheld probe means no need for separate level detectors, pulse detectors, pulse stretchers and pulse memory devices.

* Minimum detachable pulse width of 50 nanoseconds
* Maximum input frequency of 10MHz
* 100 K ohm probe

NEW LOW PRICE!

ONLY £24.95 plus VAT

LP-2 LOGIC PROBE

This extremely low-cost probe works much like the LP-1, but is for slower speed circuits and has no pulse memory.

* Minimum pulse width 300 nanoseconds
* Maximum input frequency 1.5 MHz
* 300 K ohm probe

ONLY £21.00 plus VAT

Or in kit form (LPK-1) with easy instructions, only £14.50 plus VAT

LP-3 LOGIC PROBE

It's the high speed probe that captures one-shot or low-rep events, giving you the main facilities of a top quality memory scope, but at a fraction of the cost!

* Minimum pulse width - 10 nanoseconds
* Maximum input frequency - over 50 MHz

ONLY £53.50 plus VAT

DP-1 DIGITAL PULSER

The DP-1 registers the polarity of any pin, pad or components. Press the PULSE button and it delivers a single, no bounce pulse to swing the logic state the other way. Hold the button down for more than a second and deliver a stream of pulses at 1000 Hz. With a very fast circuit, you can open the clock line and take it through its function step-by-step at single pulse rate or at 100 per second.

ONLY £56.00 plus VAT

Or in kit form (DPK-1) with easy instructions, only £19.95 plus VAT

....YOU NEED TO SEE A SPECIALIST!

Send for a Specialist!
Order today - and if you're not completely satisfied, simply return the products within 14 days and we'll refund your payments.

GLOBAL SPECIALTIES
An Interplex Electronics Company

Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.
Telephone: (0799) 21682 Telex: 817477 GSC LTD

To: GLOBAL SPECIALTIES CORPORATION (UK) LIMITED, DEPT 7II
Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.

Please send me:-

☐ LP-1 at £30.70 (inc P&P and VAT)
☐ LP-2 at £26.20 (inc P&P and VAT)
☐ LPK-1 at £18.70 (inc P&P and VAT)
☐ LP-3 at £64.00 (inc P&P and VAT)
☐ DP-1 at £68.00 (inc P&P and VAT)
☐ DPK-1 at £25.00 (inc P&P and VAT)
☐ Please send me a free catalogue and more information

Name .... Company/Address ....

....

.... Telephone ....

I enclose PO/Cheque for £ __________ or debit my Barclaycard/Access/
American Express No ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ **exp date** ______ EWW

LOGIC ANALYSERS

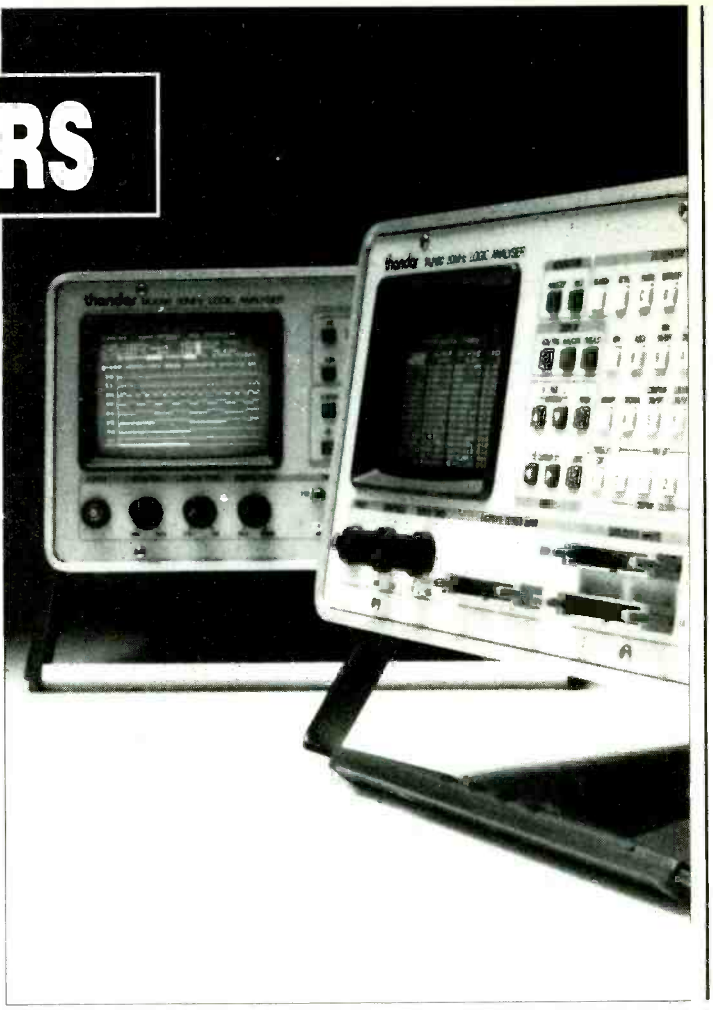
TA2080
8 channels, 20MHz, timing and state. 252 byte data and reference memories. 23 bit triggering with trigger delay by events and/or clocks. Compare and search facilities. Composite video output. Microprocessor disassembly (Z80, 6800 and 6502) and RS232 option.

TA2160
16 channels, 20MHz, timing and state. 252 word data and reference memories. Can be configured as two independent or linked 8 channel analysers with separate clocks and independently set parameters. 34 bit triggering on two levels with trigger delay by events and/or clocks. Powerful compare and search facilities. RS232 interface, composite video output. Microprocessor disassembler options for Z80, 8085, 6809 and 6502.

Both analysers can display data either as any 8 channels in timing diagram format, with cursor, window and expansion facilities, or in state format with cursor, memory compare and word search features. All inputs are high impedance and variable threshold.

Optional accessories include the TA232P serial data (RS232) pod and TP55 video printer.

For further information contact:-
Thandar Electronics Ltd. London Road, St Ives, Huntingdon, Cambridgeshire PE17 4HJ
Telephone: (0480) 64646. Telex: 32250.

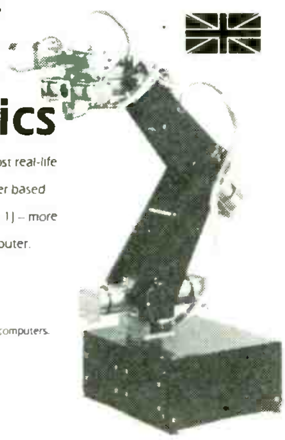


thandar
ELECTRONICS LIMITED

CIRCLE 16 FOR FURTHER DETAILS.

neptune

for low-cost training in
real-life robotics



The advanced design of the Neptune 2 makes it the lowest cost real-life industrial robot
It is electro-hydraulically powered, using a revolutionary water based system (no messy hydraulic oil!)
It performs 7 servo-controlled axis movements (6 on Neptune 1) – more than any other robot under £10,000
Its program length is limited only by the memory of your computer.
Think what that can do for your BASIC programming skills!

And it's British designed, British made.

Other features include
- Leakproof, frictionless rolling diaphragm seals
- Buffered and latched versatile interface for BBC VIC 20 and Spectrum computers.
- 12 bit control system (8 on Neptune 1).
- Special circuitry for initial compensation
- Rack and pinion cylinder couplings for wide angular movements
- Automatic triple speed control on Neptune 2 for accurate 'homing in'
- Easy access for servicing and viewing of working parts
- Powerful – lifts 2.5 kg with ease
- Hand held simulator for processing (requires ADC option).

Neptune robots are sold in kit form as follows.

Neptune 1 robot kit (inc. power supply)	£1250.00
Neptune 1 control electronics (ready built)	£295.00
Neptune 1 simulator	£45.00
Neptune 2 robot kit (inc. power supply)	£1725.00
Neptune 2 control electronics (ready built)	£475.00
Neptune 2 simulator	£52.00
ADC option (components fit to main control board)	£95.00
Hydraulic power pack (ready assembled)	£435.00
Gripper sensor	£37.50
Optional extra three fingered gripper	£75.00
BBC connector lead	£12.50
Commodore VIC 20 connector lead and plug-in board	£14.50
Sinclair ZX Spectrum connector lead	£15.00

All prices exclusive of VAT and valid until the end of 1984.

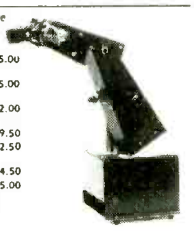
mentor
desk-top robot

This compact, electrically powered training robot has 6 axes of movement, simultaneously servo-controlled. It gives smooth operation, and its rugged construction makes it ideal for use in educational establishments. Other features include long-life bronze and nylon bearings, integral control electronics and power supply, special circuitry for inertial compensation, optional on-board ADC, and hand-held simulator as the teaching pendant. Like Neptune, Mentor's program length is limited only by your computer's memory. Programming is in BASIC.

Mentor is all-British in design and manufacture and comes in kit form at an astonishingly low price

Mentor robot kit (inc. power supply)	£345.00
Mentor Control electronics (ready built)	£135.00
Mentor Simulator (requires ADC option)	£42.00
ADC option (Components fit to control electronics board)	£19.50
BBC connector lead	£12.50
Commodore VIC 20 connector lead and plug-in board	£14.50
Sinclair ZX Spectrum connector lead	£15.00

All prices exclusive of VAT and valid until the end of 1984.



Cybernetic Applications

CYBERNETIC APPLICATIONS LIMITED
PORTWAY TRADING ESTATE, ANDOVER, HANTS SP10 3PR
TEL: (0264) 50093 Telex: 477019

CIRCLE 33 FOR FURTHER DETAILS.

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

ALL POWER SUPPLIES 200-250 V.A.C. INPUTS.
SWITCH MODE POWER SUPPLIES

3.5 VOLT 10 AMP D.C	£12.50
ADVANCE 5 VOLT 20 AMP D.C	£18.50
5 VOLT 40 AMP D.C	£30.00
5 VOLT 60 AMP D.C	£40.00

CARRIAGE & PACKING ON ABOVE £2.00

FARNELL 5 VOLT 20 AMP D.C	£20.00
6 VOLT 40 AMP D.C	£40.00

CARRIAGE & PACKING ON ABOVE £2.00

FARNELL FAN COOLED MULTI-RAIL SWITCH MODE POWER SUPPLY
+5V @ 15 AMP
−5V @ 5 AMP
+12V @ 5 AMP
−12V @ 5 AMP
£36:00
CARRIAGE & PACKING £3.50

POWER SUPPLY 110-250 V.A.C. INPUT
5V 1 AMP D.C
12V 400 M/A D.C
£7:50
CARRIAGE & PACKING £1:25

ALL TRANSFORMERS 250V PRIMARIES

LAMBDA 9-0-9V	65 AMP T/X	£25.00
C. LYONS 250V	10 AMP ISOLATING	£46.00
WODEN 11V	80 AMP	£35.00
WODEN 7.6V	120 AMP	£40.00
WODEN 27V	30 AMP	£25.00
WODEN 60-0-60V	60 AMP ISOLATING	£115.00
GOODYEAR 115V	50 AMP ISOLATING	£115.00

RING FOR CARRIAGE & PACKING

PRINTED CIRCUIT MOTOR TYPE G16M4 60V D.C. 2350 R.P.M	£26.00
EX-EQUIPMENT TESTED G9M4 24V D.C. 3700 R.P.M	£16.00

CARRIAGE & PACKING ON ABOVE £3.50

12-24V D.C. GEARED MOTOR 3 R.P.M. 8lbs INS NEW	£8.50 inc c/pack
WOODEN CASE LAB METER 0-50 MICRO AMP	£9.50 inc c/pack

CLARE CL 3001/OPTO-COUPLER 30p EACH 10 FOR £2.50
SPEC. SHEET/GRAPH AVAILABLE. CARRIAGE & PACKING 30p

ORIENTAL MINUATE CENTRIFUGAL BLOWER 115V A.C. OUTLET 1 × 1 £11.50
CARRIAGE & PACKING £2.50

4 M/M TEST PROBES	60p PAIR NEW
AMPENEOL 50Ω INSULATED B.N.C. SKT. SURFACE MOUNT	60p EACH NEW
BELLING LEE 1.5 AMP INTERFERENCE SUPRESSOR	£1.00 EACH
CATHODEN CRYSTAL OSC. 20 MHZ	£2.00 EACH
230V NEONS RED ONLY 5 FOR	£1.00
230V SUB. MIN. TOGGLE 4c/o	75p EACH 10 FOR £6.00
RED L.E.D. 25M/M 10 FOR	£1.00
230V 1c/o KEY SWITCH	£1.25
TEKTRONIK HIGH CURRENT PROBES NEW BOXED.	£48.00 INC. CARRIAGE.

65p CARRIAGE & PACKING ON ALL ITEMS

INST. COOLING FANS. CARRIAGE & PACKING ON FANS

230V 4½" × 4½" × 1½"	£5.00
115V " " "	£4.75

TESTED GUARANTEED AS NEW

115V 4½" × 4½" × 1½" NEW BOXED	£5.50
115V 6" PAPST NEW BOXED	£6.00
230V 6" ETRI/PAPST AS NEW	£7.00
GLOBE INST. 12/24V D.C. BLOWER MOTOR NEW	£6.50
ROTRON 4" 115V SKIPPER FAN NEW BOXED	£5.00

CARRIAGE & PACKING £1.45

WE ALSO STOCK AT DISCOUNT PRICES KEYBOARDS, MONITORS, PRINTERS, DISK DRIVES, OTHER TYPES OF P.S.U., TEST EQUIP., FAN'S, MOTORS F.H.P., GEARBOXES. ANY ENQUIRIES WELCOME.

ALL PRICES INCLUDE V.A.T. UNLESS STATED.

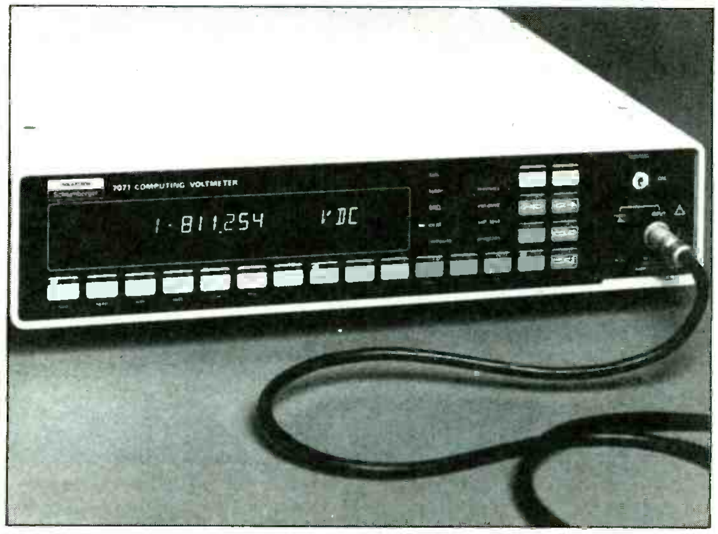
In its high resolution mode, this Datron 6½/7½ digit Autocol multimeter switches in additional circuitry to make a finer determination of zero ironings (Fig. 2e, page 76, October issue).

would be the hand-held calculator HP41C, whilst other loop members might be printers, data recorders, modems, measurement devices, terminals, etc. Used in conjunction with the 3468 HPIL volt-ohmmeter, the 41C is the location for programming tasks requiring computation.

The other in-house bus worthy of mention is I^2C used on last year's introduction by Philips — the PM2519. The inter-i.c. bus is a two-line bus data and clock) that interconnects processor and peripheral chips and is not really intended as an outside world bus. But the GPIB option does rely on this method of interconnection to the instrument by using a second i^2c processor (8440). The first i^2c chip acts as bus manager between a-d convertor, ram and display driver, the connections only requiring two lines each.

Perhaps the most useful microprocessor function for high-accuracy meters is that of automatic calibration. The precise form this takes, its traceability, and accuracy varies with calibration method maker and model. Some instruments use a calibration module that contains typically a voltage reference attentuator and standard resistor, and if all ranges are to be calibrated uncertainty factors build up and traceability can be poor on the highest ranges. With a memory, auto calibration can be greatly simplifid, adjusting out offsets and storing values for each range for subsequent adjustment of readings. With a c-mos memory energized by a lithium cell, constants can be stored for as long as five to ten years.

To enable manufacturers to claim a complete 'lids on' calibration some allowance for the source-dependant errors, such as bias current for the

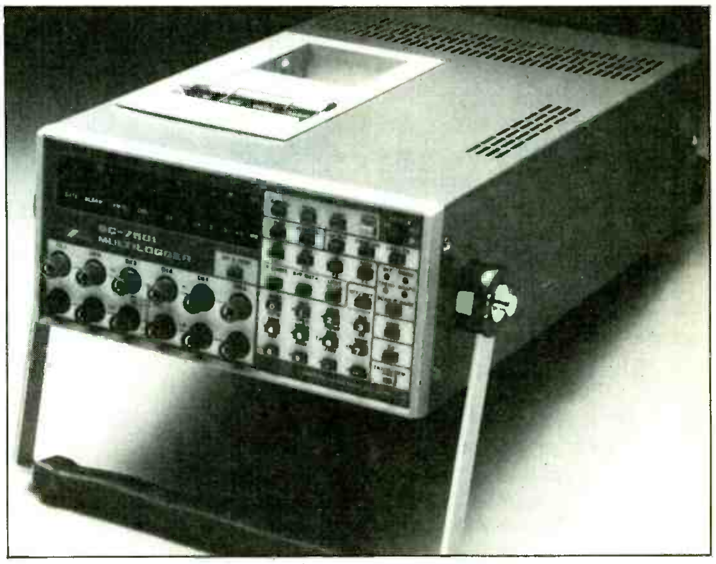


Solartron's new 7071 computing meter has error limits defined by a square root law which can predict its errors for up to 10 years (3ppm error in 24h), see text.

High accuracy systems digital multimeters

Maker	Digits	Model	Basic price	Interface (note 1)	Sens. dv	Error ±ppm/yr	Speed rdg/s	Features (notes 2,3) µP	Other	Options
Data Precision	5½	7500	12950	830 740B	1µV	70+1d	to1000	10	Ratios	4
Datron	6½	1061	1595	200,B	100nV	30+2d	to 220	1-4,7,10,11		4,t
	6½/7½	1071	2495	250	100	20+4d	2	1-5,7,10,11		4,t
	6½	1081	2950	250	10	11+2d	2	1-4,8		4,t
Fluke	6½	8505	3059	406,B,R	100nV	19+8d	to500	—	t:1MHz	Res./d.c.
	6½/7½	8506	4934	406,B,R	100	19+8d	to 200	3,5	t:10MHz	Res/d.c.
	5½	8520	2867	✓	1µ	90+1d	200/500	2-11	t:1MH,	B
		8522	3982	B	✓	data as above				
Hewlett Packard	5½	3478	1220	✓	1µV	19+2d	67	1,10	4t:300kHz	
		3497	2646	✓	1µ	20+1d	to260	6,8		
	6½	3455	4256	✓	1µ	$50+1d_{90}$	to22	2,3,10	4,t:1MHz	
		3456	3368	✓	100n	77+2d	to 290	2-8	4t:250k	
Keithley	6½	192	1355	395	1µV	70+1½d	8	2,4,6	4,1GΩ	
Philips	5½	2528	1295	✓,B	1µV	100±1d	to 18	8	4	
Rhode & Schwarz	6½	UD56	3118	✓,R	100n	40±6	330	1-4,7,9,10	4	Scanner
Racal Dana	5½	5900	3490	B✓	1µV	30+10	to 33	—	Ratio	4,t,R
	6½	6001/2	4092	✓,B	100n	30±1d	to 6000	1-7,10,13	Ratio, 4	h-speed, t
		6900	5375	B	100n	30±8d	to140	—	Ratio	4,t,R
Siemens	6	1050	2606	✓	360nV	30+30	to 12		4,2ch	
Solartron	5½	7055	1570	G,R,B	1µV	80+1d	330	1-10,12	4, T	
	6½	7151	1250	✓,R	100n	80+3d	25	2-4,6,7,9,12	4, T	
	5½/6½	7060	1150	✓	1µ	80+5d	266	3,5,13	Ratio ,4	Scanner
	6½	7065	1800	G,R,B,	1µ	40+4d	330	1-10	4,T	Scanner
		7066	2090	G,R,	100n	40	330	6,8,12	4,T	Scanner
	7½	7075	3050	G,B	1µ	20+8	200	10	ratio, cf:5	Scanner
		7071	3250	✓,R	10n	$20\sqrt{yr}$	100	1-10	ratio,1MHz	
	8½	7081	3995	✓,R	10n	$11\sqrt{yr}$	114	1-10,12	Ratio, t,	scanner

Notes. 1. Price of GPIB shown. B, R normally indicate options for bcd/parallel and RS 232 interfaces.
2. Microprocessor program key 1: auto calibration, 2: complete (offset, scale, % dev)I, 3: ratios, 4: max, min hold, limits, 5: averaging, 6: memory, 7: dB, 8: linearizing, 9: statistics (var, , r.m.s.), 10: self-test, 11: display of error limit, 12: timer 13: null facility.
3. t: true r.m.s., R resistance, T temperature, G conductance 4: four-wire measurement.



HP3468 is designed to operate with HP's interface loop, a two-wire serial bus for battery-operated instruments, see text.

This Iwatsu instrument is more properly called a 'multilogger' than a multimeter, with its 12 channels and it larger storage capacity.

True r.m.s values up to a crest factor of 8 can be measured with an error of 120ppn in 24 hours with Fluke's 8506A thermal multimeter.

resistance function and droop in h.f. response, is required which though analogue in nature need to be stored in digital form. In the Datron Autocal instruments, a digital-to-analogue converter provides the corrections during the calibration cycle (to a varicap-compensated attenuator in the a.c. case). To keep additive errors low during measurement of such correction factors, Datron use their averaging mode to give an effective, internal resolution of 1/16 of a display digit by averaging readings taken at 1/16 steps.

Specifications, particularly of error limits, require a knowledge of component behaviour under stress and their drift with time, often hard to come by because of inediquate information from component manufacturers. Solartron's research into long-term drift has shown that components can be selected so that their drift is not random but follows a predictable pattern. In the 7081, and the just announced 7071, drift rate is proportional to the square root of elapsed time, and this allows a simple 'root year' error statement to be used instead of separate error limit tables for 30 days, 90 days, 6 months, and so on. Providing a single one-year table yields error limits for periods greater and less than by taking the square of that figure. For example the two-year error limit is $\sqrt{2}$ times the one-year figure, and the six-month error limit is $\sqrt{0.5}$ times the one-year figure. So after, say, nine years without recalibration the 7081 will be within three times its one-year limit (and still be more accurate than most other meters). Its error limit summary table

d.v.

1.2ppm rdg+0.3ppm fs (24h)

11ppm rdg+0.3ppm fs ($\sqrt{\text{yr}}$)

a.v.

0% rdg+0.015% fs (24h)

0.01% rdg+0.015% fs ($\sqrt{\text{yr}}$)

resistance

1.5ppm rdg+0.3ppm (24h)

14ppm rdg+0.5ppm fs ($\sqrt{\text{yr}}$)

(For the short-term transfer error only the full-scale term is used.) So a single table not onlu reduces complexity but saves on space, in rom as well as on paper!

Solartron's 7081 precision multimeter is the only meter offering true seven and eight-digit resolution according to its makers. Meters using conversion methods other than the continuous pulse width method offer only six digits, say Solartron, and the seventh is 'invented' (by mathematical means, for example by addition of ten lpV-sensitivity readings and 'inventing' a 0.1pV answer. A resolution of the order of one part in 10^7 is essential to provide a 1 in 10^6 resolution over the whole measurement range. And, say Solartron, providing for eight-digit operation gives full confidence in the seventh.

An example of such an averaging approach to seven and eight-digit operation occurs in the Datron 1071 multimeter. Normally a $6\frac{1}{2}$ digit instrument, the display is extended to $7\frac{1}{2}$ in its 'averaging' mode, the eighth digit appearing after a five-second delay. It uses its microprocessor to compute cumulative average, based on taking 16 readings at a speed of three a second each offset from the next by 1/16, finding an average value and displaying an eighth digit after its readings thereafter updating the average after each further reading. The operation performed is the sum of the old average and the difference between the new sample and the old average, divided by the current number of samples. While admitting this is not a true time integral, Datron point out that it does *tend* to the integral with succesive samples, and argue that the process makes real use of the additional digit by increasing accuracy rather than just averaging the error. With it, they claim a 10nV resolution on the 100mV range. Hewlett Packard's 3456 volt-ohmeter also has an averaging mode to reduce the effect of random noise. They claim an improvement in sensitivity by a factor equal to the square root of the number of measurements, so sensitivity can increase from 100 to 10nV after a hundred measurements.

CIRCLE 83 FOR FURTHER DETAILS.

CIRCLE 53 FOR FURTHER DETAILS.

CIRCLE 12 FOR FURTHER DETAILS.

Megawatt sparks

An item "R.S.C. r.f.i." in the September *Wireless World* (page 29) drew attention to the long drawn out battle over the building of a new high-power h.f. transmitter complex on the site of the old Post Office receiving site at Bearsley, near Stratford-on-Avon. Although this site is about three miles miles or so from the Royal Shakespeare Theatre, fears have been expressed that r.f. interference would be caused to the theatre's lighting and audio system.

The writer of that note pointed out that such equipment should be built to withstand r.f. and, if not, could readily be 'sorted out' with a few disc ceramics and r.f. stopping resistors (ferrite beads would be better).

Unfortunately, the multiple problems of megawatt radio and radar transmissions deserve to be taken rather more seriously. The hazards of non-ionizing radiation have been studied intensively for many years. Despite the wide gap between the safety recommendations established in the USSR and those current in the West there now seems little reason to fear health hazards at distances beyond those established by the National Radiological Protection Board and B.S.I. standards. There remains however the problems of r.f.i. and also of r.f. sparks at distances that can extend to miles rather than feet.

For many years it has been recognized that metal structures and wires, located well beyond the power flux "safe distance" can act as resonant aerials and pick-up sufficient r.f. to generate small sparks. It is for this reason that mobile radio transmitters should never be used when refuelling or in close proximity to petrol tanks or in locations where explosive charges are detonated electrically. Although in practice the hazard represented by the use of low-power transmitters in hazardous environments can be exaggerated, work a few years ago at the Postgraduate School of Electrical and Electronic Engineering, University of Bradford, did show that spark ignition of flammable substances could not be dismissed in some circumstances.

That sparks could occur at considerable distances from megawatt transmitters became evident during the brief operational life of the American over-the-horizon radar at Orfordness when trawlermen complained of sparking from masts and rigging.

More recently, constructional workers building a new international sports stadium outside Riyadh in Saudi Arabia have found themselves exposed to high-voltage sparking from virtually every piece of plant and equipment. The sparks raise small blisters and have proved frightening and potentially hazardous to operatives working high-up in the building.

Cause of the sparking was found to be the 1.2 megawatt "Voice of Islam" radio transmitter located some two kilometres from the site. Since the stadium is being fitted with sophisticated electronic scoreboards, computerized security systems with electronic locks, television and radio equipment, it is having to be fitted with costly special screening, screened cable ducts etc. in addition to those ceramic disc capacitors.

Although such problems often seem to come as a surprise to contractors, equipment suppliers etc., it is interesting to note that the Admiralty marine chart for Dubai, United Arab Emirates, identifies a "danger area" that stretches some *seven miles* along the direction of the main lobe of the directional antenna of this 1480kHz broadcast radio station which has an output of about two megawatts to a directional antenna array. A note on the chart identifies the danger area as follows: "Within the pecked area (24°58′N, 54°53′E) a fire hazard to electronic equipment exists owing to radio transmissiona in the 1470 to 1490kHz frequency band. Masters of vessels are advised to avoid the area. See Admiralty Sailing Directions."

The IBA's Annual Report, 1983-84, notes that: "In Autumn 1983, the m.f. transmitter at Barns Farm in Fife near Edinburgh for Radio Forth was closed down and the service transferred to a new site at Colinswell, a few miles away. This was done in order to reduce the strength of the radio signals at a petrochemical plant adjacent to Barns Farm. The strength of the signals at this plant was considered a safety hazard as any spark might have initiated an explosion."

Yet the radiated power of the ILR transmitter is only about 2.2kW e.m.r.p.

Section 78 and r.f.i.

The susceptibility of many domestic electronic appliances to strong r.f. fields has become notorious. Local transmitters can affect not only radio and television receivers but also audio equipment, modern telephones, video cassette recorders, smoke detectors and virtually any systems using microprocessors etc. Some radio amateurs have found themselves faced with major repair problems resulting from the use of a radio transmitter in vehicles using electronic systems. Some appliances can be affected by very low power transmitters if these are within a matter of a few feet. Similarly, there are strong suspicions that r.f.i. from the powerful transmitters of Radio Free Europe was responsible for the crash in Germany of a £16-million RAF "Tornado" aircraft by affecting the on-board computers, supposedly "hardened" against r.f.

It is interesting to note that Section 78 of the Telecommunications Act 1984 for the first time empowers the Secretary of State "to make regulations imposing requirements on wireless telegraphy and related apparatus with respect to their ability to resist interference by rejecting unwanted signals. Sale of non-complying equipment will be an offence."

It remains to be seen whether DTI will attempt to implement this section of the Act which would appear to raise many legal questions. While Section 78 could clearly be applied to radio and television receivers what is one to make of "related apparatus"?

Is a v.c.r. machine, used with a tv receiver, "related apparatus"? If so, what if it is used with a visual display unit? What about an electronic telephone? How high or low a level of interference? Or will this section prove to be an idle threat, kept in abeyance in view of the difficulties of implementing it?

Friendly sets

There is a strong belief among broadcasters that the ubiquituous radio set needs to become much more 'user-friendly'. The large number of legal and illegal stations has emphasized how difficult it is for many listeners to tune the average portable or domestic receiver to a specific station.

On m.f., sets are now usually calibrated in 'kilohertz', but many people still think in terms of 'metres' or even 'kilocycles'. On h.f. not everybody understands that 6000kHz is the same thing as 6.0MHz. The European 9kHz spacing results in less memorable figures than the American 10kHz channels. Calibration is seldom accurate.

But in any case, few modern dials can be 'read' with any degree of accuracy. A few years ago when an attempt was made to discover how listeners tuned to stations it became obvious that most simply remember 'the spot on the dial' with no recollection of either frequency of wavelength. One answer might be 'channel numbers' for m.f.

There are today receivers with digital fequency readout, car radios with auto-search etc; there is the promise of automatic station selection and identification with 'Radio-data', though industry seems in no hurry to implement a system that will inevitably be confined to a few 'top of the range' models, initially car radios for which listeners seem prepared to pay more than for the average 'tranny'. Some listeners compare the inconvenience, and difficulties of radio tuning with the effective push-button selection of television channels but do not recognize that unlike television sets many radios are used in different parts of the country, complicating push-button selection.

A few years ago the BBC sought to increase the popularity of v.h.f./f.m. by developing a portable receiver using a ferrite-rod aerial in place of the awkward telescopic rod, but this has had little impact on an industry in which British production is almost non-existent.

The technology surely exists for truly 'user-friendly' radio sets at acceptable costs. With the present currency exchange rates it seems a pity that there is no sign of revival of local manufacture of receivers on which listeners could be sure of listening to the stations they want, whether this be Radio 3 or Laser 558!

The UK plans for the extension of Band 2, eventually up to 108MHz, are based on the concept of band segments allocated to five national networks, plus sub-sections for local radio. The idea is that the national services should each be tuned in the same recognized order in all parts of the UK so that the exact frequency will be of only minor import. This plan, however, could be upset if the proposed community radio stations are slotted into any empty gaps in advance of the final release of the upper portion of the 100 to 108MHz allocation, should this be delayed until 1995. There is little doubt that the major problem facing 'community radio' is financial rather than lack of frequency spectrum; but it seems irresponsible of some commentators to suggest that there is no longer any need for effective regulation of the broadcast bands.

F.m. for the young

The swing of American radio listeners to v.h.f./f.m. as opposed to m.f./a.m. listening continues with a recent Radar report putting the f.m. share at 68 per cent of the 183-million (95.6 per cent) of listeners aged 12 or more who listen to radio during any given week. The cumulative audience figures are 154 million f.m. and 115 million a.m. 88 per cent of the age-group 12-24 preferred f.m. to a.m. and only in the 50-plus age group does the balance tip the other way with 56 per cent listening more on a.m. than f.m.

Amateur Radio

Technical incentives?

The steady decline in recent years of home construction among those coming into amateur radio — most newly-licensed amateurs now tend to buy virtually all of their equipment and aerials though some later plunge into constructional work — has resulted in some decline of any deep interest in the engineering aspects of radio communication. For a significant proportion, the technical Radio Amateur's Examination and (for Class A licences) the morse test are once-and-for-all hurdles, taken with only limited intention of the further theoretical or practical study that traditionally has constituted the 'self-training' aspects of the hobby. Yet at the same time, there appears to be a continuing resentment that the media often find it difficult to distinguish between 'amateur radio' as now practised and c.b. radio.

Some amateurs believe that the problem would be reduced by making the multichoice-type RAE more difficult to pass, though there is little evidence to support the belief that this examination is any easier to pass than the old written-form of examination. Indeed there is some evidence that the RAE is deliberately made difficult by the ambiguous nature of some of the 'answers'. A more straightforward and fairer examination could be devised, perhaps, if each question had five instead of four possible answers as seems to be the practice in a number of other 'multichoice'-type examinations.

A more logical way of encouraging 'self-training' would be to adopt the technique of 'incentive licensing' used in many overseas countries, including the USA, Japan and the USSR in which progressively more difficult tests bring added operating privileges. It would be difficult and unpopular to try to introduce a full scheme of incentive licensing at this time, although there are a number of ways in which this might be achieved fairly painlessly.

Martin Atherton, G3ZAY has proposed a voluntary 'advanced RAE' rather on the lines of the advanced driving test. Amateurs would be encouraged but not compelled to take this further examination but would suffer no loss of existing operating privileges if they declined to do so.

Whether a voluntary, limited incentive scheme would really work is open to question. The problem basically is that modern, multi-mode factory-built equipment tends to use complex technology that bears little relation to the technical level of the RAE yet it would surely be a retrograde step to bar entry of 'non-professionals' to the hobby by raising its standard. The real answer would seem to lie in a fully-fledged incentive licensing scheme even if this seems unlikely ever to be adopted in the UK.

Here and there

Arthur Milne, G2MI recently celebrated his 'diamond jubilee' as a radio amateur, having been licensed in 1924. His many contributions to the hobby has been unique including the running with his wife Lucy of the RSGB QSL Bureau for many years and GB2RS newsreader for the London weekly news bulletin (Sundays 9a.m. 3650kHz) on almost 1300 occasions. To mark his jubilee he staged a fascinating exhibition of equipment, valves and components, spanning six decades. Despite his early start the callsign G2MI has not always been his; initially it was issued about 1921 to the McMichael Company. His son and grandchildren are licensed amateurs.

In April 1982, I made brief reference to these columns to the book 'Armement Clandestine' by Pierre Lorain, F2WL as an excellent source of information on the clandestine radio equipment and techniques used by SOE and British Intelligence, including also the excellent sets made by Polish engineers in England for both these rival organizations. An English adaption and translation of this book, with the collaboration of David Kahn, has now been published in the UK under the title 'Secret Warfare' (Orbis Publishing Ltd, 185 pages, £7,99). For those following the current eight-part BBC-1 documentary series on SOE this book deserves to be regarded as a classical source of additional technical information. It includes many of the author's painstakingly accurate drawings covering not only radio but also weapons, aircraft and the development of agents' 'one-time' ciphers. While the emphasis is on SOE's work, the book makes it clear that Intelligence similarly had many radio links with occupied Europe, though its procedures tended to be less complex and technically the equipment was often more crude, than the later designs by John Brown, G3EUR for SOE.

In brief

The DTI on September 10 formally published details of the new 'schecule' to the UK amateur licence, including frequency bands available to the amateur service and the amateur satellite service, their status, carrier and p.e.p. power limits and permitted modes of transmission, together with lengthy series of associated footnotes. However, the details remain basically as announced informally many months ago... 1985 president of the RSGB will be Joan Heathershaw, G4CHH. She will be the Society's first 'xyl' president... One of the few tv plays based on amateur radio, 'CQ' by Paula Milne with technical guidance from Peter Marcham, G3YXZ, was due to be transmitted on Channel 4 on October 11... The British Amateur Television Club has recently published a useful 12-page booklet 'Introducing Amateur Television' by John L. Wood, G3YQC, providing a short guide to fast-scan and slow-scan amateur television, a glossary of terms and abreviations, frequencies and the constitution of the BATC. It was issued to all new members. Membership secretary is Dave Lawton, Grenehurst, Pinewood Road, High Wycombe, Bucks HP12 4DD... The address of Rev. George Dobbs, G3RJV, energetic honarary secretary of the G-QRP Club, devoted to low-power communication, has changed following his appointment as vicar of St Aidan's Church, Sudden: St Aidan's Vicarage, 498 Manchester Road, Rochdale, Lancs 0L11 3HE (Rochdale 31812)... The 'Wireless Museum' (curator Douglas Byrne, G3KPO) at Arreton Manor, near Newport, Isle of Wight, has changed its name to 'The National Wireless and Communications Museum' and is seeking charitable status. An exhibition station, GB2WM, operates regularly on 3.5 and 7MHz... The DTI has produced special application forms for amateurs wishing to operate between 24.05 and 24.25 GHz...

Digital tuner control

by J.N. Darlington

Concluding the design of a circuit for digitally tuning Varicap-tuned f.m. modules.

In the first part of the article in September, the digital derivation of the control voltage and preset memory were outlined. The frequency display remains and constructional data is presented.

Digital readout

If it is assumed that the tuner responds linearly to changes in direct control voltage, a cheap digital read out can be accomplished by conversion of the 8 bit binary output from the counters into four digit led display information as follows:

The eight bits of data are fed as addresses A_2-A_9 to an eprom. Address A_0 and A_1 are derived from the first section of the 14518 counter and will therefore cycle

A_1	A_0
0	0
0	1
1	0
1	1
etc.	

This has the effect, when combined with the binary output, of addressing four unique locations for each one of the 256 counter steps. The data associated with each of these addresses is split in two. The low four bits (D_0-D_3) are used as digit select drivers via transistors and cycle as follows

D_3	D_2	D_1	D_0
0	0	0	
0	0	1	0
0	1	0	0
1	0	0	0
0	0	0	1
etc.			

The higher four bits (D_4-D_7) form the b.c.d. code relevant to that digit and is decoded for a seven segment display. The data is modified to suppress leading zeros on frequencies below 100.0 MHz and to read 108.0 when the counter is between 200 and 255. Only a sample of the program is given in Fig 4, as the full listing is too long to include.

```
100 PRINT"":INPUT"START ADDRESS";XW
110 DIMAD$(1124)
120 DIMDT$(1124)
130 GOTO440
140 REM**BINARY ROUTINE**
150 IFX-256=>OTHENB8$="1":X=X-256:GOTO170
160 B8$="0"
170 IFX-128=>OTHENB7$="1":X=X-128:GOTO190
180 B7$="0"
190 IFX-64=>OTHENB6$="1":X=X-64:GOTO210
200 B6$="0"
210 IFX-32=>OTHENB5$="1":X=X-32:GOTO230
220 B5$="0"
230 IFX-16=>OTHENB4$="1":X=X-16:GOTO250
240 B4$="0"
250 IFX-8=>OTHENB3$="1":X=X-8:GOTO270
260 B3$="0"
270 IFX-4=>OTHENB2$="1":X=X-4:GOTO290
280 B2$="0"
290 IFX-2=>OTHENB1$="1":X=X-2:GOTO310
300 B1$="0"
310 IFX-1=>OTHENB0$="1":X=X-1:GOTO330
320 B0$="0"
330 OP$=B8$+B7$+B6$+B5$+B4$+B3$+B2$+B1$+B0$
340 RETURN
350 REM****
360 DEC=0
370 LB=LEN(BI$)
380 FOR I=1 TO LB
390 LB=LB-1
400 IF MID$(BI$,I,1)="1" THEN DEC=DEC+(2↑LB)
410 NEXT I
420 PRINT DEC
430 RETURN
440 REM**MAIN PROGRAM**
450 A=-1:PRINT"CONVERTING ADDRESSES TO BINARY"
460 FOR I=0 TO 255
470 FOR B=0 TO 3
480 A=A+1:PRINT"ADDRESS NUMBER ";A,
490 X=I:GOSUB140
500 AD$(A)=RIGHT$(OP$,8):X=B:GOSUB140
510 AD$(A)=AD$(A)+RIGHT$(OP$,2)
520 PRINTAD$(A):NEXT B,I
530 A=-1:PRINT"CONVERTING DATA TO BINARY"
540 FOR I=880 TO 1136
550 I$=STR$(I)
560 IF LEN(I$)<5 THEN I$="0"+I$
570 FOR N=2 TO 5
580 X=VAL(MID$(I$,N,1))
590 IF I>1080 THEN I$="01080"
600 GOSUB140
610 A=A+1:PRINTA:
620 DT$(A)=RIGHT$(OP$,4):PRINTA,DT$(A),
630 X=2↑(N-2)
640 IF I<1000 AND N=2 THEN X=0
650 GOSUB140
660 DT$(A)=DT$(A)+RIGHT$(OP$,4)
670 PRINT RIGHT$(DT$(A),4)
680 NEXT N
690 NEXT I
700 FORA=0 TO 1023
710 BI$=AD$(A):GOSUB350
720 P=DEC
730 BI$=DT$(A):GOSUB350
740 Q=DEC
750 POKEXW+P,Q
760 NEXT A
```

Fig.5. **Basic program for production of soft rom.**

John Darlington joined the RAF in 1961 as a radio apprentice and trained for three years at RAF Locking, followed by a further ten years as a radar technician, during which time he obtained an HNC in electronics.

On leaving the RAF he joined Marconi Radar as a technical author attached to the Sea Wolf missile project. For the last eight years he has held production management posts, having gained a diploma in management studies at the Norwich Management Centre: first with Datron Instruments manufacturing precision digital voltmeters, and lately as works manager of Laserscan Laboratories in Cambridge.

Table 1.
Linearity of tuning control

Tuning voltage (V)	Measured frequency MHz	Linear response MHz	Calculated response MHz
1.5	86.72	86.72	86.85
2.0	90.05	88.16	89.9
2.5	92.72	89.61	92.58
3.0	94.93	91.05	94.9
3.5	96.83	92.5	96.92
4.0	98.48	93.94	98.65
4.5	99.94	95.39	100.15
5.0	101.25	96.83	101.43
5.5	102.43	98.28	102.56
6.0	103.5	99.72	103.53
6.5	104.48	101.17	105.23
7.0	105.38	102.61	105.23
7.5	106.21	104.06	106.02
8.0	106.99	105.5	106.81
8.5	107.71	106.95	107.65
9.0	108.39	108.39	108.56

Max error — 0.183% at 96.83 MHz

Table 2.
Frequency meter error

Display frequency	Tuned frequency	% error
87.6	88.	.95%
89.3	89.7	.44%
90.9	91.2	.33%
92.2	92.5	.33%
94.3	94.5	.2%
95.9	95.97	.07%
97.6	97.54	.06%
98.9	98.71	.2%
99.8	99.6	.2%
100.9	100.6	.3%
102.2	101.96	.23%
103.3	103.2	.09%
104.0	104.0	0%
105.0	105.5	.05%
106.1	106.2	.09%
107.2	107.23	.03%
107.9	107.8	.09%

I developed the program using a Commodore 4032, and Fig.5 gives the Basic listing for the production of a 'soft' rom in one of the empty rom sockets of this machine. The soft rom is then copied on the standard prom copier.

Start address input requires a decimal number response, which may vary from one type of machine to another.

Construction

The layout of the display and control keys is dependent upon individual taste as regards appearance. The main digital section was constructed on a RS Components Eurocard standard board using miniature pvc-covered single strand wire. This method is quick, easy and reliable and ideally suited to one-offs. The display used is another RS component and all keys are single-pole press-to-make except the up/down switch, which is a centre-biased, 2-pole, 2-way toggle type.

Both 15V and 5V power supplies need to be regulated and the resistors around the 3140 need to be 1% metal film types. The R-2R ladder resistors should also be metal film, 1% or better, expecially in sections 2 to 6. The overall linearity will depend upon the tolerance and ratio matching of these resistors.

Calibration consists of operating the up/down keys to obtain 88.0MHz or thereabouts and adjusting RV_2 for +2V.RV_1 is adjusted with a frequency of 108.0MHz selected to give around 11 volts (assumes tuner range is 2-11V — tuners outside this range may require different value resistors in the op-amp circuit). Finer adjustments are carried out with either a signal generator or on stations at the bottom and top end of the band using RV_2 and RV_1 respectively (if a.f.c. is switchable it should be off).

Frequency displayed	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0	D7	D6	D5	D4	D3	D2	D1	D0
88·0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0x
	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0
	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0
103·7	1	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	1
	1	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	1	0
	1	0	0	1	1	1	0	0	1	0	0	0	1	1	0	1	0	0
	1	0	0	1	1	1	0	0	1	1	0	1	1	1	1	0	0	0

Address: Binary count (A9–A0). Data: BCD code (D7–D4), Digit select (D3–D0).

x Blank leading zero

Fig.4. **Eprom sample listing for digital readout**

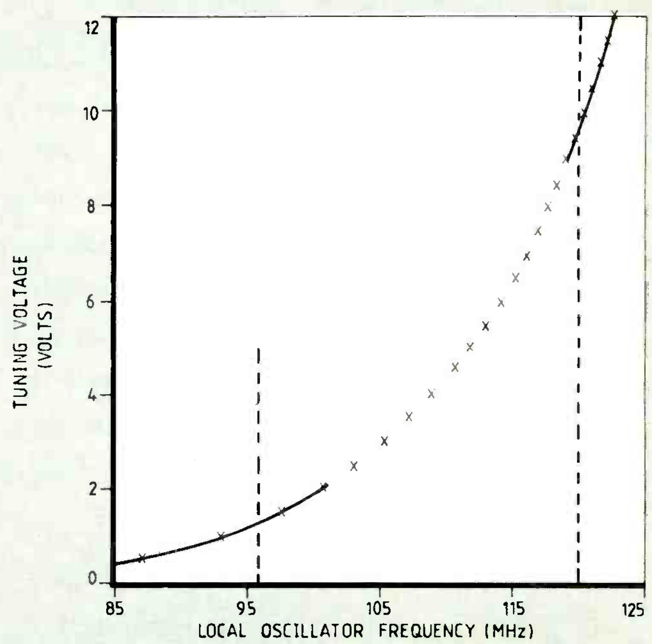


Fig.6. **Local oscillator tuning linearity of Larsholt 7254 module**

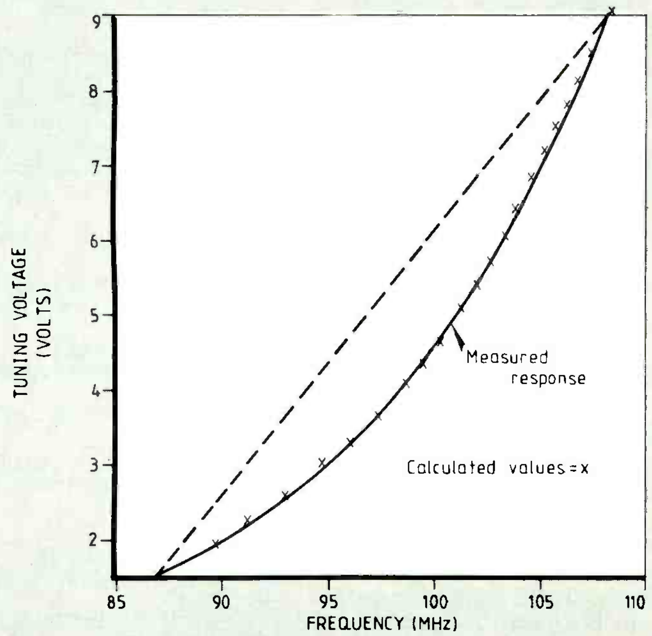


Fig.7. **Frequency meter performance.**

ENERGY TRANSFER

Once more *Wireless World* gives space to Ivor Catt's views on EM theory. It would help his efforts to overthrow the current position (the 'establishment view') if he showed more evidence that he knew what it was.

His article in the September issue of WW contains at least six major errors, any one of which is sufficient to destroy his thesis.

- Sinusoids and pulses are convenient ways of analysing waves mathematicly, be they electric, water or acoustic. The 'mistake' attributed Einstein and 'the modern physics community' just cannot exist.
- He constantly confuses impedance and resistance, leaving his transmission line analysis without value. EM energy is turned into heat by a resistance. When flowing in a transmission line or free space the energy is not changed into heat by the impedance but can be fully recovered as electrical energy. It is rubbish to say that modern physics ignores the impedance of free space, antenna theory and practice is based on it.
- He persists with his view that modern physics somehow requires electric charge to move with the speed of light in conductors. This is nonsense. It is helpful to regard a conductor as a pipe full of water, water flows in one end and out the other when pressure is applied. Naturally water flow is not the same as charge flow but those 'disciplined in the art' do not think, as Mr Catt would have us believe, that electrons have to rattle down some empty tube of a conductor, filling it up at the speed of light. A conductor already has lots of free electrons in it, all ready to start moving under the influence of a passing wave, it is this that distinguishes it from an insulator.
- He carries his conception of a capacitor as transmission line only so far and fails to complete the analysis. He shows it as an unterminated transmission line, but an open line is always terminated by free space with an approximate impedance of 377 ohms so every time a pulse travels down the line some energy is radiated and some reflected. Ivor Catt's mistake is to imagine that there can be some sort of permanent wave oscillating back and forth. Capacitors (and inductors) are only approximations, there can be no exact analysis of a capacitor without including inductive, resistive and transmission line effects. It is worth noting that it is a common v.h.f. and u.h.f. technique to use a transmission line to approximate a capacitor or an inductor.

D.J.O.'Reilly
Antwerp
Belgium

Reference the "Catt Anomaly", there is no anomaly to thoroughgoing Practising Electrician who really believes in charges, currents and fields, since to him it is obvious that a conductor is not just an empty tube. Space does not guide a TEM wave, and intrinsic semiconductors do not either and suffer from space charge effects etc. Conductors are materials that have a high density of mobile carriers, far in excess of the induced charge that moves at "the speed of light". There is no reason why a charge shoukd not move at the speed of light or even more. A charge is a local imbalance between the two polarities of particle. An electric current is the slow drift of the mobile ones. Consequently, where the drift velocity changes, there is a charge build up. The location of a charge can therefore be changed at any geometrical velocity. (A location is neither mass nor signal — thus keeping relativity happy.) Since the drifts are caused by the penetration of the external fields of the TEM wave, the actual velocity with which the drifts rearrange themselves is limited to the phase velocity of the TEM wave with the prevailing boundary conditions. In the case of a step pulse the drifting region elongates at the propagation velocity (nominally c), whilst charge pours into the moving transition region where the drifting carriers "collide" with the stationary ones. As it sweeps along, it leaves the surplus charge behind as a region of enhancement. Where does the charge come from? Nowhere. It was there all the time. All that has happened is a slight compression of the carrier density, made up at the driving end by the earth return current.

D.H. Potter
Axminster
Devon

Ivor Catt implies yet again that it is impossible for those "disciplined in the art" of conventional electromagnetic theory to understand the propagation of a current-voltage pulse or step along a twin conductor transmission line. Specifically he implies that the rapid progress of the two electrically charged zones along the conductors, terminating the electric lines of force looped between them, cannot be accounted for ("the Catt anomaly"), since the drift velocity of conduction electrons in metals is known to be small compared with the speed of light.

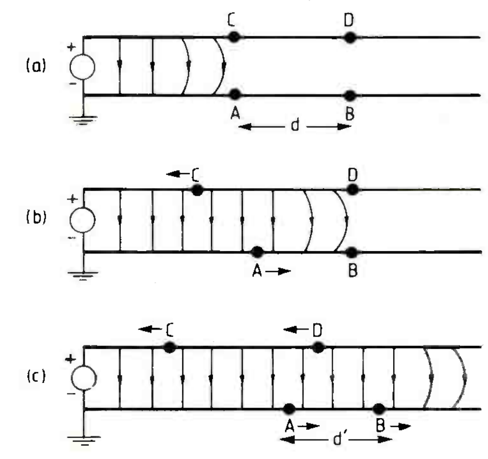
The conductors and the surrounding fields represent intimately coupled systems, both essential in the type of transmission system described by Catt. According to the elementary theory of metals the conduction electrons in a circuit behave much as the molecules of a gas contained in a loop of pipe. The current source, such as a cell, behaves as a circulation pump for the gas, sucking electrons in at the positive pole and ejecting them at the negative pole. The metal also contains positive ions, equivalent to obstructions in the pipe, and due to the associated frictional effects (equivalent to resistivity on the metal) the gas can indeed only be circulated at comparatively low speed. Catt continually overlooks the fact that *variations* in electron gas pressure and density generated by the electron pump may be propagated much faster, in the same way as sound propagates through air or a train of coupled wagons quickly jerk successively into motion when the locomotive pushes or pulls them. The zone with increased density generated, say, by a compression stroke of a pump extends to a range equal to the velocity of sound multiplied by the stroke duration. It is this principle which allows a loudspeaker to generate wavelengths much longer than the amplitude of vibration of the cone itself. The combination of the rapidly moving fluctuations in electron gas density and the background of positive ion charge yields the necessary, rapidly moving positively or negatively charged zones in the metal. The analogy with sound propagation is not quite exact, since the extra charge prefers to collect on the surface of the metal to reduce energy, much as cream floats to the surface of milk. Also, the electromagnetic interaction between the electrons equivalent to gas pressure or wagons colliding with each other, is transported principally through the surrounding dielectric medium into which the electromagnetic fields penetrate deeply in lines with typical geometry. In the gas filled pipe analogy this is equivalent to the transport of a signal via the material of the pipe itself, which one generally seeks to minimize in practical acoustics. The speed of propagation of electron density variations is accordingly limited by the speed, and in typical lines the relevant speed is that for the dielectric medium. As Catt states, the energy ultimately delivered to the load is most economically regarded as transported by the fields, the conductors acting essentially as a guide for the energy. Contrary to Catt's claim, libraries well-used by "the modern physics community" contain many texts on the transient response of transmission lines. The authors naturally assume that elementary notions of wave generation etc. were well-assimilated by the reader at an early age, and make little reference to very basic ideas.

N. Morton
Stockport

I would like to make two comments on Mr Catt's article on energy transfer.

First, I remember being taught as an undergraduate about the passage of stepwaves and pulses along a transmission line, as well as sinewaves. That was forty years ago, long before t.t.l. and e.c.l. were dreamed of. Yet we were interested in pulses even in those days (remember when radar was still called radiolocation?). So perhaps it would be unwise to assume that everybody else has been taught

Fig.1



as badly as, apparently, was Mr Catt.

Second, the Catt anomaly, the details of what happens when a step-wave passes along a transmission line, need more discussion than perhaps Mr Catt felt able to give them in a short article. The figure shows a step-wave passing from left to right. In (a) it has not yet reached two electrons A and B in the earthy wire, which are still at rest a distance d apart. The electric field at the wavefront is bowed outwards, convex in the direction of motion (remember that "lines of force" are supposed to repel each other sideways). Hence at the surfaces of the wires there are components of the field along the wires. Therefore when the wavefront passes electron A the latter experiences a momentary force (an impulse) which sets it moving relatively slowly — drifting — along the wire. In (b) is shown the situation when the wavefront has passed A, but has not yet reached B. On a truly loss-free system A does not need any further force to keep it moving, so behind the wavefront the electric field is strictly normal to the wires. The important point to notice is that the distance between A and B is decreasing.

In (c) the wavefront has passed B also. B has been set moving, with the same velocity as A, so the pair of electrons drift along together, with a constant but smaller distance d' between them. Applying this result to all electrons in the earthy wire it appears that the moving electrons everywhere behind the wavefront are slightly more crowded together than when they are at rest. Hence in unit length of the wire there is a larger number of negatively charged electrons than the number of positively charged ions in the parent atoms fixed in the wire. That is, the wire has (as expected) acquired a net negative charge on which the "lines of force" terminate. Conversely, in the live wire the passage of the wavefront causes electrons such as C and D to drift to the left, with an increase in the distance between them. In this wire the mobile (conduction) electrons are less crowded together than normal, and there is a net positive charge from which the "lines of force" originate. To sum up, if in a wire (any wire) the flow of (electron) current is in the same direction as the flow of energy then the electrons are more crowded together than normal; if in the opposite direction, the electrons are less crowded together. This is a detail in the description of the flow of current which admittedly few text books mention.

Nowhere in the foregoing argument has it been demanded that any electron should move with the velocity of light; yet the accumulation of charges, positive and negative, keeps pace with the travelling wavefront. This is because the accumulation are formed by the wavefront itself, from the electrons which are already present at the wavefront. The Catt anomaly does not exist, so any arguments which are adduced to 'explain' it are unnecessary.

In practice the crowding is, relatively, very small. Consider an air-spaced transmission line of characteristic impedance 50Ω, so that its capacitance is (very nearly) 20 pF/ft. For a step wave of amplitude 1V the net charges, negative and positive, are 20pC/ft.

Dividing this by the charge on an electron, 1.6×10^{-19}C, we find that number of excess electronics (or holes) is 1.25×10^{8}/ft. But this is small compared with the number of conduction electrons which in a metal is about 10^{23} per cc. If the wire of which the line is made is 1mm in diameter its volume is 0.24cc/ft, so the relative excess or deficit is $(1.25\times10^{8})/(0.24\times10^{23}) = 5.2\times10^{-15}$. This number is so small that Mr Catt, and possibly many other people, may be forgiven for overlooking it.

P.L. Taylor
Marple
Chehire

Ivor Catt seems to have repeated a misconception about what happens in transmission lines.

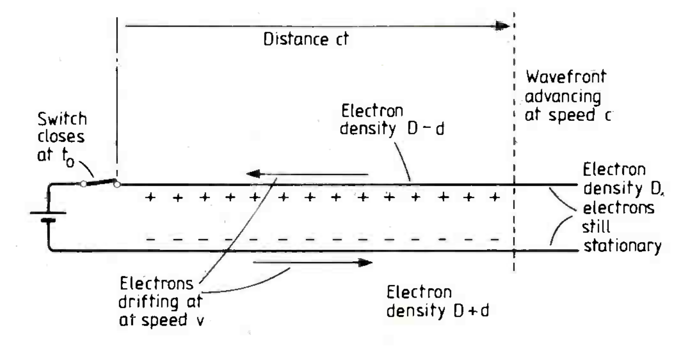
Fig.2 shows the state of affairs in a transmission line after a voltage step has been applied to its left end. The switch was closed at time t_0, and after a further time t, the wavefront has advanced a distance t, c being the speed of TEM propagation in the dielectric. The left of the wavefront there is an excess of electrons on the lower conductor and a shortage on the top conductor. The right of the wavefront there is no net charge on the conductors. Concentrating on the lower conductor, Catt wants to know where the excess of electrons came from. "Not from somewhere on the left", he says, "because such charge would have to travel at the speed of light in a vacuum", and that this "is obvious to the untutored mind." It is fairly obvious to my untutored mind that somewhere on the left is exactly where the charge came from, that there is absolutely no need for it to travel at anything like to speed of light, and that Catt is wrong.

Perhaps I can illustrate by way of analogy. Imagine a row of coins, all 25mm in diameter, and each separated from the next by 1mm. I begin to push the leftmost coin to the right at 1mm per second. After one second it touches the next coin and this begins to move. After another second this bumps into the third coin. This contact happens 26mm to the right of the first, one second later. After each second elapses, another contact occurs 26mm to the right of the previous one. We can imagine this sequence of contacts to be a "wavefront" running through the coins at 26mm per second — that is 26 times the speed of the coins themselves. To the right of the wavefront there is one coin every 26mm, but to the left there is a higher "coin density" of one every 25mm.

Returning to the bottom conductor, electrons to the right of the wavefront have the "neutral" density D, but to the left they have a slightly excess density and are drifting slowly to the right. The wavefront itself is moving at the speed of light. Obviously electrons do not "bump into" one another like coins, but the principle is the same. To a first approximation the ratio of c to v is the same as the ratio of D to λ.

In a real transmission line the "neutral" electron density D depends on the geometry of the line and the type of conductor material used. V and λ also depend on these factors, and on

Fig. 2



the size of the voltage step applied as well. The velocity of propagation of the wavefront though, depends only on the dielectric and has something pretty fundamental about it — which to my mind gives credence to the idea that energy flows through the "insulator", and not the "conductor" which is in fact a barrier to energy flow. After all, metals are shiny because light bounces off them, and I can't ever remember seeing the wires that carry the sun's energy through space to us. I wish Catt would not discredit such (at least potentially) good ideas by throwing in duds of this own.

One final point. On page 47 Catt says "The fact that parallel voltage planes, when entered at a point, present a resistive, not reactive, impedance, was for me an important break-through". Really? If a disturbance is applied at a point in such a pair of planes, a circular wavefront will propagate away from the point. As it moves out, its size will increase, and the impedance of the planes to the wavefront will fall.

As a result of this, energy will be reflected back to the original point of disturbance. This continuous reflection process will present to the disturbance an inductive impedance — won't it?

Alan Robinson
London

BAIRD

Once again the old Baird controversy has been set in motion, this time by Pat Hawker, G3VA, in the June Communications. Since its foundation in 1975 the Narrow Bandwidth TV Association has seriously tried to set the record straight by building Baird-style equipment and demonstrating its limitations and possibilities, so that people might judge the issue for themselves rather than be swayed this way or that by rhetoric.

Mr Hawker complains that Baird's 30-line system contained 'no real sync. signals' and was therefore barely 'true television'. Poor John Baird! Not so long ago his claim to be the first demonstator of 'true television' rested on his fulfilment of the three basic conditions of the 'true' art: it must show pictures of real subjects (not paper or celluloid images); the pictures must be capable of motion (not 'frozen' as in facsimile); the full scale of grey tones must be present (no mere outlines or silhouettes). No others conditions such as colour or 3D were demanded (these took Baird another two years). Now Mr Hawker introduces a fourth requirement: there must be 'real' sync. signals. Since the 'black bar' employed by Baird was totally independent of the picture content, it is difficult ot understand how its 'unreality' can be shown: certainly an oscilloscope display would favour Baird rather than Hawker. Baird's contract with the BBC demanded a signal of composite video (to use the modern term) and this he supplied to their satisfaction. He was thus, at the time of the Baird Television, well ahead of all his continental and American rivals, none of whom had serious attacked this problem, preferring to synchronize pictures via a land line, a separate carrier frequency, or just a shared a.c. mains supply. It is a flattering tribute to Baird that all the world's present-day tv systems employ this same black bar, albeit intensified to facilitate separation, and extended to swallow up almost a fifth of the picture area against Baird's modest five to ten per cent.

The cog-wheel sync device which Baird employed, and which appears to cause Mr Hawker to frown, was an elegant device without rubbing surfaces, wholly silent in operation, and the only part of a Televisor likely to work perfectly today after fifty years in a cellar. Unlike a phonic wheel it had pointed teeth to provide (by the time-window principle) a degree of immunity to false pulses near the middle of the picture. Baird's early critics "proved" the unfeasability of mechanical tv by showing that, for success, the receiver would have to keep in step with the transmitter to an angular accuracy of better than one part in a thousand over the period of an hour or so, a clearly impossible feat. Baird's success can be judged from the fact that the long time exposures needed to produce photos of the dim neon-lamp pictures frequently yielded images without any trace of blurring.

In truth, synchronization of the 30-line pictures was often poor over long transmission distances, but this arose from the primitive state of pulse-separating techniques at the time and not from any fault of the device itself. This remains a landmark in the history of tv technology, demonstrating in a single imaginative leap both the feasibility of the composite video principle and the huge potentialities of motor control through error detection and feedback. As soon as the problems of sync separation were partly solved, mechanical receivers with their built-in 'flywheel' effect were able to show their surperiority over their electronic counterparts, a lead which they maintained up to 1939 and the outbreak of war. The gap was not closed until long after the resumption of transmissions, following the general adoption of 'flywheel sync' an ingenious electronic analogue of the mechanical system.

But Mr Hawker goes further than simply denying that Baird's sync pulses were sync pulses. He claims that if sync pulses of the kind he prefers had been present, they would have been "virtually impossible to transmit on medium waves". Many of our Association members use the 7:3 composite video favoured by the present commercial operators. A number of carrier frequencies have been used experimentally for NBTV signals and no difficulties have ever been reported in conveying the xync information. I can't quote them all, but the highest is 440MHz and the lowest is 10kHz. Clearly, Mr Hawker knows something special about the medium waves that the rest of us don't!

What is it that animates the Baird debunkers who write from time to time in these pages? He had no public school background, distrusted the rich, used dockland invective when provoked, and acquired the bulk of his technical knowledge informally. Surely these things should count for little nowadays. Like many creative people he tended to abandon his brain-children soon after birth and indulges in an instant new pregnancy. This must have been hard on his assistants but doesn't explain the wider venom.

The answer may lie in his image as the small man challenging the "superior" knowledge of the broadcasting establishment and the big firms, a dangerous though, perhaps.

Or is it because "real" television must be wholly electronic and mechanical tv was a dead end that wasted everybody's time? If so, then Baird must be condemned, not alone, but in the company of Jenkins, Alexanderson, Mihaly, Bartelemy, Traub, and many others. Besides, the modern spiral-scan video tape recorder, a wonderful example of precision engineering applied to mechanical tv could not be allowed to exist, and the Dwight Canvendish 1250-line colour tv system currently being developed (with rotating mirrors Baird would have been proud of) must be dismissed as an activity conducted by fools.

Let me end on a constructive note by suggesting a way in which those who regard Baird's 30-line system as no achievement worthy of mention may do something concrete to prove their point. Let them band together to produce and demonstrate tv pictures of their own (for comparison by a neutral arbiter) with those produced by Baird. They may use any number of scanning lines they wish, and so that the contest may err on the side of generosity, they may make use of an additional fifty years of tv technology. The only strict condition they must observe is that the signal must not exceed 9kHz in bandwidth, the restriction imposed upon Baird by the broadcasting authorities when they refused him access to any BBC short wave transmitter (with a more generous bandwidth) and so brought about the medium wave experiments.

I look forward eagerly to viewing the offering of any courageous challenger, but secretly fear that this letter will be the prelude to a long and significant silence.

D.B. Pitt
Chairman, NBTVA

ISOLATED VIDEO DRIVER

With reference to Mr Mclay's video driver circuit (page 49,July issue), I feel a warning ought to be issued.

The 6N139 is rated at 3000V d.c. isolation. This is regarded by UL as adequate for 220V a.c. but as far as I know (and I admit that I may be wrong) this device is not approved for isolation from UK 240V a.c. mains.

Hewlett Packard describe the device as functioning to 1 Mbit/s, and 5 MHz sounds a bit optimistic. I would respectfully suggest that the amount of effort and cost required to obtain and fit a suitable isolation transformer to the set would probably be the same or less, and result in no curtailment of bandwidth. It may perhaps be felt that the difference between 220V a.c. and 240V is trivial, but an informed insurance company investigator would not take that view if a fire originated in the equipment, however caused. The increasing tendency of manufacturers to offer isolators rated at 7.5 or even 10kV in the European market also testifies to the importance of the matter.

M.D. Bacon
Taunton
Somerset

ELECTRIC CHARGE FROM A RADIO WAVE

I refer to correspondence concerning the article 'How to make electric charge from a radio wave' (*WW*, August 1983). In this, Professor Jennison contended that e-m energy propagating in a re-entrant slow wave structure (in this case a ring transmission line having an unusually low group velocity), can be brought to rest with reference to the laboratory frame by physical moving (rotating), the transmission line.

Several correspondents, e.g. Chris Paton (*WW*, May 1984), have likened the system to a polyphase machine stator which is commonly believed to produce a rotating magnetic field. No so. A polyphase stator contrives the vector addition of several time-varying fields produced by several spatially distributed though static electromagnets. This merely gives the impression and effect of a rotating field but is not the same as a travelling continuum of e-m energy propagating in a transmission line.

Regarding the argument that e-m energy propagating in waveguide is independent of any physical motion of the guide, I suggest that if an open ended, radiating waveguide were moved back and forth, the radiated signal received at a distance would surely exhibit the appropriate Doppler modulation. How then can it be said that the propagation velocity in the guide (relative to the receiver), is unaffected by motion of the guide itself?

M. G. T. Hewlett
Midhurst
West Sussex

PRECISION PREAMPLIFIER

Mr Self's reply (April, 1984) to my earlier letter concerning his precision preamplifier struck me as somewhat overblown, containing as it does some very unsubtle suggestions as to my competence, and I fear, attempting to brand me as that most irrational of species, the hi-fi loonie. Some persons, having been on the receiving end of such as outburst might even regard his remarks as insulting, but I prefer to take a more Christian view.

I note that Mr Self is of the Roger Bacon school of thought, wherein scientific observations take precedence over Aristoteleian dogma. This is a noble trait and much to be revered, although it becomes incumbent upon the experimenter to take such observations as are necessary to define a whole process.

After making these observations, it is of some use when informing others of the results to include the parameters of the tests. Thus, I cannot accept that any old electrolytic capacitor produces less than 0.001% distortion when I am not told of the voltage range this encompasses nor the corresponding frequencies. Let us hope that manufacturers attempting to reduce 3rd harmonic distortion in electrolytic capacitors (such as Blackgate and Nicholson in Japan) can be persuaded by Mr Self's measurements to abandon their R and D efforts as a complete waste of time and energy. Everything is apparently perfect already!

Dielectric absorption effects and induced bias in capacitors are, I quite realize, low-frequency effects because of the RC time constants employed for coupling applications. But at l.f. the effects do exist, since a voltage drop does appear across the capacitor, and the d.c. voltages induced then place an envelope delay distortion on the signal as they decay through the net impedance to earth. I would like unwarped records and perfectly set up arm/cartridge combinations as much as the next man, but since l.f. bias is independent of capacitor type and hence unavoidable, I prefer to use film coupling capacitors for their low d.a. (and low tan delta at l.f.). The poor old electrolytic, polar or not, sitting there with its electrolyte molecules in a jumble at zero bias, is a perfect candidate for a good bit of dielectric absorption from the occasional passing l.f. 'transient', and the polar electrolytic will be biased positively, or in reverse, all leading to uncertain characteristics,(1).These effects cannot be detected by audio-frequency sine waves, but do exist in practice.

As for the effects of poor contact resistance, if is a sheer waste of time to band two contacts together and measure the result immediately. Nobody disputes that the initial contact is good. Wait six months and the effect may occur as contact pressures weaken and the surfaces tarnish, silver being an obvious example, which is why a decent switch using silver or silver alloy contacts is made to be self wiping. Tarnishing is also the reason why Cromolin and other insulating lubricants were developed to keep out atmospheric pollutants on contacts.

I really feel that Mr Self is deliberately missing the point on contacts and the best of luck to him in his rusty nail world! For the modest extra expense, I once again reiterate my opinion that a gold flashing on RCA phono plugs is more than worthwhile as it simply does not tarnish (And I'm not going to argue about how pure the gold should be, etc, etc. That point has been laboured over and over again in the press.)

Finally, the hoary old argument about the music signal having been processed 15 ways to Sunday before it ever gets to the record is trotted out by Mr Self. So what? Is this an argument for more processing and switches as a paliative, or do two wrongs magically create a right?

I do not know how involved most readers of *Wireless World* are in high-fidelity sound reproduction, nor am I aware of their general sensibilities. Consequently, I do not want to appear to be preaching; but a great many of the points in dispute here have been are are being addressed in the hi-fi press. I would particularly commend to *WW* readers a series of articles running in *Hi-Fi News*, on the design of a preamplifier by one B.J. Duncan, which began in the May 1984 issue. This design, insofar as it has been revealed at present (there are five monthly articles altogether) appears to be a technically tour-de-force, in my opinion, and provides a ready, timely, and detailed approach to the proper selection and use of components for a real world design. This is not to castigate Mr Self's design as such — it is elegant. I just want to have it as nice as possible when I make mine.

W.M.B. Armstrong
Halifax,
N.S.

PAUSAID

I wonder whether you are aware that, with trivial modifications, the 'Pausaid' (May 1984 *WW*) can become a useful 'DJ Killer'? i.e. a device which will silence the chat in between musical items, and though I don't 'of course' speak from personal experience, could be arranged to provide, via a solenoid recorder, continuous music recordings.

R.G. Young
Newhaven
E Sussex

Letters

Letters for publication are always welcome. Those that are short and to the point stand the best chance of publication since space for these columns is limited.

Tape timing circuit

by Tor Knutsen

Real-time tape clock, independent of tape-recorder circuitry and needing only mechanical modifications.

This circuit was designed as part of a digital tape clock/counter and can provide the correct 'clock' and 'up/down' signals for several counter i.cs currently on the market. It is completely independent of the tape recorder's own circuitry and the only modification is purely mechanical, when the 'interface' roller, timing disc and two opto switches are attached to the deck near the tape path.

The schmitt triggers of IC_1 in Fig. 1 provide noise-free pulses with fast rising and falling edges and secure trouble-free operation of both control logic and frequency divider.

When A and B inputs are both low, the circuit is internally reset and pin 10 of IC_4 goes low. The circuit then detects which input first goes high. If A goes high first, the UP/$\overline{\text{DOWN}}$ output goes high. If B, however, goes high first, the UP/$\overline{\text{DOWN}}$ output goes low. When both A and B go high, a negative clock signal is produced at pin 11 of IC_2. The positive clock signal is obtained at pin 10 of IC_2 and fed to the dual counter IC_6, where the clock signal frequency is divided by 3, by 2 and again by 2 at the appropriate times to produce 1 clock pulse per second, dependent on tape speed. When A or B goes low after both inputs have been high, no change is made at the UP/$\overline{\text{DOWN}}$ output. As long as the tape is moving in the same direction, the UP/$\overline{\text{DOWN}}$ signal is therefore a direct voltage, changing only if the tape changes direction. The connection to the phototransistors determines which direction is named 'forward' or 'up'. The opto switch feeding input A should in any case be the one changing state first as the timing disc rotates during recording and playback. The truth table is shown in Fig. 2. No RC time constant is included in the circuit, and its performance is not influenced by the rotation speed of the timing disc. I have in vain tried to fool it.

Mr Per C. Andersen in his April, 1983 article has described the near perfect clock-to-tape 'interface' roller. Because I have no access to a precision lathe, I had to try the alternative of Fig.3. I bought from Tandberg a spare pressure roller for the TD20A tape recorder. It has an outer diameter of 25.4mm and requires a 4mm shaft. (A steel base plate with the 4mm steel shaft can also be supplied.) By attaching the roller to an electric drill and carefully applying a fine grade sand paper, the diameter was reduced to 25.2mm (25.1995mm). With a small hacksaw blade, three parallel grooves were made to improve contact between tape and roller, especially during fast wind/rewind. The timing disc in Fig. 4, with five black sectors, was attached directly to the roller. A 4mm shaft and a small p.c.b. carrying the two optical switches were fastened to a base plate.

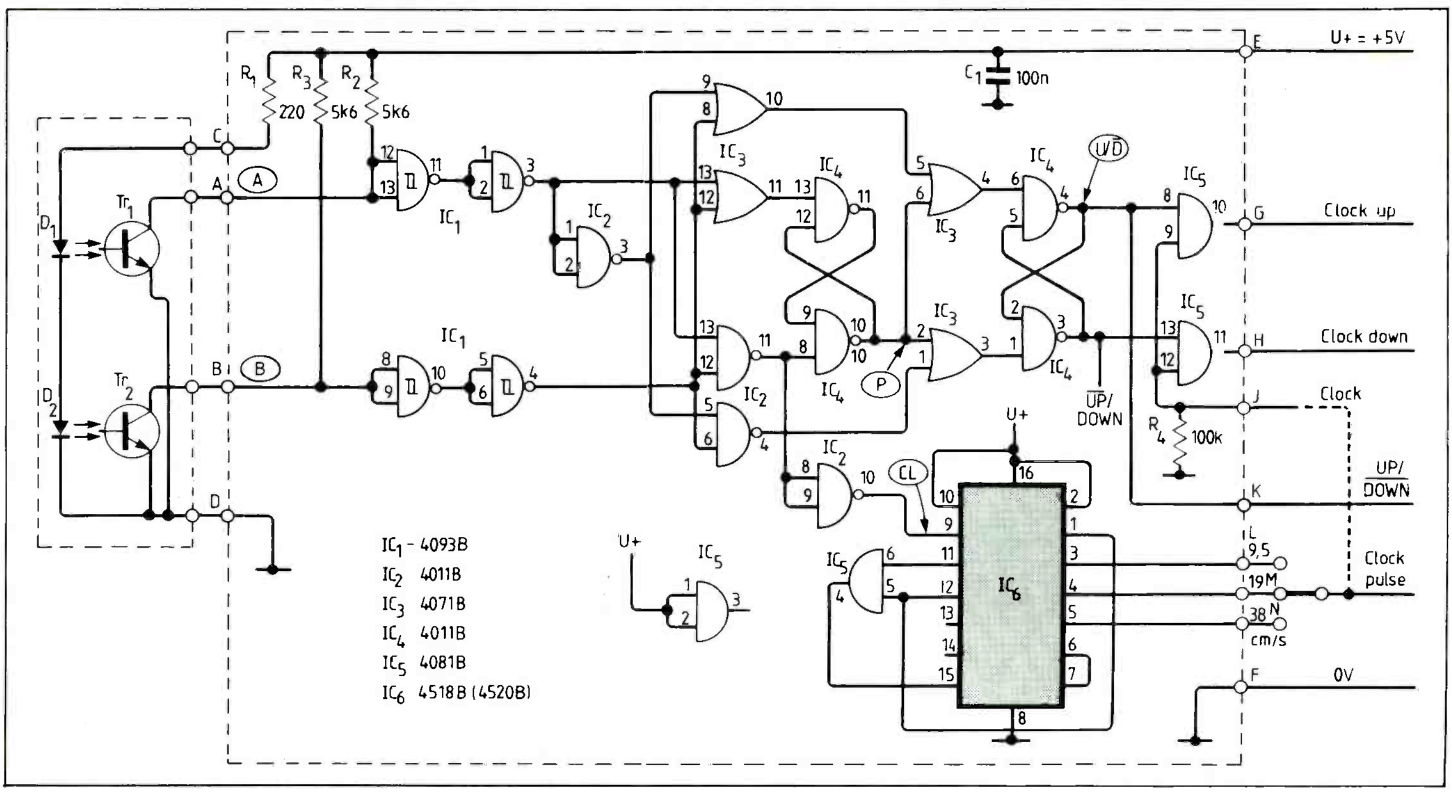
The roller has a sintered bronze bush bearing, and even though its friction is higher than that of ball bearings, it has appeared to be sufficiently low, and only light pressure against the tape has been necessary.

Truth table

	A	B	P	U/$\overline{\text{D}}$	CL
Forward:	0	0	0	X	0
	1	0	0	1	0
	1	1	1	1	1
	0	1	1	1	0
	0	0	0	1	0
	1	0	0	1	0
	1	1	1	1	1
Reverse:	0	0	0	X	0
	0	1	0	0	0
	1	1	1	0	1
	1	0	1	0	0
	0	0	0	0	0
	0	1	0	0	0
	1	1	1	0	1

Fig.2. **Truth table for UP/DOWN and clock output of Fig.1. circuit**

Fig.1. **Circuit diagram of the timer.**



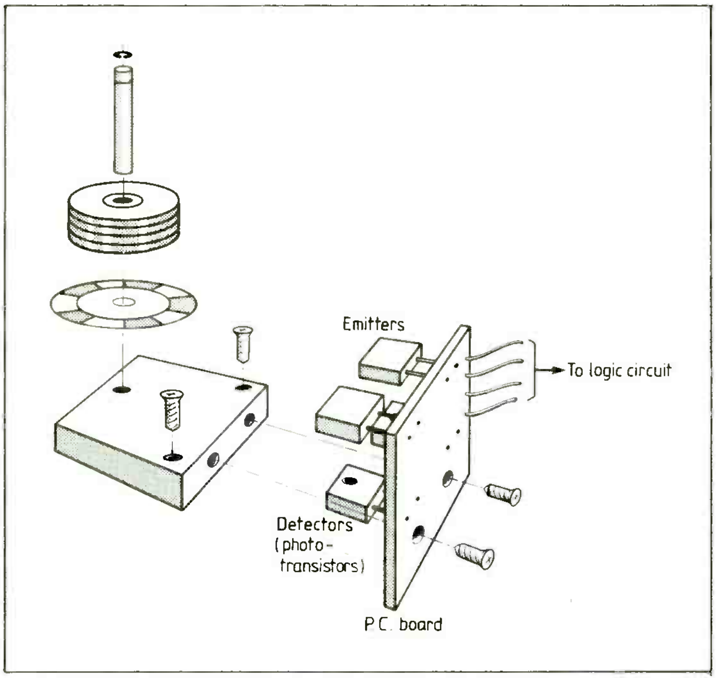


Fig.3. **Clock-to-tape 'interface' mechanism.**

Fig.6. **One form of counting and display circuit, using CMOS.**

Because different i.r. emitters and detectors have different power outputs and sensitivities, it may be necessary to change the value (5k6) of R_2 and R_3. The opto switches should be positioned so near each other that one sector of the timing disc is able to cover both optical paths at the same time. In fact, if discrete emitters and detectors are used, only one i.r. emitter is necessary for the two phototransistors.

The p.c. board shown in Fig.5 carries all the components except the opto switches and the (optional) 3-way switch.

The described circuit has been used with two minutes and seconds counters, one with four 4510 cmos b.c.d. counters and four 4511 7-segment drivers as in Fig.6, the other being a very simple construction using Intersil's ICM7217C chip shown in Fig.7. The Intersil device is easy to use and has several optional facilities built in, but it is definitely not cheap, and it may appear to be difficult to find a distributor who has it on stock. The '4510' counter counts to 9959, while the ICM7217C counts to 5959. (ICM7217 and ICM7217A are decade counters counting to 9999, while ICM7217B (common anode) and ICM7217C (common cathode) are intended for real time counting, counting to 5959.)

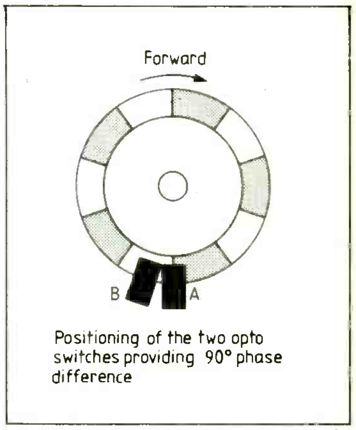


Fig.4. **Timing disc.**

One 4510 and 4511 i.cs, together with 7-segment display and their associated components were soldered to their small 'counter module' p.c.board, seen in Fig. 8, the 7-segment display being attached by the aid of another small board. Four counter modules were then attached to a common bus board. The i.cs containing the gates necessary for correct seconds and minutes counting were also soldered to a separate small p.c.b. but could

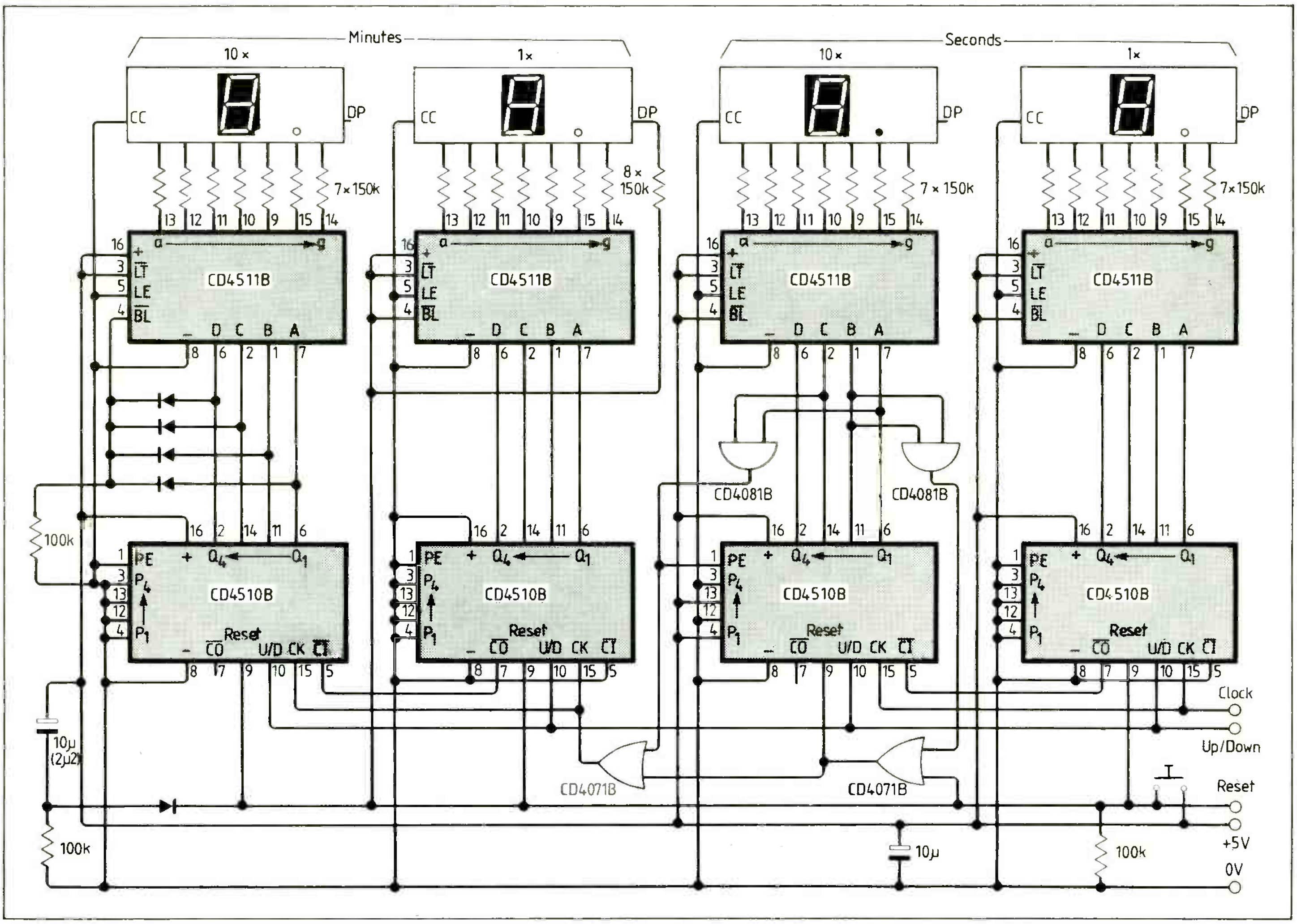
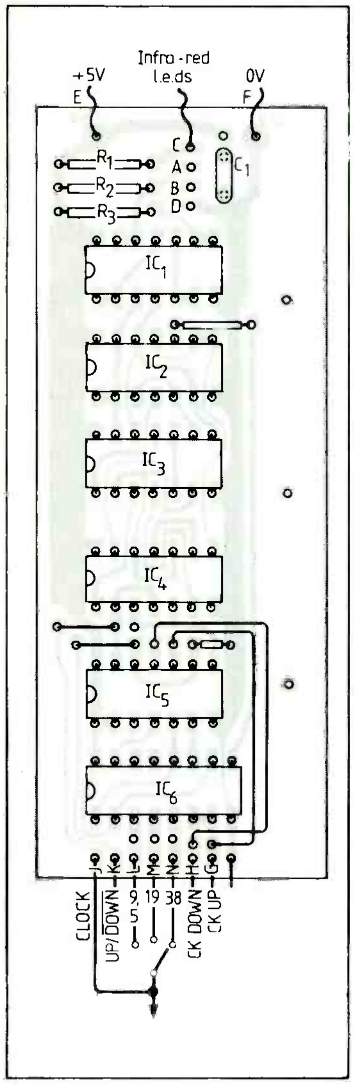


Fig.5. **Printed-circuit board layout for circuit of Fig.1.**



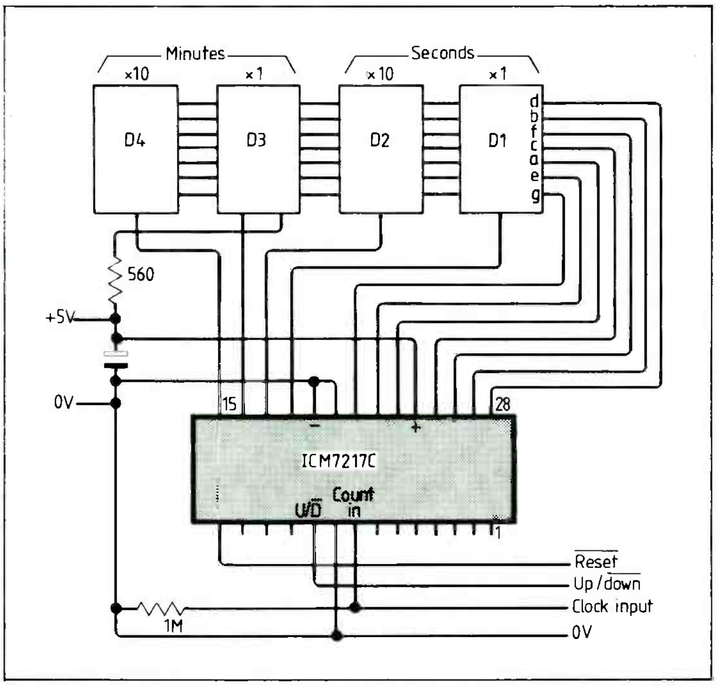
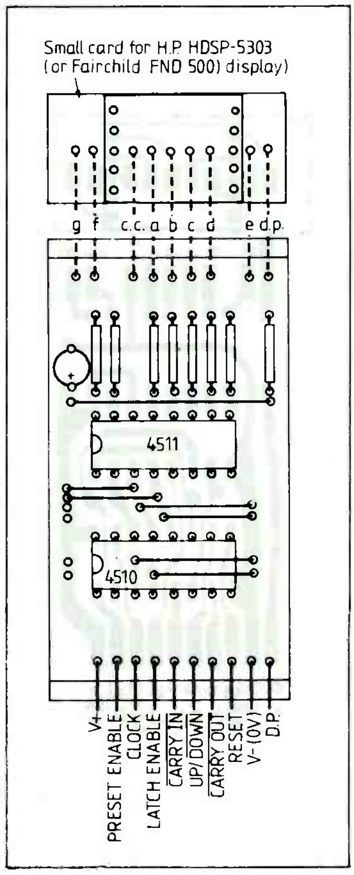


Fig. 7. **Alternative to counter of Fig.4, using intersil chip.**

Fig.8. **Circuit-board layout for CMOS circuit of Fig.7. Four such boards are needed.**



just as well be placed on the bus board, which can easily be made from a piece of Veroboard. The diodes and resistor which provide zero blanking of the 10× minutes counter can be soldered to the copper side of that module. A few additional components on the bus board provide automatic resetting of the counters at power switch-on.

Standard cmos i.cs can operate at power supply voltages from 3 to 15 (or 12) volts and are very flexible to use and not easy to destroy. If supply voltages other than the 5V indicated are used, the current limiting resistors to the displays should be chosen so that power dissipation limits of either the 4511 i.cs or the displays are not exceeded and the p.s.u. is not overloaded.

References

1. *Wireless World*, April 1983, p.58: 'A digital tape clock'.
2. *Wireless World*, August 1983, p.49: 'Letters to the editor'.
3. Intersil Data Book, 1981, pp 6-55 to 6-66: 'ICM7217 Series, ICM7227 Series 4 digit c-mos up/down counter/display drivers'.
4. RCA Cos/Mos Integrated Circuits Databook, p.628: 'ICAN-6346: Applications of the RCA-CD4093B COS/MOS Schmitt Trigger'.

LITERATURE RECEIVED

A new products Update from Electroplan reflects additions to their ranges of test and measurement equipment. Included are multimeters from Fluke and Avo, a GPIB Multifunction calibrator from Time, function generators by Wavetek and Wayne Kerr component bridges. Microcomputer equipment is also included with the Hewlett Packard HP-150, data acquisition boards for the IBM PC, and memory expansion cards for the same computer. To these are added communications and interfacing products for Microcomputers. Electroplan Ltd, PO Box 19, Orchard Road, Royston, Herts SG8 5HH. EWW 250

Not only do Verospeed have a wide range of components, they also supply technical publications and have produced a brochure to prove it. These include the TI Data Books and user guides and the 'Understanding' series from Learning Centre Publications. Verospeed, Stanstead Road, Boyatt Wood, Eastleigh, Hants SO5 4ZY. EWW 251

For data transmission speeds up to 2400bit/s the Type 2424 full duplex modem is available from Thorn EMI Datatech and is described fully in a brochure. Suitable for two-wire, dial-up and leased line applications, the V22-type modem uses a number of microprocessors which enables the inclusion of many 'advanced' features, which include autodialling, an equaliser and a network test system that allows remote testing, even through a multiplexer connection. For telephone lines with poor line quality the modem can automatically reduce its speed to 1200bit/s. Data Communications, Thorn EMI Datatech, Spur Road, Feltham, Middlesex. EWW 252

A shortform catalogue has been intoduced by Analog Devices which lists all the products concerned with angular and linear measurement. The catalogue contains enough information to be able to specify a product. In particular it lists the IS60 angular resolver which may be used as an alternative to the absolute shaft encoder. Analog Devices Ltd, Memory Devices Division, Central Avenue, East Molesey, Surrey KT8 0SN. EWW 253

Copies of the PAL Handbook, from Monolithic Memories, are now available. A comprehensive guide to the use of programmable array logic, the book contains the latest specifications, design concepts and product application together with reprints of articles relating to p.a.l. usage and the testing of p.a.l. circuits. Further information from Microlog Ltd, Elizabeth House, Duke Street, Woking, Surrey GU21 5BA. EWW 254

An extensive range of a.c.-d.c. converters as produced by Gardners who have issued a leaflet describing them. The Dilcon range are in p.c.b.-mounting form and significant features include single or dual outputs, minimum e.m.i. low power loss giving efficiencies of up to 70%, regulated and unregulated versions with power ratings up to 1.5W and physically and electrically interchangable with most rival imported versions of these British products. Gardners Transformers Ltd, Christchurch, Dorset BH23 3PN. EWW 255

Benchware is the term used by STC to describe their range of production tools and materials which are illustrated in the latest edition of their *Benchware Book*. Adhesives, heat-shrink tubing, cable markers and tapes are included for the first time as are a variety of soldering equipment. Also included is a wide range of batteries. STC Electrical Services, Edinburgh Way, Harlow Essex CM20 2DF. EWW 256

If there is anything measureable in f.m. radio and television equipment then it seems that Rohde and Schwarz has devised an instrument to measure it. A vast range of such equipment is described in a hefty book, *Rigs and recipes*, which is obtainable from them, Rohde and Schwarz (UK) Ltd, Roebuck Road, Chessington, Surrey KT9 1LP EWW 257

Cad techniques are used in the speedy design of p.c.bs at Circuit Consulants (Norwich) Ltd, Hurricane Way, Norwich NR6 6HU. They have started a 'flexible' system of paying for the designs at different prices depending on the urgency of the job. It is possible to name your own price and then be told when to expect delivery! This is in addition to the company's normal and Superfast services. EWW 205

LOW COST ACOUSTIC MODEM

At "half the cost of any other modem available", the Protek 1200 is compatible with any RS232/423 computer and provides a 1200/75 baud link to Prestel or similar viewdata systems and a 1200/1200 baud half-duplex link for computer-to-computer communication. The unit is battery-driven and acoustically couped to the telephone handset. Acoustic coupling has been criticised for being subject to interference from external noise, but the Protek device has been designed to exclude such noise. The retail price for this BT approved modem is £59.95 inclusive but an additional interface pack is necessary for specific computers. For example, the BBC computer pack for £14.95 includes a hook-up lead and the software provided on cassette; the Sinclair Spectrum needs an RS232 interface box and the interface pack costs £24.95. Interfaces are ready for these computers and the Commodore 64 and are being prepared for a wide range of other nome micros including the Amstrad, Oric, Sinclair QL and all MSX computers. Available in the High Street stores the Modem is marketed by Cirkit Holdings plc, Park Lane, Broxbourne, Herts EN10 7NQ. EWW 206

CMOS 6502

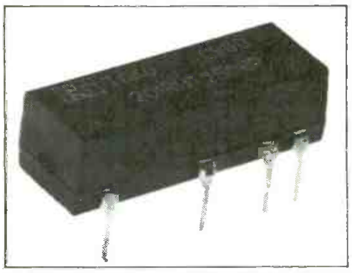
Pin-compatible with the bi-polar 6502, Rockwell's 65C02 offers several advantages. Its power consumption at 1MHz is only 20mW, about 4% compared with its prodecessor. It has better tolerance to voltage fluctuation and better noise immunity. It can act as a plug-in replacement and use all the same instructions but improvements in internal architecture has allowed the addition of several more instructions. These are principally concerned with zero page addressing and allow indirect addressing and indexing. Zero page memory bits may be set and reset directly rather than through the accumulator. This allows more compact and faster machine-code programming. Versions are available for 1,2,3 or 4MHz operation with the suffixes P1 to P4 respectively. So, for example a BBC micro would use an 65C02P2. RCS Microsystems have a special offer to BBC users with the processor and its data sheet along with software to enable the extra instructions to be used in the BBC's assembler, all for £17.25 inclusive. They also have details of other members of the 6500 family in c.mos including a PIA and an ACIA, and especially interesting is the advance information on a two-processor chip which can directly address 128Kbytes of ram.
RCS Microsystems Ltd, 141 Uxbridge Road, Hampton Hill, Middlesex TW12 1BL.
EWW 207

THROWAWAY SOLDER SIPPER

A rugged low-static-potential desoldering tool provides sufficient suck for most requirements including the re-working or removal of static-sensitive mos i.c.s. Priced at £3.70 it is easily replaceable.
Circuit Plating Equipment Ltd, Newbury, Berks.
EWW 208

FLOPPY-DISC CONTROLLER

Filling the gap created by the world-wide shortage of Intel 7282 and NEC uPD765A integrated circuits, Rockwell have produced the R6765-5 double-density floppy disc controller. A direct replacement for the other controllers, it is IBM compatible in both single and double-density formats and is also compatible with a wide range of 8 and 16-bit microprocessor buses. The 40-pin device can control up to four disc drives and offers programmable data record lengths of 128, 256, 512, or 1024byte/sector. Pelco (Electronics) Ltd, Spring Gardens, Romford, Essex RM7 9LP. EWW 209



BUFFERED DELAY LINES

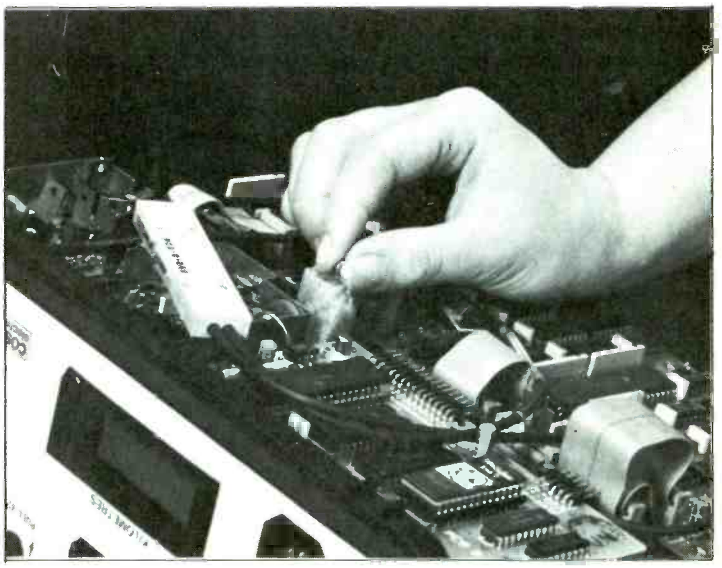
Lumped-constant buffered active delay lines which incorporate Schottky t.t.l. logic elements in the input and output terminals are available from Ashcroft. The modules can be used as t.t.l. elements with a precisely fixed delay time. Any change of delay time due to temperature variations may be compensated by complimentary matching of the delay line and the i.c. Seven types are included in the series, offering delay times from 20 to 250ns with five tapped outputs available to the user incrementing the delay by 4 to 50ns with a rise time of 3 or4ns. Significant saving of component count is made by the use of the RHT series of delay lines, making the design of digital circuitry easier and providing highly accurate pulse timing. Ashcroft Components Ltd, 28 Somerford Road, Cirencester, Glos GL17 1TW. EWW 210

CIRCUIT ANALYSIS ON A MICRO

Versions of the computer program 'Analyser' are available for the Acorn/BBC and the Sinclair ZX Spectrum microcomputers. Analogue circuits with up to 16 nodes and 60 components can be entered into the system to give analyses of input impedance, output impedance and gain (magnitude and phase) at linear or logarithmically spaced intervals. Resistors, capacitors, inductors, transformers, op-amps, bipolar transistors and fets can all be simulated by the program and the a.c. performance of circuits containing any combination of these can be evaluated without the need for breadboarding and bench testing. It is easy to alter the values of components in order to assess the circuit's sensitivity to component tolerances, stray capacitance etc.

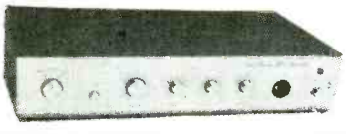
The program is particularly suited for frequency response analysis of filter circuits, audio amplifiers, wideband amplifiers, tuned r.f. amplifiers, linear integrated circuits and the like and has been in use as such for two years by the electronics consultants who designed it. £35 inclusive. Number One Systems, 9A Crown Street, St. Ives, Huntingdon, Cambs PE17 4EB. EWW 211

FIBRE-OPTIC TESTING



The photon-counting properties of silicon avalanche photodiodes have been used to produce an optical fibre fault locater. Based on techniques developed by BT, the instrument is claimed to have a sensitivity 10 000 greater than conventional test devices. The instrument used optical time-domain reflecrometry and can be used to locate cable damage and also to measure attenuation and splice losses along a fibre. The term photon-counting derives from the fact that the diodes can detect individual light particles (photons) which have energies of only 10^{-21}W. Using this property, Cossor have been able to develop an instrument capable of locating defecting cables up to 30km. away. They hope to be able to use similar techniques in such areas as nuclear instrumentation where bulky and fragile photo-multiplier tubes are used. Cossor Electronics Ltd, The Pinnacles, Elizabeth Way, Harlow, Essex. EWW 212

LINSLEY-HOOD 300 SERIES AMPLIFIERS



35 Watt Complete Kit. MosFet O/P £79.50
45 Watt Complete Kit. MosFet O/P £83.50
Reprints of Original Articles from 'Hi-Fi News' .... £1 no VAT.

LINSLEY-HOOD 100-WATT MOSFET POWER AMPLIFIER

The very latest amplifier design, published in 'Wireless World' by the renowned John Linsley-Hood. This may now be taken as the standard by which the rest are judged! Our kit, approved by the designer, has massive heat sinks and power supply and includes all components needed to build. Case size 412mm wide, 254mm deep and 145mm high. Automatic switched speaker protection is included as standard. Cost of all parts is over £120. Our complete stereo kit price **£105.50**.

LINSLEY-HOOD CASSETTE RECORDER CIRCUITS

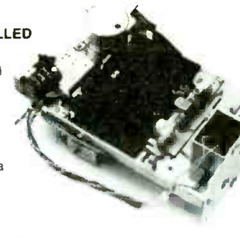
Complete record and replay circuits for very high quality low noise stereo cassette recorder. Circuits are optimised for our HS16 Super Quality Sendust Alloy Head. Switched bias and equalisation to cater for chrome and feric tapes. Very easy to assemble on plug-in PCBs. Complete with full instructions.
Complete Stereo Record/Play Kit £25.26
VU Meters to suit .... £2.30 each
Reprints of original Articles .... 75p. No VAT.

STUART TAPE RECORDER CIRCUITS

Complete stereo record, replay and bias system for reel-to-reel recorders. These circuits will give studio quality with a good tape deck. Separate sections for record and replay give optimum performance and allow a third head monitoring system to be used where the deck has this fitted. Standard 250mV input and output levels. Full details are in our lists.
Reprint of Original Articles .... £1.30. No VAT.

SET OF 4 SUB-MINIATURE IF TRANSFORMERS for high quality AM tuner. THE SET ONLY 38p!
Application circuit if required 10p
Suitable ferrite rod antenna 85p

DGS001 2-MOTOR, SOLENOID CONTROLLED CASSETTE DRIVE.



Fully solenoid controlled cassette mechanism suitable for Hi-Fi or digital use. With a logic control board the deck can be operated by lightweight touch controls or output from a micro. Ideal for applications under automatic control such as telephone answering machines, data loggers, automatic background music systems, remote control recorders and microcomputer program and data storage. Two motors and three solenoids control all functions including search in fast forward and rewind.
Standard fittings include reed switch for auto off, 3 digit counter, stereo R/P and erase Head.
Overall size 176mm × 130mm × 75mm.
DGS001 Cassette Mechanism. **£37.25** Quantity prices on request.
INF140. Full technical specification and drawings £1.

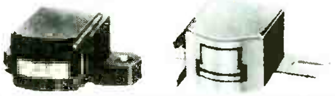
STEREO CASSETTE DECK
Following the runaway sellout of our last cassette deck we have now obtained a small quantity of an even nicer one. Main features are full auto-stop, Chrome/Ferric Switch, Manual record level control (invaluable for computer use), twin VU meters and 3-digit counter. Complete with all record and replay circuitry, control keys and cassette carrier/door. Very good quality and only **£21.80** inc Vat and Post. Circuit diagram and Notes 35p.

COMPLETE STEREO TUNER MODULE
Three band LW/MW/FM Stereo Tuner fully assembled on PCB 165 × 85mm. Supplied with Ferrite rod aerial and band switch fully wired. Facility provided to drive tuning meter and stereo LED. Only needs 12v DC supply. FM sensitivity 2.5uV. **Price only £7.99 inc. VAT and post.**

'STEREO AMPLIFIER MODULE'
Ready built and tested quality power amplifier module complete and ready to use. Mains input 220/240v with power to spare for tuner and tape deck. Size 190 × 110 × 65mm.

TUNER AND PRE-AMP MODULE
Matching unit to above. Contains Long, medium and short wave AM tuner. Stereo FM tuner and pre-amp with switched inputs for tuners, tape and pickup. Complete with flywheel drive and cord assembly. Size 400 × 220 × 63mm.
Special offer for both items only **£16.90.**

HIGH QUALITY REPLACEMENT CASSETTE HEADS



Do your tapes lack treble? A worn head could be the problem. Fitting one of our replacement heads could restore performance to better than new! Standard mountings make fitting easy and our TC1 Test Cassette helps you set the azimuth spot-on. We are the actual importers which means you get the benefit of lower prices for prime parts. Compare us with other suppliers and see! The following is a list of our most popular heads, all are suitable for use on Dolby machines and are ex-stock.
HC20 Permalloy Stereo Head. This is the standard head fitted as original equipment on most decks £5.11
HM90 High Beta Permalloy Head. A hard-wearing, higher performance head with metal capability £8.06
HS16 Sendust Alloy Super Head. the best head we can find. Longer life than Permalloy, higher output than Ferrite, fantastic frequency response £9.91
HQ551 4-Track Head for auto-reverse or quadrophonic use. Full specification record and playback head £9.73
Please consult our list for technical data on these and other Special Purpose Heads.
MA481 Latest version Double Mono (2/2) Record/Play head. Replaces R484 .... £8.90
SM166 Standard Mounting 2/2 Erase head. Compatible with above or HQ551 4 Track head £5.90
H524 Standard Erase Head. Semi double gap, high efficiency £1.50
H561 Metal Tape Erase Head. Full double gap £4.90

HART TRIPLE-PURPOSE TEST CASSETTE TC1

One inexpensive test cassette enables you to set up VU level, head azimuth and tape speed. Invaluable when fitting new heads. Only **£4.66** plus VAT and 50p postage.

Tape Head De-magnetiser. Handy size mains operated unit prevents build up of residual head magnetisation causing noise on playback £4.54
Curved Pole Type for inaccessible heads £4.85

Send for your free copy of our LISTS. Overseas please send 2 IRCs to cover surface Post or 5 IRCs for Airmail.
Please add part cost of post, packing and insurance as follows:

INLAND
Orders up to £10 – 50p
Orders £10 to £49 – £1
Orders over £50 – £1.50

OVERSEAS
Please send sufficient to cover Surface or Air Post as required.

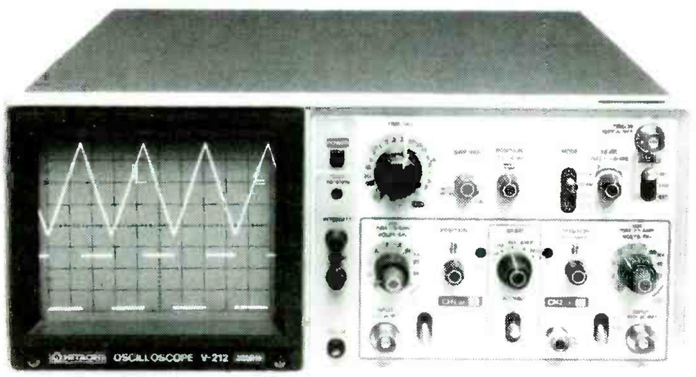
Personal callers are always very welcome but please note that we are closed all day Saturday | 24hr SALES LINE (0691) 652894 | ALL PRICES EXCLUDE VAT UNLESS STATED

HART ELECTRONIC KITS LTD
PENYLAN MILL
OSWESTRY, SHROPSHIRE
SY10 9AF

CIRCLE 74 FOR FURTHER DETAILS.

Hitachi Oscilloscopes

the highest quality the most competitive prices — from **£299 + VAT**



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 (illustrated)	20MHz Dual Trace	V-209	20MHz Mini-Portable
		V-509	50MHz Mini-Portable
V-222	20MHz Dual Trace	V-1050F	100MHz Quad Trace
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-650F	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 22 FOR FURTHER DETAILS.

WRONG TIME?

MSF CLOCK is ALWAYS CORRECT — never gains or loses, SELF SETTING at switch-on, 8 digits shown Date, Hours, Minutes and Seconds, auto GMT/BST and leap year, larger digit Hours and Minutes for easy QUICK-GLANCE time, can expand to Years, Months, Weekday and Milliseconds or make a second-in-a-month STOPCLOCK, parallel BCD output for computer or alarm and audio to record and show time on playback, receives Rugby 60KHz atomic time signals, only 5×8×15cm, built-in antenna, 1000Km range, £79-70. GET the TIME absolutely RIGHT.
ANTENNA TUNER, 0.1-30MHz, £25-20, ideal for FRG7700 etc.

Each fun-to-build kit (ready made to order) includes ALL parts, case etc, by-return postage and list of other kits.

CAMBRIDGE KITS

45 (WL) Old School Lane, Milton, Cambridge. Tel 860150.

Toroidal Transformers

as manufacturers we are able to offer a range of quality Toroidal Transformers at high competitive prices and fast delivery.

Mail Order Price List

30VA **6.54.** 50VA **8.36.** 80VA **9.15.** 120VA **10.55.** 160VA **11.98.** 225VA **15.61.**
300VA **17.19.** 500VA **22.33.** 625VA **27.96.** 750VA **31.05.** 1KVA **41.40.** *price includes p+p & vat.*
Available from stock in the following voltages:— 6-0-6, 9-0-9, 12-0-12, 15-0-15. 18-0-18, 22-0-22. 25-0-25, 30-0-30, 35-0-35, 40-0-40, 45-0-45, 50-0-50, 110, 220, 240 (max. 10 amp). Primaries 240, 220, 120 volt please state which.

Quantity Prices and delivery on request
(we also manufacture conventional E1 type transformers)

AIR LINK

Airlink Transformers.
Unit 6, The Maltings, Station Road, Sawbridgeworth, Herts. Tel: 0279-724425.

CIRCLE 65 FOR FURTHER DETAILS.

CIRCLE 72 FOR FURTHER DETAILS.

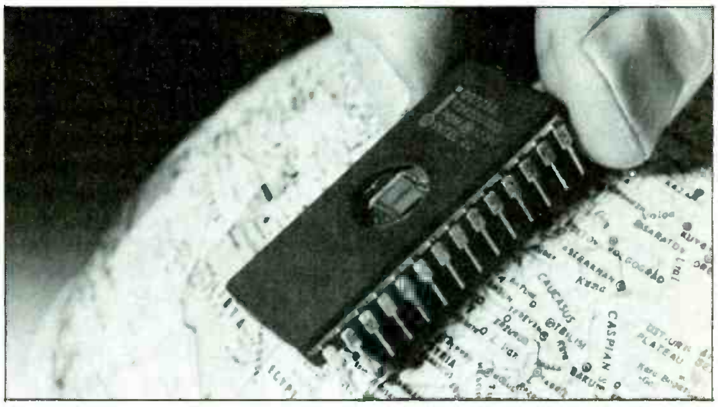
CIRCLE 54 FOR FURTHER DETAILS.

CIRCLE 69 FOR FURTHER DETAILS.

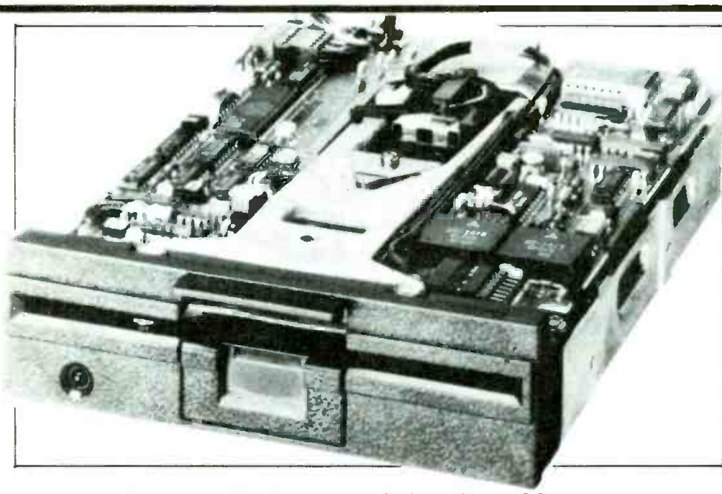
CIRCLE 67 FOR FURTHER DETAILS.

256K EPROM

Two high capacity eproms, including a 256K device, claimed to be the world's first come from Intel. The 27128 is a 16K, 8-bit memory and the 27156 a 32K, 8-bit. Maximum access time for either device is 250ns which is compatible with high-speed microprocessors without the need for the introduction of 'wait' states. Active power consumption is 100mA with a standby power mode of 40mA. Used with the appropriate programming equipment, the memories incorporate the implementation of 'intelligent programming algorithm' to enable fast and efficient programming of these devices. Complete operating systems, high-level language interpreters or look-up tables can be held in a single memory device which will operate at the full speed of the system. Jermyn Distribution, Vestry Estate, Sevenoaks, Kent. EWW 213



DISC DRIVES SHRINK



All the data formerly stored on an 8in floppy disc can now be squeezed onto a 5.25in disc using a Mitsubishi M4854 disc drive. The unformatted capacity is 1.6Mbytes, with 77 tracks and a 500Kbit/s transfer rate. Track-to-track access time is 3ms. Recording density is 9621bit/in, using the high coercivity recording medium available from many sources (see below). Using the drive to replace 8in versions gives the benefits or reduced cost, size, weight and power while retaining the investment in software and controller designs. Mitsubishi Electric (UK) Ltd, Herford Place, Maple Cross, Rickmansworth, Herts WD3 2BJ. EWW 214

...and discs to fit them

Memorex have introduced a 5.25in disc, intended to be completely compatible with 8in discs of the same capacity (1.6Mbyte). They offer 60% more capacity than 5.25in format discs. Memorex claim greater data protection for their discs by using continuous seam sealing for their outer covers. Memorex UK Ltd, 96 to 104 Church Street, Staines, Middlesex TW18 4XU.

EWW 215

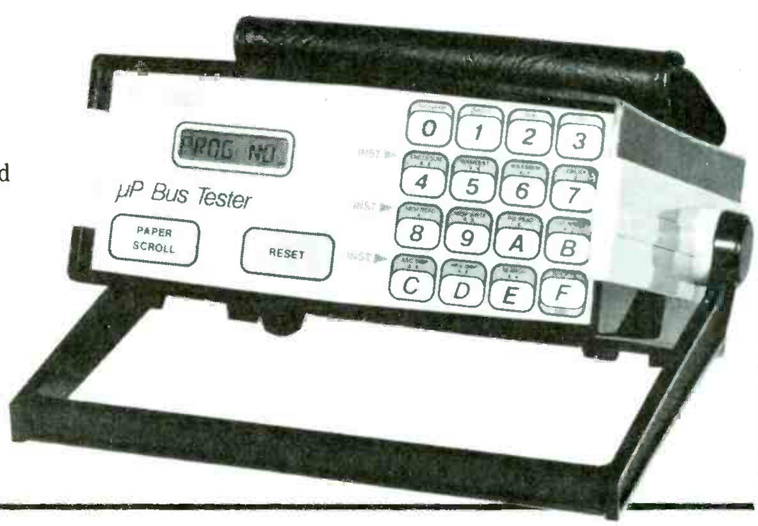
SATELLITE BEACON FOR AIR—SEA RESCUE

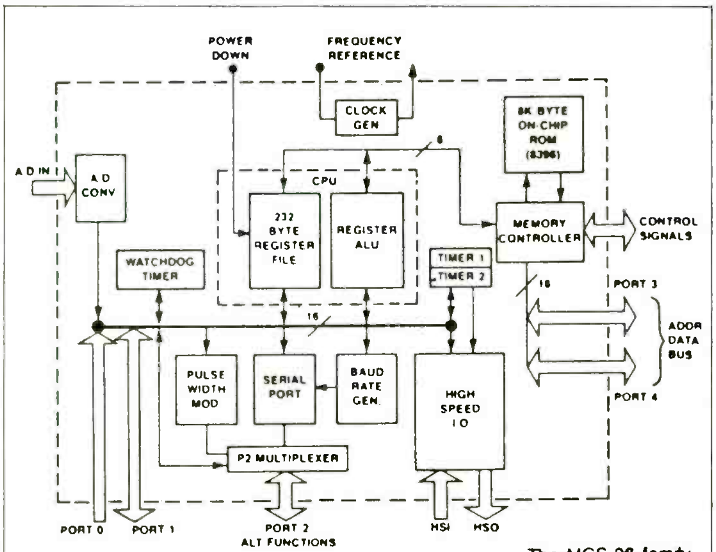
For use with the Marisat series of satellites, three of which are now in operation. A portable beacon has been developed by Graseby Dynamics in Watford. Designed to be stowed aboard lifecraft and to be included in survival packs for aircrew members, the beacons emit signals automatically in an emergency. They operate on a new distress frequency of 406MHz and transmit a 5W, 400ms burst every 50 seconds. The signal data includes the class of user, country of origin, identity and type of emergency.

The system is designed to work with Sarsat (search and rescue satellite aided tracking), an international system which monitors the whole surface of the world continually for distress signals and can locate the new type of beacon to within 2 to 5km. Rescue services can be launched within three hours of the transmitted signal, compared with days, under former systems. Graseby Dynamics Ltd, Park Avenue, Bushey, Watford, Herts WD2 2BW. EWW 217

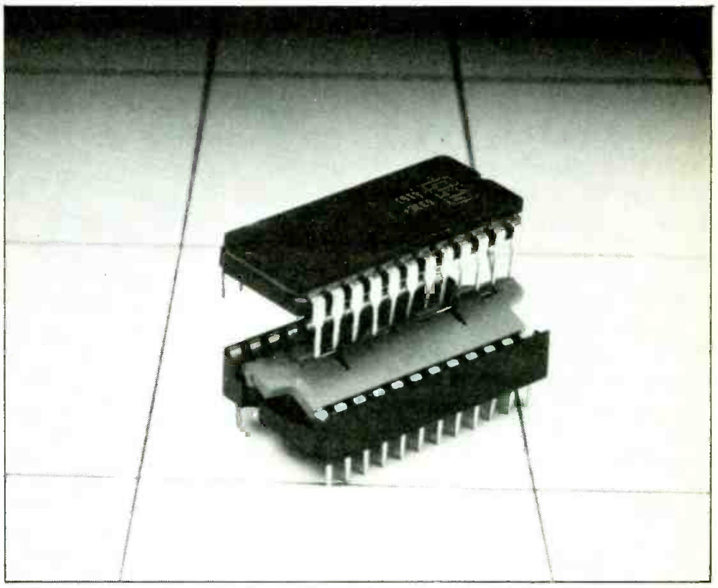
MICROPROCESSOR BOARD TESTER

A trouble-shooting instrument is designed to diagnose and locate faults in microprocessor systems. The Antron B2000 simulates the target processor by taking command of the address, data and control buses. The test are performed using the functions programmed into the unit and initiated through the touch-sensitive front-panel keypad. Fifteen tests with each up to 12 steps can be stored in a non-volatile memory. An alphanumeric display give operator prompts and program use. Faults and results are recorded on the built-in thermal printer. Cards plugged internally can support Z80, 8085, 6800 or 6502 families of processors and the test features include memory mapping, ram test, rom checksum, bus shorts and i/o tests. The unit can also disassemble rom programs and decode and print hexadecimal and Ascii characters. Antron Electronics Ltd, Hamilton House, Hamilton House, 39 Kings Road, Haslemere, Surrey GU27 2QA. EWW 216





The MCS-96 family



16-BIT CONTROLLER

Up to 48 digital or 40 digial and eight analogue inputs, can be accomodated by the Intel MCS-96 family of 16-bit single-chip microcontrollers. Based around the 8096 16-bit processor, i/o and peripheral facilities are built into the same silicon substrate. One version (8396) has 8K of internal rom and eight different configurations are available. The processor instruction set supports bit, byte, word and 32-bit double-word operations and with a 12MHz input frequency, execution time averages 1 to 2μs for each instruction.

External event recording is provided by four high-speed trigger inputs. Six trigger pulse generators are available to control external events at preset times and four timers can perform simultaneously through the output unit under software control. The devices are equipped with serial ports, an internal watchdog timer and a p.w.m. output signal. MEDL Distribution, East Lane, Wembley, Middlesex HA9 7PP. EWW 218

NIF SOCKETS

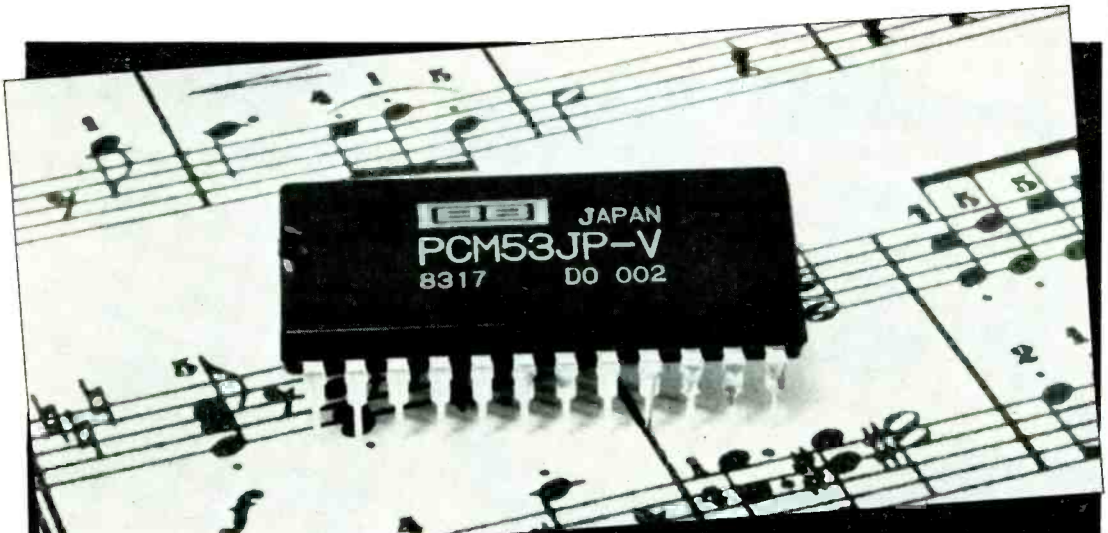
No insertion force makes a welcome change from zero insertion force, even if its the same thing. Unlike the bulky zif socket with its locking lever, the nif socket from Dage has a hinged base incorporated within it which protrudes by approximately 1.5mm beyond the i.c. After the i.c. is inserted, a little pressure on the protruding fingers of the base causes the hinge to click over and lock the i.cs legs into place. Versions are available for 24, f28, 40 or 48-pin devices. The sockets are only 5mm high with contacts of copper-beryllium plated with tin-lead or gold, as required. Dage Eurosem, Rabans Lane, Aylesbury, Bucks HP19 3RG. EWW 220

TV TUNER CHIP

A single i.c. frequency synthesiser has been designed for tv tuning. The SP5000 from Plessey, used with a varicap tuner, forms a complete p.l.l. tuning system. The circuit consists of a divide-by-16 counter with its own preamplifier and a 14-bit programmable divider controlled by a serially-loaded data register. Band selection lines can give four switched output combinations. The frequency/phase comparator has a reference frequency derived from a 4MHz crystal using an on-chip oscillator. Only one external transistor is required for varicap line driving. The device can select frequencies from 30MHz up to 1024MHz in 62.5kHz steps. The devices can select frequencies from 30MHz up to 1024MHz in 62.5kHz steps. It is controlled from a four or eight-bit microprocessor which is also used to decode the remote control and keyboard inputs and to drive a two-digit display of the channel selected. Versions of the chip are available for up or down-conversion of frequencies to connect tv aerial inputs to cable distribution systems. Plessey Semiconductors Ltd, Cheney Manor, Swindon, Wilts SN2 2QW.
EWW 221

AUDIO DAC

A 16-bit monolithic digital-to-analogue converter has been designed for use in professional recording studios and for stereo digital disc playback in the home. The Burr-Brown PCM53JP-V is fast enough to process both channels of a stereo signal simultaneously and provides 16-bit resolution with a total harmonic distortion of 0.002% at full-scale input and 0.02% at -20dB, a settling time of 3μs and a dynamic range of 96dB. The low-cost plastics package has had severe environmental tests to reveal a m.t.d.f of about 4.5 years. Burr-brown International, Cassiobury House, Station Road, Watford, Herts WD1 1EA. EWW 219



COMPUTER WAREHOUSE

1000's OF BARGAINS FOR CALLERS

THE 'ALADDIN'S' CAVE OF COMPUTER AND ELECTRONIC EQUIPMENT

HARD DISK DRIVES

Fully refurbished DIABLO/DRE series 30 2.5 Mb disk drives DEC RK05, NOVA, TEXAS compatible
Front load Free stand or rack mount £550.00
Exchangeable type (via lid removal) £295.00
me3029 PSU unit for 2 drives £125.00
DIABLO/DRE 44-4000A/B 5+5 ex stock from £995.00
1000's of spares for S30, 4000, 3200, HAWK ex stock.
Plus in house repair, refurbishing service
Call for details or quotation

HOT LINE DATA BASE

DISTEL©

THE ORIGINAL FREE OF CHARGE dial up data base 1000's of stock items and one off bargains.
ON LINE NOW – 300 baud, full duplex CCITT tones, 8 bit word, no parity.
01-679 1888

COMPUTER 'CAB'

All in one quality computer cabinet with integral switched mode PSU, Mains filtering, and twin fan cooling. Originally made for the famous DEC PDP8 computer system costing thousands of pounds. Made to run 24 hours per day the PSU is fully screened and will deliver a massive +5v DC at 17 amps, +15v DC at 1 amp and -15v DC at 5 amps. The complete unit is fully enclosed with removable top lid, filtering, trip switch, 'Power' and 'Run' LEDs mounted on Ali front panel, rear cable entries, etc. etc. Units are in good but used condition – supplied for 240v operation complete with full circuit and tech. man. **Give your system that professional finish** for only £49.95 + Carr Dim. 19" wide 16" deep 10.5" high. Useable area 16"w 10.5"h 11.5"d.
Also available LESS PSU, with FANS etc. Internal dim. 19"w. 16"d. 10.5"h. £19.95. Carriage & insurance £9.50.

EX STOCK INTEGRATED CIRCUITS

OVER 100,000 ITEMS INCLUDING:
Intel D8085AH-2 £25.00 D8271 £65.00
D8202 D8257-5 8255 D3002
2732 EPROM SPECIAL fully guaranteed
450ns £3.75, 350ns £4.00, 300ns £4.50

STILL IN STOCK

FP1500 Heavy Duty 25 cps daisy wheel RS232 interface, bi directional printers, Brand New at £499.00
CALL FOR MORE DETAILS

COOLING FANS

Keep your hot parts COOL and RELIABLE with our range of BRAND NEW professional cooling fans.
ETRI 99XU01 Dim. 92 x 92 x 25 mm. Miniature 240 v equipment fan complete with finger guard. £9.95.
GOULD JB-3AR Dim. 3" x 3" x 2.5" compact very quiet running 240 v operation. NEW £6.95
BUHLER 69.11.22. 8-16 v DC micro miniature reversible fan. Uses a brushless servo motor for extremely high air flow, almost silent running and guaranteed 10,000 hr life. Measures only 62 x 62 x 22 mm. Current cost £32.00. **OUR PRICE ONLY £12.95 complete with data.**
MUFFIN-CENTAUR standard 4" x 4" x 1.25" fan supplied tested EX EQUIPMENT 240 v at £6.25 or 110 v at £4.95 or BRAND NEW 240 v at £10.50. 1000's of other fans Ex Stock. Call for Details. Post & Packing on all fans £1.60

SAVE £250 SUPER PRINTER SCOOP

BRAND NEW CENTRONICS 739-2

ONLY £199

The "Do Everything Printer" at a price that will NEVER be repeated. Standard CENTRONICS parallel interface for direct connection to BBC, ORIC, DRAGON etc. Superb print quality with full pin addressable graphics and 4 type fonts plus HIGH DEFINITION internal PROPORTIONAL SPACED MODE for WORD PROCESSOR applications. 80-132 columns, single sheet, sprocket or roll paper handling plus much more. Available ONLY from DISPLAY ELECTRONICS at the ridiculous price of ONLY £199.00 + VAT Complete with full manual etc. Limited quantity – Hurry while stocks last. Options: Interface cable (specify) for BBC, ORIC, DRAGON or CENTRONICS 36 way plg £12.50. Spare ribbon £3.50 each BBC graphics screen dump utility program £8.60. Carriage and Ins. £10.00 + VAT

BUDGET RANGE VIDEO MONITORS

At a price YOU can afford, our range of EX EQUIPMENT video monitors defy competition!! All are for 240v working with standard composite video input. Units are pre tested and set for up to 80 col use on BBC micro. Even where MINOR screen burns MAY exist – normal data displays are unaffected.

1000's SOLD TO DATE

9" HITACHI very compact fully cased, dim. 21cm H x 21cm W x 22cm D. Black and white screen **£44.95**
12" KGM 320-321, high bandwidth input, will display up to 132 columns x 25 lines. Housed in attractive fully enclosed brushed alloy case. B/W only **£32.95** GREEN screen **£39.95**
24" KGM large screen black & white monitor fully enclosed in light alloy case. Ideal schools, shops, clubs etc. **ONLY £55.00**
14" BRAND NEW Novex **COLOUR** type **NC1414-CL.** Many exacting features such as RGB TTL and composite video input, **GREEN TEXT** key, internal speaker and audio amp. Even finished in BBC micro matching colours. Fully guaranteed. **ONLY £199.00**
Carriage and ins on ALL videos £10.00

DUAL 8" DISK DRIVES

Current, quality, professional product of a major computer company, comprising 2 x 40 track MPI or Shugart FULLY BBC COMPATIBLE single sided drives in a compact, attractively styled, grey ABS structured case with internal switched mode PSU. The PSU was intended to drive both drives and an intelligent Z80 controller with over 70 ic's. The controller has been removed leaving ample space and current on the +, -5, +12 and -12 supply for all your future expansion requirements. Supplied tested with 90 day guarantee in BRAND NEW condition with cable for BBC micro. Ex Stock at only **£259.00** + £10.00 carr. **Limited Quantity Only**

SPECIAL 300 BAUD MODEM OFFER

Another GIGANTIC purchase of these EX BRITISH TELECOM, BRAND NEW or little used 2B data modems 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 2B has all the standard requirements for data base, business or hobby communications. All this and more!!

- 300 baud full duplex
- Full remote control
- CCITT tone standards
- Supplied with full data
- Modular construction
- Direct isolated connection
- CALL, ANSWER and AUTO modes
- Standard RS232 serial interface
- Built in test switching
- 240v Mains operation
- 1 year full guarantee
- Just 2 wires to comms. line

NOW ONLY £29.95

Order now – while stocks last. Carriage and Ins. £10.00

SEMICONDUCTOR 'GRAB BAGS'

Mixed Semis amazing value contents include transistors, digital, linear, I.C.'s triacs, diodes, bridge recs., etc. etc. All devices guaranteed brand new full spec. with manufacturer's markings, fully guaranteed. 50+ £2.95 100+ £5.15
TTL 74 Series A gigantic purchase of an "across the board" range of 74 TTL series I.C.'s enables us to offer 100+ mixed "mostly TTL" grab bags at a price which two or three chips in the bag would normally cost to buy. Fully guaranteed all I.C.'s full spec. 100+ £6.90 200+ £12.30 300+ £19.50

GE TERMIPRINTER

A massive purchase of these desk top printer-terminals enables us to offer you these quality 30 cps printers at a SUPER LOW PRICE against their original cost of over £1000. Unit comprises of full QWERTY, electronic keyboard and printer mech with print face similar to correspondence quality typewriter. Variable forms tractor unit enables full width – up to 13.5" 120 column paper, upper – lower case, standard RS232 serial interface, internal vertical and horizontal tab settings, standard ribbon adjustable baud rates, quiet operation plus many other features. Supplied complete with manual. Guaranteed working £130.00 or untested £85.00, optional floor stand £12.50 Carr & Ins £10.00

8" 19MB WINCHESTER DISK DRIVE

Made in the UK by a subsidiary of the World's largest disk drive manufacturer. This BRAND NEW "end of line" unit offers an outstanding opportunity to add a MASSIVE 19 mb of storage to your computer system. Superbly constructed on a heavy die cast chassis the DRE 3100 utilises 3 x 8" plattens in a dust free cavity. All drive functions are controlled by microprocessor electronics using an INTEL 8035 cpu and TTL support logic. Data to the outside world is via two comprehensive 8 bit TTL level bi directional data busses with full status reporting for ease of interfacing. Many features such as Av. seek time 35 ms, 512 bytes per sector, +24, -24 and +5 v DC supply, plug in card system, and compact size of approx. 19cm H x 21cm W and 42cm D etc, etc, make this item a real snip.

Units are BRAND NEW and BOXED and sold at a FRACTION of original cost – hence unguaranteed. Complete with 150 page manual, circuits and applications guide.

ONLY £225.00 Carriage £10.00
Suitable power supply unit – sold ONLY with drive £39.95.

DATA MODEMS

Join the communications revolution with our range of EX TELECOM data modems. Made to most stringent spec and designed to operate for 24 hrs per day. Units are made to the CCITT tone spec. With RS232 i/o levels via a 25 way 'D' skt. Units are sold in a tested and working condition with data. Permission may be required for connection to PO lines.
MODEM 20-1 Compact unit for use with MICRONET, PRESTEL or TELECOM GOLD etc. 2 wire direct connect. 75 baud transmit 1200 baud receive. Data i/o via RS232 'D' socket. Guaranteed working with data £49.95
MODEM 20-2 same as 20-1 but 75 baud receive 1200 baud transmit £130.00
TRANSDATA 307A 300 baud acoustic coupler RS232 i/o £95.00 brand new. C£4.50
NEW DSL2123 Multi Standard modem selectable V21 300-300 bps, V23 75-1200, V23 1200-75 full duplex. Or 1200-1200 half duplex modes. Full auto answer via modem or CPU. LED status indicators. CALL or ANS modes Switchable CCITT or BELL 103 & 202. Housed in ABS case size only 2.5" x 8.5" x 9". £286.00 + VAT
For further data or details on other EX STOCK modems contact sales office.
Carriage on all modems £10.00 + VAT.

PROFESSIONAL KEYBOARD OFFER

An advantageous purchase of brand new surplus allows a great QWERTY, full travel, chassis keyboard offer at fractions of their original costs.
ALPHAMERIC 7204/60 full ASCII 60 key, upper, lower + control key, parallel TTL output plus strobe. Dim 12" x 6" +5 & -12 DC. £39.50.
DEC LA34 Uncoded keyboard with 67 quality, GOLD, normally open switches on standard X, Y matrix. Complete with 3 LED indicators & i/o cable – ideal micro conversions etc. pcb DIM 15" x 4.5" £24.95 Carriage on keyboards £3.00

EX STOCK DEC CORNER

BA11-MB 3.5" Box, PSU, LTC	£385.00
DH11-AD 16 x RS232 DMA interface	£2100.00
DLV11-J 4 x EIA interface	£310.00
DUP11 Sych. Serial data i/o	£650.00
DZ11-B 8 line RS232 mux board	£650.00
LA36 Decwriter EIA or 20 ma loop	£270.00
LAXX-NW LA180 RS232 serial interface and buffer option	£130.00
LAX34-AL LA34 tractor feed	£85.00
MS11-JP Unibus 32 kb Ram	£80.00
MS11-LB Unibus 128 kb Ram	£450.00
MS11-LD Unibus 256 kb Ram	£850.00
MSC4804 Qbus (Equiv MSV11-L) 256 kb	£499.00
PDP11/05 Cpu, Ram, i/o, etc.	£450.00
PDP11/40 Cpu, 124k MMU	£1850.00
RT11 ver. 3B documentation kit	£70.00
RK05-J 2.5 Mb disk drives	£650.00
KL8JA PDP 8 async i/o	£175.00
M18E PDP 8 Bootstrap option	£75.00
VT50 VDU and Keyboard – current loop	£175.00

1000's of EX STOCK spares for DEC PDP8, PDP8A, PDP11 systems & peripherals. Call for details. All types of Computer equipment and spares wanted for PROMPT CASH PAYMENT.

66% DISCOUNT

ELECTRONIC COMPONENTS EQUIPMENT

Due to our massive bulk purchasing programme which enables us to bring you the best possible bargains we have thousands of I.C.s, Transistors, Relays, Cap's, P.C.B.'s, Sub-assemblies, Switches, etc. etc. surplus to our requirements. Because we don't have sufficient stocks of any one item to include in our ads. we are packing all these items into the BARGAIN PARCEL OF A LIFETIME. Thousands of components at giveaway prices! Guaranteed to be worth at least 3 times what you pay. Unbeatable value!! Sold by weight.
2.5kls £4.25 + pp £1.25 — 5kls £5.90 + £1.80
10kls £10.25 + pp £2.25 — 20 kls £17.50 + £4.75

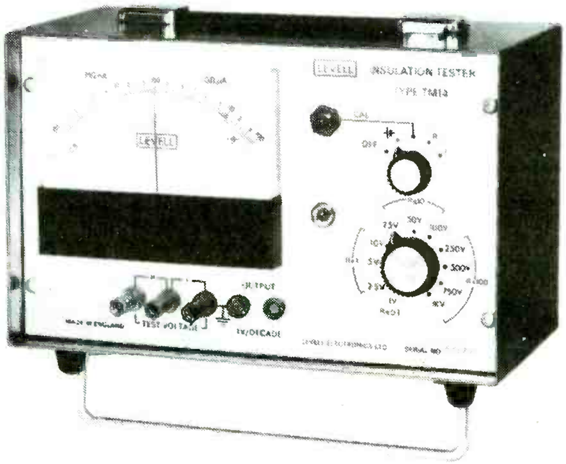
ALL PRICES PLUS VAT

All prices quoted are for U.K Mainland, paid cash with order in Pounds Stirling PLUS VAT. Minimum order value £2.00, Minimum Credit Card order £10.00. Minimum BONA FIDE account orders from Government depts., Schools, Universities and established companies £20.00 Where post and packing not indicated please ADD £1.00 + VAT Warehouse open Mon-Fri 9.30 – 5.30. Sat. 10.15 – 5.30. We reserve the right to change prices and specifications without notice. Trade, Bulk and Export enquiries welcome.

DISPLAY -ELECTRONICS-
32 Biggin Way, Upper Norwood, London SE19 3XF
Telephone 01-679 4414 Telex 27924

CIRCLE 79 FOR FURTHER DETAILS.

INSULATION TESTER



A logarithmic scale covering 6 decades is used to display either insulation resistance or leakage current at a fixed stabilised test voltage. The current available is limited to a maximum value of 3mA for safety and capacitors are automatically discharged when the instrument is switched off or to the CAL condition. The instrument operates from a 9V internal battery.

RESISTANCE RANGES
10M Ω to 10T Ω (10^{13} Ω) at 250V, 500V, 750V and 1kV.
1M Ω to 1T Ω at 25V, 50V and 100V.
100k Ω to 100G Ω at 2.5V, 5V and 10V.
10k Ω to 10G Ω at 1V.
Accuracy ± 15% + 800 Ω on 6 decade logarithmic scale.
Accuracy of test voltages ±3% ±50mV at scale centre.
Fall of test voltages <2% at 10μA and <20% at 100μA.
Short circuit current between 500μA and 3mA.

CURRENT RANGE
100pA to 100μA on 6 decade logarithmic sale.
Accuracy of current measurement ±15% of indicated value.
Input voltage drop is approximately 20mV at 100pA, 200mV at 100nA and 400mV at 100μA.
Maximum safe continuous overload is 50mA.

MEASUREMENT TIME
<3s for resistance on all ranges relative to CAL position.
<10s for resistance of 10G Ω across 1μF on 50V to 500V.
Discharge time to 1% is 0.1s per μF on CAL position.

RECORDER OUTPUT
1V per decade ±2% with zero output at scale centre.
Maximum output ±3V. Output resistance 1k Ω.

TYPE TM14 £210
+ VAT

FREE delivery in the UK. QUANTITY DISCOUNTS available.
We supply many other instruments including:
OSCILLATORS, COUNTERS, OSCILLOSCOPES, FUNCTION GENERATORS, dB & MICROVOLTMETERS.

LEVELL ELECTRONICS LTD. Moxon Street, Barnet, Herts. EN5 5SD, England.
Telephone: 01-440 8686/449 5028.

CIRCLE 6 FOR FURTHER DETAILS.

Newrad

NEWRAD INSTRUMENT CASES LTD

Unit 19, Wick Industrial Estate, Gore Road, New Milton, Hants BH25 6SJ. Tel: New Milton 615774/621195

WE MANUFACTURE BEAUTIFUL ENCLOSURES, AND THEY ARE NOT EXPENSIVE.


PLUG-IN MODULE SYSTEM


RECESSED CONTROL PANEL


FLAT CONTROL PANEL

Where can you buy a fully enclosed 2U height 19" rack mounted enclosure 300mm depth for £18, that has a recessed front panel and high quality extrusions?

LET US PUT 10 YEARS EXPERIENCE AT YOUR DISPOSAL. ASK FOR OUR CATALOGUE.

CIRCLE 58 FOR FURTHER DETAILS.

VIDEO TAPE RECORDERS Philips NI500/1/2 series, colour, int Rx, with two cassettes & circs, £65 Ferrograph Series. 6 Audio, single chan 3 speed, int spk, very good cond with book. £85 **SCOPES** Solartron CD523S general purpose bench scope, single beam, 1 Mill/V to 60v Cm, DC or 100Kc to 10 Megs, T.B. X.1 Us to 1 Sec Cm, up to X5 expansion, 4" PDA CRT tested with book. £95 **MARCONI TF1041B** VTM AC/DC volts 300 Mill/V to 300V FSD in 7 ranges, Ohms 50 to 500 Megs in 8 ranges, as DC/Ohms & RF probe to 1500Mc/s tested with book. £48 **SIG GENS** Marconi TF995/A2 1.5 to 220Mc/s AM/FM with book. £100 TF144G 85Kc to 25Mc/s AM large bench unit with circ etc £65. **X BAND WAVEMETERS** cal 9170 to 9470Mc/s with meter ind and var 0 to 100Db I/P atten. £23 also Tx loads & Echo Boxes X band. **NOISE GEN CT207** 100/600Mc/s mains, var noise o/p & int 600 ohm O/P meter with book. £35 **DUMMY LOAD WATTMETER** CT214 30/400Mc/s 50/75 ohms 20/200 watts, with connec. £55. **FREQ CONV** 240v to 115v 400c/s 100 watts one phase sine wave solid state new. £85. **POWER & DRIVE UNIT** for 240v provides 12v at 5 amps or 24v 2.5 amps stab also FR O/Ps at 10 crystal controlled freq in range 2/8Mc/s var O/P O to 2 watts into 50 ohm all transis unit tested. £55. **ELEC** CONDS. 2700Uf at 250v DC Wk HD type new. £3.50 **H.V. INSUL** T.S. CT91 O/40kv metered two part unit. £65. **ATTEN** Muirhead 600 ohm var 0 110 Db in ½ Db steps. £28 **RACK CASES** size int 19X21" front 18" deep hammer grey. £28 **POWER UNITS** 200/250v to 28v DC at 15 amps semi stab size 16X7X7" ground P.U. for ARC—52. £38 **AERIALS** 70/73Mc/s Ground Plane new with connec Pye. £10 collect. **RACKS** 6ft with doors 19" £30 collect.

Above prices include carr/postage & VAT.
Goods ex equipment unless stated new. List 35 available on request.

A.H. SUPPLIES
122 Handsworth Road, SHEFFIELD S9 4AE.
Tel: (0742) 444278

CIRCLE 8 FOR FURTHER DETAILS.

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.

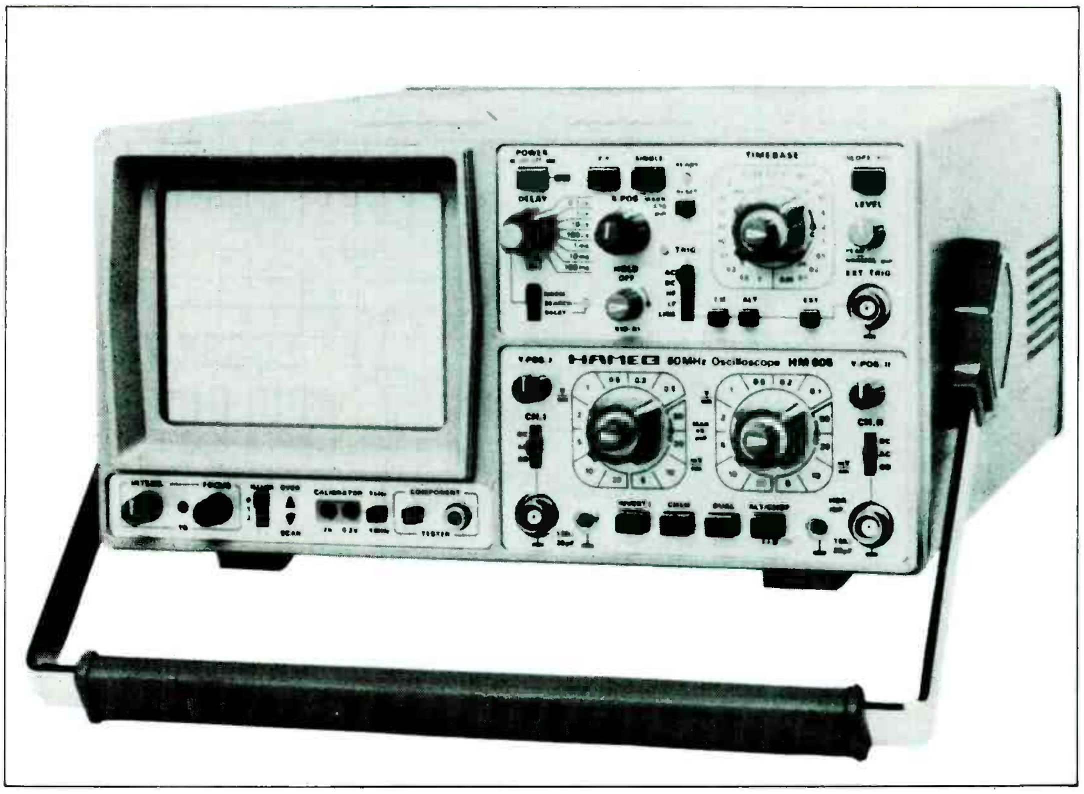
21 Lodge Lane, N. Finchley, London, N.12. 5 mins. from Tally Ho corner

Telephone 01 445 2713/0749

CIRCLE 66 FOR FURTHER DETAILS.

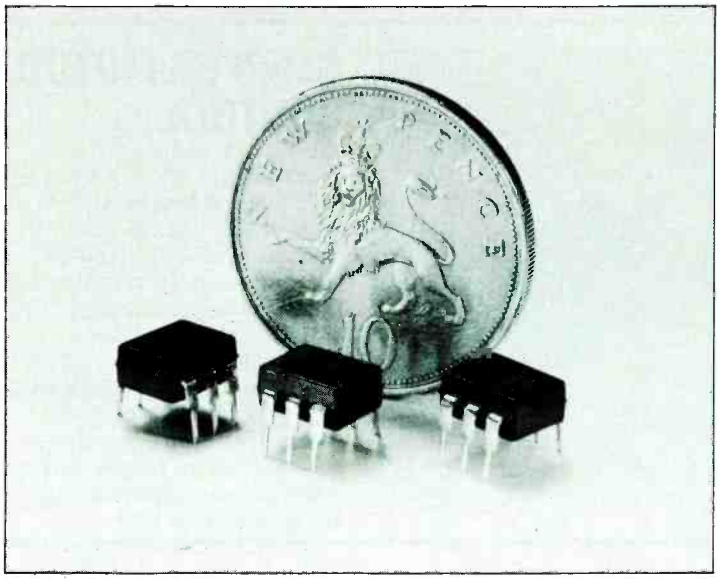
TWO CHANNEL OSCILLOSCOPE

Two new dual-channel oscilloscopes come from the Hameg stable. HM204-2 is a 20MHz instrument and Hm605 can measure up to 60MHz. Both instruments have sensitivities variable from 1 to 50mV/cm and there is a signal delay line to view the trigger edge of a waveform. A variable sweep delay enables the expansion of any section of the waveform and the sweep range is variable in the HM204-2 from 10ns to 1.25/cm and in the HM605 from 5ns to 2.5s/cm. Both oscilliscopes have built-in component testers for checking components individually in or out of circuit. 1kHz and 1MHz square wave calibration outputs are provided as is z modulation. Levell Electronics Ltd, Moxon Street, Barnet, Herts EN5 5SD.
EWW 222



RGB DRIVER FOR COLOUR CRT

A250V bipolar i.c. may be used to drive directly the red-green-blue cathodes of a colour tv tube. The TDA 8150 replaces several discrete components while offering an equivalent or better performance. Inside the chip there are three independant video output amplifiers with a circuit to generate the first grid voltage. Each output stage is protected by an internal clamp diode against flashover discharges in the tube and further protection may be provided by the addition of a low cost spark-gap. The circuit is intended for use in sets that have a sequential cut-off system for adjustment and includes a common sensing output. Typically the chroma processor will drive each input in turn during the frame-blanking interval, adjusting the drive level so that the video black level corresponds to the beam cut-off voltage. The TDA8150 conform to CCIR standards and has a typical bandwidth of 5MHz (80V peak-to-peak). It operates from a 200V supply (250V maximum) and features a 100ns rise and fall time.Output voltage swing is at least 180V peak-to-peak with a 200V supply. SGS, via C. Olivetti 2, 20041 Agrate, Brianza, Italy.EWW 223

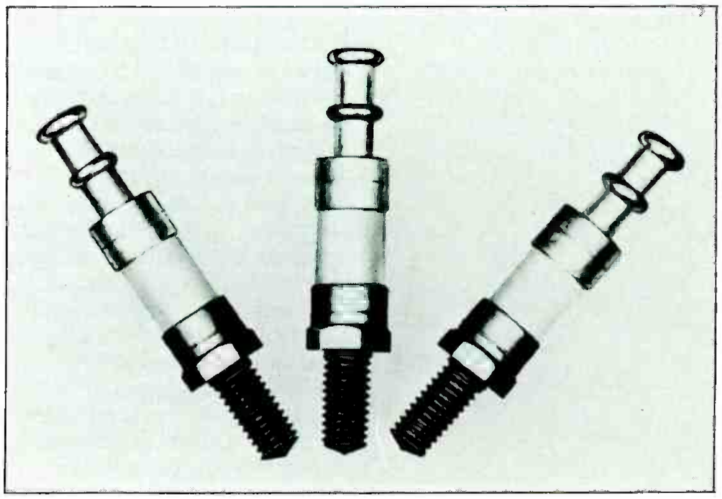


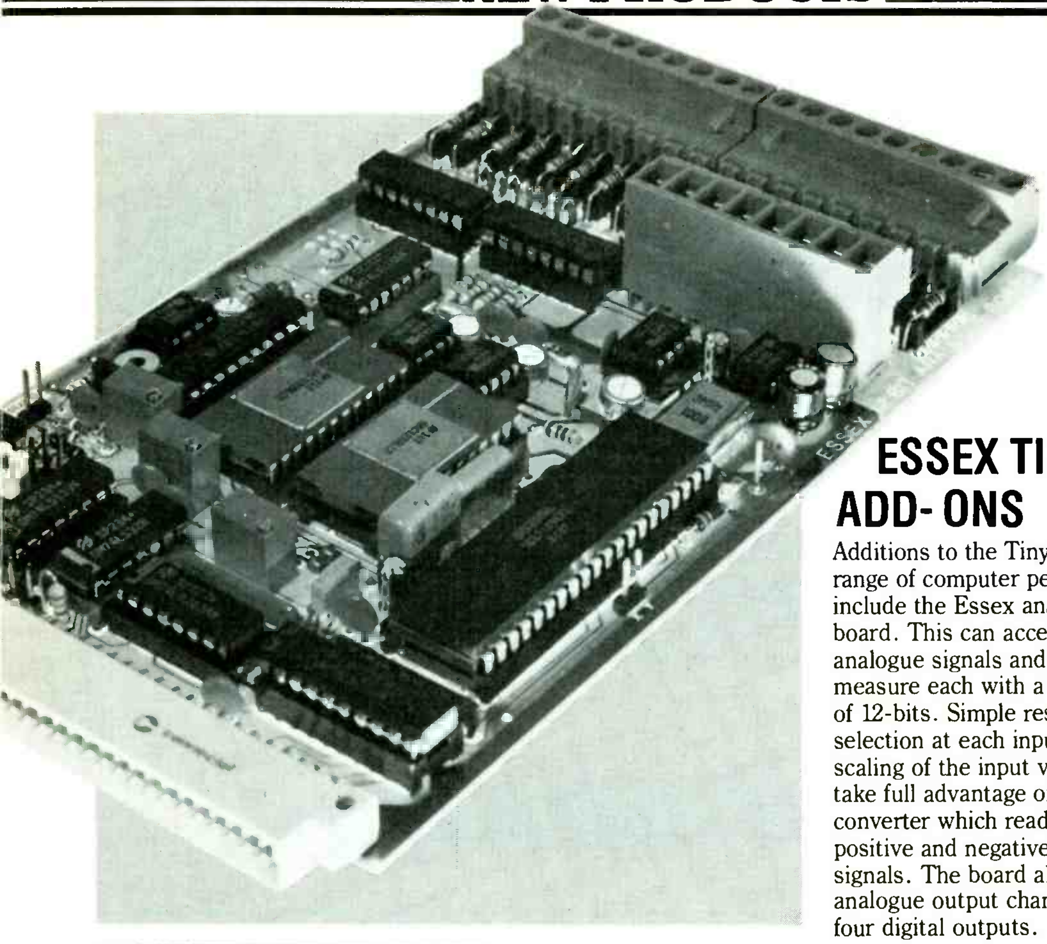
OPTO RELAYS

A range of optically isolated triac drivers, miniature solid-state relays, can drive small a.c. loads directly. The MCP series from General Instrument have the advantage of 'zero-crossing' circuuitry which only allows the controlled triac to switch on when the a.c. supply crosses the zero voltage point, reducing interference. Internally they use infra-red leds for high stability and rapid response. The devices may be used to power lamps, motors, solenoids etc. as well as to trigger larger triacs for higher power applications. General Instrument (UK) Ltd, Times House, Ruislip, Middlesex HA4 8LE.
EWW 225

STAND-OFF INSULATORS

To meet a demand for good anchorage and location when multi-point insulator, Jackson Brothers have developed the Type-U Stand-off insulator.It is one of a selection of insulators and terminal strips, all of which are subjected to vigorous quality control and can withstand temperatures from -40 to 100°C.
Jackson Brother (London) Ltd, Kingway, Waddon, Croydon, Surrey CR9 4DG.
EWW 224



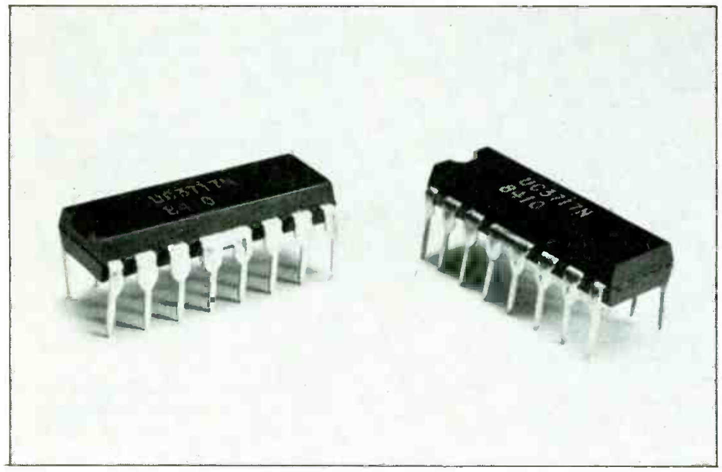


ESSEX TINY ADD-ONS

Additions to the Tiny Basic range of computer peripherals include the Essex analogue board. This can accept up to 16 analogue signals and can measure each with a resolution of 12-bits. Simple resistor selection at each input allows scaling of the input voltages to take full advantage of the a-to-d converter which reads both positive and negative-going signals. The board also has two analogue output channels and four digital outputs. Connections are made to screw terminals which can be connected off the board and then simply plugged into it.

Another interface from the same stable is an opto-isolator board which provides the isolation needed in electrically noisy environments. Twelve input and twelve output channels are provided. The v.mos power fets at the output stages are capable of switching 5 to 60V of 800mA current while offering over 1kV of breakdown protection. The isolated digital input circuits will accept 'on' voltages from 2.6 to 40V thus accommodating a wide range of external supplies. Two-part screw terminals similar to those on the analogue board are used.

Both boards are single Eurocard size and are directly compatible with the Essex Tiny Basic computer and its system bus. Essex Electronics Centre, University of Essex, Colchester CO4 3SQ.
EWW 226



STEPPER MOTOR CONTROL

A monolithic i.c. can control a wide range of bi-polar stepper motors. The UC3717 from Unitrode is all that is needed between a control computer and the motor being controlled. The circuit is provided with a t.t.l.-compatible input, a current sensor and an output stage with built in Schottky protection diodes. The device provides a constant current chopped drive which achieves high efficiency and performance with unstabilized motor supply voltages of between 10 and 45V d.c. output currents from 10mA to 1A can be selected in steps or varied continuously. Additionally the circuit can operate in step or half-step modes. A built-in time delay ensure that there is never a short circuit in the output stage during a phase shift. Two UC3717s and a few passive components form a complete control and drive system for a microprocessor-controlled stepper motor system. Unitrode (UK) Ltd, 6 Cresswell Park, Blackheath, London SE3 9RD.
EWW 227

RADIO MODEM

A u.h.f. pair of a transmitter and a receiver with a modulator and a demodulator respectively constitute the Micro-Tel system. It can receive and transmit data at any rate up to 1200 baud at a line-of sight distance of up to 10km. Further distances are possible if used on high buildings or from aircraft. The transmitter, powered from 12V d.c. can accept serial input from t.t.l. level or +12V (RS232) or anything in between. Inside the transmitter, the received signal is used to generate two audio sinwaves and these are used in turn to phase-modulate the r.f. carrier. A led indicates by flickering when data is being sent.
The receiver operates from the same voltage supply level as the transmitter. It emodulates the received r.f. signal converts it back into audio tones which are converted to an output signal, either t.t.l. or RS232 levels. Again a led indicator flickers when a signal, either t.t.l. or RS232 levels. Again a led indicator flickers when a signal is being received and an audio amplifier is incorporated to enable the user to find a clear channel or detect interference. Helical whip antennae are supplied with each unit and are suitable for most application although an external aerial can be used. The transmitted power is restricted to the maximum allowed in the U.K, 0.5W although 3 or 10W power boosters are available on export models. The units may, of course be used to transmit computer data, but the makers see the units to be of most use in the remote monitoring of instruments used in telemetry and surverying, and in unmanned weather stations. Measurement Devices Ltd, Bennico Centre, 23 Commerce Street, Aberdeen AB2 1BE.
EWW 228

TERMS OF BUSINESS

- ★ All prices exclude V.A.T. and carriage. Please add carriage to order total before adding V.A.T.
- ★ Carriage charges extra on all orders as follows:

Components	£0.75
Books/Data/Software	£2.00
Printers, Monitors, Disc drives, etc.	£4.50

- ★ Strictly cash with order or credit card (Access or VISA) only.
- ★ Delivery is normally from stock but please allow up to 28 days.
- ★ Any query or complaint regarding an order should be made in writing 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 V.A.T. 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.

Hi-Tech

HI-TECH COMPONENTS,

6502 FAMILY

6502	3.50
6502A	4.95
6520	2.25
6520A	2.45
6522	3.40
6522A	4.45
6532	5.45
6532A	5.95
6551	5.95

6800 FAMILY

6800	2.15
6802	2.70
6803C	8.40
6809E	6.25
6809P	6.25
6810	1.70
6821	1.70
6840	3.70
6845	6.45
6850	1.70
6862	3.75
6875	4.95
68B00	4.30
68B09	9.95
68B10	1.88
68B21	3.70
68B40	6.60
68B50	1.58
68B54	7.95

8086 FAMILY

8086	29.50
8088-2	22.50
8216	0.75
8237A-5	23.50
8251A	7.50
8253-5	7.50
8255A-5	7.00
8259A	6.60
8272	35.00
8284A	9.50
80C86	46.65
80C88	46.65
82C52	15.68
82C54	19.04
82C55A	212.98
82C59A	15.22
82C82	6.26
82C84A	8.94
82C88	16.80

Z80 FAMILY

Z80ACPU	2.99
Z80ACTC	2.99
Z80ADMA	7.95
Z80APIO	2.99
Z80ASIO-0	7.95
Z80ASIO-1	7.95
Z80ASIO-2	7.95
Z80BCPU	5.95
Z80BCTC	5.95
Z80BPIO	5.95
Z80BSIO-0	9.95
Z80BSIO-1	9.95
Z80BSIO-2	9.95
Z80SIO-0	6.00
Z80SIO-1	6.00
Z80SIO-2	6.00

6805 FAMILY

MC1468052P	12.60
MC146818P	7.20
MC146823P	8.80
MC68705KT3	75.00
MC68705R3L	40.00
MC68705U3L	36.00

68000 FAMILY

MC68000G10	50.00
MC68000L8	50.00
MC68008L8	45.00
MC68230L8	19.50
MC68451L8	67.00
MC68901P	75.00

TI 9900 FAMILY

TMS9901-95	4.50
TMS9902	4.50
TMS9918	35.00
TMS9927	11.60
TMS9928	13.00
TMS9929	13.00
TMS9937	6.70
TMS9980	17.20
TMS9995	13.70

Hi-Tech components

0379 4131

MEMORIES — EPROM

2532-300ns	4.95
2532-450ns	3.95
2564-300ns	6.95
2708-450ns	3.95
2716-450ns	3.50
2716-3 RAIL	7.95
2732-350ns	4.95
2732-450ns	4.45
2764-200ns	7.95
2764-250ns	5.15
2764-300ns	4.75
27C64-250ns	10.95
27C64-300ns	10.45
27128-250ns	19.00
27128-300ns	16.00

MEMORIES RAM

4116-150ns	1.28
4116-200ns	1.20
4164-150ns	4.45
4416-200ns	4.70
4532-200ns	2.45
4564-150ns	4.45
8118-100ns	1.95
81256-150ns	25.00
8416-200ns	6.00
8416-LP-200ns	6.40
8417-200ns	6.00
8417-LP-200ns	6.40

MEMORIES — RAM *ZERO POWER ZKXB CMOS*

MK48Z02B-150ns	32.00
MK48Z02B-200ns	24.00
MK48Z02B-250ns	23.00

BIPOLAR PROMS

TBP18S030N	1.54
TBP18SA030	1.38
TBP24S10N	2.06
TBP24S41N	6.68
TBP24S81N	5.50
TBP24SA10N	1.40
TBP24SA41N	4.40
TBP28L22N	3.10
TBP28LA22N	4.14
TBP28S166N	19.00
TBP28S42N	4.50
TBP28S46N	4.50
TBP28S86N	5.00
TBP28SA42N	4.50
TBP28SA46N	4.50
TBP28SA86N	8.62
AM27S13PVC	3.74
AM27S19PC	1.92
AM27S191DC	15.00
AM27S25DC	15.00
AM27S29DC	6.46
AM27S35DC	22.00

MEMORIES E2 PROM

X2804AP-300ns	14.95
X2804AP-350ns	13.45
X2804AP-450ns	12.75
X2816AP-300ns	29.95
X2816AP-350ns	25.00
X2816AP-450ns	22.50

LINEAR/INT. DEV.

4702	8.90
HCI-55564-5 (Speech Synthesis)	10.66
AM7910DC	34.88
AM7911DC	34.88
25LS2518PC	3.60
25LS2521PC	3.28
25LS2538PC	2.72
25LS2539PC	2.72
26LS31PC	2.62
26LS32PC	2.62
6402	6.40
75107BN	0.69
75110AN	0.86
75150P	0.86
75154N	1.05
75159	2.30
75160AN	2.60
75161AN	2.82
75162AN	4.08
75172NG	1.96
75173N	1.44
75174	2.82
75175	1.96
75182	0.50
75183	0.50
75188	0.86
75189	0.86
75451BP	0.22
75452BP	0.29
75453BP	0.22
75454BP	0.22
75468N	0.88
75491N	0.31
75492N	0.41
AY-3-1015	3.50
AY-3—1270	9.40
AY-3-8910	6.40
AY-5-3600	8.84
DP8304	4.50
L203	0.99
LF398	3.80
LM301AN	0.30
LM308AN	0.94
LM308N	0.56
LM311N	0.60
LM317MT	0.80
LM317T	1.06
LM319N	3.30
LM324N	0.50
LM337T	1.20
LM339	0.48
LM339N	0.48
LM348N	0.64
LM350T	3.12
LM358N	0.60
LM3900	0.68
LM393N	0.48
LM725CN	3.00
741CP	0.16
LM747CN	0.60
LM748CN	0.30
MC1413P	0.80
MC1416	0.80
MC14411	10.10
MC14412	14.20
MC1458CPI	0.35
MC1495L	6.30
MC1496P	0.70
MC1723P	0.40
MC3242A	6.30
MC3302P	0.48
MC3340P	2.36
MC3357P	1.90
MC3423PL	0.81
MC3441AP	2.90
MC3446AP	2.90
MC3447P	4.30
MC3448A	3.99
MC3470P	6.44
MC3480	7.76
MC3487	1.80
NE555P	0.25
NE556CP	0.65
RO32513-L	9.40
RO32513-U	9.40
TL010-CP	0.44
TL061-CLP	0.28
TL062-CP	0.47
TL064-CN	0.95
TL066-CP	0.28
TL071-CP	0.28
TL072-CP	0.56
TL074-CN	1.10
TL081-CP	0.29
TL082-CP	0.49
TL084-CN	1.02
TL091-CP	0.39
TL092-CP	0.72
TL094-CN	1.30
TL487-CP	0.59
TL489-CP	0.59
TL494-CN	1.99
TL496-CP	0.59
TL507-CP	1.22
ZN450-E	6.08
ZN451-E	7.40
ZN451-KIT	29.95

F.D. CONTROLLERS

8272	35.00
FD1771P	30.00
FD1791	15.50
FD1791-02	11.00
FD1793	18.40
FD1793-02	11.00
FD1795	25.00
FD1797	21.00
WD1691	14.00
WD2143	12.00

DATA CONVERTERS

ZN425E-8	3.76
ZN425J-8	8.00
ZN426E-8	1.90
ZN427E-8	6.68
ZN427J-8	12.50
ZN428E-8	5.10
ZN428J-8	9.70
ZN429E-8	1.60
ZN432CJ-10	20.79
ZN432E-10	13.00
ZN433CJ-10	25.00
ZN434	0.98
ZN435	4.38
ZN436E	1.26
ZN440	55.00
ZN441	46.80
ZN447	7.80
ZN448E	6.66
ZN448J	12.48
ZN449	2.72
ZNA134J	22.50
ZNA234E	9.40

VOLTAGE REF.

ZN404	0.50
ZN423	0.98
ZN458	0.92
ZN458A	0.92
ZN458B	1.12
ZNREF 025	1.90
ZNREF 040	1.90
ZNREF 050	1.90
ZNREF 062	1.90
ZNREF 100	3.05

BUFFERS

81LS96	1.10
81LS97	1.10
81LS98	1.10
8T26A	1.10
8T28	1.10
8T28A	1.10
8T95	1.10
8T97A	1.10
8T98	1.10

OPTOISOLATORS

4N25	0.75
4N26	0.75
4N33	0.90

UHF MODULATORS

UM1111	2.95
UM-1233	3.45

VOLTAGE REG.

7805	0.75
7812	0.75
7815	0.75
78H05SC	7.50
78H12ASC	8.95
78HGASC	9.95
78L05	0.30
78L12	0.30
78L15	0.30
78S40DM	7.50
78S40PC	3.00
7905	0.95
7912	0.95
7915	0.95
LM309K	0.95
LM317K	2.45
LM323K	4.95
LM338K	4.50

FAIRCHILD FAST

74F00PC	0.60
74F04PC	0.60
74F08PC	0.65
74F109PC	0.65
74F11PC	0.52
74F138PC	0.52
74F138PC	1.26
74F139PC	1.26
74F151	1.26
74F153	1.26
74F157	1.30
74F158	1.17
74F161	2.34
74F164	1.68
74F175	1.82
74F181	3.90
74F189	5.10
74F190	3.20
74F191	3.20
74F194	1.68
74F20PC	0.52
74F240	3.16
74F241	2.42
74F243	2.80
74F244	2.96
74F245	6.08
74F251	1.26
74F253	1.26
74F257	1.26
74F258	1.34
74F280	1.74
74F283	1.74
74F32PC	0.52
74F352	1.26
74F353	1.26
74F373	3.16
74F374	3.16
74F379	1.83
74F381	6.62
74F382	4.22
74F398	3.16
74F399	2.70
74F521	2.76
74F533	3.16
74F534	3.16
74F537	6.02
74F538	4.38
74F539	4.38
74F64PC	0.52
74F74PC	0.58
74F86PC	0.77

HIGH SPEED CMOS

74HC00N	0.42
74HC02N	0.42
74HC03N	0.64
74HC04N	0.44
74HC08N	0.42
74HC107N	0.78
74HC109N	0.50
74HC10N	0.64
74HC112N	0.86
74HC113N	0.86
74HC132N	1.28
74HC137N	1.81
74HC138N	1.20
74HC139N	0.78
74HC151N	1.16
74HC153N	0.90
74HC157N	1.02
74HC158N	1.02
74HC160N	0.90
74HC161N	0.90
74HC162N	1.51
74HC163N	1.51
74HC164N	0.95
74HC165N	2.24
74HC173N	1.35
74HC174N	0.80
74HC175N	0.78
74HC194N	1.28
74HC195N	1.28
74HC20N	0.40
74HC237N	1.80
74HC240N	1.38
74HC241N	1.34
74HC242N	2.24
74HC243N	2.24
74HC244N	1.32
74HC251N	1.03
74HC253N	1.03
74HC257N	1.03
74HC266N	0.92
74HC273N	2.24
74HC27N	0.80
74HC280N	3.26
74HC32	0.40
74HC373N	2.40
74HC374N	2.40
74HC393N	1.78
74HC4002	0.64
74HC4017	1.16
74HC4020	1.46
74HC4024	1.20
74HC4040	1.46
74HC4060	1.46
74HC4075	0.64
74HC42N	0.90
74HC4511	2.51
74HC4514	3.76
74HC4538	2.36
74HC4543	3.04
74HC51N	0.64
74HC533N	2.40
74HC534N	2.40
74HC589N	1.72
74HC58N	0.64
74HC595N	1.84
74HC597N	1.72
74HC73N	0.84
74HC74N	0.84
74HC75N	0.92
74HC76N	0.64
74HC85N	2.02
74HC86N	0.80
74HCU04N	0.80

TTL

74LS00	0.25
74LS01	0.25
74LS02	0.25
74LS03	0.25
74LS04	0.25
74LS05	0.25
74LS08	0.25
74LS09	0.25
74LS10	0.25
74LS109	0.54
74LS11	0.25
74LS112	0.54
74LS113	0.42
74LS114	0.44
74LS12	0.25
74LS122	0.75
74LS123	0.95
74LS124	2.30
74LS125	0.49
74LS126	0.49
74LS13	0.46
74LS132	0.73
74LS136	0.46
74LS138	0.77
74LS139	0.77
74LS14	0.80
74LS145	1.23
74LS148	1.50
74LS15	0.25
74LS151	1.10
74LS153	1.10
74LS155	0.77
74LS156	0.77
74LS157	0.62
74LS158	0.62
74LS160	0.80
74LS161	0.80
74LS162	0.80
74LS163	0.80
74LS164	1.10
74LS165	1.30
74LS166	1.95
74LS173	1.13
74LS174	1.30
74LS175	0.96
74LS181	2.09
74LS190	0.98
74LS191	0.75
74LS192	1.10
74LS193	1.10
74LS194	0.78
74LS195	0.78
74LS196	1.10
74LS197	1.10
74LS20	0.25
74LS21	0.25
74LS22	0.25
74LS221	1.08
74LS240	1.40
74LS241	1.40
74LS242	1.36
74LS243	1.36
74LS244	1.40
74LS245	1.95
74LS248	1.16
74LS249	1.16
74LS251	0.78
74LS253	0.78
74LS257	0.78
74LS258	0.78
74LS259	1.77
74LS26	0.30
74LS261	2.60
74LS266	0.35
74LS27	0.25
74LS273	1.35
74LS279	0.77
74LS28	0.25
74LS283	1.00
74LS290	0.86
74LS293	0.86
74LS30	0.25
74LS32	0.25
74LS33	0.30
74LS365	0.55
74LS366	0.55
74LS367	0.55
74LS368	0.55
74LS37	0.25
74LS373	1.50
74LS374	1.50
74LS375	0.75
74LS377	1.50
74LS378	1.22
74LS379	1.50
74LS38	0.25
74LS386	0.50
74LS390	1.10
74LS393	1.10
74LS40	0.25
74LS42	0.85
74LS47	1.00
74LS48	1.00
74LS49	1.00
74LS51	0.25
74LS54	0.25
74LS55	0.25
74LS670	2.30
74LS73	0.30
74LS74	0.35
74LS75	0.50
74LS76	0.35
74LS78	0.35
74LS83	0.90
74LS85	1.16
74LS86	0.42
74LS90	0.66
74LS91	1.30
74LS92	0.66
74LS93	0.66
74LS95	0.77

CMOS 4000 Series

4000	0.25
4001	0.52
4002	0.25
4006	0.90
4007	0.25
4008	0.92
4009	0.25
4010	0.25
4011	0.30
4012	0.25
4013	0.45
4014	0.50
4015	0.65
4016	0.46
4017	0.63
4018	0.46
4019	0.39
4020	0.45
4021	0.56
4022	0.42
4023	0.34
4024	0.66
4025	0.25
4026	0.74
4027	0.52
4028	0.34
4031	0.93
4033	2.40
4034	1.00
4035	0.54
4040	0.65
4041	0.36
4042	0.76
4043	0.64
4044	0.62
4045	2.00
4046	0.77
4047	0.50
4048	0.40
4049	0.50
4050	0.49
4051	0.52
4052	0.48
4053	0.66
4054	1.30
4055	0.72
4060	0.68
4063	0.60
4066	0.50
4068	0.25
4069	0.40
4070	0.40
4071	0.40
4072	0.40
4073	0.40
4075	0.46
4076	0.48
4077	0.40
4078	0.25
4081	0.40
4082	0.25
4085	0.66
4086	0.40
4093	0.32
4099	0.50
4502	0.86
4507	0.47
4508	0.96
4510	0.68
4511	0.69
4512	0.40
4514	1.76
4515	1.84
4516	0.68
4518	0.40
4519	0.25
4520	0.96
4521	1.32
4522	0.84
4526	0.52
4527	0.52
4528	0.48
4532	0.68
4541	0.82
4543	0.60
4553	2.40
4555	0.48
4556	0.44
4585	0.48

CRYSTALS

A111B	1MHz	4.50
A112A	1.008MHz	4.00
A113A	1.8432MHz	3.50
A116A	2.4576MHz	2.00
A120B	4MHz	1.25
A132A	6MHz	1.70
A140A	8MHz	1.25
A169A	3.6864MHz	2.00
A173A	9.8304MHz	2.75
A182A	19.6608MHz	2.50

DIL SKTS TIN

		1+	100+
07070802	8 PIN	0.07	0.05
07071402	14 PIN	0.09	0.07
07071602	16 PIN	0.09	0.07
07071802	18 PIN	0.15	0.10
07072002	20 PIN	0.19	0.14
07072202	22 PIN	0.21	0.15
07072402	24 PIN	0.24	0.16
07072802	28 PIN	0.26	0.17
07074002	40 PIN	0.29	0.18

DIL SKTS GOLD

06060802	8 PIN	0.16
06061402	14 PIN	0.20
06061602	16 PIN	0.21
06061802	18 PIN	0.22
06062002	20 PIN	0.28
06062202	22 PIN	0.32
06062402	24 PIN	0.42
06062802	28 PIN	0.46
06064002	40 PIN	0.66

DIL SKTS W/WRAP TURNED PIN

9090802	8 PIN	0.36
9091402	14 PIN	0.75
9091602	16 PIN	0.85
9091802	18 PIN	0.96
9092002	20 PIN	1.08
9092202	22 PIN	1.18
9092402	24 PIN	1.28
9092802	28 PIN	1.50
9094002	40 PIN	1.70

ZIF SOCKETS

08082402	24 PIN	5.70
08082802	28 PIN	6.90
08084002	40 PIN	8.25

Appointments

Advertisements accepted up to 12 noon Thursday Nov 1st. for Dec 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: LUCY O'SULLIVAN, 01 661 3033 (DIRECT LINE)

Cheques and Postal Orders payable to BUSINESS PRESS INTERNATIONAL LTD. and crossed.

ecm

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 076 384 676 (till 8pm most evenings) or send your C.V. (no stamp needed) to:

ELECTRONIC COMPUTER AND MANAGEMENT APPOINTMENTS LIMITED
Freepost, Barkway, Royston, Herts SG8 8BR

(1926)

Civil Aviation College (Gulf States) DOHA, QATAR

REQUIRED FOR SEPTEMBER 1984:

INSTRUCTOR AVIATION ELECTRONICS

University Degree and Professional Qualifications in Aviation Electronics. Qualified and Experienced in Installation and Maintenance of Modern Radio Systems.
Must have MINIMUM TEN YEARS' EXPERIENCE with Three Years' Instructional Experience at an ICAO Recognised Training Centre.
Salary and Allowance up to US dollars 3400 Per Month.

Applications to:
THE PRINCIPAL
CIVIL AVIATION COLLEGE (GULF STATES)
P.O. BOX 4050
DOHA
STATE OF QATAR

(2672)

MOSTEK MK 38P70 DEVELOPMENT PROCESSORS

For sale or rent
£12.50 each in lots of 10
£8.50 each in lots of 100

Rental £2/month each P+P £1.50

Datex UK Ltd., 101, Acorn Street, Leicester 0533-666518

2746

NIMBUS RECORDS LTD

Require a practical person able to build and wire up prototype electronic equipment from given circuits, also preferably able (with some guidance) to undertake faultfinding and maintenance on existing equipment. This is not simply a wireman's job — it needs a high level of general intelligence as well.
Write to: —

Head of Research,
Nimbus Records Ltd,
Wyastone Leys,
Monmouth, Gwent
NP5 3SR.

(2696)

Appointments

Systems Engineers

Outstanding opportunities for pragmatic Systems Engineers to become Senior Systems Engineers, Technical Managers or Project Managers, dealing from scratch with one of several new, exciting, large high technology projects.

Up To £20K+

Several unique opportunities affording excellent career prospects with a large, expanding, performance orientated company exist for engineers with a degree or HNC in Physics or Engineering (preferably Electronics or Systems Engineering, but possibly Mechanical Engineering). Candidates should have acquired good systems experience whilst working in the Electronics or Defence Industries and ideally will have practical knowledge of prototype production or trials.

Your task will be to assist our client, who has developed an enviably secure base in the development and manufacture of complex weapons systems, to develop new business areas for high technology systems in both the defence and commercial sectors. The number of persons ultimately involved in a project will vary from 20 to 750 and the development costs will range from £20M to £200M and consequently there will be tremendous opportunities for you to progress to the control of the running of very large projects as well as to higher levels of management. By proposing, developing and evaluating systems and design options, producing prototypes and arranging for all necessary trials and tests, your team's objective will be to produce complete technical and cost proposals for complex, state-of-the-art systems whose technical excellence and competitiveness will ensure that large contracts are secured. To have acquired the necessary skills and experience to meet this formidable challenge you will probably be at least 30 to 35 years old; have management experience especially of dealing with people outside your direct control; have experience of customer liaison and project planning; and will have developed commercial and business awareness.

These important new positions offer excellent rewards and conditions with first class future prospects in the thriving division of a leading company in the High-Technology and Defence Industries that is part of a highly successful, major international group. The division has an order book which takes them potentially beyond the year 2000, is committed to developing several new business areas, and is poised to move into the world market in a big way.

TO FIND OUT MORE and to obtain an early interview, please telephone JOHN PRODGER in complete confidence on HEMEL HEMPSTEAD (0442) 47311 during office hours or one of our duty consultants on HEMEL HEMPSTEAD (0442) 212650 evenings or weekends (not an answering machine). Alternatively write to him at the address below.

Executive Recruitment Services

THE INTERNATIONAL SPECIALISTS IN RECRUITMENT FOR THE ELECTRONICS, COMPUTING AND DEFENCE INDUSTRIES

25-33 Bridge Street, Hemel Hempstead, Herts., HP1 1EG.

Dolby

Dolby Laboratories Inc. manufacture and market Audio Noise Reduction equipment which is used by major recording companies, recording studios, the film industry and broadcasting authorities throughout the world.

Due to increased sales and the introduction of new products we have the following vacancies:—

Electronic Test Technicans (£135 pw NEG) We need people educated to HNC level (or equivalent) with the potential to develope test and fault finding skills (to component level) in a semi-automated test environment.

Electronic Test Engineer (£8000 pa NEG) We need experienced Test Engineers educated to HND to equivalent level who demonstrate a practical knowledge of Analog testing and rapid "trouble-shooting" to component level.

For further information contact: Sarah Kennedy, Dolby Laboratories Inc. 346 Clapham Road, London SW9 9AP. 01-720 1111

(2724)

BORED ?

Then change your job!

1) Data Communications Customer service engineer to work on local area networks. To £13,000 + car. Berks.

2) Test Engineer to work on peripheral and printers to component level. To £9,000. Berks/Bucks/Hants.

3) CAD/CAM Field Service Engineers. To work on PDP 11 based graphic display to £12,000 + car. Berks/Bucks.

4) Office Automation Systems Technical Support Engineer to work on Z80 based systems. To £11,000 + car, Berks/Bucks.

Hundreds of other Electronic and Computer vacancies to £12,500

Phone or write:

Roger Howard, C.Eng., M.I.E.E., M.I.E.R.E.

CLIVEDEN CONSULTANTS

92 The Broadway, Bracknell, Berkshire

Tel: 0344 489489

(1640)

CLIVEDEN

Electronics Engineers £9561

Communications Design in High Tech Country

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 (£7149-£9561) or Scientific Officer (£5682-£7765) 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 of working environment most suited to your career plans.

The Recruitment Officer, HMGCC, Hanslope Park, Buckinghamshire MK19 7BH. (2448)

TECHNICAL PROJECTS LIMITED

is a young and rapidly growing company specialising in the development, manufacture and marketing of audio products for the professional entertianments industry worldwide. Our customers include the BBC, independant television companies, local radio, hire and production houses, manufacturers, education and MOD etc. We are noted for product quality and customer service. Due to expanding business opportuniies the following two vacancies have arisen:

FIELD SALES ENGINEERS
(Audio/Acoustic Measuring Equipment
1. Wales, Midlands & East Anglia
2. Northern England and Scotland

Applications are invited from sales engineers ideally in the field of professional audio/acoustic measurement and its relted test products, possibly working in a large company and wishing an impact in a smaller one using their expertise and experience in field sales to promote the company's growth.

A combined five figure salary and commission of circa £19.000 is envisaged in the first year with every opportunity for increase and advancement into management. Company car provided plus normal benefits.

Please write or telephone:
The Sales Manager, TECHNICAL PROJECTS LIMITED,, Unit 2, Samuel Whites Ind. Estate, Medina Road, Cowes, Isle of Wight, PO31 7LP Telephone: (0983) 291553 (2755)

TELEVISION OPERATIONAL ENGINEER

We have a vacancy for a Television Operational Engineer in our Production Division at Chalfont Grove near Gerrards Cross, which provides Training Programmes for the British Forces.

The work includes the installation, operation and maintenance of professional television equipment. The facilities for this comprise C Format VTR's, Flying Spot Telecine, Studio and ENG cameras, Graphics and Duplication equipment. Candidates should have reach HNC level in Electronics and have a working experience of the task and equipment outlined above. Other candidates with limited experience wishing to progress their careers in this field will however be considered.

A good salary will be paid. Good Pension Scheme. Assisted travel and free lunches.

Apply by letter giving details of experience and present salary to:

Mr E G Locke
Personnel Officer

The Services Sound and Vision Corporation
Chalfont Grove, Gerrards Cross, Bucks SL9 8TN.

SSVC

(2765)

UNIVERSITY OF GLASGOW

Language Centre

RESEARCH TECHNOLOGIST

A key position in Britain's first computer-automated centre for language teaching and related Audio-Visual production. This newly created Department offers a unique opportunity for the creative development of applications software and specialised hardware in a University enironment. It requires staff of vision and enterprise with a keen practical interest in project linking the computer and A/V technologies.

The person appointed will be responsible to the Director for technical supervision of the Centre and for hardware development in digital audio, interactive video, and micro-electronic real-time operations. Candidates will have at least a good honours degree or the equivalent in a relevant discipline. A broad interest in modern languages wil be an asset.

Appointment will be within the range £7,190 — £14,125 (under review) on Grade 1A/II of the scales for Other Related Staff, with placement according to qualifications and experience.

Further particulars may be obtained from the Academic Personnel Office, University of Glasgow, Glasgow, G12 8QQ, where applications (10 copies), giving the names and addresses of not more than three referees, should be lodged on or before 31st October 1984.

Informal enquiries may be made to the Director, The Language Centre, 041-339 8855, Ext. 255.
In replay please quote Ref. No. 5341WA

(2757)

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:

Telephone now for our free jobs list
We have vacancies in all areas of the UK
Salaries to £15,000 pa

01 808 3050
(24hours)

CAPITAL APPOINTMENTS LTD
76 WILLOUGHBY LANE, LONDON N17 0SF

(291)

CUT THIS OUT!

Clip this advert and you can stop hunting for your next appointment. We have a wide selection of the best appointments in Digital, Analogue, RF, Microwave, Microprocessor, Computer, Data Comms and Medical Electronics and we're here to serve *your* interests.

Call us now for posts in Design, Test, Sales or Field Service, at all levels from £6,000-£16,000.

Technomark
Engineering & Technical Recruitment
11 Westbourne Grove, London W2. Tel: 01-229 9239.

(1935)

Advanced telecommunications:

careers with extensive scope at Cheltenham

Join the Government Communications Headquarters, one of the world's foremost centres for R & D and production in voice/data communications ranging from HF to satellite – and their security. Some of GCHQ's facilities are unique and there is substantial emphasis on creative solutions for solving complex communications problems using state-of-the-art techniques including computer/microprocessor applications. Current opportunities are for:

Telecommunication Technical Officers

Two levels of entry providing two salary scales:
£6262-£8580 & £8420-£9522
Minimum qualifications are TEC/SCOTEC in Electronics/Telecommunications or a similar discipline or C & G Part II Telecommunications Technicians Certificate or Part I plus Maths B, Telecommunication Principles B and either Radio Line Transmission B or Computers B or equivalent: ONC in Electrical, Electronics or Telecommunications Engineering or a CIE Part I Pass, or formal approved Service technical training. Additionally, at least four years' (lower level) or seven years' (higher level) appropriate experience is essential in either radio communications or radar, data, computer or similar electronic systems. At the lower entry level first line technical/supervisory control of technicians involves "hands-on" participation and may involve individual work of a highly technical nature. The higher level involves application of technical knowledge and experience to work planning including implementation of medium to large scale projects.

Radio Technicians – £5485-£7818

To provide all aspects of technical support. Promotion prospects are good and linked with active encouragement to acquire further skills and experience. Minimum qualifications are a TEC Certificate in Telecommunications or equivalent plus two or more years' practical experience.

Cheltenham, a handsome Regency town, is finely endowed with cultural, sports and other facilities which are equally available in nearby Gloucester. Close to some of Britain's most magnificent countryside, the area also offers reasonably priced housing. Relocation assistance may be available.

For further information and your application form, please telephone Cheltenham (0242) 32912/3 or write to:

GCHQ

Recruitment Office, Government Communications Headquarters,
Oakley, Priors Road, Cheltenham,
Gloucestershire, GL52 5AJ.

(2452)

NEW CAMBRIDGE RESEARCH COMPANY LTD

MANAGER

Applications are invited for the post of manager of a new 'venture workshop' in Cambridge. New Cambridge Research is a member of the Newmarket group of international venture capaital investment companies and is one-third owned by King's College, Cambridge. The venture workshop will provide facilities and support for the development, test and appraisal of new inventions to the prototype stage. The prototypes can then be assessed for commercial development.

QUALIFICATIONS: Applicants should have a good degree and research experience in engineering or science. Practical experience in industry is desirable. Initiative, enthusiasm and a technically adventurous mind are essential. The post offers great scope for the successful candidate, probably aged between 28-35, who will be given the opportunity to widen his experience internationally with the Newmarket Group and will participate in the success of new companies.

SALARY: Negotiable, depending on the experience and suitability of the candidate.

Applications, including full c.v. should be sent by 27th October to:

**Miss S.V. Brinton,
New Cambridge Research Company Ltd
Unit 5, Clifton Industrial Estate,
Cherry Hinton Road,
Cambridge. CB1 4BW.
Telephone: 0223 214661**

(2747)

SWISS COMPANY

**LOOKS FOR EXPERIENCED ENGINEER FOR INSTALLATION AND SERVICE OF
– SSB TRANSCEIVERS 1.6 – 30 MHZ FREQUENCY SYNTHESIZED
– IN ADDITION 1 KW POWER AMPLIFIERS
INTERESTING POSITION WITH SOME TRAVELLING**

**Mr. K. Minder
TIG BICORD AG. CH 6331 Huenenberg Zug Switzerland.**

(2712)

• DESIGN ENGINEER •

Required to design basic VHF FM transmitter circuits on a commission basis. Experience in micro circuit techniques would be an advantage.
The ultimate requirement will be the design of micro circuit devices capable of providing up to 5MW output. Applicants should indicate current employment situation and salary together with previous experience in this field.

(2759)

Classified

SKC® **MINI FLOPPY DISK**

PERFECTION ASSURED

FLOPPY DISKS MEET ANSI, DIN, ECMA, IBM, JIS AND SHUGART SPECIFICATIONS.
EVERY DISK IS CERTIFIED AND GUARANTEED TO BE 100% ERROR FREE.

ALL THESE PRICES INCLUDE VAT

LOW PRICE—HIGH QUALITY

BOXES OF 10 disks

40 track	S/S S/D	£12.00
	S/S D/D	£12.60
	D/S D/D	£14.80
80 track	S/S D/D	£14.70
	D/S D/D	£18.40

Add £1 Post and Packing

ALSO COMPUTER CASSETTES

Boxes of 100

C10 £26.50
C15 £27.50
C20 £28.75

ADD £3.50 CARRIAGE

P. V. TUBES
Dept. D
104 ABBEY STREET,
ACCRINGTON, LANCS BB5 1EE.
Telephone: (0254) 36521 (0254) 32611
Telex: 635562 Griffin G for PV

PHONE IN ACCESS/VISA CARD NO. FOR SAME DAY DISPATCH

ARTICLES FOR SALE

BRIDGES waveform/transistor analysers. Calibrators, Standards. Millivoltmeters. Dynamometers. KW meters. Oscilloscopes. Recorders. Signal generators — sweep, low distortion, true RMS, audio, FM, deviation. Tel. 040 376236. (1627)

WAVEGUIDE. Flanges and dishes. All standard sizes and alloys (new material only) from stock. Special sizes to order. Earth Stations, 01-228 7876, 22 Howie Street, London SW11 4AR. (2099)

When replying to classified advertisements, readers are recommended to take steps to protect their interests before sending money

(2519)

UNIVERSITY OF WARWICK
Department of Psychology

Electronics Technician Grade 5

Applications are invited for the post of Electronics Technician (Grade 5) — **£6,581—£7,684** in the Psychology Department.
Candidates should be familiar with both hardware aspects of microprocessors and a working knowledge of video systems would be a distinct advantage.
Duties will include design, construction and maintenance of a wide variety of standard and specialised electronic equipment.
Informal and specilised electronic equipment.
Informal enquiries to **G. Wales (0203) 24011, Extension 2611**
Application in writing, giving details of qualifications and experience and quoting the names and addresses of two referees to **The Personnel Office, University of Warwick, Coventry CV4 7AL, quoting Reference No. 9/T/84/20. Closing date 1st November 1984.** (2762)

HIGHLAND HEALTH BOARD
Department of Medical Physics and Bio-Engineering
Raigmore Hospital, Inverness

SENIOR TECHNICIAN/ TECHNICIAN — ELECTRONICS SECTIONS

A vacancy exists for a **Senior Technician/Technician,** with ONC or high qualifications. The work involves disign, construction, repair and maintenance as well as clinical involvement.
Salary is:
Grade III £6132—£7926
Grade IV £5171—£6798
(under review)
Job description and application form from **Area Personnel Officer, Highland Health Board, 17 Old Edinburgh Road, Inverness.** *(Tel (0163) 239851).*
For additional information contact **Mr A R Bowley, Duputy Director.** *Tel (0163) 234151* **Ext 276 or 277.**

(2753)

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:

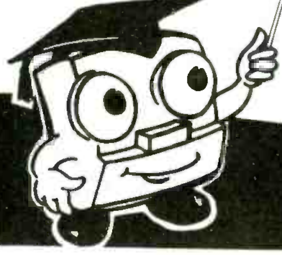
Digital Processing, Professional Video Recording, Digital Magnetic Recording, Microprocessor Based Equipment.

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.

AMPEX
INTERNATIONAL
TRAINING



Reading (0734) 875200

AMPEX, ACRE ROAD, READING RG2 0QR.

(2723)

Technical Author

Sony Broadcast Ltd, one of the world's leaders in the professional broadcast television industry, operates throughout Europe, the Middle East and Africa.
An excellent opportunity for an experienced Technical Author has now arisen at the Company's international headquarters which are located in Basingstoke.

The successful candidate will be responsible for writing high quality technical manuals on our major products.
A background in electronic engineering, preferably with experience in the broadcast industry, is required together with the ability to write clear, concise English.

This position carries an attractive salary and first class conditions of employment.
If you are interested please write to Mike Jones, Senior Personnel Officer or alternatively telephone our 24 hour answering service on Basingstoke 59583.

(2748)

SONY® Broadcast

Sony Broadcast Ltd.
City Wall House
Basing View, Basingstoke
Hampshire RG21 2LA
United Kingdom
Telephone (0256) 59 5 83

KING'S COLLEGE SCHOOL OF MEDICINE & DENTISTRY of KING'S LONDON
DENMARK HILL
LONDON SE5 8RX

ELECTRONICS ENGINEER

Applications are invited for a suitably qualified graduate to join a multi-disciplinary team researching into the design of novel instrumentation for the measurement of bloodflow using ultrasound. Applicants should prossess a good degree of electronic or electrical engineering, and industrial experience would be an advantage. Suitable applicants will be given the opportunity to register for a higher degree.
The post, which is tenable for a year in the first instance, is funded by the British Technology Group. Salary will be within the range £6,310—£8,530 p.a. + £1,186 London Weighting, placement being according to age and experience.
Formal applications, including the names and addresses of two referees, should be sent to the Secretary at the above address from whom further details of the post may be obtained. Interested applicants may write directly to Professor V. C. Roberts, Department of Medical Engineering & Physics, Dulwich Hospital, East Dulwich Grove, London SE22.
The closing date for applications will be 7 November 1984. (2761)

CHALLENGING POST

Dynamic radio service engineer required for Nigeria
For HF SSB and VHF/UHF Synthesised equipment
The position is well rewarded
Contact
01 444 7207

(2764)

SIGNAL RADIO

Require a

BROADCAST ENGINEER

For general duties in the Engineering Department. The successful applicant will have a HND/Degree qualification or equivalent training in a relevant subject.
Experience in broadcasting and a clean driving licence desirable.
Salary: Negotiable depending on experience.
Apply with full C.V. to:
Dave Donahue,
Chief Engineer,
Studio 257,
Stoke Rd., Stoke-on-Trent.
ST4 2SR (2680)

THE UNIVERSITY OF SUSSEX

ELECTRONICS TECHNICIAN

A vacancy exists for an electronics technician in the Psychology Laboratory, froms as soon as possible. Applicants with at least seven years' experience in electronic work are sought. Someone with less experience will also be considered, especially if with an interest in the computer and/or audio/visual fields.
Salary in the Technician Grade 5 range, £6,279—£3,332 per annum, according to age and experience, but someone with less than seven years' experience would be appointed on a lower grade.
Send self-addressed envelope (9in×6in) for application form Mrs. S. Cory-Wright, Personnel Office, Sussex House, University of Sussex, Falmer, Brighton BN1 9RH.

Applications must be received by 9 November 1984 (2749)

Microwave Engineers

Space Technology

The market demand for space communications has resulted in a rapid growth of our satellite projects

The Marconi Space Centre at Portsmouth has been in the forefront of satellite technology from its inception. We are now looking for experienced degree qualified microwave engineers to design satellite microwave systems and equipment covering the frequency range 200 MHz to 50 GHz. This will involve a range of components including filters, mixers low noise amplifiers, power amplifiers multiplexers and antennae.

We offer both challenging work in an innovative environment with full technical support and particularly good career prospects. Salaries reflect the levels of seniority, and the attractive benefits package includes assistance with relocation expenses to a pleasant part of Southern England.

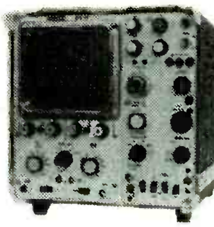
Telephone Portsmouth (0705) 674019 for an application form. Alternatively you can write to Jack Burnie, Marconi Space Systems Limited, Browns Lane, The Airport, Portsmouth, Hants. Quoting Ref BL 221.

(All posts are open to men and women)

Marconi
Space Systems

(2763)

ARTICLES FOR SALE



Latest Bulk Government Release — Cossor Oscilloscope COU150 (CT531/3) £150 only. Solid state general purpose bandwidth DC to 35MHz at 5 MV/CM — Dual Channel — High brightness display (8×10cm) Full delayed time base with gated mode — Risetime 10NS — Illuminated graticule — Beam finder — Calibrator 1KHz squarewave — Power 100 — 120V. 200V — 250 volts AC — Size W 26CM — H 26CM — 41CM deep — WT 12.5 K.G. carrying handle — colour blue — protection cover front containing polarized viewer and camera adaptor plate — probe (1) — Mains lead. Tested in Fair condition with operating instructions — £150.00.

Electron Microscope. Made by Jeol Type JEM — 200A — Resolving power: 3.4Å (Lattice or 5Å (Lattice) or 5 Å (point to point) Accelerating voltage 50, 100, 150, 200KV. Magnification X 1000 — 200,000. Surplus from well known government department. Test reports up to 1983. Supplied complete with all books and manual, spare parts and tool kits £6500.00. (probably a once in a lifetime chance of obtaining this instrument at this price)

Communication Receivers. Racal 500KC/S to 30MC/S in 30 bands 1MC/SWIDE — **RA17 MK11** £125. **RA17L** £150. **RAii7E** £200. **New Metal Louvred Cases for above** £25. All receivers are air tested and calibrated in our workshop — supplied with dust cover — operation instructions — circuit — in fair used condition. **Racal Synthesisers** (Decade frequency generators) **MA350B** Solid State for use with — MA79 — RA217 — RA1218 Etc £100 to £150. **MA250** — 1.6MC/S to 31.6 MC/S £100. **MA1350** for use with RA17 eceiver £100. **MA259G** Precision frequency standard 5MC/S — 1MC/S — 100KHz £100 to £150. **Panoramic Adaptor** RA66 £150. **RA137 and RA37** £40 to £75 LF convertors 10 to 980KC/S. **RA218** Independent SSB unit £50 **RA98** SSB-ISM Covertor £50. **RA121** SSB-ISB convertor £75. **RA152 and RA253** Twin-channel receiver 1 to 30 MC/S. This is virtually two RA117's in one case £150 to £200. **RA1218** Solid State receiver with electronic frequency display to 10HZ — Frequency 1 to 30MC/S £500. **RA337** LF Convertor 3 to 980KHz for use with solid state receivers £150. **Eddystone Communication Receivers EC958** Solid State — High stability — 100KHz to 30MC/S £350 to £400. **EC964/7K** Solid state — single channel — SBB— mains or battery — 1.6 to 27.5 MC/S and 400 to 535KHZ £100 with manual **Plessey PR155G** SOlid State 60KC/S — 30MC/S £400. **Redifon SBB Receiver R499** — Solid State — 10 fixed channels — range 1.5 to 30MC/S and 255KHz to 525KHz — mains or battery — complete with SIB adaptor ARU10A £100 with manual. **Creed 75 Teleprinters** — Fitted tape punch and gearbox for 50 and 75 bauds — 110volts AC supply — in original transport tray sealed in polythene — like new £15EA. **Redifon TTii Audio Teleprinter convertor** receiver solid state — supply 110 or 240AC — Made for use with above teleprinter enabling print-out of messages received from audio input of communication receiver £15 with circuit tested. **Redifon TT10 Convertor** as above but includes transmit facilities £20. **Oscilloscopes — stocks always changing — Selab's 111** Solid State — 18MC/S £125 **Telequipment D75** — 50MC/S £250 **Tektronix 465** — 100MC/S £750. **Solatron CD1740** — 50MC/S £200 **Tektronix main frame type 7704** £750 — **7504** £600 — **7704A** £1000. **FM** Recorder Sanghmd Sabre 111 14 channels £350. **Transtel Matrix printers — AF11R** — 5 level Baudot Code — up to 300 Bauds — for print out on plain teleprinter paper £50 to £100. **Transtel AH11R** — As above but also 8 level ASC11 (CCITT No 2 and CCITT No.5) Like new £100. **Army field telephone sets.** Type F — L and J — Large quantity in stock £6 to £15 depending on type and quantity P.O.R. **Don 10 Telephone Cable** — half mile canvas containers £20. **Night veiwing infra-red AFV periscopes** — Twin Eyepiece — 24 volt dc supply £100ea. Original cost to government over £11,000ea **Static invertors** — 12 or 24 volt input — 240 volt DC supply £100ea. Original cost to government over £11,000ea. **Static invertors** — 12 or 24 volt input input — 240 volt AC sinewave output — various wattages P.O.R. **XY Ploters and pen recorders** various — P.O.R. **Ferrograph series 7 ape recorders** mono £100 or 240 volt mains input £25 to £50. **Signal Generators various — TF995/A3** £60. **TF2015** 10MC/S — 510MC/S AM and FM £600 **TF8010/8s** — 10MC/S to 485MC/S £90 **TF144H/A4** £90. **TF1060/2** £60. **HP606A** and B — £90 B. £140 **HP608** £50 **HP612A** £100 **HP614A** £100 **HP618B** £100 **HP620A** £100. **Marconi TF1064B/5** £100 **Teleonic SM/2000 Sweep Generators** L3 and L5 plug-ins 4 to 75 MC/S £60 **Telonic Sweep Generators 2003** — 850 to 2150 MC/S £275 **TF313 Bridge** £100 **TF791 Deviation meter** £100 **TF893A Power meter** £50. **Aerial mast assembly** 30ft high complete with 16ft whip aerial to mount on top — guyropes — Insulators — Base and Spikes etc., in heavy duty carrying bag — new £30. **Racal frequency counter** Type 836 £50 **Tektronix plugs-ins** — 1A1 £50, 1A2 £40, 1A4 £100 M£50. All items are bought direct from H.M. Government being surplus equipment. Price is Ex works. S.A.E. for enquiries. Phone for appointment for demonstration of any items. Also availability or price change. V.A.T. and carriage extra.

EXPORT TRADE AND QUANTITY DISCOUNTS GIVEN
JOHNS RADIO (0274) 684007
WHITEHALL WORKS, 84 WHITEHALL ROAD EAST
BIRKENSHAW, BRADFORD BD11 2ER

WANTED: REDUNDANT TEST EQUIPMENT — RECEIVING AND TRANSMITTING EQUIPMENT — VALVES — PLUGS — SOCKETS SYNCHROS ETC.

(2743)

JAYSOFT MICRODEVELOPMENT Telephone 036-16-458

Designed for ease of use with no comprise in technical accuracy. These programs are suitable for professional or amateur use.

Oscillator: RC and LC circuits. Includes coil design
Electron 1: Class A bias optimisation. 741 opamp LP HP and BP Active filters
Logic: Software simulation of up to 30 logic gates to check design before the hardware stage. Can simulate fault conditions to aid fault analysis.
Suitable for BBC Commodore 64 *PET *TandyM100
(*non or reduced graphics. Logic not available).

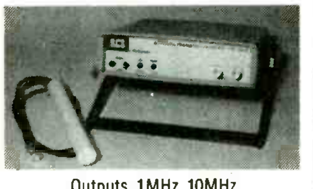
New programs available every month. Disk £20.00 Tape £17.50

JAYSOFT MICRODEVELOPMENT 2, Wester Row, Greenlaw, Berwickshire.

(2729)

BURROUGHS DISC DRIVES 8in master and salve, DS/DD excellent condition with documentation £165 the pair. Constant Voltage Transformer, 3KVA Isolated secondary input 240v output 240/220v, +1%. £135. MR Ellis, Scunthorpe (0724) 782751 anytime. (2760)

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, Wolsey Road, Ashford, Middx. Phone 53661. (2656)

Townley Times

FREE Mail Order newspaper of Bargains. Relays; Diodes; Thyristors; Capacitors; Resistors; Bridge Rectifiers; Cable Straps; High Speed Fuses and Mechanical Components.

Harehill, Todmorden, Lancs. OL14 5JY
Tel. Todmorden (STD 070 681) 4931

(2530)

RUN 9 VOLT CIRCUIT FROM A SINGLE NICKEL-CADMIUM CELL

with the Verkon V9 miniature p.c.b.-mounted dc/dc converter, the reliable alternative to expensive batteries. Send s.a.e. for data sheet listing technical and economic benefits to; J.Biles Engineering, 120 Castle Lane, Solihull, West Midlands.

(2756)

WANTED

VALVES WANTED. PX4, PX25, PP3/250, PP5/400, 12E1, SB/255M, KT66, KT88, GZ32, PL509-19, PY500A PCL805. We will purchase complete lots. Billington Valves, 23, Irwin Drive, Horsham, RH12 1NL. Callers by appointment only. (2752)

VALVE HI-FI, Quad, Leak, Garrard, Radford, Lowther, Thorens etc., All types of valve equipment considered for purchase. The Vintage Wireless Co., Tudor House, Cossham Street, Mangotsfield, Bristol BS17 3EN. Tel: 0272-565472, or Telex 437287 Sharet G. (2671)

Brandenburg 50Kv EHT supply **£50 £89.** Mullard High-Speed valve-tester **£45.** Chart recorder. Contractors. Kent Chromalog 2 **£65.** Pulse Generator. DML Digital Voltmeter, five digits. Wow/Flutter meter **£55.** Thickness Guage **£20.** Oxygen meter. Tinsley Automatic Current Controller **£35.** Wayne-Kerr AF Analyser **£59.** Avo Wattage & Power Factor Unit **£30.** Sweep Generator. Centrifuge. **£49.** EHT Meter **£30.** Large Compressor. MIG Welder. Atomic Absorption Spectrophotometer **£90.** Oxygen cyliner, valve, regulator, meter. frame **£45.** Weston Electrodynamometer **£25.** Philips micro/milli/voltmeter, DC, **£35.** Decade Standard Capacitor **£49.** Wayne-Kerr Video Oscillator **£45.** Reciprocal Ohms Resistance Box. **£29.** Variable Standard Capacitor **£29.** True-RMS milli/Voltmeter **£49.** Sullivan DC Thermistor Bridge **£39.** Micromatch Transformer (Precision matching). **£40.** Creed Teleprinter Terminal. Books. Manuals. Miniature spot welding electrodes **£2.50.** ea. Wires for spot welding to thermocouples. **£3.50** pack. etc. etc. (2016)

040 376236

(2016)

UNAVAILABLE COMPONENTS? If we can't get them, nobody can. Specialist import is cheap, even for a single item. Orders processed as part of a batch can be on your bench in weeks. Rickman Unavailable Components, Ronaldsvoe, South Ronaldsay, Orkney, KW17 2TW Phone 085683-430 (2750)

Private enquiries, send 13p in stamps for brochure

THE QUARTZ CRYSTAL CO. LTD.

Q.C.C. WORKS, WELLINGTON CRESCENT NEW MALDEN. SURREY 01-942 0334 & 2988

(8493)

ENCAPSULATING EQUIPMENT FOR coils, transformers, components, degassing silicone rubber, resin, epoxy. Lost wax casting for brass, bronze, silver, etc. Impregnating coils, transformers, components. Vacuum equipment, low cost, used and new. Also for CRT regunning metallising. Research & Development. Barratts, Mayo Road, Croydon CR0 2QP. 01-684 9917. (9678)

MORSE READING PROGS. Work on clean signals without hardware interface. ZX81 1K UNEXPANDED MEMORY. Translated code with word and line spaces for easy reading Automatic scroll action. £7 incl.

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, SCREENED WIRE, SCREWS, NUTS, CHOKES, TRANSFORMERS, etc.

ALL AT KNOCKOUT PRICES – Come and pay us a visit ALADDIN'S CAVE

TELEPHONE: 445 0749/445 2713

R.HENSON LTD.
21 Lodge Lane, North Finchley, London, N.12
(5 minutes from Tally Ho Corner) (1613)

OPTOELECTRONICS DATA BOOK 1984

Price by Texas £6.00

DIGITAL ELECTRONIC CIRCUITS & SYSTEMS by N.M. Morris PRICE: £5.45

MICROELECTRONICS: A PRACTICAL INTRODUCTION by R.A. Sparkes PRICE: £8.50

SOLDERING IN ELECTRONICS by R.J. Klein Wassin Wassink PRICE: £51.00

OPTICAL FIBER COMMUNICATIONS BY G. Keiser PRICE: £9.50

DIGITAL IMAGE ANALYSIS by S. Levialdi PRICE: £26.00

SEMI-CUSTOM IC DESIGN & VLSI by P.J. Hicks PRICE: £13.50

INTRODUCTION TO MOS LSI DESIGN by J. Mavor PRICE: £18.50

HANDBOOK OF BATTERIES & FUEL CELLS by D. Linden PRICE: £63.00

THE DESIGN & DRAFTING OF PRINTED CIRCUITS by D. Lindsey PRICE: £41.50

★ *ALL PRICES INCLUDE POSTAGE* ★

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST of British and American Technical Books

19-21 PRAED STREET LONDON W2 1NP

Telephone: **01-402 9176**
Closed Saturday 1 p.m.
Please allow 14 days for reply or delivery

(2245)

WANTED

WANTED

Test equipment, receivers, valves, transmitters, components, cable and electronic scrap and quantity. Prompt service and cash. Member of A.R.R.A.

M & B RADIO
86 Bishopsgate Street
Leeds LS1 4BB
0532 435649

(9956)

SURPLUS

We offer good prices for test equipment, components, redundant computers, PCB's connectors. Immediate settlement.

TIMEBASE
94 Alfriston Gardens
Sholling, Southampton SO2 8FU
Telephone: (0703) 431 323

(1832)

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 etc. ANY QUANTITY. (2616)

WANTED

VERBGATE LTD.

We buy large and small parcels of surplus I/C, transistors, capacitors and related electronic stock. Immediate settlement

Tel: 01-208 0766

Telex: 8814998

(2478)

WANTED

SURPLUS ELECTRONIC COMPONENTS AND EQUIPMENT

We also welcome the opportunity to quote for complete factory clearance

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS.
Phone: Ely (0353) 860185

(2483)

CAPACITY AVAILABLE

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 delivey and close co-operation with the customer.

Assembled boards at 100% inspected before flow soldering and reinspected after automatic cropping and cleaning.

Every batch of completed boards is issued with a signed certificate of conformity and quality – our final assurance.

For further details, contact us at our new works:

Blenheim Industrial Park
Bury St. Edmunds
Suffolk IP33 3UT
Telephone: 0284 3931 (1466)

• Layout • Fast service
• Artwork • Competitive

pcb design

0386-832152

Williams P.C.B. Artwork, 49 Westbourne, Honeybourne, Evesham, Worcs. WR11 5PT.

(2537)

ELECTRICAL & ELECTRONIC assembly and wiring capacity available. PCB manufacture, artwork, cable forming, etc. Prototype thur to small batch production. For high quality work at low prices contact, Phasor Circuits, Unit 18, Enterprise Workshop, 76 Linden Street, Leicester. Tel 0533 735825 (2743)

FREE P.T.H. PROTOTYPE of the finest quality with EVERY P.C.B. artwork designed by us. Competitive hourly rates, and high standard of work. Halstead Designs Limited, 34, High St., Halstead, Essex. Tel. (0787) 477408/474554. (2126)

SERVICES

FOR THE BEST PCB SERVICE AVAILABLE

***Circuit Design & Development**
Digital and Analogue

***Artwork Layout**
PCB artwork layout and mechanical detailing. P.O. approved standard.

***Board Manufacture**
Prototype to semi-production, excellent rates.

***Wiring & Assembly**
PCB assembly, wiring and cable forming. Flow soldering facilities available.

***Test**
Full test facilities available.

One or all services available. Please telephone Chelmsford (0245) 357935, or write to HCR Electronics, The Industrial Unit, Parker Road, Chelmsford. (30mins from Liverpool Street St.) (1169)

BILLINGTON VALVES

We retail a huge range of top quality valves by Mullard, Mazda G.E.C. etc etc, at competitive prices; and cut price versions of popular types at very low prices. Don't miss our October 1984 catalogue, available on request (S.A.E. please; 2 I.R.C. overseas)
We offer many types of C.R.Tube and a comprehensive range of valve sockets and specialise in wholesale of valuves and certain I.Cs. We will gladly quote against customers requirements (2 I.R.C. with overseas inquiries please)

EXPRESS MAIL ORDER SERVICE; CALLER BY APPT ONLY
23 Irvin Dr, Horsham, W.Sussex, RH12 1NL
WORLD WIDE EXPORT SERVICE

2751

SERVICES

SMALL BATCH PCBs, produced from your artwork. also DIALS, PANELS, LABELS. Camera work undertaken. FAST TURNAROUND. Details: Winston Promotions, 9 Hatton Place, London ECIN 8RU. Tel. 01-405 4127/0960. (9794)

DESIGN AND MANUFACTURE. ANALOGUE, DIGITAL, RF AND MICROWAVE CIRCUIT AND SYSTEM DESIGN. Also PCB design, mechanical design and prototype/small batch production. — **Adenmore Limited**, 27 Longshot Estate, Bracknell, Berks. Tel: Bracknell (0344) 52023. (656)

TURN YOUR SURPLUS i.cs transistors etc. into cash, immediate settlement. We also welcome the opportunity to quote for complete factory clearance. Contact COLES-HARDING & CO, 103 South Brink, Wisbech, Cambs. 0945 584188. (9509)

PCB HAND ASSEMBLY —any quantity. Highest quality at sensible prices. INTERESTED? Phone 01-274 3070 (2570)

SHEETMETAL FOLDERS 18% x 18G, Vice or Bench model. £38. Leaflet, 01-890 7838 Anytime. (2569)

ANALOG COMPUTERS LIMITED
CAPACITY NOW AVAILABLE FOR:

chartpak stockist

Design & Development, Complete Artwork Service, Camera Work, Prototype thru to Production PCB Manufacture/Assy.

5 Cork Street, Eccles, Maidstone, Kent, ME20 7HG

TELEPHONE (0622) 79987 TELEX 965633 (2348)

CIRCOLEC
THE COMPLETE ELECTRONIC SERVICE

Artwork, Circuit Design, PCB Assembly, Test & Repair Service, Q.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.

TAMWORTH MANOR
302-310 COMMONSIDE EAST, MITCHAM

(1391)

PROFESSIONAL DESIGN SERVICE. Analogue/RF circuit/System design. Specialising in microwave amplifier, oscillator and network design. MOTOROLA 6805/6809 series microprocessor design/development capability. All work carried out to a high standard by competent professional engineers. Trontech Electronic Design Services Ltd., Unit 8B, Rose Industrial Est., Bourne End, Bucks. 06285 28835 (2439)

DESIGN AND DEVELOPMENT SERVICE. RF transmitters and receivers. Telemetery U.H.F. V.H.F. Anologue and digital circuits, control systems. Full manufacturing facilities. RCS Electronics, Wolsey Road, Ashford, Middx. Phone Dr. Eric Falkner on 53661. (2637)

ELECTRONIC DESIGN SERVICES, from concept to finished product. Our unique service includes digital or analogue electronic design, product development, PCB design, manufacture and assembly of prototype or production units. CIRCUIT SOLVE, Denbigh House, Denbigh Road, Bletchley, Milton Keynes Tel:0908 648866 (2754)

BUSINESS OPPORTUNITIES

ELECTRONIC BUSINESS well known established over 20 years complete going concern with 5,500sq ft. freehold factory 3 miles Heathrow, owner retiring. Box No 2740 (2740)

VALVES, PROJECTOR Lamps, 6000 types, list 75p, world wide export. Cox radio (Sussex) Ltd., The Parade, East Wittering, Sussex. Phone (0243) 672023 (1991)

PTH BOARDS Fast turnround (24 hour for rush jobs), competitive prices, full inspection, any quantity considered, Kirk, Bridge Works, Cinderford, Glos. Tel 0594 22084 (2741)

CLASSIFIED ADVERTISEMENTS

Use this Form for your Sales and Wants

PLEASE INSERT THE ADVERTISEMENT INDICATED ON FORM BELOW

To "Wireless World" Classified Advertisement Dept., Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS

- Rate £4.00 PER LINE. Average six words per line. Minimum £25 (prepayable)
- Name and address to be included in charge if used in advertisement
- Box No. Allow two words plus £5
- Cheques, etc., payable to "IPC Business Press Ltd." and cross "& Co."

NAME ....

ADDRESS ....

....

....

		REMITTANCE VALUE	....	ENCLOSED	

PLEASE WRITE IN BLOCK LETTERS. CLASSIFICATION .... **NUMBER OF INSERTIONS** ....

ELECTRONICS & Wireless world

INDEX TO ADVERTISERS

Appointments Vacant Advertisements appear on pages 94—103

OVERSEAS ADVERTISEMENT AGENTS

France & Belgium: Norbert Hellin, 50 Rue de Chemin Veat, F-9100, Boulogne, Paris.

Hungary: Ms Edit, Bajusz, Hungexpo Advertising Agency, Budapest XIV, Varosliget.
Telephone: 225 008 — Telex: Budapest 22-4525 INTFOIRE

Italy: Sig C. Epis, Etas-Kompass, S.p.a. — Servizio Estero, Via Mantegna 6, 20154 Milan.
Telephone: 347051 — Telex: 37342 Kompass.

Japan: Mr Inatsuki, Trade Media — IBPA (Japan), B.212. Azabu Heights, 1.5.10 Roppongi, Minato-ku 106.
Telephone: (03) 585 0581.

United States of America: Jay Feinnan, Business Press International Ltd, 205 East 42nd Street, *New York*, NY 10017 — Telephone (212) 867-2080 — Telex: 23827.
Jack Farley Jnr., The Farley Coi. Suite 1584, 35 East Walker Drive, *Chicago*, Illonois 60601 — Telephone (312) 63074.
Victor A. Jauch, Elmatex International, P.O. Box 34607, *Los Angeles*, Calif. 90034, USA — Telephone (213) 821-8581 — Telex: 18-1059.
Jack Mantel, The Farley Co., Suite 650, Ranna Building, *Cleveland*, Ohio 4415 — Telephone (216) 621 1919.
Ray Rickles, Ray Rickles & Co., P.O. Box 2028, *Miami Beach*, Florida 33140 — Telephone (305) 532 7301.
Tim Parks, Ray Rickles & Co., 3116 Maple Drive N.E., *Atlanta*, Georgia 30305. Telephone (404) 237 7432.
Mike Loughlin Business Press International, 15055, memorial Ste 119, *Houston*, Texas — Telephone (713) 783 8673.

Canada: Colin H. MacCulloch, International Advertising Consultants Ltd., 915 Carlton Tower, 2 Carlton Street, Toronto 2 — Telephone (416) 364 2269.

*Also subscription agents.

Printed in Great Britain by Index Printers Ltd., Oldhill, Dunstable, and typeset by Legendary Characters, South Street, Lancing, for the proprietors, Business Press International, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. *Wireless World* can be obtained abroad from the following: AUSTRALIA and NEW ZEALAND: Gordon & Gotch Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service Ltd., Gordon & Gotch Ltd. SOUTH AFRICA: Central News Agency Ltd: Willian Dawson & Sons (S.A.) Ltd. UNITED STATES: Eastern News Distribution Inc., 14th Floor, 111 Eighth Avenue, New York, N.Y. 10011.

LANGREX SUPPLIES LTD

RST Climax House, Fallsbrook Rd., Streatham, London SW16 6ED **RST**

Tel: 01-677 2424 Telex: 946708

SEMICONDUCTORS

AA119	0.10
AAY30	0.17
AAY30	0.17
AAZ13	0.15
AAZ15	0.15
AAZ17	0.15
AC107	0.55
AC125	0.25
AC126	0.25
AC127	0.25
AC128	0.30
AC141	0.28
AC141K	0.35
AC142	0.28
AC142K	0.35
AC176	0.30
AC187	0.28
AC188	0.28
ACY17	1.30
ACY18	1.15
ACY19	1.10
ACY20	1.10
ACY21	1.15
ACY39	2.50
AD149	0.75
AD161	0.35
AD162	0.35
AF106	0.75
AF114	0.75
AF115	0.75
AF116	0.75
AF117	0.75
AF139	0.33
AF186	1.00
AF239	0.39
AFZ11	4.00
AFZ12	4.00
ASY26	1.40
ASY27	0.90

ASZ15	1.20
ASZ16	1.10
ASZ17	1.00
ASZ20	2.30
ASZ21	2.50
AU113	2.50
AUY10	3.00
BA145	0.13
BA148	0.15
BA154	0.10
BA155	0.11
BA156	0.10
BAW62	0.05
BAX13	0.06
BAX16	0.06
BC107	0.16
BC108	0.16
BC109	0.16
BC113	0.15
BC114	0.15
BC115	0.18
BC116	0.19
BC117	0.23
BC118	0.18
BC125	0.18
BC126	0.18
BC135	0.15
BC136	0.19
BC137	0.19
BC147	0.12
BC148	0.12
BC149	0.13
BC157	0.13
BC158	0.13
BC159	0.13
BC167	0.11
BC170	0.11
BC171	0.11
BC172	0.11

BC173	0.11
BC177	0.28
BC178	0.28
BC179	0.28
BC182	0.11
BC183	0.11
BC184	0.11
BC212	0.11
BC213	0.11
BC214	0.11
BC237	0.11
BC238	0.11
BC301	0.33
BC303	0.34
BC307	0.11
BC308	0.11
BC327	0.12
BC328	0.12
BC337	0.12
BC338	0.12
BCY30	1.25
BCY31	1.50
BCY32	1.50
BCY33	1.10
BCY34	1.00
BCY39	3.40
BCY40	2.80
BCY42	0.30
BCY43	0.30
BCY58	0.19
BCY70	0.17
BCY71	0.18
BCY72	0.17
BCZ11	1.75
BD115	0.42
BD121	1.70
BD123	2.80
BD124	2.00
BD131	0.44

BD132	0.48
BD135	0.40
BD136	0.40
BD137	0.40
BD138	0.48
BD139	0.48
BD140	0.50
BD144	2.00
BD181	1.20
BD183	0.80
BD2137	0.54
BD238	0.54
BDX10	0.91
BDX32	2.00
BDY20	1.50
BDY60	2.75
BF115	0.35
BF152	0.16
BF153	0.16
BF154	0.17
BF159	0.17
BF160	0.17
BF167	0.24
BF173	0.30
BF177	0.35
BF178	0.35
BF179	0.35
BF180	0.28
BF181	0.28
BF182	0.30
BF183	0.28
BF184	0.28
BF185	0.30
BF194	0.14
BF195	0.12
BF196	0.13
BF197	0.14
BF200	0.40
BF224	0.25
BF244	0.28

BF257	0.27
BF258	0.27
BF259	0.28
BF336	0.34
BF337	0.33
BF338	0.36
BFS21	4.00
BFS28	2.25
BFS61	0.20
BFS98	0.20
BFW10	0.97
BFW11	0.96
BFX84	0.30
BFX85	0.30
BFX87	0.30
BFX88	0.30
BFY50	0.25
BFY51	0.25
BFY52	0.25
BFY64	0.30
BFY90	0.95
BSX19	0.27
BSX20	0.27
BSX21	0.29
BT106	1.20
BTY79/400R	2.00
BU205	1.30
BU206	1.50
BU208	2.00
BY100	0.40
BY126	0.13
BY127	0.14
BZX61	0.17
Series	
BZY88	0.10
Series	
CRS1/40	0.60
CRS3/40	0.75
CRS3/60	0.90
GEX66	3.00

GEX541	5.00
GJ3M	1.50
GM0378A	1.75
KS100A	0.45
MJE340	0.60
MJE370	0.73
MJE371	0.71
MJE520	0.47
MJE521	0.73
MJE2955	1.30
MJE3055	1.10
MPF102	0.35
MPF103	0.35
MPF104	0.35
MPF105	0.35
MPSA06	0.26
MPSA56	0.28
MPSU01	0.53
MPSU06	0.65
MPSU56	0.69
NE555	0.45
NKT401	3.50
NKT403	2.50
NKT404	2.20
OA5	1.20
OA7	0.60
OA10	0.55
OA47	0.12
OA70	0.25
OA79	0.12
OA81	0.17
OA85	0.17
OA90	0.08
OA91	0.08
OA95	0.08
OA200	0.15
OA202	0.15
OA211	1.50
OAZ200	1.50
OAZ201	1.50
OAZ206	1.50

OAZ207	1.50
OC16	2.50
OC20	2.50
OC22	2.50
OC23	4.00
OC24	3.00
OC25	1.00
OC26	1.50
OC28	2.00
OC29	2.00
OC35	1.50
OC36	1.50
OC41	0.90
OC42	0.90
OC43	1.50
OC44	0.85
OC45	0.65
OC71	0.55
OC72	1.00
OC73	1.00
OC74	0.70
OC75	0.65
OC76	1.00
OC77	1.00
OC81	0.65
OC81Z	1.20
OC82	0.90
OC83	1.00
OC84	0.80
OC122	2.75
OC123	2.00
OC139	3.00
OC140	4.00
OC141	4.25
OC170	1.25
OC171	1.25
OC200	1.50
OC201	2.50
OC202	2.75
OC203	3.00
OC204	3.00

OC205	2.75
OC206	2.75
OC207	2.50
OCP71	2.00
ORP12	1.00
R2008B	2.00
R2009	2.25
R2010B	2.00
TIC44	0.27
TIC226D	1.20
TIL209	0.16
TIP29A	0.43
TIP30A	0.45
TIP31A	0.33
TIP32A	0.36
TIP33A	0.54
TIP34A	0.67
TIP41A	0.44
TIP42A	0.42
TIP2955	0.70
TIP3055	0.56
TIS43	0.43
ZS140	0.25
ZS170	0.21
ZS178	0.54
ZS271	0.23
ZS278	0.57
ZTX107	0.12
ZTX108	0.12
ZTX109	0.12
ZTX300	0.13
ZTX301	0.14
ZTX302	0.18
ZTX303	0.18
ZTX304	0.20
ZTX311	0.13
ZTX314	0.25
ZTX500	0.14
ZTX501	0.14
ZTX502	0.18
ZTX503	0.19

ZTX504	0.21
ZTX531	0.24
ZTX550	0.25
1N914	0.05
1N916	0.09
1N4001	0.06
1N4002	0.06
1N4003	0.06
1N4004	0.07
1N4005	0.09
1N4006	0.11
1N4007	0.12
1N4009	0.07
1N4148	0.04
1N5400	0.13
1N5401	0.13
1S44	0.04
1S920	0.08
1S921	0.09
2G301	1.00
2G302	1.00
2G306	1.00
2N404	1.30
2N696	0.32
2N697	0.32
2N698	0.32
2N705	1.25
2N706	0.25
2N708	0.25
2N930	0.25
2N1131	0.30
2N1132	0.30
2N1302	1.20
2N1303	0.80
2N1304	1.20
2N1305	1.00
2N1306	1.50
2N1307	1.10
2N1308	1.75
2N1309	1.20
2N1613	0.32

2N1671	5.00
2N1893	0.32
2N2147	4.00
2N2148	3.75
2N2218	0.32
2N2219	0.32
2N2220	0.20
2N2221	0.20
2N2222	0.20
2N2223	4.25
2N2368	0.25
2N2369A	0.25
2N2484	0.25
2N2646	0.50
2N2904	0.32
2N2905	0.32
2N2906	0.21
2N2907	0.21
2N2924	0.26
2N2925	0.22
2N2926	0.15
2N3053	0.26
2N3054	0.55
2N3055	0.65
2N3440	0.70
2N3441	0.85
2N3442	1.25
2N3614	2.20
2N3702	0.11
2N3703	0.11
2N3704	0.11
2N3705	0.11
2N3706	0.11
2N3707	0.11
2N3708	0.10
2N3709	0.11
2N3710	0.10
2N3711	0.10
2N3771	1.40
2N3772	1.60
2N3773	1.80

2N3819	0.30
2N3820	0.39
2N3823	0.60
2N3866	1.00
2N3904	0.17
2N3905	0.17
2N3906	0.17
2N4058	0.20
2N4059	0.20
2N4060	0.16
2N4061	0.16
2N4062	0.16
2N4124	0.16
2N4126	0.16
2N4286	0.15
2N4288	0.18
2N4289	0.18
2N4400	0.11
2N4401	0.11
2N4402	0.11
2N5457	0.32
2N5458	0.32
2N5459	0.32
2S017	10.00
2S019	12.00
2S026	25.00
2S103	1.50
2S302	2.00
2S303	1.50
2S322	3.50
2S324	3.50
2S701	2.00
2S745A	0.95
2S746A	0.95

CV Devices
Large stocks
Prices on
application

VALVES

A1834	9.00
A2087	13.50
A2134	17.50
A2293	16.00
A2426	27.50
A2521	25.00
A2900	15.00
A3343	45.00
AZ31	2.75
AZ41	2.60
BK448	114.90
BK484	155.35
BS90	58.00
BS810	60.00
BT5	58.95
BT17	151.00
BT19	44.05
BT29	349.15
BT69	354.80
BT95	129.90
CBL31	4.00
CL33	4.00
CY31	3.00
C1K	20.00
C3A	22.00
C3JA	22.00
DA41	25.00
DA42	18.70
DAF91	1.75
DAF96	1.75
DET22	35.00
DET24	49.00
DF91	1.75
DF96	1.75
DK91	1.75
DK92	2.00
DK96	1.75
DL92	2.00
DL94	1.75
DL96	1.75
DLS10	14.00
DLS15	12.50
DLS16	12.50
DLS19	12.50
DM70	2.00
DM71	2.00
DM160	4.75
DY87	1.50
DY802	1.50
E55L	45.00
E80CC	8.81
E80CF	11.27
E80F	14.19
E80L	13.73
E81CC	8.00
E81L	13.27
E810F	35.48
E82CC	8.10
E83CC	8.40
E86C	8.25
E88C	8.25
E88C	8.42
E90CC	9.47
E90F	9.90
E91H	6.25
E92CC	8.75
E99F	9.10

E130L	18.50
E180CC	10.50
E180F	10.20
E182CC	13.25
E186F	11.50
E188CC	8.91
E280F	22.51
E283CC	12.00
E288CC	17.50
EA52	126.00
EA76	2.50
EABC80	1.25
EAC91	3.50
EAF42	2.50
EAF801	2.00
EB41	4.00
EB91	1.50
EBC33	2.50
EBC41	2.50
EBC81	1.50
EBC90	1.25
EBF80	1.50
EBF83	1.75
EBF89	1.50
EBL31	10.00
EC90	1.25
EC91	8.00
EC92	1.75
EC157	410.00
ECC33	4.50
ECC35	4.50
ECC40	4.50
ECC81	1.75
ECC82	1.75
ECC83	1.75
ECC84	1.75
ECC85	1.75
ECC86	2.50
ECC88	2.10
ECC89	2.00
ECC91	8.93
ECC189	2.10
ECC807	1.75
ECC808	3.00
ECF80	1.55
ECF82	1.50
ECF86	2.50
ECH35	3.00
ECH42	3.50
ECH81	3.00
ECH83	2.50
ECH84	2.50
ECL80	1.50
ECL81	1.75
ECL82	1.50
ECL83	3.00
ECL84	1.50
ECL85	1.50
ECL86	1.75
EF37A	5.00
EF39	2.75
EF40	5.00
EF41	3.50
EF42	4.50
EF50	2.50
EF54	5.00
EF55	3.50
EF80	1.75
EF83	4.00

EF85	1.75
EF86	3.50
EF89	2.50
EF91	2.95
EF92	6.37
EF93	1.50
EF94	2.50
EF95	5.99
EF98	2.00
EF183	2.00
EF184	2.00
EF804S	12.00
EF805S	15.00
EH90	1.75
EK90	1.50
EL32	2.50
EL33	4.00
EL34MUI	4.00
EL36	2.50
EL41	2.80
EL42	2.50
EL81	5.25
EL83	6.00
EL84	2.25
EL86	2.75
EL90	2.25
EL91	9.69
EL95	2.00
EL156	30.00
EL360	8.50
EL500/504	3.00
EL509	7.00
EL821	13.00
EL822	13.97
EM34	5.00
EM80	2.50
EM81	2.50
EM84	2.00
EM85	2.75
EM87	2.50
EN32	17.46
EN91	6.50
EN92	6.96
EY51	2.75
EY81	2.50
EY83	2.50
EY84	9.24
EY86	1.75
EY88	1.75
EY500A	3.00
EY802	1.75
EZ35	1.75
EZ40	2.50
EZ41	2.50
EZ80	1.50
EZ81	1.50
EZ90	2.00
FW4-500	3.50
FW4-800	3.50
G1.371K	35.00
G551K	12.00
G180.2M	17.50
G240.2D	12.00
G400.1K	17.50
GN4	9.00
GN4A	9.00
GS16	16.00
GT1C	15.00
GU50	20.00

GU51	20.00
GXU1	15.35
GXU2	30.00
GXU3	25.40
GXU4	44.50
GXU50	20.00
GY501	3.00
GZ32	4.00
GZ33	4.75
GZ34	3.00
GZ37	4.75
KT61	5.00
KT66	12.00
KT77 Gold Lion	9.00
KT88	15.00
KTW61	2.50
KTW62	2.50
KTW63	2.50
M8079	12.34
M8080	8.25
M8081	9.82
M8082	9.69
M8083	8.58
M8091	10.43
M8096	6.80
M8097	8.10
M8098	8.15
M8099	8.00
M8100	9.52
M8136	10.23
M8137	10.23
M8140	6.00
M8141	6.50
M8142	8.75
M8144	7.50
M8149	6.50
M8161	9.35
M8162	10.40
M8163	8.25
M8190	5.00
M8195	10.85
M8196	7.50
M8204	7.05
M8212	11.37
M8223	6.00
M8224	6.30
M8225	4.50
M8248	14.03
MD2901	115.00
MU14	2.50
MX119	55.00
MX123	72.00
MX145	56.70
MX151	17.25
MX152	131.25
MX161	152.25
MX163	20.25
MX164	25.52
MX166	147.00
MX168	50.00
N78	15.00
OA2	3.25
OA3	2.50
OA4	6.00
OB2	4.35
OB3	2.50
OC2	4.35
OC3	2.50

OD3	2.50
OZ4	3.50
PC86	2.50
PC88	2.50
PC95	1.75
PC97	1.75
PC900	1.75
PCC84	1.50
PCC85	1.50
PCC88	2.00
PCC89	1.75
PCC189	2.50
PCC805	1.60
PCC806	1.60
PCE82	2.00
PCF80	2.00
PCF82	1.50
PCF86	2.50
PCF87	2.00
PCF200	3.25
PCF201	3.25
PCF801	2.50
PCF802	2.50
PCF805	1.70
PCF806	1.70
PCF808	1.70
PCL82	2.00
PCL83	3.00
PCL84	2.00
PCL85	2.50
PCL86	2.50
PCL805/85	2.50
PD500	6.00
PE06-40N	45.00
PFL200	2.50
PL36	2.50
PL81	1.75
PL81A	2.00
PL82	1.50
PL83	2.50
PL84	2.00
PL504/5	2.50
PL508	2.50
PL509	6.00
PL519	6.00
PL801	1.50
PL802	6.00
PY33	2.50
PY81	1.50
PY82	1.50
PY83	2.50
PY88	2.00
PY500A	4.00
PY800	1.50
PY801	1.50
QF451	82.50
QQV02-6	31.80
QQV03-10	23.50
QQV03-20A	48.38
QQV06-40A	75.00
QQV07-50	69.74
QQZ06-40A	75.00
QU37	12.50
QV03-12	6.80
QV04-7	3.50
QV08-100	171.20

QY3-65	63.24
QY3-125	68.64
QY4-250	70.14
QY4-400	76.20
QY5-500	190.00
QY5-3000A	450.00
QZ06-20	32.70
R10	6.00
R17	3.00
R18	3.00
R19	9.24
R20	2.50
RG3-250	32.68
RG3-250A	32.68
RG3-1250	59.50
RG4-1250	61.60
RG4-3000	99.45
RR3-250	40.00
RR3-1250	45.75
S11E12	65.00
S130	6.00
S130P	6.00
STV280-40	14.00
STV280-80	21.00
SU41	5.00
SU42	10.00
TD03-10	35.00
TD03-10F	35.00
TT15	50.00
TT21	30.00
TT22	37.50
TT100	60.00
TY2-125	65.00
TY4-400	80.00
TY4-500	105.00
TY5-500	214.00
TY6-800	210.00
TY6-5000A	490.00
TY6-5000B	395.00
TY6-5000W	425.00
TY7-6000A	525.00
TY7-6000W	525.00
TZ40	25.00
U18-20	3.50
U19	13.75
U25	2.50
U26	2.50
U37	12.00
UABC80	1.25
UAF42	2.50
UB41	3.00
UBC41	2.25
UBF89	1.50
UCC84	1.75
UCC85	1.85
UCF80	2.00
UCH42	2.50
UCH81	2.50
UCL82	1.75
UCL83	2.75

UF41	2.00
UF42	2.10
UF80	1.75
UF85	1.75
UF89	2.00
UL41	5.00
UL84	1.75
UM80	2.00
UY41	2.25
UY85	2.25
VLS631	15.00
XG1-2500	55.00
XG2-6400	141.90
XG5-500	26.60
XG2-6400	162.00
XR1-1600A	53.75
XR1-3200	81.97
XR1-3200A	
XR1-6400	165.00
YD1120	395.00
YD1240	490.00
Z759	25.00
ZM1000	8.00
ZM1001	8.00
ZM1020	9.00
ZM1021	9.00
ZM1022	9.00
ZM1023	9.00
ZM1040	19.36
ZM1041	16.66
ZM1042	17.77
1B3GT	3.00
1B24	25.00
1B35A	48.00
1B63	64.00
1R5	1.75
1S5	1.75
1T4	1.75
2AS15	11.50
2C39A	60.00
2C43	70.00
2D21	3.25
2E26	8.25
2J42	98.00
2J55	175.00
2J70A	383.00
2J70B	336.00
2K25	125.00
3-400Z	85.00
3-500Z	85.00
3A5	3.00
3B24	11.00
3B28	15.35
3B29	20.05
3B240M	17.50
3B241M	17.50
3C23	25.00
3C45	24.50
3CX100A5	47.00
3E29	45.00
3S4	2.00
3V4	1.75
465A	60.00
4-125A	60.00

4-250A	80.00
4-400A	87.00
4B32	20.00
4C35	78.00
4CX250B	45.00
4CX350A	80.00
4X150A	60.00
4X150D	56.00
5B254M	35.00
5B255M	35.00
5C22	160.00
5J180E	1650.00
5R4GY	3.50
5U4G	3.00
5U4GB	2.50
5V4G	2.50
5Y3GT	2.50
5Z3	4.00
5Z4G	2.50
5Z4GT	2.50
6-30L2	1.75
6AB4	1.75
6AB7	3.00
6AC7	3.00
6AF4A	4.25
6AG7	3.00
6AH6	5.00
6AK5	5.99
6AK6	2.50
6AL5	1.50
6AM4	4.00
6AM5	9.69
6AM6	6.02
6AN5	4.75
6AN8A	3.50
6AQ5	2.25
6AS6	8.66
6AS7G	8.75
6AT6	1.25
6AU5GT	5.00
6AU6	2.50
6AV5GA	4.50
6AV6	1.50
6AX5GT	3.00
6B7	3.25
6B8	3.25
6BA6	1.50
6BA7	5.00
6BA8A	4.00
6BC4	4.00
6BE6	1.50
6BH6	2.50
6BJ6	2.25
6BK4	4.50
6BL6	85.00
6BL7GT	4.50
6BM6	115.00
6BN6	2.00
6BQ7A	3.50
6BR7	6.00
6BR8A	3.50
6BS7	6.00
6BW6	6.00
6BW7	1.50
6BX7GT	5.00
6BZ6	2.75
6C4	1.25
6CB6A	2.50
6CD6GA	5.00

6CG7	2.50
6CH6	13.00
6CL6	3.75
6CW4	8.00
6D2	1.50
6DK6	3.00
6DQ6B	4.75
6EA8	3.00
6EB8	2.50
6EW6	2.25
6F6	3.00
6F23	1.60
6F28	1.60
6F33	33.50
6H1	14.00
6H2N	2.75
6H3N	2.75
6H6	3.00
6J4	5.50
6J6	8.93
6J7	4.75
6K4N	2.50
6K6GT	2.75
6K7	3.00
6K8	3.00
6KD6	7.00
6L6G	3.00
6L6GA	3.00
6L6GC	3.50
6L6GT	3.00
6L7	2.50
6N2P	2.50
6N3P	2.50
6N7	3.00
6P25	4.00
6Q7	3.75
6R7	3.25
6SA7	3.00
6SC7	2.75
6SF7	2.50
6SH7	3.00
6SJ7	3.25
6SK7	3.50
6SK7GT	3.00
6SN7GT	3.00
6SQ7	3.40
6SR7	4.00
6SS7	2.75
6U5G	3.50
6U8A	2.25
6V6GT	2.25
6X4	2.00
6X5GT	1.75
7B7	2.50
7C5	4.00
7C6	2.50
7H7	4.00
7R7	4.25
7S7	3.50
7Y4	2.25
7Z4	2.00
11E3	55.00
12AH8	5.00
12AT6	1.50
12AT7	1.75
12AU6	2.50
12AU7	1.75
12AV6	2.50
12AV7	3.50

12AX7	1.75
12AY7A	4.00
12B4A	3.50
12BA6	2.50
12BE6	2.50
12BH7	2.75
12BY7	3.00
12E1	20.00
12E11TT	28.00
12E14	65.00
13E1	170.00
19H4	27.50
19H5	47.50
24B9	67.25
30C15	2.00
30C17	2.00
30C18	2.00
30F5	1.60
30FL1/2	1.38
30FL12	1.80
30FL14	2.00
30L1	1.50
30L15	2.00
30L17	2.00
30P4	2.50
30P19	2.50
30PL1	3.00
30PL14	1.80
30PL15	1.80
35W4	1.00
50C5	1.50
75B1	6.05
75C1	4.50
85A1	7.50
85A2	6.45
90AG	12.96
90AV	12.96
90C1	6.00
90CG	14.54
90CV	15.45
92AG	20.00
92AV	20.00
95A1	8.45
150B2	6.50
150B3	8.35
150C2	3.25
150C4	6.00
211	35.00
723AB	125.00
803	25.00
805	45.00
807	3.75
811A	18.33
812A	29.50
813	125.86
833A	193.16
866A	20.03
872A	20.00
922	6.00
931A	18.50
1624	4.00
1625	3.50
2050	7.50
4212E	300.00
4212H	300.00
5544	81.97
5545	165.00
5551A	114.90
5552A	155.35

5642	9.00
5654	3.00
5651	4.45
5670	4.50
5675	28.00
5687	6.00
5696	4.50
5718	7.50
5725	5.50
5726	11.37
5727	7.05
5749	2.50
5751	4.00
5763	4.50
5814A	4.00
5840	4.00
5842	12.00
5876A	31.50
5879	5.00
5886	17.50
5963	2.50
5965	3.50
6005	2.25
6021	4.50
6057	10.23
6058	12.34
6059	6.00
6061	6.00
6063	3.75
6064	8.58
6067	10.23
6072	6.00
6080	14.00
6097A	235.00
6097B	200.00
6146A	8.25
6146B	8.25
6159B	19.00
6189	9.50
6201	11.40
6442	20.00
6883B	8.25
6973	4.00
7025	3.00
7551	6.25
7586	12.00
7587	18.50
7609	56.00
7868	6.00
7895	12.00
8005	110.49
8068	14.00
8122	90.00
8136	2.50
8417	6.00
18042	11.53
18045	10.49

Tested
Ex-Equipment
4CX250B 6.50
CV Devices
Large stocks
Prices on
application

BASES

B7G unskirted	0.25
B7G skirted	0.35
B9A unskirted	0.25
B9A skirted	0.35
Int Octal	0.35
Loctal	0.55
Nuvistor base	2.00
8 pin DIL Texas	0.10
14 pin DIL Texas	0.10
16 pin DIL Texas	0.10
Valve screening cans all sizes	0.40

CRTs

2AP1	8.50
2BP1	9.00
3BP1	12.00
3DP1	5.00
3EG1	10.00
3FP7	6.00
3GP1	6.00
3JP1	8.00
3JP2	8.00
3JP7	10.00
3KP1	15.00
3RP1	35.00
3WP1	20.00

5ADP1	55.00
5CP1	10.00
5CP1A	40.00
5FP15A	15.00
5UP7	25.00
DG7-5	63.32
DG7-31	58.07
DG7-32	58.07
DG7-36	65.00
DH3-91	56.83
DH7-11	113.12
VCR97	12.00
VCR138	12.00
VCR138A	12.50
VCR139A	8.00

VCR517B	10.00
VCR517C	10.00

Tube Bases
Prices on
application

INTEGRATED CIRCUITS

7400	0.16
7401	0.17
7402	0.17
7403	0.17
7404	0.18
7405	0.18
7406	0.43
7407	0.43
7408	0.20
7409	0.20
7410	0.17
7412	0.29
7413	0.32
7416	0.32
7417	0.32
7420	0.18
7422	0.20

7423	0.33
7425	0.30
7427	0.30
7428	0.43
7430	0.17
7432	0.30
7433	0.40
7437	0.32
7438	0.32
7440	0.32
7441	0.90
7442	0.72
7447AN	1.17
7450	0.18
7451	0.18
7453	0.18
7454	0.18

7460	0.18
7470	0.38
7472	0.33
7473	0.38
7474	0.38
7475	0.54
7476	0.42
7480	0.56
7482	0.75
7483	1.00
7484	1.05
7486	0.39
7490	0.60
7491	0.82
7492	0.60
7493	0.60
7494	0.82

7495	0.73
7496	0.82
7497	3.15
74100	1.54
74107	0.45
74109	0.73
74110	0.51
74111	0.71
74116	1.85
74118	1.00
74119	1.54
74120	0.83
74121	0.43
74122	0.62
74123	1.18
74125	0.58
74126	0.58
74128	0.63
74132	0.72

74136	0.51
74141	0.89
74142	2.30
74143	2.60
74144	2.60
74145	1.00
74147	2.00
74148	1.76
74150	1.80
74151	0.94
74154	1.80
74155	0.90
74156	0.90
74157	0.75
74159	2.20
74170	2.40
74172	4.40
74173	1.42
74174	1.60

74175	1.02
74176	1.16
74178	1.36
74179	1.36
74180	1.20
74190	1.90
74191	1.90
74192	1.90
74193	1.90
74194	1.25
74195	1.20
74196	1.35
74197	1.35
74198	2.70
74199	2.30
TAA570	2.30
TAA630S	3.50
TAA700	3.90
TBA480Q	1.84

TBA520Q	2.30
TBA530	1.98
TBA540Q	2.30
TBA550Q	3.22
TBA560CQ	3.22
TBA673	2.20
TBA700	1.52
TBA720Q	2.30
TBA750Q	2.07
TBA800	1.20
TBA920	2.90
TBA920Q	2.90
TBA990Q	2.90
TCA270Q	2.90
TCA760A	1.38

Terms of business: CWO. Postage and packing valves and semiconductors 50p per order. CRTs £1.50. Prices excluding VAT, add 15%. Price ruling at time of despatch.
In some cases prices of Mullard and USA valves will be higher than those advertised. Prices correct when going to press.
Account facilities available to approved companies with minimum order charge £10. Carriage and packing £1.50 on credit orders.
Over 10,000 types of valves, tubes and semiconductors in stock. Quotations for any types not listed. S.A.E.

Telephone 01-677 2424/7
Telex 946708
E. & O.E.
Open to callers Monday-Friday 9 a.m.-5 p.m.

WW-11

CIRCLE 2 FOR FURTHER INFORMATION

DATAMAN ORIGINALS...

EPROM PROGRAMMERS

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's takes 2 minutes, NORMAL programming takes 14. All possible levels of Vpp are covered including 25, 21 and 12.5 volts. G8 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

SOFTY 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-OFFSETS 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, ROMULATOR-cable with 24 pin DIL Plug and power supply included, ready to plug-in and use **£195**
2764 and 27128 ADAPTOR lets SOFTY 2 handle larger EPROMS for **£25.00**

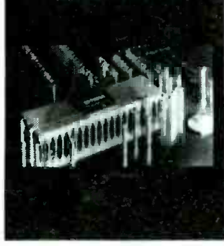
Z80 DEVELOPMENT TOOLS

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 flylead and power-supply costs **£99**

MICROSYSTEM TESTERS

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 or 8085 mnemonics.
When your SCOPE or MULTIMETER can't find the problem — consult the MD. When you order say which processor or ask about 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.
MT72017 chip prices: **£12.50** (1 to 99) **£11.25** (100-999) **£10.25** (1000 up). **We do not sell samples of the MT72017 without a controller.**

LOGIC ANALYSERS

CP/M COMPUTERS

OLIVETTI INTERFACES

LOGIC ANALYSER TA2080 by THANDAR with SPECIAL MODS by DATAMAN 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 QX10, HX20 and PX8, PC8800. 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, HPIB (IEEE) and PARALLEL including fitting.................. **£195**
EPROM ERASERS from.. **£39.00**

If you need more data send for a FREE LIT-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. TELEX: 418442. PHONE (0305) 68066.**

CIRCLE 3 FOR FURTHER INFORMATION