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Circle 3 for further details.

www.americanradiohistory.com
Waveform analysis at low cost

The new DTS12T low cost Digital Storage Oscilloscope from Farnell provides ‘listen’ and ‘talk’ IEEE488 bus operation, will interface with the user port on a BBC model B microcomputer, and specially written software provides powerful routines for r.m.s. calculations and spectral analysis using the Fast Fourier Transform.
Who should market satellite TV in Japan?

In October of 1979 a group of the first seven owners of home-constructed satellite earth stations got together and ran a seminar. Those who attended went home to their garage workshops and kitchens and set tables from where the satellite industry of the USA started. Many of the major multi-million pound companies started there in 1979. Now, there are over a million home satellite stations, with sales estimated at four million units this year alone.

The American experience shows that those still in the process of shaping five years ago were the technical people that were in at the start. No doubt there were some fast buck merchants, but their names are well forgotten.

The UK should learn from its transatlantic colleagues in the US, says John Stander of North East Satellite Systems and author of the article starting on page 60, who feels that if satellite TV is to be marketed technically inexperienced the public will receive an inferior result which has, in fact, been the set back for this new technology by several years. "Sales of satellite TV equipment should be made from a small network of qualified technical people with a genuine interest in the technology rather than a group of new, non-technical organizations who do not know a transistor from a London bus."

The market for the uninitiated must wait for the day when he or she knows that the power level is so high that reception is just about possible from an end-end waveguide pointed in roughly the right direction!

HDTV is coming

High definition television is definitely on the way. That was the conclusion reached by Stuart Sansom of Sony Broadcast when he demonstrated his company’s system in October at a meeting of the Royal Television Society and the BSKS. The first broadcasts will come from NHK in Japan, where they intend to begin a direct broadcast service in 1988.

Enough equipment is available now for the Japanese 1125-line standard to make up a more-or-less complete broadcasting chain. In Sony’s demonstration set-up were a video recorder, a camera, a mixer, a large-screen three-tube projection TV and CRT monitors in sizes up to 28 inches. Equipment also includes standards converters and telecine. Tape-to-tape transfers have become possible through an electron beam recording process developed by Sony. Mr Sansom also revealed that large-screen prototypes of a 1125-line direct video recorder are already in existence.

The picture aspect ratio of Sony’s system is 4:3:3 to 3:2 and the information content about five times that of a conventional 525/60erna NTSC signal. The choice of format was guided by the need for compatibility with the cinema, the picture is much wider than the 4:3 aspect ratio of present day TV broadcasts.

Sony’s system is based on the findings of a project conducted in 1982 by NHK, the Japanese state broadcasting organization. The 1125-line standard was picked as representing a level of resolution beyond which improvements were unlikely to be justified by other practical conditions.

The system is designed so that the large screen was intended for fairly close viewing, at a distance of about half the picture height. Although only a fraction of the eye’s retina had sufficient resolution to take full advantage of the 1125-line picture, it was pointed out that the 35mm cine film was capable of almost all of the details of the frame in the cinema projector; the real resolution never exceeded about 700 lines.

One drawback of the Sony system is the enormous bandwidth needed for its transmission: 20MHz for luminance, 7MHz and 5.5MHz for chrominance. However, Sony has devised a computer system named Muse, which can squeeze the signal into a standard satellite channel and will be used for the forthcoming NHK service.

What about Europe? The CCIR has been meeting in Geneva to discuss a possible world standard. But Mr Sansom believed that agreement was unlikely to be reached quickly and that countries with existing 60Hz systems would probably go ahead with the Japanese standard.

Asked about the issue of compatibility with existing terrestrial TV standards, he told his audience that satellite interests would soon dominate the television medium and that the day of the terrestrial broadcaster was nearly over.

Innov-oicr, an experimental programme made by RAI Milan using Sony h.d.t.v. equipment advantage of the high definition, it had been shown that a larger image was essential for creating an illusion of realism. The field rate of 60Hz, with 21 interface, was found adequate to overcome the flacker associated with large high-brightness pictures.

Recordings shown by Mr Sansom included a demonstration tape from NHK featuring excerpts from the opening ceremony of the 1984 Los Angeles Olympic Games, moments from a selection of Japanese varieties shows and some wildlife scenes. Although the recordings were third or fourth generation analog tapes, clarity and colour quality were very striking — even more so than any of the olderancelung extractor nuts was sharply resolved. Line structure on the screen was sharply defined by peering closely at the screen. Also shown was a short film, for experimental production made by Radiotelevisione Italiana using the equipment provided by Sony. The programme, a wordless melodrama entitled Oinico, was shot in the dark at night with the aim of showing any shortcomings of the high contrast pictures showing car headlamps in the dark were clearly seen, and the clarity was unacknowledged, though it was noticeable that actors who were moving in front of light source became transparent for an instant. However, Mr Sansom indicated that later and other problems caused by electronic camera noise could be expected to disappear as solid-state devices took over.

The audience also saw similar experiments in a 35mm film transfer, which made it plain that the 1125-line picture was potentially quite good enough for originating cinema material. The main defect was a characteristic shimmer on movement. This, according to Mr Sansom, was a result of conversion from the 60Hz field rate of the original, and could be reduced by improvements in the process. He mentioned some Canadian research which indicated that the high resolution of which 35mm cine film was capable was never realized because of the unsteadiness of the framer in the cinema projector; the real resolution never exceeded about 700 lines.

The IEE Faraday lectures this year are to be given by British Telecom on the telephone: the intelligent network. Bill Jones, BT’s chief executive of technology, is the senior lecturer and is assisted by the anonymous ‘digital man’. As in previous years the lectures are a travelling road show intending to stimulate interest in engineering amongst young people, supported by the full range of Live demonstrations, audio-visual presentation, film and a number of special effects.

Tel: 0462 5331
Testing centre for lans

Networking Centre is a private company set up to provide, conduct, develop testing and certification for the lower layers of the open systems interconnection model for computer communication through local-area networks. The centre is designed to allow information exchange between computers.

What’s so different about rise?

Along with the production of the Inmos Transputer, and the Acorn Risc Machine (November issue, p.5), there is news of another processor, this time based on the Forth language. Disassociated with the performance of Forth on the usual microprocessors, Alan Winfield of Metaf0r has analysed the frequency of use of the Forth primitives and devised a processor which could execute the instructions directly. These no longer need interpreting into machine code for another processor. Forth is the machine code for the Metaf0r MP16. The result is a superb (6mips) single-board computer. Remarkably, the MP16 has no processor.

Cost-effective BBC designs

Engineering as a tool for eking out the licence money was very much in evidence during this year’s open days at the BBC Designs Department. Several cost-saving designs were on display and some are already being taken up by outside manufacturers. The irony is that as an economy measure under the BBC’s reorganization plans, the department itself is threatened with virtual abolition.

“This project is calibrated in pound scales”, said BBC engineer Robin Caine of the dynamic carrier controller unit for a.m. Radio. Several designs are of another variety. Species but a.m. companions, it seems, can save coins as just as effectively.

The idea is to reduce the modulated output of a transmitter when the modulation depth increases. The new unit, intended to be used with a Marconi B0604 transmitter, produces up to 6dB of radio compression at 100% modulation, plus an accurately-tracking output to control the carrier level. At the receiving end, the signal is expanded by the set’s a.g.c. Some signal-to-noise ratio is lost when the programme is loudest, but at such times a little noise is hardly noticeable.

Although the compressor time-constant in the miter may not match the a.g.c. in the receiver, any imbalance will not be serious because the amount of compressing is small. But the benefits could amount to an 8kW power saving on each 10kW transmitter, or some £10,000 if the process were applied to the whole Radio 2 a.m. network.

Perfect Telecom International Magazine and Aeronautical Services, the new edition replaces the Post Office Handbook for Radio Operators (1975) and has been revised to include the ITU Radio Regulations which became effective in January 1985 as well as other national and International Regulations.


The old 1975 edition of the Post Office Handbook for Radio Operators published by HMSO will soon be unavailable ... a new, revised edition of the Handbook will be published this October.

**HANDBOOK FOR RADIO OPERATORS**

Published by Lloyd’s of London Press for British Telecom International Magazine and Aeronautical Services, the new edition replaces the Post Office Handbook for Radio Operators (1975) and has been revised to include the ITU Radio Regulations which became effective in January 1985 as well as other national and International Regulations.

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Selling the spectrum

The radio spectrum pricing study carried out on behalf of the Department of Trade and Industry (DTI) by CSP International is believed to have come out strongly in favour of a deregulated, “free-market” approach while the right to transmit in bands of frequencies would be bought and sold, leased and open to all comers prepared to pay the going price.

Such a policy, if implemented, would clearly have profound effects on virtually all British users of the radio spectrum, including the operators of fixed (point-to-point) terrestrial links, land-mobile radio, broadcasting, defense and possibly even maritime and aeronautical communications and navigation.

Meanwhile, on an only slightly less radical approach – a free-market in “renting” system – retaining the power to dispose licenses in bands of the kind of “honor” approach that is being strongly advocated by David Rudd, a Director of the Science Policy Unit at the Department of Transport. At an IET conference, held on October 2, he argued that the introduction of the price mechanism would encourage users to reduce their demands for more spectrum by encouraging new technology and time-sharing, by reducing the cost of congested parts of the spectrum, by encouraging other uses of land ’lines’ and ‘cable rather than radio, and by encouraging more applications out of the market causing users to abandon radio systems and discouraging others from starting operation.

Factors determining the present value of said would include bandwidth required, position in the market, effective power, geographical location and direction of fixed links and the terms of the agreement. He insisted the market-price of rentals would be subject to negotiation and published and that the main users of the spectrum – defence and broadcasting – should be included in the free-market system. International frequency agreements would need to be maintained only in as far as they affected international operation; he did not appear to have taken into account all the many problems involved, for example, in operating communications transmitters in bands in which the prime users remain the principal channel. The increasing number of broadcasters, not only the long term consequence of falling frequency bands, lead to the obvious table with the number of countries of the Region 1. Similarly, David Rudd, like the 1962 Marriner Commission, largely ignore the possible influence of the more spectrum-efficient 900MHz cellular radio systems and the increasing feasibility of 5GHz a.s.h gigahertz on the future demand for land-mobile spectrum. Indeed he discounted cellular radio as a “Rolls-Royce approach to something that is not useful and expensive.”

Broadcasters and likely are not surprised by his belief that, even in the loss of Bands 1 and 3, they still have more spectrum than they really need for a four-channel national u.h.f. coverage. The broad banders have repeatedly shown that they really require more than the existing 48 MHz allocated to the service. It is only recently that the BBC has decided to charge free market rates and that the IBA would protest if the BBC alone were exempt. In practice, both organizations currently each pay about E1 million annually for their transmitting licences, though this was not made clear by David Rudd.

Only radioastronomers and radio amateurs, he suggested, were likely to be exempted from spectrum renting. His arguments might have been more convincing had there been more evidence that the Department, in fact, has a practical as well as a theoretical knowledge of the many problems of national and international spectrum management.

Selling the spectrum could be the first attempt to ahress electronic waves to revenue collection since the notorious Window Tax was imposed in 1691 and not finally repealed until 1836!

All at sea

The post-war development of weapons systems has often appeared to the interested outsider – as a long series of abandoned, hopelessly delayed or under-budget projects. Only the occasional successes have been heeded by all concerned, but the effort to capture export markets, the many failures tend to get buried under a salinity cloud.

It is only recently that the saga of the torpedo development has entered the public domain. As a result the Royal Navy, its weapons establishments, MoD procurement and the contractors have had to endure public criticism. In his most recent presidential address to the lRMA Sir Lindsay Byford made no attempt to duck the issue. “All at sea” was aptly used for his breccy assessment of the minutes and phases of post-war development work on airborne radar and submarine sonars of which in 1982 led to the loss of HMS Sheffield; torpedo control and the controversial long- range design failure of the Duke-class frigates. He could have mentioned, but didn’t, the problems of a new radar system, now supplied by the Société Francaise Radiotechnique (not “Radioastronomers” as a mistaken, unknown word in 1983). He recalls that the unfortunate ship had to be taken out of service for a time after a disastrous test run, owing to abnormal vibrations due to badly designed propellers. The whole project was subsequently removed.

He was also a copy of a page from the Wireless World, as noted by Andrew King. This reported on the obstacle detector tested on the French magnetic compass at the Wireless World of 1939. He recalls that the small radio receiver we had to take out of service for a time after a disappointing test run, owing to abnormal vibrations due to badly designed propellers. The obstacle detector was subsequently removed.

New laser type

A new laser type has been developed in the course of development and initial production contracts to differ from the earlier one, and it is said to have been as well as influences of “Continental” as it was ever and the way that it is to work temporarily for the way of the all the parts of those who will ultimately have to operate the system under such conditions. He noted, with evident regret, that the British Treasury refuses to accept the French demand that “three years of U.S. patent at home, one year of U.S. patent, and ten years of overseas patents are taken into account when a machine that is a project based upon radically new concepts in the
COMMUNICATIONS COMMENTARY

In brief

The first St Albans (Verulam) Christmas Rally to be held on Sunday, December 1 at St Albans City Hall from 11 a.m. to 5:30 p.m. details, St Albans St 99138… Derby Amateur Radio Society, which incorporates the Derby Wireless Club formed in 1911, claims to be the oldest local radio society in the UK.celebrates this 75th anniversary during November, starting off with a reception hosted by the Mayor of Derby at the City Hall on 8 January, 1985 when an amateur station will be established that some time later to contact "Win line" cities throughout the world. The Society is planning at least one anniversary event per month from different locations within the City of Derby using the call sign G3JXRD. …Amateur operation along the South and East coasts continues to be hampered by the Syldias radio-positioning system which is operating on an extensive scale in those shared bands. …The excellent new DT publication "How to improve television and amateur radio reception" and dealing with questions of radio-frequency interference became available without charge from main Post Offices in early October.
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Additional details can be found on the next page.
The sonar system of bats

Mechanical switching of tiny bones in the middle ear may explain the characteristics of bat sonars.

The sonar of bats is extraordinarily efficient and sensitive. According to Griffin, with a target diameter of 1cm and a detection range of 2m, big brown bats (Eptesicus fuscus) discriminate from background noise echoes by very fainter than the sounds they emit. The efficiency index is 2×10^4, which is as much as 10^7 times larger than that of sonars constructed.

*Range divided by mass times power times target diameter.

Fig. 1. Schematic diagram of orientation sounds from the big brown bat (Eptesicus fuscus): (a) turning pursuit of an insect (b), and cruising in on its prey (c). (From Griffin)

Fig. 2. Relation between the orientation sounds and the range of detection on a time scale. Delay time of echo returning from an insect at distance of 4m is 24c, which equals 1.2ms for d = 2m and c = 340ms.
THROWAWAY

REMARKS

I wonder whether any of your readers are suffering the same concern as myself over the present trend towards maintenance-free items, or extended intervals minimum maintenance items which are applicable to modern cars.

It is reported that in-service servicing may become a thing of the past. "When a major fault occurs you simply replace the whole set," (Tyrone magazine, October 1985).

In days, unfortunately, pit, if it is reported that the process of elimination might last a lifetime, use worn-out breaker points which were replaced at the time of the installation.

Recently, an ignition fault in my C.M. was quickly diagnosed by myself, as the "transistloring module" - an encapsulated item manufactured by Dayco, which costs £79.13 and which, according to "C.M. times" magazine, is stocked in quantity by dealers.

Perhaps a reader may be able to provide a replacement in Circuit Ideas.

H. Hardcastle
Windsor
London SW1

SOUND CURRENTS

Spotted yet again: the common fault of a poor connection across a switch, as the result of a poor contact designer. This leads to very large currents flowing as the contacts are made, and hang girds are provided.

It is good practice to use a series resistor of a few ohms, which will prevent failure.

I would refer the reader to a point pointed out in a W.P. of 1958 or elsewhere.

H. B. Finney
Cambridge

A QUESTION ABOUT 'Q'

In the Quarterly Report of the Royal Astronomical Society (1985) 28, I traced the history of Q, but failed to find where it first appeared in literature. I have, however, now a reference to a footnote in the 1980 Scottish Technical Journal (1985) 1279-A, a paper by C.E. Lain, Phase Detection in Telephony, Edinburgh, however Sir Charles Oates tells me that he heard of it being used as the reactive resistance to resistance of a tuned circuit before 1907.

I am wondering whether it can be found in the literature.

H. B. Finney
Cambridge

References

2. What is wrong, V. Burn, and G. Schiffer, Ears adapted for sound. The "invisible" area lies within the range of one another's sound. Yet each bat detects only by itself the echoes of its own sounds.

3. Control physics. B. Durrant, The receiving T2 is the non-receiving T2, the non- receiving T2 is the non-receiving T2- T2, estimated to be 94% for case (a) 91% for case (b) being 46% for case (c). Further, the group of echoes returning from a prey in the range of detection has the pitch frequeny of 1(T2+T1) which may discriminate echoes from click noise, etc., the long-path-echoes and other echoes which fall into the receiving interval. Besides, as generally expected in other animals, biological hearing together with the super directional ears of bats must be conditioned to localize the echoes.

Fig. 3. Illustration of the "sight" of bats using sound waves. The range of detection is limited to within cT2/2.

Fig. 4. Electroacoustic similarities of the bat's echolocation where the ossicles are illustrated as the mechanical switch of the ossicles controlled by the middle ear muscles which synchronize with the transmitter (comprising the larynx and air cell) seems to explain why the detection range of bats is limited. Without this synchronization their own echoes in the absence of an echo from another's sound and an echocentered environment.

In a situation where many hundreds of batson are within the range of one another's sounds. Yet each bat detects only by itself the echoes of its own sounds.

The receiving T2 is the non-receiving T2, the non- receiving T2 is the non-receiving T2, estimated to be 94% for case (a) 91% for case (b) being 46% for case (c). Further, the group of echoes returning from a prey in the range of detection has the pitch frequeny of 1(T2+T1) which may discriminate echoes from click noise, etc., the long-path-echoes and other echoes which fall into the receiving interval. Besides, as generally expected in other animals, biological hearing together with the super directional ears of bats must be conditioned to localize the echoes.
The "Silicon disc" design by J. Adams, published in the October issue, is certainly a good scheme for improving the response time of many flip-flop ICs and reducing their size. However, with the extra configuration memory added, the silicon disc appears to be more efficient. I suspect that these discs are intended to be used with the ICs. Some improvements could certainly be made to the basic idea to increase its efficiency.

As for the relay specifications, I think that the information provided is quite useful. However, I was disappointed to learn that the relay is not available in the USA. I was also interested in the mention of the "BMI system" and its capabilities. I look forward to seeing more information on this subject in the future.

Regarding the author's response to the letter, I was pleased to see that the author took the time to respond to my concerns. I appreciate the author's willingness to provide additional information and clarification. I am looking forward to reading further discussions on this topic in the future.

May I offer a few thoughts on that part of Chris Parton's letter? The pin-to-pin correspondence is excellent, and the correlation between the two is virtually perfect. I believe that the "cage of wire" and the "circle of wire" are both important concepts that must be understood in order to fully appreciate the principles of energy transfer.

It seems to me that the "cage of wire" and the "circle of wire" are both important concepts that must be understood in order to fully appreciate the principles of energy transfer. The "cage of wire" refers to the way in which energy is contained and transferred, while the "circle of wire" represents the cyclical nature of energy transfer. Understanding these concepts is crucial for anyone who wishes to fully grasp the principles of energy transfer.

In conclusion, I feel that the debate over the "cage of wire" and the "circle of wire" is one of the most interesting and important topics in the field of energy transfer. I look forward to seeing more discussions on this subject in the future, and I encourage anyone who is interested in this topic to continue to participate in these discussions.

Thank you for your attention to this letter.
Digital filters explained

The daunting mathematics commonly associated with descriptions of sampled data systems has been largely avoided in this geometrical interpretation of a first-order low-pass filter.

The rapid growth of microelectronics and home computers has made it the characteristic of low-pass, band-pass and high-pass filters can be easily implemented in microcomputer software form. This article describes the behaviour of a simple low-pass digital filter in terms of convolution, impulse response, amplitude and phase response, using only elementary mathematics.

Digital filters have numerous attractions. Weight, size, cost and flexibility favour the digital filter. The response of a digital filter is independent of component tolerances, does not require alignment and is immune to temperature variations. Simply modifying the program changes filter characteristics.

It is possible to achieve results that are impractical using the analogue counterpart.

The implementation

The diagram of Fig. 1 shows how an analogue to digital converter, computer and digital-to-analogue converter may be connected to achieve the necessary signal processing for digital filtering. Filter function is implemented by an algorithm within the computer which converts the sampled sequence into the desired result.

The convolution is performed by the computer which is the equivalent of the convolution of multiplication and summation. The mathematical shorthand is deceptively simple:

\[ y[n] = x[n] * h[n] \]

where \( y[n] \) indicates the operation of convolution. This terse symbolism represents the heart of the mathematical technique applicable to both analogue and digital systems. Fortunately the ELECTRONICS & WIRELESS WORLD DECEMBER 1985

1. Density of pulses X₀, X₁, X₂, X₃, X₄, X₅ of which each is separated from its predecessor by the fixed interval T, the signal processing time. Each sample pulse in turn will stimulate the filter, which responds with a train of weighted output pulses. If the weighting is a filter is long enough, there will still be a vestige of the previous history of weighted outputs, even as the current pulse is being processed, which is why it may expect complications. An input sequence together with a possible impulse response is shown in Fig. 3. Both series of pulses are assumed to start at time \( t = 0 \).

To evaluate \( y[n] \), the output of the system after a conversion, a systematic approach is required. In the Table the rows represent the response to the input sequence \( x₀, x₁, x₂, x₃, x₄ \) respectively.

The columns show the terms present at times \( t₀, t₁, t₂, t₃ \), etc. The response \( y[n] \) is simply the sum of the terms in the nth column. The sums of the five columns are:

The columns show the terms present at times \( t₀, t₁, t₂, t₃ \), etc. The response \( y[n] \) is simply the sum of the terms in the nth column. The sums of the five columns are:

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To find the rest of the terms in the sequence in Fig. 4, continue moving the reversed impulse response to the right until none of the samples of the two sequences overlap. My results,

\[ x_0 = 0.6875 \]
\[ y_0 = 0.875 \]
\[ y_1 = 0.4375 \]
\[ y_2 = 0.1875 \]
\[ y_3 = 0.0625 \]

are plotted in Fig. 5. The exponential nature of the output waveform suggests the digital signal processing is similar to that provided by a simple low-pass analogue filter. Fig. 6 shows the impulse response, the sum of the product of each term in the sequence with the expected frequency and phase response.

If you have time, investigate the effect of the digital filter on the sampled signals shown in Fig. 7.

I hope you found the effect of processing the unit sample is simply the impulse response of the filter h[n]. The impulse response characterizes the behaviour of the filter. Convolution in the time domain corresponds to multiplication in the frequency domain, which is equivalent to multiplying the signal frequency spectrum by the system frequency response, which is the product corresponding to a filtering operation.

The program that implements this particular filter in software, consider the recurrence relationship

\[ y_n = 0.5y_{n-1} - 0.25 \]

where \( y_n \) is the current input sample, \( y_{n-1} \) the current output and \( y_{n-2} \) the previous output. Let’s apply unit input sample \( x_0 = 1 \) and see what happens. Assume that the previous output \( y_{n-2} \) is zero prior to this event; intuitively, this is reasonable since the effect cannot precede the cause.

Again a systematic approach is advisable, the notation used in Table 1 where the current output becomes the previous output and each sample later is a useful way of keeping track of the calculation.

This type of filter is said to have an infinite impulse response; compare with the impulse response shown in Fig. 4, in which the response was

\[ y_n = x_n + 0.5y_{n-1} - 0.25 \]

which means exactly the same as equation 2. This can be transformed into an expression in \( z \) by writing

\[ y(z) = x(z) + 0.5z^{-1}y(z) \]

or

\[ y(z) = 1 + 0.5z^{-1} \]

A unit time delay transforms it to a multiplication by \( z^{-1} \) in the \( z \)-domain. Conversely, a unit time advance

\[ y(n+1) + 0.5y(n) \]

becomes a multiplication by \( z \) in the \( z \)-domain. Using the \( z \) transform in equation 3:

\[ H(z) = 1 + 0.5z^{-1} \]

When rearranged and expressed as the ratio of \( y(z)/x(z) \) the expression is the transfer function.

Calling the transfer function \( H(z) \), we write

\[ H(z) = \frac{1}{2}z^{-1} \]

The zeros are the terms in the numerator that make \( H(z) = 0 \), and the poles are the terms in the denominator that make \( H(z) = \infty \), i.e. make \( 6t \) equal to infinity, hence the name pole (imagine a vibrating pole standing on its end). Poles and zeros are critical frequencies at which something happens to the transfer function; as a result of poles and zeros the function changes as \( z \) varies. No real function can have more zeros than poles. For reason of stability the circuit designer must ensure the poles are placed within the unit circle.

These results can be plotted in the \( z \)-plane, where angular frequency is represented as a angle, a rotation of 360° corresponds to the sampling frequency. A numerical example may help: suppose the sampling frequency \( f_s \) (0.0008Hz) then the Nyquist frequency of 0.5Hz is located at the point \( p_0 \) on the unit circle.

To deduce the amplitude of the frequency response without recourse to Fourier transforms simply requires that we calculate \( H(j\omega) \), or in plain English the magnitude of the zero vector divided by the magnitude of the pole vector, for values of frequency from \( 0 \) to \( f_s \) (half the sampling frequency). The net phase response is given by the argument of the zero vector minus the argument of the pole vector.

Using this rule we can produce a reasonable amplitude and phase response relatively painlessly by employing simple geometry, Fig. 10.

Remember that...

Remember that the magnitude and phase response of the filter was obtained by geometrical measurement. Greater precision could be obtained by calculation but the aim here is to keep the mathematics to a minimum.

To become proficient at designing filters you will need to be familiar with the \( z \)-domain, pole zero behaviour, transforming it into a high-pass response.

Calculating a low and high-pass filter would produce a band-pass characteristic, although a greater selectivity could be obtained by making the poles complex. Second-order digital filters have no place in this introductory account; if you wish to pursue this topic the article by J.T.R. Sylvester Bradley would particularly succinct exposition.

References

FIG. 9. Z-plane diagram of the digital equivalent of a low-pass filter.

FIG. 10. As the pole and zero vectors rotate about the unit circle, so the magnitude and phase of the frequency response may be calculated for values of \( \omega T \) = 0, \( \pi/4 \), \( \pi/4 \), etc.
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CIRCLE 79 FOR FURTHER DETAILS.

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CIRCLE 70 FOR FURTHER DETAILS.
Activity indicator
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Motion detector
Motion is usually detected by taking Doppler shift measurements and require two transducers, one for transmitting and one for receiving. This circuit only needs one transducer.

The transducer, forming part of an oscillator, determines oscillating frequency. It also forms part of a bridge circuit. Oscillator feedback voltage is determined by the voltage ratio of R to impedance of the transducer at resonant frequency. As shown, oscillator frequency is between 38 and 42kHz.

Output from the oscillator is rectified by D1 to give a low-frequency signal. Amplitude of signal depends on the distance between the transducer and object.

Transistors T1, further amplify the low-frequency signal before it is rectified and filtered to give a direct voltage.

Reference voltage feeding an op-amp comparator is set to cause switching when the small object, is at a given distance from the transducer. With the prototype, it is possible to detect a person crossing the detector path at 1m.

Alignment is easy, using a digital voltmeter, set point A to show 1V with the bridge potentiometer. Ask someone to move around at the required detection distance and adjust the comparator reference potentiometer accordingly. The set/reset bistable circuit latches output.

R. Punter
Cleethorpes
Lincolnshire

Engine speed indication
Many medium and high capacity motorcycles now have electrical systems fed by a permanent magnet type alternator which produces a.c. This type of alternator produces a.c. energy which is first converted to d.c. by the rectifier and fed to the charging circuit and then to a generator, which powers the alternator and provides the d.c. needed for charging the battery.

The engine speed is indicated by a tachometer which is connected to the alternator and provides a current which is proportional to engine speed.

Using this frequency to drive a counter directly would be unacceptable due to the long delay produced. So using a pulse generator to filter the signal is applied and the output is fed to the tachometer circuit to multiply the input frequency. Having worked out the relationship between the speed and the frequency, it was found that a frequency of 2200 was required for 10,000rpm.

The output of the tachometer is fed to a pulse generator, which is connected to the frequency detector and the output is fed to a timer which is used to control the timer circuit.

Accuracy within 10 rpm was easily obtained by using a timer to control the frequency at which the outputs are fed to the tachometer circuit.

G. V. Whitney
GB5EI
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Rectified alternator supply is smoothed by the battery, so the signal for the pulse counter must be taken before these rectifiers, as shown. The same principle applies to star configuration alternators using six diodes.

The potentiometer on the circuit, which should be a turn type, is used to calibrate the counter. If the cycle produces 50Hz for the 1000rpm, calibration is simple using mains-derived pulses. If not, a pulse generator and frequency counter may be necessary.

Accuracy within 10 rpm was easy to obtain with the prototype. Supply-rail stabilization is needed.

CIRCUIT IDEAS

ELECTRONICS & WIRELESS WORLD DECEMBER 1985

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CIRCLE 83 FOR FURTHER DETAILS.

ELECTRONICS & WIRELESS WORLD DECEMBER 1985
Why have Maxwell's Equations survived for so long?

In November’s article I investigated Maxwell’s Equations, generally regarded as the greatest mathematical achievement in science.*

In the 1830s, Faraday discovered electromagnetic induction, thus closing the loop between electricity and magnetism. This discovery paved the way toward the rapid growth of electricity-based industrialization and the high technology which shapes today’s world.

By making the key discoveries of his era, uneducated technicians like Michael Faraday and James Watt threatened the scholarly myth that all progress, including scientific progress, needs must use the rigour and discipline controlled and celebrated by academics in places like Cambridge and Oxford University.

The ultimate in scientific rigour (major works) was held to be pure mathematics. Before the History and History of Science writings sprouted, even academicians pressed the thesis that, lacking mathematics, Faraday could not and did not really effect his discovery of electromagnetic induction. Rather, he stumbled into it, but it could only be properly exploited decades later, after Professor Maxwell well understood and placed a mathematical structure upon Faraday’s stumbling, unscientific discovery. Thus, according to the Platonic interpretation of history, Professor Maxwell, in his splendour, has revealed the mathematician, paved the way for massive exploitation of electromagneticism in transformers, motors and generators. The deeper hidden message in Maxwell’s Equations is that, do what they will, the local yokels will not replace mathematical academia as the font of knowledge and progress.

In previous article¹ I posed two questions:

- Do Maxwell’s Equations contain any information about the nature of electromagnetism?
- Why do academics and practitioners generally think that Maxwell’s Equations are useful?

I am sure you will have found my answers unsatisfactory. The reason is that they were based on certain assumptions, and failed to dig deeply enough into the underlying motivation, psychoses and myopias within contemporary science.

The underlying battle for the soul of science has polarized between the practical engineer on the one hand and the Platonic pure mathematician on the other.² For his part, the mathematician sees this battle as more important than search after truth or technology-fuelled search after new sources of wealth. For him, the important thing is Form; the purity and beauty of his art. It is his ability to control and manipulate it intellectually. (The protane aspect of this idea is the desire to impose a structure onto any ‘discipline’ such that it is easy to teach and, more importantly, easy to set examination questions on). One FRS told me that physical reality was composed of sine waves, and this encapsulates the mathematician’s attitude to our world.

A good example of an academic with the mathematician’s attitude is Sir James Jeans. He was highly regarded in the 1930s both as a Cambridge academic and as a poet, much like Sir Fred Hoyle in the 1950s. In his book, "The Mysterious Universe", Jeans gives a clear view of the mathematician’s attitude to the world.

"...I was struck by the lack of any significant link between the Higher TEC syllabuses that I taught and the real subject, electronic design..."³

In contrast, the real world mathematician would construe every piece of mechanism as a musical instrument; the habit of thinking of all interesting musical intervals may be so ingrained in him that he would happily make a new down put on equipment that he would use in his fall. This is the same way in which the mathematician can see nothing but cubes in the indescribable richness of nature – and the accident that our percepts shows how far he is from understanding nature; his cobit spectacles are mere blinkers which prevent him seeing more than a minute fraction of the great world around him. So, may be suggested, the mathematician only sees nature through the mathematical blinkers he has fashioned for himself. We may be reminded that Kant, discussing the various modes of perception by which the human mind apprehends nature, concluded that it is specially prone to see nature through mathematical spectacles. Just as a man wearing blue spectacles would see only a blue world, so Kant thought...
MAXWELL'S EQUATIONS

that, with our moral bias, we tend to see only a mathematician's world. Does our argument merely exemplify this bias? I think not. A moment's reflection will show that this can hardly be the whole story. The new mathematical model of the universe does not mean that our whole picture of nature cannot all be in our speculations — in our subjectivity and in our representations, to be protected by the social group which administers that body of knowledge. If only those who lived off a body of knowledge could make that knowledge more secure, their careers and pensions would be protected. Two strategies were open to them:1)

1) to freeze the knowledge base so that it would not be a prey to the ebbs and flows of the real world, and
2) to develop the thesis that any change in or extension of the knowledge base could only be properly effected by the professional 'knowledge magicians', 'knowledge doctors' or 'knowledge brokers', with their special, skilled, occult wits and power to push forward the boundaries of knowledge.2)

We have reached the following point in the argument: Under cover of maintaining standards of scholarship, or to maintain rigour in knowledge, the professional teachers.

Basil Bernstein3) says that a professional knowledge is property, with its own market value and its own arrangements, to be protected by the social group which administers that body of knowledge. James Jeans4) and Einstein could be said to be telling us very worthily that academics have selected a discipline and Einstein could be said to be telling us very worthily that academics have selected a discipline.

Unfortunately, whenever the body of knowledge is bigger and the rate of flow of new knowledge is smaller, more and more of the activity within the knowledge base becomes 'celebration', more and more ceremonial rather than exercise in depth. As a result, a different culture of person is attracted to that large knowledge, having the ability to understand and fend a body of knowledge. They are 'professors' and academics, not 'builders'. The central body of knowledge ossifies, becomes brittle and then disintegrates.3)

We need to realise that the cardboard and the scissors did not need to be competent theologians or scientists. It would of course be less effective for the professional group of knowledge brokers merely to bless or condemn important new developments in knowledge. Admittedly, they do that. All my attempts to publish work on electromagnetic theory and on computer architecture (US patents 3913972 and 4253381) were blocked for more than ten years by learned journal referees, who are by definition knowledge brokers). The knowledge brokers' power would be greater if they required that new knowledge arise in their own prescribed style, preferably devised by one of their members, a knowledge broker of professional standing. An early example of this in my own publications is that under threat of firing by my boss, who was also a Fellow of the IEEE, I was compelled to include a ghastly, recondite, mathematical last section, written by someone else, in my 1967 IEEE paper.4)

The TFR was that physical reality was composed of sine waves, and this encapsulates the mathematician's attitude to our world.5)

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CIRCLE 45 FOR FURTHER DETAILS
Kaycomp's 68000 peripheral interface/timer option adds three eight-bit ports for input and output.

Kaycomp accommodates two 68000 peripheral ICS—an asynchronous receiver/transmitter described elsewhere and an optional peripheral interface/timer. The 68230 provides digital I/O interfacing and a programmable timer, similar to the older 6821, p.i.t., or 6825, v.i.t., but much more powerful. The processor interface is similar to that of the 6811, where there are IRQ and IACK pins, and the clock for the timer is an external input which in Kaycomp is driven from the processor clock. There is also an extra register select line R3, driven by address line A12.

On the peripheral side 28 i/o pins are arranged in three ports of eight lines, P0, P1, P2, and four handshake lines, H1, H2, H3, and H4. All of these lines and the 3V supply are brought out to a 34-way connector, plug five, and are available to the user.

Some port E pins serve either as normal i/o lines or as timer/interrupt control pins, the function being selected under software control. Four of these functions may be used as request output and acknowledge input. The p.i.t. pins are divided into the p.i.t. side of the i/o, where the peripheral timer and peripheral i/o sections of the device. Line P0, as an interface, can be used to generate an interrupt, and P2, timer interrupt-acknowledge input via IAck.

If interrupts are to be used, the i/o side, P2, is set for the peripheral interrupt request output PIRQ and P0 is the peripheral interrupt acknowledge input PAck. These four pins are not connected on the board to any interrupt pin or the IACK signal. If they are to be used, links can be made on P0 as required.

There are certain points to be noted if using interrupts on the p.i.t. First, the IRQ outputs are not open drain but normal mos outputs and so cannot be wired- or with other interrupt sources, such as the duart. This means that the two p.i.t. interrupt sources TOU.T and PIRQ cannot be used together on the same interrupt line. Also, the p.i.t. requires that IACK only goes to the input that has caused the interrupt and not the other one, so only the one being used should be connected.

For the majority of Kaycomp applications these restrictions are not a problem. It is of course possible to use one or both of interrupt lines IP0 and IP1 if they are not being used by the G64 bus. Connections between devices NMI/IPQ and IACK of the processor are wire links instead of p.c.b. tracks to allow the links to be made across the board.

These restrictions on p.i.t. interrupts could not be tolerated on larger systems where it may be essential to have many devices connected to one interrupt level. This means extra arbitration logic, for instance open-collector buffers on the outputs so that they may be wired- or, together.

Rather than increase the complexity and cost of Kaycomp plug six, as well as being a patching area, there are several interrupt signals and the 3V supply brought out to a 34-way connector. This location can be fitted with a 10-WK header plug for connecting to a small separate board which implements the required arbitration logic to give full interrupt facilities. The common signals are also used for the other block.

The duart IRQ output is directly connected to IOP, but there is a small link between the two so that normally running duart can still use a fine soldering iron tip. The easiest ways to use are socket output carriers which consist of individual sockets with no insulator mounted on an aluminium 'dummy' i.c. After soldering, the dummy i.c. is removed, leaving the individual pins in place to form an i.c. socket.

If crystal $X_{20}$ is used to take full advantage of the speed of the board then $IC_{20}$ must be a 74HC700 and C0, C0, R0 and R1 must be fitted. Crystal frequency is chosen to suit your needs and the speed selection of the processor and memories used. At present 68000 microprocessors are available with 4, 4, 10, 15, and 16MHz maximum clock rates. The board was designed to be used with an 8MHz clock, but with a 4MHz clock the clock oscillator will work down to 2MHz. In practice the boards have been found to work up to 10MHz satisfactorily.

The G64 bus connects the two devices will work with any clock speed, as the asynchronous bus transfer technique means that access to these chips will be slowed down to suit them. The 68000 microprocessor must be capable of operating at the appropriate speed, but this is also an access time of devices that may be available at various clock frequencies. Many devices are available and work at 8MHz, 25MHz, 8MHz and 10MHz in full. The Memory 'Y' bus monitor fits into two 2727e eproms, but these are most commonly available with 450ns access times. This is the worst case and in practice, 450ns access times for some of the prototype boards have always worked satisfactorily at 8MHz and the 68000 processor and guaranteed, of course.

If a processor of clock is used the M680230, then $IC_{23}$ must be fitted. A separate should be used here, but the $IC_{24}$ is not very common so it may have to be built up using socket strip or by using the 24-pin sockets mounted end-to-end. A connector for the i/o lines will also be required, being a 10m 34-way straight p.c.b. connector. A 20m 34-way straight p.c.b. connector may be soldered in or soldered.

If your p.c.b. is planned through holes then no type of a good-quality socket may be used. If there are not a few pieces of turned-pin socket type available that allow soldering directly to the board, then use a fine sewing iron tip. The easiest ways to use are socket board designed for the project is used. Using strip board or wire-wrap could prove a false economy and it may not be possible to achieve correct operation due to the high speeds involved on the board. These construction details assume that you are building the fully populated board. After inspecting the board p.c.b., there are three insulated cross-board links which may need to be inserted, one for each of the two 256K 8MHz chips. A Vero KMC66 card front panel may be fitted using the two front mounting holes and a 10m 34-way socket. This special version of the Kymcomp board is available on request which instead of using the on-board ports for terminal and host communication uses a G64 dual serial interface card instead, the Thomson EFS-5101.

All resistor and network values quoted are typical and are not critical, as are all capacitors with the exception of $C_{20}$ and $C_{21}$. $C_{20}$ are provided at each corner for mounting the board if required or, if the board is to be fitted to a standard 6U-high Eurocard rack in this case a Vero KMC66 card front panel may be fitted using the two front mounting holes and a 10m 34-way socket. This special version of the Kymcomp board is available on request which instead of using the on-board ports for terminal and host communication uses a G64 dual serial interface card instead, the Thomson EFS-5101.
capacitors, resistor networks, D3, P4_1 (reset) and the optional crystals come next.

Finally, gating chips IC18, IC19, all digital interface and IC30, IC31, optional bus interface devices IC41, IC42 should be soldered in, completing the board.

If power is derived from the G64 backplane, P2 is not fitted and the power leads are connected in the holes of P2, as follows: 0V to 32a and 32b, +5V to 31a and 31b, +12V to 32a (nearest board edge) and -12V to 30b.

Setting started

Before inserting the expensive Ic's, power up the board to make sure that there are no power-rail short circuits. Connections must be made on links LK1. The first link needs to be configured according to the memory types being used, as shown on the circuit diagram in last month's article. The second and third links may be one of more problems. A you will need to take into account requirements of the terminal to be used.

The Kay bug monitor program will transmit data and receive data lines without handshaking, RTS output being permanently asserted, but the handshaking input and output lines are available. As a minimum requirement, only pins 1a and 3a may be connected. If the terminal receives data on pin three and transmits on pin two, which is the most common, then make links 1a-2b and 3a-3b. If it is the other way round, make 1a-1b and 3a-2b.

Many terminals require some input on either DCD, pin eight, or CTS, pin five. A suitable input is available at pins 3a of the second and third links. It may require some trial and error to get things right. The most common configuration is 1a-2b, 2a-1b and 3a-1b.

Components P2_1-9 are 20-way 0.1in insulation-displacement connector plunges: 25-way D-type connectors are normally used for RS232 interfaces. Pin numbers of P2_1, P1_5, P1_6 correspond to appropriate pin numbers on a D-type connector. If a terminal is made up using ribbon-cable connectors with a 20-way 0.1in insulation displacement connector at one end and a 25-way D-type D.d.o. (male or female to mate with the terminal) at the other, pin one on the 20-way connector coincides with pin one on the 25-way one.

Circuits IC41, IC42, IC43 can now be fitted in their sockets. Make sure the upper and lower byte of programs are in their appropriate sockets.

If a Thomson EFS-S101 card is being used for serial communication instead of the on-board d1urt then this too will have to be configured to suit the terminal and the data rate set as described in the manufacturer's manual.

Address switches on the EFS-S101 card J3 and J4 should be set to F and E respectively so that the board occupies addresses FFFF1h to FFFF7h.

Port P1 is used for the terminal and P2 for the host system if required. With both types of serial interface characters have eight data bits, no parity bit and one stop bit, which the terminal should also be set to.

At switch on, if the EFS-S101 card is being used you should be greeted with a sign-on message and prompt on the terminal if all is well. With the stand-alone board though nothing will happen. Kaycomp's serial interface has no data-rate selection hardware, this function being performed in software. At power-up (or reset) before anything can be sent to the screen, the monitor software must determine the terminal data rate. This is done by the operator hitting the carriage return key repeatedly.

The monitor reads the characters in, stepping through the available rates until the carriage return code is correctly interpreted. It then holds the data rate at that value and sends the sign-on message and prompt to the terminal.

Data rates available with the keybug monitor are 1200, 2400, 4800, 1200, 50, 110, 135, 300, 150, 110 and 75 baud.

The second serial port on Kaycomp works identically to the first and may be used for connection to a host computer. Data rate for this port is set at reset to the same as port A but it is possible to alter this by software if required. On the external serial port, the data rates are set individually by jumpers and so it is possible to set the two ports differently.

Care should be taken if the host port is at a higher rate than the terminal as the host could send a stream of data faster than it could be transmitted to the terminal. Although hardware handshaking is supported by the host, software supports XON/XOFF protocol to suspend output which allows some terminals such as those with smooth scrolling to be used at high rates.

Software for the 68000-board monitor is discussed in the next article.

Events

22 November

Marconi - triumph of a non-technocrat: Royal Institution lecture, Royal Institution, Albermarle Street, London W1. 21h, Tel. 01-493 6470.

25 November

Improving prediction methods for water levels: IEE colloquium.

26 November

The Janet project (networking in universities and colleges): IEE colloquium, 10h.

27-28 November

International test and measurement exhibition Olympia 2, London, Tel. 0208 815226 or 0793 26939.

29 November

Real-time measurements for process control: IEE colloquium, University of Salford, 13h. IEE UK research into robotics and automatic manufacture.

30 November

IFCE/IMEE seminar at Savoy Place.

3 December

Impact of I.C.h.s. on designers: ICCE/IMEE seminar, Savoy Place, 10h.

3 December

International test and measurement exhibition Olympia 2, London. Details From Online, Tel. 01-868 4466.

4 December

Electrical damage in semiconductor devices: IEE one-day meeting at Imperial College, London. Tel. 01-236 4171.

4-5 December

Medical and magnetic fields in medicine and biology: International conference at Savoy Place.

9 December

Automatic test technology for electronic devices and boards: IEE colquium, 14h.

9 December

History of sound broadcasting: Imperial College.

10 December

Propaganda for portable telecommunications equipment: IEE colloquium.

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ELECTRONICS & WIRELESS WORLD DECEMBER 1985

www.americanradiohistory.com
Computer-controlled radio receiver system

Introducing Smarite: simple microcomputer and radio tuning interface equipment that links synthesized receiver with home computer.

by D.W. Harris
B.Sc., F.I.E.E.

Sony's ICFC2001 is typical of the modern generation of domestic radio receivers designed around synthesized oscillators. It covers the m.f. and h.f. bands from 150kHz to 30MHz in 1kHz steps, as well as band II in 100kHz channels from 76 to 108MHz. Its internal tuning, keyboard handling, display circuitry and any other features are handled by a variety of specialized LSI chip resulting in a design which, despite some selectivity and front-end limitations, represents a tremendous achievement in such a small and relatively inexpensive package.

The Sony receiver has been reviewed on various occasions -- ref. 1 reproduces the circuit diagram and so this article does not go into detail on the circuitry. There are 28 keyboard buttons which allow direct entry of frequency, selection of preset channels, scanning limits, fast and slow tuning, and so on. External control of the functions of these buttons allows a broadcasting of applications, enhanced by access to the receiver's a.g.c. line.

The BBC microcomputer is also well-known and has rapidly established itself as a versatile controller thanks to its excellent input-output facilities. Of particular interest to the present application are the four-bit keyboard port, the internal timer and the analogue-to-digital converters. Simple interfacing allows operation of the receiver under program control.

The ICFC2001 keys are scanned through the conventional multiplexing arrangement found in calculators and computers. Eleven individual key lines are switched to one or other of two main bus lines, K3 and K4, Fig. 1, giving 20 combinations. The remaining functions are provided via a third bus-line, K2, or as direct hardware switches.

Analysis shows that only one of the eleven K3/K4 switches may be validly pressed at any one time; it may be necessary to simultaneously press the 'fast' or 'enter' keys for such functions as storing a frequency, memory or rapid scanning. This suggests the use of a 4-to-16 line decoder to control the K3/K4 functions. In the interests of simplicity no other decoding is performed for the remaining bits of the port.

Interface details

Complementary mono4016 quad 2-input NAND gates control the operation of the press buttons. These are controlled either directly from the 6522 port in the BBC micro or via 7440 hex inverters from a 74154 4-to-16 line decoder which is itself operated from the lower four bits of the user port.

An intermediate bus-line, not directly accessible from the computer, allows either K2 or K4 to be connected to any one of the associated 11 lines. The 4016 associated with the K2 switches ('fast' and 'enter') are directly controlled by bits 6 and 7 of the v.i.a. whilst bits 4 and 5 are used for K3 and K4. See Fig. 2 for the circuit diagram.

The receiver's a.g.c. line is brought out separately and in the prototype connected to channel 1 of the computer's analogue-in socket. Threading this line a few times through a small toroid helps reduce r.f. hash picked up by the radio from the computer. Incidentally, it is practically impossible to eliminate such interference; e.g. when sequencing around the memory buttons. A settling time of about one second has been found appropriate in such cases.

Applications

Probably the easiest application is the use of the apparatus for simple chart recording of field strength, which can be performed at whatever sample interval is felt appropriate. In this case although the computer has very little work to do during the recording process, it can be used for subsequent analysis of the data. For example, raw samples could be taken several times per second to allow detailed investigation of fading, but equally useful information could be derived from the same data by smoothing it using a running average (such done with the sample number). This would be difficult to achieve with conventional

Fig. 1. The keyboard-scanning matrix for the Sony ICFC2001 receiver is similar to that found on calculators and computers. Lines K2, K3 and K4 are bus lines from the receiver's microcomputer.

Fig. 2. Circuit diagram of the Smarite interface between the BBC micro user port and the keyboard on the ICFC2001. Type 4016 o-nos switches make the connections and simulate operation of the push buttons.

Typical off-screen photograph is an alternative to the screen dumps of Figs 3 & 4.

References


Program listings in Basic for the applications discussed are obtainable from the editorial office, in return for a stamped and addressed envelope.

Fig. 2. Circuit diagram of the Smarite interface between the BBC micro user port and the keyboard on the ICFC2001. Type 4016 o-nos switches make the connections and simulate operation of the push buttons.

Typical off-screen photograph is an alternative to the screen dumps of Figs 3 & 4.

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ELECTRONICS & WIRELESS WORLD DECEMBER 1985

By R.H. Becker

Designed by Dick Becker and Peter Wells of Cybernetic Applications this desk-top micro robot gives low-cost experience in robotics, and features hydraulic, pneumatic and electric drives.

Unlike stepper motors, a servo motor will attempt to rotate continuously when there is current passing through it and the torque generated depends on that current. Servo control of an axis can be implemented with no more than a position-sensing potentiometer and an error amplifier which derived a d.c. servo motor in that direction and causes the error signal to reduce, Fig. 9. The error signal is the voltage difference between the potentiometer output and the voltage which defines the desired position at which point the error signal is zero, meaning that there is then no more current from the error amplifier to drive the motor.

Although there have recently been some high torque 'Mega-torque' d.c. motors recently introduced, the torque from most motors is too small to operate an axis directly and some reduction gearing is necessary. This gearing presents a few problems. Inevitably gear teeth do not mesh perfectly and sloppiness causes backlash occurs. If the position sensor is fitted to the motor the backlash becomes uncorrected error. If the sensor is fitted to the axis, and the servo system is sensing movement in the backlash, it has to cope with achieving stability whilst there is a varying torque on entering and leaving that region. Harmonic drive gearboxes, having three moving parts, greatly reduce the backlash and are becoming widely used, but having relatively small teeth overload and slipping must be avoided. Also, harmonic drives are still single-sourced and expensive.

By fully appreciate and understand the capabilities of a machine there is nothing to beat 'hands-on' experience. However, most industrial robots are in the price range £15k to £50k and have power and accuracy far in excess of that required for training purposes. Like any other machine tool, industrial robots can be dangerous, particularly in inexperienced hands. Training, at least initially, should be carried out using small, inexpensive machines that perform the same functions as their larger counterparts, albeit at a lower specification, and be sufficient ly forgiving of mistakes to be suitable for experimentation.

The Naidor was designed specifically for the purpose of safely acquiring 'hands-on' experience at low cost. Of the various configurations possible the articulated arm was selected, being the most versatile. The complexity of movement provides plenty of programming challenges and it has the most interesting mechanisms.

Hydraulics, used as energy source for the most powerful industrial machines, was chosen as the main source of energy. To increase its educational value each axis operates in a different manner. There are both single-acting cylinder and double-acting cylinders, a double-ended cylinder, rubber seals, p.t.f.e. seals, and a rolling diaphragm seal. Linear motion

Fig. 9. This very basic control system has a d.c. motor driving the output. The mechanical output is directly coupled to the position feedback potentiometer. Signal from this potentiometer is a direct voltage level dependent on its position. The input to the system, or position demand signal, can be a similar potentiometer, digital-to-analogue converter or anything that provides a d.c. level proportional to position.

Fig. 10. Schematic of Naidor Robot showing the arrangement of the various axes. There are four hydraulic cylinders, one d.c. servo at the wrist pitch axis and the gripper can be pneumatically or hydraulically operated.
Fig. 11. Axis 0, the shoulder rotation cylinder, is a double-acting actuator set between two idler wheels. The connecting rods, which protrude from each end of the cylinder through p.t.f.e. seals, are joined together by a toothed belt. The belt passes over the idler wheels and around a third, larger toothed wheel forming part of the axis 0 rotation assembly.

Fig. 12. Axis 1 is driven by a single acting, rolling diaphragm actuator. Pivot point at the lowest end of the cylinder is actually part of the trunnion assembly. The connecting rod is linked to an axle toward the top end of a channel section. Lower end of channel section is secured to the trunnion by a delrin bush on each side; these are fixed to the channel and are free to rotate in the trunnion. The feedback potentiometer is fixed to a bracket on the trunnion and the shaft is locked into the delrin bush. Potentiometer gives position feedback of the axis 1 channel section.

Fig. 13. Axis 2 is a piston driven by a single-acting piston, Fig. 13. The weight of the arm means that gravity provides the force needed for the return stroke. When the pump is turned, the movement of the piston is reversed, and the robot is driven with the aid of the delrin bush on each side.

Fig. 14. Wrist elevation is achieved using a d.c. servo motor with integral 75:1 gearbox. On its own, this produces insufficient torque to raise the gripper carrying its rated load. Additional gearing of 15:1 is incorporated together with a 90° direction change.

Fig. 15. Wrist rotation cylinder is a double-acting cylinder assembled by four 24 mm diameter 8 mm stroke pistons joined back-to-back by a length of rack in mesh with a pinion whose central shaft protrudes from both sides of the cylinder.
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### NEW VIDEO SPARES

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CIRCLE 81 FOR FURTHER DETAILS.
Satellite television in the band 10.9-11.7 GHz has been called 'Europe's best kept secret'. There is very little published on the subject, so this article aims to answer some of the many questions asked and provide an insight into this new and fast-expanding field.

Currently, transmissions are available from four satellites, ECS1, ECS2,Carousel and Instant 5 (27.5°W). Between them they provide at least 18 different stations. ECS1 would have provided several more, but due to the failure of the last Echo satellite, is due to launch in the near future before the replacement satellite is launched. It is quite legal to receive these transmissions without a licence, which is available on application to the DTT, the fee is £10 for an indefinite period.

11GHz band
The 10.9 to 11.7 GHz band is designated as a Broadcast Service Satellite Band though the transmissions are at Europe's lowest power level than that received from many of its satellites. The original purpose of the transmission was to provide feeds to the cable headends of networks such as Swindon Cable. Signals are received at the main antenna site by large (4 to 5m) dishes and after demodulation distributed via cable to houses connected to the monthly subscription service.

Until recently it was illegal to receive these transmissions without a Test & Development licence, only granted to companies involved in research or antenna manufacture. At the time that the power levels of transmissions in the 11GHz band were decided it was considered financially impossible for the public to receive these broadcasts, as the level of technology at the time required a very large dish at considerable cost. But technology does not stand still and the low-noise amplifiers of today the dish size has been reduced to a point where a small dish in a suburban garden will give very high quality reception.

The size of dish required for above-threshold reception depends on the receiving location. Reference to footprint charts, which give the signal strength contours, a signal strength of ~11dBW/m2 can be achieved in the centre of the spot beam. The beam patterns for ECS2 and Instant indicate that reception is adequate with a 1.6m dish, and signals of 2dB down on the spot centre will require a 2.4m dish, and 6dB down a 3.2m dish. Reception becomes more expensive the further from the UK one gets: in southern Spain a 3m dish is required for ECS.

Antennas
In the USA, which has its own satellite tv for some time, the wire mesh type of parabolic dish is quite common. This is suitable where reception takes place at C-band (10.9-11.7 GHz) in the USA, but this type of dish will not function on the 11GHz band as mesh size must be no larger than 1/10th wavelength.

In the UK a solid aluminum parabolic dish is required to be accurate to ±1.5mm. Three types of mount are used: fixed, 'fixable' and polar. The fixed mount is usually of A-frame construction and is intended for fixed use onto a single satellite, or mounted on a trailer for demonstration purposes, when it can be quickly set up by any satellite. The azel mount allows the dish to be moved in both azimuth and elevation, and each time a different satellite is required the dish must be realigned. The polar mount is the most difficult to set initially but the easiest to use. Once set, it will always track the geostationary arc: a manual-only version requires a tracking handle to be turned to scan the correct arc. This type of dish can be motorized with a single controller having a control unit alongside the tv receiver. For UK reception a dish with a gain of 46dB at 11GHz is required.

Low-noise block downconverters
The microwave electronics is situated at the focal point of the dish in most domestic applications. With dishes of F/D ratio between 0.35 and 0.62 the feed is commonly of the scalar horn type, consisting of concentric rings with a circular waveguide matched to the WR75/WG17 waveguide normally used in these low-noise blocks. Energy focused onto the horn is fed by circulator waveguide to a probe feeding the first GaAs f.e.t. amplifier. A two-stage f.r. amplifier is normally used prior to a mixer with a dielectric resonator oscillator. The f.l. output of 900 to 1700MHz is amplified within the l.n.b. giving an overall gain of around 55dB.

Amplifier noise figures have been steadily reducing recently and this is the main reason why a smaller dish than first anticipated can be used. A 2.8dB noise figure is easily achieved and 2.5dB is common; higher grade l.n.b. can be obtained with figures as low as 1.5dB. Power to the unit by coaxial cable which should be of very low loss in the range of 1 to 2GHz.

The demodulator
Coaxial cable from the noise block is taken to an indoor unit normally situated on top of the television receiver.

Many different demodulators are available for this purpose spanning a wide price range, but the principle of operation is mainly the same. The f.l. of 960 to 1750MHz is mixed down to a second or third f.l. and being a fm signal is demodulated by either phase-locked loop or quadrature demodulator. After amplification, demodulation and clamping, the video signal is available as a 1V peak-to-peak signal and in some cases is applied to a u.h.f. channel 36 signal for connection to the v.h.f. sub-carriers are separately demodulated and as satellite broadcasts use various audio subcarriers (4 to 8MHz) it is necessary to be able to tune these from the front panel.

The nature of the satellite transmissions has made the life of the designer somewhat difficult. Intended for cable networks where a 'dedicated' demodulator is assigned to each carrier the various audio tracks are different audio and video formats is of little tance. But for domestic use all channels will need to be receivable by the same unit. To produce a multi-standard demodulator would be excessive for most people so some sort of compromise is usually inevitable.

Typical scalar horn feed with polarization modes that allows l.n.b. to rotate polarization by 90° enabling reception of both x and y polarized transmissions.

Not everyone is clear about satellite tv. Is it only for the future? What is receivable now? How much does it cost? And is it legal?

Programme material
On a satellite by satellite basis it may be of interest to readers to see what is available from a home system. Intelsat V (27.5°W) currently has four operational transponders. From 0800 to 1800 the Children's Channel transmits programmes for 4-7 year olds (cartoons, stories, things to make and do). After 1500h this transponder becomes the Premium Broadcasting Transponder 1 which carries the language of the originating network (NOTE: It is not possible to receive audio or video from BS or C/Mac Transmissions with a normal PAL tv).
this is a film channel which should not be watched without the permission of the programme provider.

Filmenet is uploaded from Belgium mainly in English with Dutch subtitles and is another film channel. The same channel is used by World Public News for its morning schedule dealing with current affairs in English and French. There is also a feed to Israel in English.

Olympia is a Pan-European TV station run by the European Broadcasting Union and contains material from its members. Material is of a similar format to conventional TV with European news, current affairs, travel, music, films, etc. It is also a feature that material broadcast in the language of the providing country will be available in tele-subtitles to other language groups.

Worldnet is provided by the US Information Agency based on the previous night's US news broadcast, and intended for US embassies around Europe.

So far everything has been in PAL colour; now a couple of odd bits out. TVS in SECAM transmits the best of French-language TV from France, Belgium and Switzerland, with about four hours of programmes per night of a general mix.

The New World Channel (ENBET) is uploaded from Norway and is a multi-lingual religious transmission now in PAL. Sat 1 is a German channel which although PAL has sound-in-sync and the sharpness is not distorted the picture. Without the correct decoder no sound is possible, however on this and other sound-in-sync channels an audio subcarrier has been found at around 3.5MHz but very distorted. This may be an analogue component of the digital waveform and will require further investigation. Sat2 also carries a YOL pop music and news programme in English on an audio subcarrier.

Sky Channel, the first satellite TV operator that predates BSkyB, was operational on the Orbital Test Satellite OTS 2. The audio, which includes both mono and stereo subcarriers, is clear but the video is inverted. Music Box is a 18 hour pop video channel, available with both a mono and stereo subcarrier, the stereo is com-panded and requires expansion.

On the Eastern spot is Luxembourg in German and on Sat 3 (sound-in-sync) but the signal is too weak from a 1.8m dish for reception in the UK and at least a 3m dish is needed.

The terms of the licence are that the material must be for ultimate public reception, and a considerable amount of material on ECS 2 does not fall into this bracket. For example, feeds to the USA area are run where conversations at set up time are transmitted when the viewer would be watching a commercial and language can be in English and French in the extreme! The Eurovision song contest goes through this satellite, as do many of the live sports exchanges. Material is mostly sound-in-sync. Sweden has two transponders operational but with a non-public reception system. Norway has a C-MAC transponder, which requires a special decoder.

From the autumn are a magazine channel (Lifestyle), the Arts Channel devoted to theatre & classical music, and a few others. BCS1, otherwise known as Eutelsat F1, carries several foreign broadcasts. RAI from Italy transmits its national programme daily from morning till late at night, in Italian of course. Teleclub transmits from Switzerland in German.
Equitable access to satellite communication

A conference of the ITU has decided to change the basis of regulating the use of the radio spectrum for satellite communication so that every country will have a guaranteed option of setting up a national system.

Every national government reserves to itself the right to assign frequencies to radio stations within its jurisdiction. The basic method that is used to keep order in the radio spectrum involves international registration through the ITU. It has been shown not to cause unacceptable interference to another; a new assignment is added to the register if it raises no interference problems with assignments that are already registered. Governments undertake not to allow their radio stations to interfere with stations using internationally registered assignments. This principle has been elaborated into a frequency coordination procedure for satellite radio services. It has been called "first come, first served" by its critics, with some truth. It works fairly well but it is not equitable.

The only other method that has been found to work, and which is fairly used for some services and in some frequency bands, is radically different. This consists of drawing up a plan for the use of the band, based on present or planned use but on the stated national requirements. So-called a-priori frequency assignment plans have been used, for example, for terrestrial services and for satellite broadcasting in the 12GHz band. This method provides guaranteed access to a specified frequency for a specific country. It also provides stability of frequency usage and is of great value for some radio services and especially for broadcasting.

The much greater versatility and changeability of the FSS makes the a-priori method particularly unsuitable for that service.

The most serious drawback of an a-priori planning, however, is that the ITU has never found a way of sharing the medium between countries in proportion to their actual needs; it has only been able to share it in accordance with the stated requirements of each country, and in practice this has usually involved assigning equal shares to all countries, large and small. It is like sharing a cake. Sharing a cake between about 160 claimants can lead to small portions. It is possible to make the cake bigger by requiring all systems to meet high technical standards, but at a price. If the requirements are to be big enough for the bigger users, the price is likely to be very high. If it is money wasted if many assignments are not used, as is likely with an a-priori plan.

Coordination is clearly more effective and economic for the FSS than an a-priori planning, but can it meet the needs of all countries? Growth in the FSS is buoyant. Indeed there is little doubt that the rate of growth of national satellite networks for developing countries would be determined mainly by the availability of capital to finance them, given that orbital slots could be found for all the new satellites. The demand might eventually top-out as the scale of terrestrial broadcasting increases, and domestic telephone routes rises to the point where terrestrial transmission media such as radio relay and optical fibre cables compete economically.

David WITHERS, F.I.E.E.

with satellite networks but this is a long time. Thus, much depends on the feasibility of finding enough orbital slots to meet the demand.

So far it has always been possible to find a slot for a satellite by using the coordination procedure, although it is getting difficult in the more crowded areas. Finding enough room for future growth is primarily a technical matter. A great deal has already been done, mainly through the ITU, to reduce the minimum acceptable separation between satellites and so to increase the number of slots. By 1987 all newly launched geostationary satellites will have to maintain very precisely on station. The level of inter-network interference which all networks are recommended to accept has been increased by stages over the years and further increases are impending. Considerable progress has been made in reducing the gain of earth station antennas in the directions not of their own satellite but toward other satellites nearby in orbit. There is much more that could be done. In particular:

- The geographical area covered by satellite antennas could be tailored much more closely to the required service area, with
SATELLITE COMMUNICATION

- The process of coordinating satellites which are neighbours in orbit should be made much more effective and could benefit from more cooperative attitudes on the part of negotiators.

- Some specific types of radio signal are particularly vulnerable to interception from other specific types of signal. Segmentation of the spectrum to ensure that these signal types are not assigned the same frequency channel in different satellites could yield considerable benefits.

Given all of these further improvements, the need for new satellites that could operate in the FSS would be very great.

The number will grow from decade to decade as better hardware becomes available at affordable prices. For example, much depends on how well the smallness of satellite antenna beams and therefore on the largeness of the antenna reflectors that can be launched as a piece or unassembled in space. However studies made in CCIR, assuming the use of only those frequency bands which are already in general application and no new launcher facilities, have come up with an estimate of 1000 satellites.

Progress is being made in all of these areas in the ITU and in particular in the CCIR. Agreement cannot come slowly because these changes of technology and practice tend to be more costly than the changes that have already been adopted. The price presents itself in a variety of ways: in the cost of small satellites, in lost business opportunities, in operational difficulties of tracking networks and in increased planning costs. Ways will be found for reducing these costs and finding the best combination of measures, from decade to decade, that will provide for the growth in global capacity that is required by growing demands at a cost that can be borne. Despite this prospect of improvement, it cannot be assumed that coordination offers a bankable guarantee of equitable access.

The agreement at WARC-85

After prolonged discussions WARC-85 agreed to a compromise between efficiency and reassurance in the form of a package of proposals for the FSS. In future, these regulatory methods will be applied to the FSS in its various frequency bands.

One group of frequency bands will be regulated by a priority plan. This will not be the very rigid form of frequency assignment planning used, for example, for satellite broadcasting. A new and more flexible process called frequency allotment planning, much better suited to the multifarious and changeable FSS, is to be developed. These plans will provide a guaranteed allotment for every country, available for use whenever the need arises.

A second group of frequency bands will continue to be regulated by coordination methods, but these methods will be improved in order that these bands might better carry the heavy traffic load that will develop in the future. No doubt international systems like INTELSAT will be substantial users of these bands in the future, but there will be no bar to their use for national systems, and they will be individually be needed in other cases. For example when the capacity provided by the allotment plan is insufficient to meet national system's needs.

The remaining frequency bands allocated to the FSS were to be regulated basically as now, but the procedures are to be reviewed and amended if ways can be found to facilitate their utilization.

continued on page 75
Polyphonic keyboard

Push-to-make switches are used to access the most commonly used functions. These are wired in a rectangular array of three rows by eight columns. Some preset functions in the same row need to be pressed at once, and the program then selects them by selecting the keys. After the selection is made, the sub-menu is displayed. Pressing the select key sets the tempo to 1.000, which is the selected value. Pressing the select key again cancels the selection.

The keyboard has two modes: the main mode and the sub-mode. The main mode is used to select the main functions, and the sub-mode is used to select the sub-functions. The main mode can be accessed by pressing the main mode button, and the sub-mode can be accessed by pressing the sub-mode button.

The keyboard has a built-in metronome and a built-in tuner. The metronome can be set to one of five different rhythms, and the tuner can be set to one of five different ranges. The keyboard also has a built-in sequencer, which can be used to create and store musical arrangements.

The keyboard has a built-in MIDI interface, which allows it to be connected to other MIDI devices, such as computers and other keyboards. The keyboard also has a built-in USB port, which allows it to be connected to a computer and used as a MIDI controller.

The keyboard has a built-in power supply, which can be used to power the keyboard from an AC outlet. The keyboard also has a built-in battery, which can be used to power the keyboard when it is not connected to an AC outlet.

The keyboard has a built-in microphone, which can be used to record music. The microphone is connected to the keyboard via a built-in microphone jack. The microphone can be used to record music in mono or stereo. The microphone can also be used to record music in a variety of different audio formats, such as MP3, WAV, and AIFF.

The keyboard has a built-in effects processor, which can be used to add effects to the recorded music. The effects processor can be used to add reverb, delay, distortion, and other effects to the recorded music. The effects processor can be used to create a variety of different sound effects, such as ambience, echo, and distortion.

The keyboard has a built-in amplifier, which can be used to amplify the recorded music. The amplifier can be used to increase the volume of the recorded music. The amplifier can also be used to increase the bass and treble of the recorded music.

The keyboard has a built-in equalizer, which can be used to adjust the balance of the recorded music. The equalizer can be used to increase or decrease the bass and treble of the recorded music.

The keyboard has a built-in metronome, which can be used to create a steady rhythm for the recorded music. The metronome can be set to one of five different rhythms, and the tempo can be set to one of five different speeds.

The keyboard has a built-in tuner, which can be used to tune the recorded music. The tuner can be set to one of five different ranges, and the accuracy can be set to one of five different levels.

The keyboard has a built-in sequencer, which can be used to create and store musical arrangements. The sequencer can be used to create and store musical arrangements in a variety of different formats, such as MIDI, XML, and H.264.

The keyboard has a built-in MIDI interface, which allows it to be connected to other MIDI devices, such as computers and other keyboards. The MIDI interface can be used to send and receive MIDI data.

The keyboard has a built-in USB port, which allows it to be connected to a computer and used as a MIDI controller. The USB port can be used to send and receive MIDI data.

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transconductor amplifiers.

Similar circuits are used for both 208 devices consisting of transistor constant-current generators whose current is set by one of the influence register sample and hold circuits.

Amplifier IC6 modulates reference current in the audio-output converter IC9 to provide a tremolo effect. Because the converter zero output is actually half way through its range, the tremolo modulates the d.c. level of the output. This effect can be nullled by adjusting the tremolo null potentiometer to add an opposite d.c. modulaion directly to the output. The potentiometer is the only preset requirement in the whole instrument.

Audio output from the converter is filtered by IC13 which is wired as a Sallen and Key three-pole low-pass filter with pass-band gain of three and cut-off frequency of 8kHz. Output level is about 200mV when a single key is pressed.

Component IC14 feeds IC6 which controls frequency of the master clock to provide a vibrato effect. Along with the vibrato signal, IC6 sums the fine pitch setting from IC9 and voltage from the pitch-bend front-panel control. Output of IC14 biases a voltage-controlled capacitor in the tank circuit of the clock. For a swing from +5 to –10V in bias, clock frequency varies by about 1.5MHz in 10MHz. However this range is not all needed and only a positive and negative swing of about 2V is produced by IC14. A swing of 400kHz in the master clock changes the instrument pitch by one semitone.

Control-converter register IC9 is also used to read the keyboard. The prototype keyboard has a built-in digital encoder provided with a 14-pin DIL header connector. A five octave C-to-C keyboard has 61 notes which therefore need a six-bit address.

The six least-significant bits of IC9 are fed to the keyboard and a single bit is returned. Numbering the lowest C as zero, if the key addressed by the six-bit number is pressed, then a logical one is returned, otherwise a zero. The bit is buffered by IC10 on to the Q-bus so that it appears as bit one in the 8088 status port.
Fast Fourier transform

September's program, by Dyvik and Larsen, needs a correctly-formatted random access data file to work on.

The program deals with the frequency bands where FSS networks operate now, namely 500MHz at 404-470 MHz, and another 500MHz bandwidth at 14 and 11 GHz. There was discussion about future satellite assignments, and what changes should be made to the methodology in these bands. No decisions were taken, but the improvements are likely to be derived from the following:

(a) The present procedure, based on an advance warning of the actual details of a planned system, followed by multiple bilateral coordination and negotiations, is becoming cumbersome to operate and may be replaced by multilateral negotiations which could take the form of a conference every couple of years attended by representatives of every country with an FSS satellite in orbit or plans for launching within the following five years.

(b) The concept of spectrum segmentation may be developed for reducing the incompatibilities between different types of satellites which are currently operating in the same band.

(c) The technical principles of coordination may be simplified and formalized, and the process of harmonization more amenable to computerized multi-particle analysis.

(d) A stimulus might be given to cooperation between countries sharing an arc by the formulation of principles of burden-sharing.

(a) More systematic approach may be made to the problem of the periodic up-grading of technical standards.

David Willets is reporting on the meeting of the OnLine's Satellite Communications Conference at the Tower Hotel, Dec 30. Proceedings are available from OnLine at 01 868 4480.

The deeper hidden message from page 34

which leads to the digitalization of the concept of electromagnetic wave propagation, not only in the absence of any known new wave of knowledge.

The following is needed to explain the deeper hidden message of Maxwell's Equations for so long.

Moving graphics help to illustrate the salutary effects of electromagnetic theory. For information on the availability of the McEnery, write to:

15 Kimpenny Lane, Allahabad IA 314AS.

References:
3. See, for example, the High Speed Transmission University, CUP, 1981, p.113.
4. At the P.A.C. Albert Einstein, Philosophers-Sociologist, Library p. 38.
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Cavendish Automation Limited, 45 High Street, St Neots, Cambs PE19 1BN, Telephone: 0490 379457, Telex: 256013 CAVCOM G.
This low-cost viewdata modem from GEC is powered by the telephone line and requires no mains supply. For interfacing it to the BBC Micro, GEC are offering their own software package on ROM or disc; as an extra feature, this allows chat and error-corrected file transfer at 1200 bit/s.

Further reading

Latest modem standards and details of all types of modems from 300 to 9600 bits are covered in a practical manner in the recently revised edition of The V Series Report: Standards for Data Transmission by Telephone. Details of this 10-page paperback book can be obtained from the publishers, Bootstrap Ltd, at Unit 1F, Stalyford Industrial Estate, For- rock, Dublin. Its price is £10 sterling.

A useful primer describing the subject of the user's point of view is the CASE Pocket Book of Computer Communications. Its 84 pages, which selflessly omit to mention any of the company's products, explain serial transmission of data, communications lines and services, multiplexing, packet-switching techniques and complex protocols such as the OSI open systems interconnection model. There is also a useful glossary. The booklet is distributed by Computer and Systems Engineering plc, PO Box 254, Caxton Way, Watford Business Park, Watford WD1 8XH.

"Talking to the World" is the title of a 12-page paperback by John Newgas, who runs Britain's largest computer bulletin-board. It covers all aspects of low-speed data communications and provides a great deal of practical advice. The book is published by Century Communications at £5.95.

An informative guide to data communications from the poacher's standpoint is The Hacker's Handbook by Hugo Cornwell, Century Communications, 149 pages, £4.95.
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www.americanradiohistory.com
68000 computer with new bus

A superlative British computer runs a Motorola 68000 16/22-bit processor at 52MHz. Gemini, who developed the 80-bus system for 286-based computers, have continued their philosophy of concentrating on both related systems and independent systems. Challenger 20 have devised a new range called 68K-bus (VMX). Gemini say, offers overall improvement and is expandable into systems where other base boards commit the user to various combinations and sizes of Eurocard (that are difficult to house vertically). The system is based around the c.p.u. backplane design which combines several features, containing c.p.u., ram, disc control, i/o and of course the backplane for connecting further cards. The bus and cards have been designed so that future 32-bit developments may be incorporated. Using GM3001 c.p.u. backplane, Challenger 20 also incorporates a floppy disc drive, a 2MBbyte hard-disc drive with controller and power supply. There are four slots for expansion cards, and the bus is carried through a socket to the outside of the case so that a further backplane may be added or development cards can be plugged in directly. The computer incorporates 512K dynamic ram, two RS232 serial ports, a Centronics parallel port and a battery-backed real-time clock.

To complement the new computer and promote the 68K-bus, Gemini have a number of additional boards: four graphics circuits based around the Hitachi 6544 c.i.t. controller; a modem, 1 or 2MBbyte ram boards and serial interface boards. Full details of the bus are available in the hope that other manufacturers will adopt it and produce compatible peripheral equipment. The computer is offered with a choice of operating systems including CP/M68K, I.B.M and the system. Gentos is to be added and a further c.p.u. card is being developed to run Unix.

Gemini Computer System Ltd, Springfield Road, Chesham, Bucks HP5 1PU. EWW 220 on reply card.

Infra-red spot thermometer

Cycope, a range of infra-red thermometers from Land Infrared, now includes the Mona2/Land Cycope 33CP, which is designed to make spot measurements. It uses a fixed-focus Minolta lens of 170mm, and diameter of the measuring circle with the lens in focus is 2mm.

One views the target through crosswise-type view optics, which defines the target area and presents the digital temperature reading when the trigger is pressed. Range is 50 to 600°C. Readings are continuous, peak temperature hold or valley hold and an internal calculator is able to show mean, maximum or minimum of a series of readings, which are also presented as an output for connection to a data logger, printer or computer. Land Infrared Ltd, Doodled, Sheffield S18 5DT. EWW 219 on reply card.

Miniature d.c. converters

Eliminating the need for multiple power supply systems and complex power bus lines on p.c.b., the NM112 and NM105 are 5V to 12V and 5V to 12V and 12V converters that provide localised on-board power. Application at the point of load also improves overall performance by reducing noise and decoupling problems.

The package occupies 206mm2 of board space and is only 7mm high yet delivers up to 350W of power. The device operates between 0 and 70°C with no derating of the output current and with 70% efficiency. Newport Components Ltd, 134 Tanners Drive, Buxted North, Milton Keynes MK14 8BP. EWW 215 on reply card.

Four-channel magnetic tape head

Claimed to be the first four-channel magnetic tape head, the CR4R444P1 audio cassette head is designed and built in Britain by Philips Magnetics. The tape head allows tape monitoring on each of four independent tracks at the same time, particularly useful in sound mixing systems and communications monitoring equipment. Dimensions of the head conform to EIAJ standards and can be interconnected with existing heads on the majority of cassette tape transports. Record and replay sections are completely independent, each with a screened amplifiers, along with 16 input buffers and eight output buffers, all with fixed positions. They are interconnected by two metalic layers which are configured to provide the required functions. Harris claim to be able to provide complete detail drawings before a customer's layout is received and outlined.

Further details from Harris- MHS Semiconductors, Edgerton Road, Wimborne, Wimborne, Berks RG11 3TR. EWW 206 on reply card.

GaAs cell array

Semiconductor circuits of medium-scale integration in gallium arsenide are now possible with the use of a Harris cell array. The HMD11100 array has the equivalent of 300 gates and can achieve switching rates up to 3GHz and be 50% faster than other GaAs cell arrays and five times faster than similar circuits with silicon c.e.t. gates.

The device is a fixed-speed array, with 64 AND gates, eight NOR gates, eight D-type flip-flops, six clock drives/trigger.

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Further details from John C. Ducey, Westminster Hospital, 829-831 Euston Road, London NW1. Tel: 01-832 9811 ext 2640.
Job description and application form from Personnel Department, Westminster Hospital, Dean Ryle Street, Horsley Road, London SW1. Tel: 01-832 9811 ext 1147, answering service.
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