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WIRELESS WORLD, SEPTEMBER 1980

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A.C. MICROVOLTMETERS

<table>
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<tr>
<th>VOLTAGE &amp; dB RANGES</th>
<th>RESPONSE</th>
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<tbody>
<tr>
<td>150V, 500V, 100V, 50V</td>
<td>± 3dB from 1Hz to 3MHz.</td>
</tr>
<tr>
<td></td>
<td>± 0.5dB from 3Hz to 1MHz above 500V</td>
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RESPONSE

<table>
<thead>
<tr>
<th>FILTER</th>
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</thead>
<tbody>
<tr>
<td>-10dB/ +20dB</td>
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<tr>
<th>H.F. RESPONSE</th>
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</thead>
<tbody>
<tr>
<td>± 3dB from 300kHz to 400MHz</td>
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</table>

L.F. RANGES

As TM3.

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<table>
<thead>
<tr>
<th>D.C. RANGES</th>
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<tr>
<td>100V, 50V, 15V, 10V</td>
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CURRENT RANGES

<table>
<thead>
<tr>
<th>30mA, 10mA, 3mA, 1mA</th>
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<tbody>
<tr>
<td>30mA, 10mA, 3mA, 1mA</td>
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LOG RANGE

<table>
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<tr>
<th>5V at 10% full.</th>
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<tr>
<td>± 5mV at 50% full.</td>
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</table>

RECORDER OUTPUT

<table>
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<tr>
<th>1V at full into &gt; 1kΩ</th>
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</table>

Types:

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<thead>
<tr>
<th>Model</th>
<th>Price</th>
<th>Function/Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>RALAC</td>
<td>£3550</td>
<td>1651/10 Mhz Generator 240 Volt A/F AM 19&quot;</td>
</tr>
<tr>
<td>TEKTRONIX</td>
<td>£1975</td>
<td>466/100 MHZ Storage 4 Channel 300 Mhz 10mV/div</td>
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<tr>
<td>4921 Dual Trace Storage 60 Hz 10mV/div</td>
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<tr>
<td>7421 Oscilloscope 6ns-5s/div.</td>
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</table>

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- **Audiocassette**
  - **Carston**
    - £298 (no. 50)
  - **Philips**
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At the outset we were determined to produce a home video system that was nothing short of outstanding. That's why VHS offers standards of reproduction, reliability and compatibility that are quite simply second to none.

And of course, if you build a better system in the first place there's less need to change it later on.

So while we have continually improved the quality of our recorders—there are now triple standard VHS machines which accept PAL, SECAM and NTSC—we have never changed the design of the VHS cassette. And it will not change in the future either. Which is more than can be said for some of our competitors.

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- Hum Pickup (typical at 60Hz): 10 dB equivalent SPL @ 1 milliwatt test
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**He who hesitates...**

Democratic, parliamentary government is a fine thing. Matters of correspondence to the community cannot be left to the whims of dictators, unless they happen to be of an unusually benevolent disposition. The imposition of taxes, the control of education, health care, transport — all must be discussed and arranged in a properly democratic manner. But, when ministers are seen to shy away from the decision which must be taken when the talking stops, one can sometimes begin to wish for a benevolent despot, or at least a well-heeled entrepreneur.

In America, Japan and one or two European countries, thousands of millions of pounds worth of investment have been used to build vigorous research, development and production programmes in integrated-circuit technology. In the UK, Sir Keith Joseph hesitated over the second £25 million for Inmos. He would clearly have preferred the company to raise the money from private sources, but only discerned "lickers of interest" from private enterprise. That the interest is only a flicker does not show the City in a particularly advantageous light — it evidently likes to apply its risk capital in an area of slightly less risk — but the decision has to be accepted. Since the original plan to fund Inmos to the tune of £50 million was made, the company has lived up to its promises and is on schedule with its US operation: nothing has changed. Although the original decision was made by a Labour government, there seems to be no reason why the Tory incumbents should wish to throw away the first £25 million by holding back the second. Inmos have said that they have already lost £62 million in the time spent haggling over the second instalment. If it had not been for this, Inmos would almost certainly have survived, but as an American company, possibly raising money from US sources.

The question of whether we need Inmos has been raised. It is somewhat late in the game, after all, to start competing with the established giants, particularly as the said giants are pretty well entrenched in Britain already. One American view is that Europe has no need of a semiconductor manufacturer capable; the application is all, so they say, so why not leave the supply of raw materials — chips — to others? One hesitates to appear shrill in the face of such altruism, but the Americans ought not to be asked to shoulder the whole burden of mountainous profits from semiconductor making.

They do have a very good point, of course. Software and applications development do not run away with the millions in the way that chip design, manufacture and marketing can in the early stages. The UK is already rather good at software (less so at industrial application) so perhaps we should concentrate on this side of the "microelectronic revolution".

If there were a choice, that would possibly be a sensible one. But is there a choice? Is it really in our best interests to leave to foreign firms the conception, design and manufacture of chips which we are constantly being told will be central to our future economy? Will we then be supplied with the devices we want or supplied at all? Having already seen control of many of our established industries pass from our hands in an involuntary way, it hardly seems reasonable to forego a chance of holding on to one of such significance.

It may be that the pathetically small investment in Inmos which is all that is possible, unless private enterprise becomes more enterprising, is far too little and about fifteen years too late, but however small a UK microelectronics industry finds itself to be when the situation stabilizes, a nucleus of capability strong enough to supply special needs and, more important, to attract the necessary brain power, must be kept. This is a decision which carries extremely long-term consequences; future options should not be limited by further haggling over the petty cash.
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SPECIFICATIONS

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- Impedance: 150 ohms
- Power output (at 1.000 Hz, Open Circuit Voltage): 1000 mV
- Hum: (1000 Hz) Power Sensitivity: 0.16 mV
- Shock Mount: Patented internal vibration isolator
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The floating bridge

New design principle for audio amplifiers

by R. M. Brady

This article describes a design principle which has the advantages of the bridge amplifier but none of its disadvantages. A simple amplifier which drives four ohm, 15-watt speakers using power from a 12-volt car battery is described in part 2 and test results are included. The design is further applied to a 200-watt version suitable for group use.

Bridge amplifiers offer many potential advantages over single push-pull amplifiers: high power, high voltage swing for moderately low-voltage components, lower power dissipation in each transistor, and the capability of operating with high impedance loads, thereby reducing transmission losses and permitting a high damping factor. They are almost essential if power supply voltage is limited as, for example, with a car battery. Present designs, however, are necessarily of complex and cumbersome manufacture, making them expensive and not so reliable. They also have limited bandwidth and poor distortion performance, because of the close coupling between individual halves of the amplifier.

One half controls the instantaneous potential of one output terminal with respect to earth, and the other does the same on the other terminal. The new system uses one amplifier to control the difference between output terminal potentials, and a second, cheaper amplifier to control a quantity which could loosely be called the sum of these voltages. This amplifier acts merely as a "slave" to the first one, enabling a full voltage swing to occur, but not in any way directly affecting the required output. The second amplifier is capacitively coupled by-passed at high frequencies, where a full voltage swing is not so important in audio work. This by-passing prevents the instability for which bridge amplifiers are renowned.

The simplest version of the circuit requires that the earth (i.e., chassis, screening and mains earth) be floating, changing potential with respect to the power supply. Although this is unusual, it is perfectly safe and acceptable provided steps are taken to prevent stray mains currents from passing through the system.

It turns out that the design of both component amplifiers may be considerably reduced in complexity by using this system. Extra, such as current protection, may be added easily and far more simply to the floating bridge than to conventional amplifiers.

The new system has the following advantages over conventional bridge amplifiers:
- Wide bandwidth and lower distortion
- Optimized voltage swing, because both amplifiers must bottom before the output is affected
- Saving in cost and complexity
- One output terminal may be earthed, thus allowing the possibility of using two floating bridges to make a bridge-bridge amplifier.

The next section presents the system in block diagram form, contrasting it with a conventional bridge amplifier configuration, and then subdividing the circuits for tracing through the feedback loops of the whole system, prior to reading the later paragraphs. The circuits are rather unconventional.

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**Fig. 1.** In version A, A1 is a high quality amplifier which controls the difference between output terminal voltages, x - y, while A2 is a cheaper amplifier which controls the sum x + y so that full voltage swing can occur. Note the unusual position of the earth. (x and y are potentials with respect to point A.)

**Fig. 2.** Version B of the floating bridge amplifier is similar to version A, but has a different input configuration.

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**The floating bridge**

**New design principle for audio amplifiers**

by R. M. Brady

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Wireless World, September 1980

and if you do, you may find it good advice to forget temporarily the electronics you have already learnt, and to investigate the circuits from first principles.

**Block diagram analysis**

Two alternative but similar arrangements of the bridge amplifiers are shown in Figs 1 & 2. Amplifiers are inverting and non-inverting and A1 is insensitive to the state of the power supply. Output terminals are labelled x and y as shown, being instantaneous potentials with respect to point A, and in both cases the feedback loops are arranged so that at low frequencies A1 controls the value of x - y, and A2 controls the value of xR1 + yR2 = x + y. Capacitor C2 by-passes A2 at high frequencies, where large voltage swings are unnecessary. Circuit A, Fig. 1, inverted bridge amplifier, Fig. 2, does not.

For consider a simple-minded approach to a conventional bridge amplifier, Fig. 3. Feedback loops are arranged so that if V is the instantaneous input voltage then x = GV and y = GV, and the output across the load is x - y = 2GV. Remembering the close coupling between individual amplifiers, imagine that x rises for some reason because of effects in A1. This causes A2 to turn on, to keep y constant. The fact that A2 has turned on effects the value of x, causing A1 to react each time there is a small phase shift, which can easily be amplified by this mechanism and cause unwanted oscillation. Hiding things can happen at the cross-over point where both amplifiers must conduct simultaneously. The new system almost completely eliminates this coupling effect.

Effect of A1 in circuit A Fig. 4 shows A2 as an associated feedback loop. For the present A1 can be regarded as a sink which will accept any current generated by A2. In the quiescent state, A1 stabilizes x - y to its own (ideally zero) offset voltage. Imagine that the potential y rises with respect to x for some reason. The potential at the + input to the + terminal remains at earth potential x, so that there is a voltage across R1 which tends to make a current pass into the + input. This causes A2 to turn on in such direction as to make a current pass from x to y through the load impedance, thereby reducing the value of y - x and stabilizing the system. A2 is acting as a virtual earth amplifier, and its voltage gain is R2/R1. Because A1 is insensitive to supply voltages, then any change in potential y with respect to the power supply will not be noticed by A2 (apart from stray capacitance effects). As the potential

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WIRELESS WORLD, SEPTEMBER 1980

- REFERENCES:

  [1] Kirchhoff's Law: if current is supposed to disappear down the earth line, where is it supposed to be going? (Page 41)

  [2] There is also a low frequency coupling, discussed in part 2, page 41.

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Fig. 3. In the conventional bridge amplifier A1 and A2 are identical good quality amplifiers arranged so that output x is proportional to the input and output y is the negative of this. It enables a high maximum voltage swing to occur for a given power supply, but is expensive and prone to instability.

Fig. 4. A1, amplifier of version A. Ignoring the earth connection, imagine voltage y rises; feedback is arranged so that this causes a current to flow into x, causing x to rise, and so restoring the correct output x − y (i.e. negative feedback). As there is only one earth connection it cannot short out any currents! Amplifier gain is R1/R2.

Fig. 5. A1, amplifier of version B. Similar to that of version A, but with slightly different input. Amplifier gain is again R1/R2.

Fig. 6. Cheap amplifier A1 controls the sum x + y. Normally, this must control the current so that y = −x, which would be the case if R1 = R2. At high frequencies full voltage swing is not so important and C2 gives feedback so that y remains constant; this greatly simplifies design.
supply. Preamplifier converts the signal into current negative rail, so many floating bridges can be operated on the same power supply.

Fig. 9. Change-of-origin preamplifier. Earth is connected to the power supply, and the power supply, not affect the output. Bottoming of A\textsubscript{1} and A\textsubscript{2} is again decoupled from each other and the floating bridges. This happens when the value of \( y = x \), times the input voltage. A\textsubscript{1} is again decoupled from A\textsubscript{2}. Effect of A\textsubscript{2} in circuit \( y \) is seen that, whilst the system is working, it is hard to eliminate. A typical value in the feedback loop of A\textsubscript{2}, and is thus in the capacitor in parallel with it. The capacitor is a typical value for a stereo arrangement. A call for papers has been issued for the Microsystems 81 conference, being held at the Wembley Conference Centre, London from March 11-13, 1981. The first two days are intended for design engineers and those involved in designing and implementing microsystems of all types. Scope includes case studies, communications, distributed processing, industrial control, interfacing, microprocessors, project management, real time languages, signal processing, software development, and testing. The third day is devoted to personal computers and small business systems and their use in commerce, industry, and education. Synopses of papers for consideration should be sent by September 12, 1980 to Robert Parry, Microsystems 81, P.O. Box 63, Westbury House, Bury Street, Guildford GU2 5BH.

Micro '81
Fig. 9. Change-of-origin preamplifier. Earth is connected to the power supply negative rail, so many floating bridges can be operated on the same power supply. Preamplifier converts the signal into current I1, which passes through R1 from an e.c. point of view. Output x - y is therefore I1 * R1.

y with respect to the power supply is the only thing which is affected by A2. Then A1 is decoupled from A2. This confers a high degree of stability on the circuit, and enables A1 to be of cheap design, with good distortion performance, in what will remain a high fidelity system.

Effect of R1, in circuit B (Fig. 5) shows A1 and A2 are associated feedback loop. R1 is large-valued, providing bias, so that R2 conditions are identical with those for circuit A. Imagine that the input voltage rises. This causes A1 to conduct in such a direction as to cause y to rise with respect to x. Negative feedback is applied through R2, causing the potential of the + input to rise until it equals that of the - input, and the circuit stabilizes. This happens when the value of y-x is R2/R1 times the input voltage. A1 is again decoupled from A2, so that feedback loop, C1 by-passes A2 at high frequencies. Resistance R2 will be set nearly equal to R1 so that at low frequencies A1 controls the potential of y in such a way that y-x is always equal to the potential at point A. This corresponds to the voltage swings experienced in conventional bridge amplifiers, and has the advantage that the power dissipation is shared equally between the two important amplifiers. In practice, however, R2 will be set slightly larger than R1 so that at low frequencies, A1 branches shortly before A2 does. This enables a full voltage swing to occur, and is illustrated in Fig. 7. The system can cope with a poor quality device for R1, and the required output being appreciably affected. Cost savings can be quite large in this area.

Earthing arrangements. Fig. 8 shows a typical power supply arrangement. Capacitors C1 are reservoirs, C0 the stray capacitance between earth and the bulky components of the power supply, and C0 the stray capacitance between primary and secondary of the transformer.

An apparent problem as regards hearting devices so far described is the Wembley Conference Centre, London from March 11-13, 1981. The first two days are intended for design engineers and those involved in de-
Electronic cryptography
Codes, ciphers, communications and computers

Lively controversy in the USA about the degree of security provided by the new NBS data encryption standard. At the end of 1976, the US government security be better served by going to one of the proposed "public key" systems that claims to be unbreakable in principle. In important bearing on data transmission in the UK, as well as in the USA.

Pat Hawker provides background information and details that even clever coding systems may not be quite as secure as you think.

The marriage of communication technology and computers has proved a fruitful one in recent years. Many profound advances in the technology of information collection, collation, processing and distribution, affecting government, commerce, industry and not least the citizen concerned with the privacy of the individual. The act of communicating so much information so rapidly and accurately has increased the extent and variety of information available to a determined eavesdropper but the same modern technology also makes eavesdropping easier and relatively less costly. It is not solely a question of data-processing technology. The use of microwave radio relays rather than cable, combined with direct long-distance telephone links, allows the interception of public and defence telecommunication traffic without the need for physical tapping of wires and without the eavesdropper being in proximity to the target of his surveillance. The ability to program a computer to select from a flood of messages only those containing key words or specific addresses or telephone or telelex numbers makes possible far more selective eavesdropping.

Communication technology, admitted, does encourage the casual listener by multiplying large numbers of circuits on a single bearer or by the use of high transmission speeds, including burst techniques and, by confidentiality, so that signals to narrower, sharper beams and increasingly higher frequencies. But none of these techniques can be expected to defeat the determined eavesdropper. Techniques of eavesdropping, provided by the eavesdropper, which seek to conceal the very existence of communication, such as pseudo-noise or spread spectrum techniques, or transmission or information concealed on substrates within conventional communications, cannot be guaranteed to elude for long the attention of listeners equipped with spectrum analysers and the like.

This article does not intend to probe the sensitive area of electronic surveillance, the surveillance of the communications of any kind. Signals intelligence (SIGINT) can be gathered from the simple statistic that 40,000 of the 139 billion family units in the world, which numbers over 150 billion of people (according to the United Nations), are producing by purpose, e.g. communication receivers were manufactured post-1956, not all, but a considerable proportional number of people have been used for American surveillance work.

The capture by the North Koreans of American electronic equipment on the USS Pueblo is said to have made possible the breaking of an encoded store of messages intercepted in previous years - and to have led to the attempt at the American recovery of a deep-sea recovery vessel Glomar Explorer and its vastly expensive efforts to raise the sunken Russian submarine off Hawaii. The Russian "bombardment" of the US embassy in Moscow, where microwaves appears to have been an attempt to prevent the Americans from intercepting microwave trunk systems, in the manner alleged to have been carried out by the Russians in Washington DC and other places in other parts of the USA, almost certainly aided by computer selection of circuits of particular interest.

Modern data transmission, commercial as well as official, is thus facing an increasing desire for better security that can be provided only by cryptography. Messages need to be enciphered in a code that cannot be economically read by an eavesdropper and that conveys sufficient proof of authenticity. Any cryptographic system that is less secure than unsecured communication is open to serious commercial advantage, cost or risk. A code thought to be secure invariably tempts users to transact information that it is not possible to兼顾 that a complete code, well known and available, would never be entrusted to radio transmission. While it is true that technical experts on current code-breaking research, for example, are familiar with the international Q-code which overcomes long-distance difficulties and makes transmission time but is not intended to provide privacy. An ordinary telephone dialling plan could, in principle, be completely an address can be reduced to a unique TID number, (However, it would be virtually impossible to deduce the number without making an extensive search, and such a search, being arranged only in alphabetical order of names.) Codes based on words and phrases, such as the enigma machine, are not any less secure. Codes, such as codes may be used with a cipher where personal privacy is involved.

Ciphering is the process of changing the original message or data so that it is in a form which cannot be read or understood by an unauthorized person. The original message, known as the cipher; information that remains of value even when it takes days or weeks to evaporate, but also strategic and logistic information that was of great value. The two secrets that will, at least in theory, be known to the eavesdropper: the general form of the substituions and transpositions (the algorithm) and the key. In practice, both secrets, both need to be known and it may not be necessary for the users to keep both secrets to the eavesdropper. In electronic systems for commercial use, it may even be advantageous to establislsh and publish an agreed algorithm, the security of the cryptosystem then depending upon the key. It will then be essential that the key should not be accessible to the eavesdropper and it is not known to the eavesdropper. Ideally the same substitute-alphabet should be used only randomly: the users need to be instructed by means of a running key which is a substitute-alphabet to be used at any one time. There are many forms: book ciphers may use words or letters taken in some form of the page of a readily available book, proverbs or poems may be committed to memory; special key blocks provide running keys which may be printed in miniature book or pad; in electronic systems a key generator providing a specific string, for example, or a number which may be in a potted, sealed module.

Historically a further form of secret writing has been important: concealment of messages or ciphers, more correctly termed steganography where the users endeavoured to hide their secrets, making it initially be unknown to the eavesdropper: the general form of the substituions and transpositions (the algorithm) and the key. In practice, both secrets, both need to be known and it may not be necessary for the users to keep both secrets to the eavesdropper. In electronic systems for commercial use, it may even be advantageous to establislsh and publish an agreed algorithm, the security of the cryptosystem then depending upon the key. It will then be essential that the key should not be accessible to the eavesdropper and it is not known to the eavesdropper. Ideally the same substitute-alphabet should be used only randomly: the users need to be instructed by means of a running key which is a substitute-alphabet to be used at any one time. There are many forms: book ciphers may use words or letters taken in some form of the page of a readily available book, proverbs or poems may be committed to memory; special key blocks provide running keys which may be printed in miniature book or pad; in electronic systems a key generator providing a specific string, for example, or a number which may be in a potted, sealed module.

A true one-time system is unconditionally secure and will defy all forms of cryptanalysis.

Cipher machines
For centuries, manual encryptions was done painstakingly by hand, aided sometimes by simple abacus-type machines available as printed papers. Polyalphabitically, first proposed in 1854 by a German, Leo•... Abbe•... (the original hardback edition contains the phrase of the original message, known as the cipher; information that remains of value even when it takes days or weeks to evaporate, but also strategic and logistic information that was of great value. The two secrets that will, at least in theory, be known to the eavesdropper: the general form of the substituions and transpositions (the algorithm) and the key. In practice, both secrets, both need to be known and it may not be necessary for the users to keep both secrets to the eavesdropper. In electronic systems for commercial use, it may even be advantageous to establislsh and publish an agreed algorithm, the security of the cryptosystem then depending upon the key. It will then be essential that the key should not be accessible to the eavesdropper and it is not known to the eavesdropper. Ideally the same substitute-alphabet should be used only randomly: the users need to be instructed by means of a running key which is a substitute-alphabet to be used at any one time. There are many forms: book ciphers may use words or letters taken in some form of the page of a readily available book, proverbs or poems may be committed to memory; special key blocks provide running keys which may be printed in miniature book or pad; in electronic systems a key generator providing a specific string, for example, or a number which may be in a potted, sealed module.

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Electronic cryptography

Codes, ciphers, communications and computers

Lively controversy in the USA about the degree of security provided by the new NBS data encryption standard and whether the requirements for security be better served by going to one of the proposed "public key" systems. The issue is central to the development of an all-electronic communications system. In important bearing on data transmission in the UK, as well as in the USA.

Pat Hawker provides background information and points out that even clever coding systems may not be quite as secure as you think.

The marriage of communication technology and computers has proved a fertile department for the many profound advances in the technology of information collection, collation, processing and distribution, affecting government, commerce, industry and not least the citizen concerned with living under the shadow of his electronic dossier. But increasingly important is this cozy interplay relationship are those out-of-wedlock twins: cryptography and computer technology. This is no altogether fanciful: the first true electronic computer, Colossus, was conceived by Turing and Flowers for that wartime temple of the black art at Bletchley Park.

Diffie and Hellman have pointed out in an important tutorial contribution to the effect that "Until recently cryptography has been of interest primarily to the military and diplomatic community, and to a limited extent to commercial organisations who have sometimes considered it necessary to resort to encryption for protection of their trade secrets and confidential communication, and those that have, have seldom done so with particular care." The traditional commercial telegraphic code books were developed primarily to reduce the number of words that needed to be transmitted; used in isolation they did nothing to ensure privacy. But the minuscule size of the telegraphic codebook, centralised information storage linked with multiple visual display units, the implications of digitalized packet-switching telecommunications networks and the general growth of information technology together pose an increasingly significant threat to the privacy of the individual and to commercial confidentiality. Electronic storage and transmission of information has opened the way to new forms of traditional criminal behavior - theft, industrial espionage, sabotage, fraud - altogether a new dimension to invasion of privacy of the individual.

The act of communicating so much information at a distance, the communication of public and defence telecommunication traffic without the need for physical tapping of wires and without the eavesdropper being in proximity to the target of his surveillance. The ability to program a computer to select from a flood of messages only those containing key words or specific addresses or telephone or telex numbers makes possible far more selective eavesdropping.

Communication technology, admittedly, discourages the casual listener by multiplying the numbers of circuits on a single bearer or by the use of high transmission speeds, including Bursting technologies and by confining data to signals to narrower, sharper beams and increasingly higher frequencies. But none of these techniques can be expected to defeat the determined eavesdropper. Techniques of steganography, by which it is possible to conceal the very existence of communication, such as pseudo-noise or binary wheels which are available, would never be entrusted to such a user. During World War II the Germans famously relied on a system which they regarded as secure, the Enigma machine.

In a complex ciphering system there are two secrets that will, at least initially, be known to the eavesdropper: the general form of the substitu­ tions and transpositions (the algorithm) and the specific details of any piece of text, both need to be known and it may not be necessary for the users to keep beyond the eavesdropper. In electronic systems for commercial use, it may even be advantageous to es­ tablish and publish an agreed algorithm, the security of the cryptosystem then depending upon the key. It will then be essential that the key should not be available to the eavesdropper and it is a basic requirement on the strength of key management and key distribution.

One-time systems

To be secure a polyalphabetic cipher needs to use a large number of different substitute-alphabets so that each repeated only rarely. Ideally the same substitute-alphabet should be used only randomly: the users need to be instructed by means of a running key which is not a polyalphabetic cipher; for each letter of the plain text, and their instructions should, if possible, be given in a truly random sequence, in other words the sequence indicated by the key should never recur. In practice this can be done by means of a "one-time pad" or "one-time tape" containing strings of random letters, figures or binary digits. Such a key may indicate to the user by how much each letter should be shifted along the alphabet; a form of addition (but unlike arithmetical addition with no carry) see Fig 2.

A true one-time system is distinctly secure and will defy all forms of cryptanalysis.

Cipher machines

For centuries, manual encryption was done painstakingly by hand, aided sometimes by simple abacus-type machines as the use of equal paper. Polyalphabetic, first proposed in 1553 by Johannes Kepler, later by the great Basili Alberti, at the request of the Pope's secretary, gradually established itself, but usually at a lower grade encryption and was the basis for the first successful coding machines and later for on-code machines. A series of early encrypting machines were devised from about 1880 (e.g. Tucholke, Koch, Damm, Scherbius) and a basically similar machine but using six wheels and a drum driven by a hand-crank - the Enigma was developed by Hagelin in 1934.

Most machines had a number of interlocking wheels and drums between input and output contacts as to form in the process of encrypting and substituting ciphers. With polyalphabetic substitution ciphers, when more than one letter is involved, there may be some 26² letters before Fig 1. Simplified outline of conventionally encrypted communication link in which the same running key is used for encoding and decoding with the same form of algorithm.

Basis of cryptography

Over the years cryptography has acquired a bad name so that it appears to be apart from communication engineering in its own world. With the advent of digital coding, pulse code modulation and error detection and correction codes. For the historian developed development of telegraphy and ciphers read Kahn's The Codebreakers (the original hardback edition contains more technical material than the later paperback). Here only a few terms and techniques relevant to electronic cryptography are discussed; more details are in the tutorial paper by David Hellman.

The term cryptography covers both codes and ciphers; in essence a code is a plain message re-written using pre-aranged code blocks, for example five-letter or five-figure groups. Each group representing a word or phrase of the original message, known as plain text. A cipher is an encryption, that is thus not directly related to the number of letters or words in the plain text but unless further manipulated any given code group always represents the same plain text. Radiocodes, for example, are familiar with the international Q-code which overcomes language difficulties and makes it possible to send messages by teletype machines post-1950: not all, but a considerable proportion of these messages needed to be known and it may not be necessary for the users to keep beyond the eavesdropper. In electronic systems for commercial use, it may even be advantageous to esta­ blish and publish an agreed algorithm, the security of the cryptosystem then depending upon the key. It will then be essential that the key should not be available to the eavesdropper and it is a basic requirement on the strength of key management and key distribution.

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SHIFT

In one sense all cipher text intended for the cipher alphabet sequence repeats, stream with a running key, also in some further permutations made possible, for example, by a manually adjustable jackknife.

Those who devised rotor machines had every reason to believe that they would be secure against all then-known methods of practical cryptanalysis; the combined efforts of codebreakers in Poland, France and at Bletchley Park, and the work of Friedman in the United States, showed this not to be the case. The Enigma-type machines of the Germans and Japanese (more complex forms of a machine developed and patented for commercial use) provided a massive input to the codebreakers for subsequent distribution as Ultra, Purple, etc. Methods of successfully attacking even single short messages in Hagelin cipher text with known plain text, or longer messages without this aid, have been described. Nevertheless there is no evidence that all rotor-type machine ciphers have been broken, even with computer assistance, as it is possible to add to their complexity in many ways, for example by increasing the number of rotors.

Digital coding

In one sense a cipher text intended for telegraphic transmission involves the use of digital codes. Morse code, for example, is a binary, non-return-to-zero digital code. However modern practice is to convert the plain text into a code which is not in any way related to Morse code, or to some other such code. The various techniques, if not actually secure, are at least formidable. Physical security of the entire system in jeopardy; if the derived keys.

In practice the cage and keywheels of the Hagelin machine and the rotors of Enigma, Sigaba and the British Typex machines provided the workhorse for high-grade traffic until the development of purely electronic, on-line systems based on digital techniques.

Many systems may be relatively impervious against a listener who has access only to the enciphered messages, but may be fallible if some or all of the plain text of some of the messages is known. There are various ways in which this situation may arise. For example, if system faults, human errors or by deliberately inducing the user to send a message of which at least some words will be known to the codebreaker. Then again it is usually necessary for the sender to include key groups which provide instructions for the decoder, or include instructions for the decoder, or include instructions for the sender, which may reduce its security. The techniques of traffic analysis, particularly when applied to military communications, can provide valuable intelligence even when the code remains unbroken. Deception techniques, including the holding and subsequent re-transmission of an operational message at a different time, or (where the code can be broken) the alteration of its contents may be less applicable to communications other than the military scene, but cannot be disregarded.

Deception operations which were directed by the use of codes thought to be secure or in which the codes disregarded included the now well-known "Double-Cross" and the German "North Pole" exploitation of radio links.

Human fallibility, including failure to operate strictly the signalling rules of a system, plays an important role in cryptographic systems. It is only once the experience to decode a message made secure by a one-time pad with a plain text that read "Hawker is not repeat not to have access to the code books". When I delivered my message, he called. He dressed himself in his handsome dress and told me to continue decoding his messages as before in which the codes have a habit of defeating systems.

The existence of a communications channel carrying coded messages provides a strong temptation to unautho-
The cipher alphabet sequence repeats, although the authorized users (with identical machines and rotors) only had to know which permutation to use, their initial settings and usually some further permutations made possible, for example, by manually adjust-able jackfields.

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The IBM approach has therefore been to use relatively few key bits but to subject each block of text to a very complex series of transformations, including both transpositions of order and substitutions based on the derived keys. The aim has been to produce a computationally secure cryptosystem comprising a large number individual ciphers each of which employs the same algorithm yet which can be decoded only by someone who can generate the derived key. This may be done by a mind-boggling total of the possible key permutations until a correct, though relatively unique, key sequence is produced. From a manufacturing viewpoint, there are clearly significant advantages if it is a requirement that all components of all commercial/industrial data systems can be made using only one standard encryption algorithm. The user also gains because systems become compatible. In 1977, what might at first sight seem an absurdity was published in the USA: a "standard" for a secret encryption system. But, of course, only a determined eavesdropper in possession of both the plain text is divided into separate blocks each block of data is then independently enciphered into a non-secure cipher text to produce an unconditionally secure cryptosystem. Today the "standard" has become the DES. Since the number of rotors.

Security of codes

The so-called one-time pad, that is to say the provision of truly random paired keys of unlimited length, has long been accepted as one of the few systems that are unconditionally secure. The use of such a system however involves a number of practical difficulties, including the production and distribution of thousands or even millions of tapes. If used for multiple-address messages then the loss of one pad puts the entire system in jeopardy; if operated only with paired-users the production and distribution costs become formidable. Physical security of machines is important and personnel handling and storage costs become formidable.

In practice the cage and keywheels of the Hagelin machine and the rotors of Enigma, Sigaba and the British Type machines provided the workforces for high-grade traffic until the development of purely electronic, on-line systems based on digital techniques.

Many systems may be relatively impregnable against a listener who has access only to the encrypted material but may be fallible if some or all of the plain text of some of the messages is known. There are various methods which in this situation may be of great value. For example, system faults, human errors or by deliberately leaking the user a message of which at least some words will be known to the codebreaker. Then again it is usually necessary for the restroom to include key groups which provide instructions for the decoder, or information to aid the decipherer which may reduce its security. The techniques of traffic analysis, particularly when applied to military communications, can provide valuable intelligence even when the code remains unbroken. Deception techniques, including the holding and subsequent re-transmission of an operational message at a different time, or (where the code can be broken) the alteration of its contents may be less applicable to the commercial than the military scene, but cannot be disregarded. Deception operations which were dissembled by the use of codes thought to be secure or in which the information disregarded included the now well-known "Double-Cross" and the German "North Pole" exploitations of radio links.

Fig. 1. Simplified form of polyalphabetic substitution enciphering in which the position of each letter of the original text (key B) is shifted along the alphabet by an amount determined by the corresponding letter of the key. For example N+B=P. A cipher text letter may thus represent any letter of plain text except itself. If the running-key is truly random and of unlimited length the cipher cannot be broken.

Fig. 2. Simplified form of polyalphabetic substitution enciphering in which the position of each letter of the original text (key A) is shifted along the alphabet by an amount determined by the corresponding letter of the key. For example N+B=P. A cipher text letter may thus represent any letter of plain text except itself. If the running-key is truly random and of unlimited length the cipher cannot be broken.

Fig. 3. Simplified form of digital polyalphabetic cipher. Random key running key acts individually on each bit of the digitized plain text to produce an unconditionally secure cryptosystem.

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

PLAIN TEXT A B C D E F G H I J K L M N O P Q R S T U V W X Y Z


RUNNING KEY 6 4 7 9 2 5 3 1 8

SHIFT 2 1 3 5 4 2 6 1 5 6 11 18 8 9 7 10 14 19 21 6

CIPHER TEXT Z N W S U E J U N M Y F T G R

Fig. 4. Basic outline of DES shows the form of structure of the data manipulation and derived key generation; pattern is repeated many times and provides non-linear logic.

Fig. 5. Basic arrangement of DES shows the form of structure of the data manipulation and derived key generation; pattern is repeated many times and provides non-linear logic.

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The emphasis is on making the transformation of the plain text so complicated that even with massive computer power it would be totally uneconomical to search out all possible solutions; such ciphers are then termed computationally secure. However not all ciphers that are thought to be secure against computer attack may be so in reality. According to Martin Hellman, "At present mathematicians lack the tools for proving systems to be computationally secure and the history of cryptography demonstrates all too well that supposedly unbreakable systems have hidden flaws."

Security of codes

The so-called one-time pad, that is to say the provision of truly random paired keys of unlimited length, has long been accepted as one of the few systems that are unconditionally secure. The use of such a system however involves a number of practical difficulties, including the production and distribution of thousands or even millions of tapes. If used for multiple-address messages then the loss of one pad puts the entire system in jeopardy; if operated only with paired-users the production and distribution costs become formidable. Physical security of machines is important and personnel handling and storage costs become formidable.

In practice the cage and keywheels of the Hagelin machine and the rotors of Enigma, Sigaba and the British Type machines provided the workforces for high-grade traffic until the development of purely electronic, on-line systems based on digital techniques.

Many systems may be relatively impregnable against a listener who has access only to the encrypted material but may be fallible if some or all of the plain text of some of the messages is known. There are various methods which in this situation may be of great value. For example, system faults, human errors or by deliberately leaking the user a message of which at least some words will be known to the codebreaker. Then again it is usually necessary for the restroom to include key groups which provide instructions for the decoder, or information to aid the decipherer which may reduce its security. The techniques of traffic analysis, particularly when applied to military communications, can provide valuable intelligence even when the code remains unbroken. Deception techniques, including the holding and subsequent re-transmission of an operational message at a different time, or (where the code can be broken) the alteration of its contents may be less applicable to the commercial than the military scene, but cannot be disregarded. Deception operations which were dissembled by the use of codes thought to be secure or in which the information disregarded included the now well-known "Double-Cross" and the German "North Pole" exploitations of radio links.

Human fallibility, including failure to operate strictly the signalling rules of a system, plays an important role in cryptography and it is only once the experience to decode a message made secure by a one-time pad with a plain text that read. "Hawker is not repeat not to have access to the code books."

When I discussed the case with the police, dressed, he laughed and told me to continue decoding his messages as before in which case hisотов had a habit of defeating systems.

The existence of a communications channel carrying coded messages presents a strong temptation to unautho-
Use of users, who seek access to the channel for their own purposes. When the Americans built an elaborate defense microwave network in Vietnam it was regarded as almost as much appreciated by the Viet Cong. At a lower level, signals personnel may establish their own private networks of communication.

Data encryption standard

During the past few years the relatively open study of modern cryptography, particularly by IBM and at Stanford University, California, is leading to a better understanding of the requirements of systems for the protection of commercial and administrative data transmission. The IBM work has led to the development of a data encryption standard (DES) for the safe transmission of sensitive (but not highly classified) information. At a major conference in Paris in 1976, IBM announced a new ciphering system designed to ensure that the output can never contain the key or plain text. However, it is feared that the system can be broken and that it is now possible to assess the strength of DES even though nobody has yet proved publicly that this is the case. An alternative family of novel cryp
tography has been set out in some detail by the Home Office data protection committee, and no attempt is made to promote the adoption by the business and intelligence communities.

Public-key systems

Although the DES algorithm is being applied widely, its use is currently limited to the protection of computer data rather than to the protection of data carried on the telephone network. The most important aspect of public-key cryptography is that it does not require the exchange of a secret key. Each party establishes a pair of keys: one that is kept secret (the private key) and another that is made known to everyone (the public key). A message encrypted with one party's public key can be decrypted only with the other party's private key. This is the basis of the security of the system.

Public-key cryptography, although it seems to be a strong alternative to DES, is not yet widely used because it is more complex and computationally intensive. However, public-key systems are being developed and could become important in the future.

DES provides a ciphering algorithm or set of rules involving both substitution and transposition techniques and capable of being implemented in current, i.e. technology; Figs. 4, 5 and 6. Each data block passes through 16 data-manipulation stages in which 16 different internal coding keys are derived from a 56-bit main key (with 64-bit input coding). This provides 2" to 10" keys, presenting a codebreaker with the need for a truly massive search, always provided that nothing is known about the en
ciphering key. Diffie and Hellman, advocates of the public key system, pointed out that knowledge of even a quite small part of the basic key would greatly reduce the search required, and that i.e. technology now makes it possible to contemplate searching of gigantic proportions. They postulate a decoding machine using a million i.e. chips, that could search each of the full 10" keys could be searched in about a day. This modern version of "Colossus" could cost an estimated £10 million, with an average cost per solution of about £2500. While only a very few organizations, including governments, could possibly contemplate building decoding machines, the mere possibility tends to send shivers down the spines of those who are intending to trust their security to the NBS standard. There is some suspicion, reflected in

Fig. 6. Simplified arrangement of the 40-pin i.e. chip which forms a microprocessor peripheral capable of implementing DES up to speeds of 640 bits or faster by parallel connection of devices.

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Like Faraday (Maxwell) looked upon the role of conductors in electricity as a minor one, since they were only terminations of the lines of force of the surrounding electric field.

Physics offers several other examples of dual representation – light waves and electrons as particles or waves (electron diffraction) – but only in electrical phenomena are the two dual representations, circuit and field, always and exactly interchangeable. It is only in the present century that there has been such an enormous development in the techniques of circuit analysis, while earlier scientists such as Faraday (1791-1825), Maxwell (1831-1879) and Poynting (1852-1914) regarded fields as pre-eminent. (It should be added that fields involve the use of vectors, and often difficult geometry, whereas circuits involve only the algebraic properties of one-dimensional quantities.) The development of waveguide and associated techniques, for which circuit representation is impracticable, may tend to reverse this balance.

The first question asked nowadays is "Are fields real?" Those who ask this question overlook the fact that the established alternative to fields is action-at-a-distance, another concept of modern physics, such as the wave nature of the electron and the quark; one has to go through a difficult concept of wave mechanics (sometimes introduced in terms of "wave-particle duality") to provide the theoretical basis for the whole of modern solid-state technology. Einstein's principle of equivalence and the connection of the problem of gravitational action-at-a-distance was to enhance Newton's law, that a force between two bodies situated in one space, may act simultaneously in both directions.

One becomes a significant part of the period of the alternating current, which is producing it.

So acceptable is the concept of fields and waves in substitution for action-at-a-distance that scientists are now looking for gravity waves (without much success so far). It is true that discarding the "luminiferous aether" which was supposed to be an all-pervading medium supporting electromagnetic waves, the two dual representations, field and particle, were originally thought of as "states of stress in a medium" must now be regarded as "properties which exist in space", but this is more difficult to accept than other indispensable concepts of modern physics, such as the field of force E and D is a field which quantifies the energy stored in the region of space occupied by the field, and the volume occupied by the field is the total field energy stored in the region of space occupied by the field, and the volume occupied by the field is the total field energy stored in the region of space occupied by the field, for the field to spread from one side of the loop to the other becomes a significant part of the period of the alternating current, which is producing it.

The second approach was to accept the concept of fields as analogous to the gravitational force which pervades space, and waves in substitution for action-at-a-distance and the "luminiferous aether". Indeed, the concept of fields developed rapidly and been successful to such an extent that it was regarded as an "established alternative to fields". However, it is true that fields involve the use of vectors, and often difficult geometry, whereas circuits involve only the algebraic properties of one-dimensional quantities. The development of waveguide and associated techniques, for which circuit representation is impracticable, may tend to reverse this balance.

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The energy stored in a charged capacitor made up of two plane parallel electrodes separated by a dielectric which has no effect on the lines of force of the surrounding electric field, but the energy stored is expressed in terms of the power flow per unit area (

\[ P = E \cdot H \]

The subject of magnetism has been concerned with the study of magnetic materials, and is more complicated because the simple (scalar) relationships of electrostatics must be replaced by vector relationships. The equation for the energy stored in a multi-turn inductor is given by

\[ E = \frac{1}{2} n^2 B_0^2 \pi L \]

where \( B_0 \) is the magnetic field strength, \( L \) is the length of the inductor, and \( n \) is the number of turns.

The vector P is at right angles to the plane of the loop, and its magnitude is

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An introduction to Poynting's Theorem

by D. A. Bell, First Inst., F.I.E.E.

WIRELESS WORLD, SEPTEMBER 1980

are space and/or time-varying fields; and the difference between $D$ and $E$ in a material medium is due to the reactions to the field of the various charged particles in the medium. From an engineering viewpoint, however, it is convenient to split the fields between "cause" and "effect", the former being independent of the medium. In electrostatics the total value of $D$ integrated over a surface is equal in SI units* to the electric flux from the integral over which the "flux of electric induction $D$" originates (Gauss's theorem). This is always the case when the boundary is a closed surface except for a charge. But the result, so $D$ can be regarded as a primary field which originates from charge, the "cause" of any observed phenomenon. Then the electric force field in an area $A$ is an integral of the electric field in the medium, which is usually expressed in the circuit quantities $E$ and $B$.

The vector $\mathbf{P}$ is at right angles to the plane of the inductor $E$ and $H$ and its magnitude is $EL\sin\theta$, where $E$ is the angle between $E$ and $H$ and $L$ is the length of the inductor. The coil provides an example of the use of vector methods, and in general these are useful in a system in which the electric and magnetic fields are coupled. In this case the system is to be considered a second-order system, and the vector field $\mathbf{P}$ is divided into two components, $\mathbf{P}_{\mathbf{E}}$ and $\mathbf{P}_{\mathbf{H}}$. The latter can be expressed as the product $\mathbf{E}\times\mathbf{H}$.

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As long as $H_{\text{int}}$, the value of $H$ will be the same. In Fig. 2(d) the process has been pushed to the limit, with only one turn. Alternatively the changes can be thought of as taking the original winding with groups of different numbers of turns in parallel instead of in series. Clearly the number of turns, or the series/parallel connection of turns, do not matter as long as the total current circulating around the solenoid is kept constant. For Fig. 2(d) in particular one can write

$$H = \frac{1}{b} \text{ampere/metre}$$

(11)

It is a simple matter to squash the inductor of Fig. 2(d) into the strip by making so that the potential difference will remain unchanged. If $H$ is not negligible, the conditions near the component conductor are obvious. By using Gauss's theorem as a method of calculating the Poynting vector, one can neglect penetration of the currents from the inner surface and decreases towards the outer surface. The direction of power flow, which is parallel to the axis of the coaxial system, is given by the magnitude $\text{EH}$ of the Poynting vector multiplied by the vector $\text{dr}$ of the annulus. (The directions of the Poynting vector is of course parallel to the axis of the coaxial system.)

$$\text{dW} = \text{EH} \cdot r \text{dr} \cdot (r/\text{ln}(b/a)) \quad \text{(A3)}$$

The total power flow is then

$$W = \text{dr} \cdot (r/\text{ln}(b/a))$$

(A4)

But the value of the integral is in inch$^2$ so

$$W = \frac{\pi r^2}{\text{ln}(b/a)} \quad \text{(A5)}$$

If the resistance of the conductors is significant, then just as in the case of the strip line there will be a component of $E$ parallel to the length of the system and a component of the Poynting vector pointing into the conductors to account for the $\text{PR}$ loss.

**APPENDIX**

Power flow in a lossless coaxial cable.

A cross-section of a coaxial cable having inner conductor radii $r$ and $r_a$ is shown in Fig. 4. Calculation is simplified if it is assumed that (a) the working frequency is so high that one can neglect penetration of the currents into the conductors and (b) resistive voltage drop along the length of the conductors is negligible. In fact conditions (a) and (b) are not independent since the skin depth depends on the resistivity.) At distance $r$ from the axis of the magnetic field is $H = \frac{1}{r}$. We know that the electric field is greatest at the inner surface and decreases logarithmically as one moves outward, but its relationship to the potential difference between the two surfaces is not obvious. By using Gauss's theorem as in the previous section, one can find the capacitance between coaxial cylinders if it can be shown that at radius $r$, $E = \frac{V}{r \text{ln}(b/a)}$. (In the symbol for a natural logarithm, otherwise denoted by log.)

The power flow through an annulus between radii $r$ and $r_a$ is given by the magnitude $\text{EH}$ of the Poynting vector multiplied by the annulus area $2\pi dr$. (The direction of the Poynting vector is of course parallel to the axis of the coaxial system.)

$$\text{dW} = \text{EH} \cdot 2\pi \text{dr}$$

(A3)

The total power flow is then

$$W = \int \text{EH} \cdot 2\pi \text{dr}$$

(A4)

But the value of the integral is in inch$^2$ so

$$W = \frac{\pi r^2}{\text{ln}(b/a)} \quad \text{(A5)}$$

If the resistance of the conductors is significant, then just as in the case of the strip line there will be a component of $E$ parallel to the length of the system and a component of the Poynting vector pointing into the conductors to account for the $\text{PR}$ loss.

**BOOKS**

Telecommunication System Engineering, by Roger Driscoll, is described as "a textbook and ready reference for the student, professional, or engineer, planner and telecom engineering." The view of telecommunications adopted is the widest possible, since in 488 pages radio is only allotted 66, which does seem a small amount, to say the least. The main body of the book is therefore concerned with the communication over telephone circuits of voice messages, data and facsimile, in analogue and digital forms. In the field the author sets out to cover it is difficult to imagine a more complete treatment, starting as it does with a diagram showing two telephones, a cable and a battery, and finishing with the concept of digital data networks and the economical technical planning involved in national networks. The author is American, which may mean that some transatlantic terms are unfamiliar, although he has used the UK engineers' term "bearer," for example, to denote the signal-carrying medium. The book is published by John Wiley and Sons Ltd, Baffins Lane, Chichester, West Sussex, P0191UD.

Practical Hi-Fi Sound, by Roger Driscoll, is intended to dispel the absurd technospeak so carefully built up by makers of sound equipment. The main difference between this one and a great many of the other books is that this author keeps his object well in mind and does not fall prey to the temptation to show off his own technical superiority.

The treatment is not detailed, but rather seeks to answer the questions which would be asked by someone who wanted to know the limits of the background of the present state of audio equipment. The two introductory chapters are concerned with musical sounds and their reproduction, being followed by two sections on equipment, including useful tuning and alignment. For a loudspeaker, the book fulfils its avowed purpose admirably and can be recommended. It costs £4.95. Published by Ian Allan Ltd, Aeronaut House, 280 Old Kent Road, Elephant and Castle, London SE1.

Simple alternatives to the monostable

Using low-cost gates for non-critical timing circuits

By D. Price

In comparison with other i.c.s, c.m.o.s. monostables are rather expensive, the 4528 package costing about £1 for two circuits. In a non-critical situation, for example when a reset pulse is required, cheaper solutions are available. A 4083 NAND Schmitt trigger, costing about 10p per gate, provides the basis for a satisfactory alternative. Referring to Fig. 1, the high input impedance of a c.m.o.s. gate ensures that the absence of other constraints, the voltage at B follows the voltage at A. However, gate protection diodes and the bias resistor modify the voltage performance in the following way. After a long quiescent period, the input voltage $V_a$ will be high and the output low. If a negative pulse is applied by $G_1$, the input to $G_2$ will go low and the output will go high. The input potential must be kept low for the duration of the pulse, otherwise the output will be prematurely terminated. A positive going excursion from $G_2$ will drive $V_a$ above the supply rail but, as soon as a voltage of $V_a < V_{qs}$ is reached, the gate protection diode starts to conduct and dissipates any excess charge. The circuit is therefore quick to reset. If the resistor is taken to the negative rail, all of the pulse directions are reversed.

The output pulse length is determined by $R_1$ and $C_1$ and is given by $\frac{1}{2\pi R_1 C_1}$. For a 4083 NAND Schmitt trigger, the supply voltage is $\pm 15$V, the RC time constant occurs above 15p, providing a monostable operation.

This principle can be used with two inputs simultaneously as shown in Fig. 2, which gives two gated monostables. However, the NAND property of the gate will not allow the resistors to be connected to the negative rail.

If a slow fall time can be accepted, which is often the case, an AND gate can be used as shown in Fig. 3 where a three input NAND becomes a trio of gated monostables, costing about 2p each. If an inverted output is required, replace the NAND with an AND gate and take all of the resistors to the negative rail and use a NOR gate.

During the operation of the gate, both output transistors are switched on and are dissipating power. For this reason, long time constants, i.e. slow transistions, should be avoided. Adding a diode to the external components of the above circuits produces a monostable which is activated while the input is low, and the RC time constant occurs after the input goes high, see Fig. 4. A somewhat more complex arrangement can provide two time constants as shown in Fig. 5. Although this circuit is not a conventional monostable, it is useful if, for instance, a delayed switch on and off is necessary.

A wide range of RC values can be used with c.m.o.s. but, to avoid excessive dissipation and possible damage to the gate protection diodes, capacitor values below 100nF should be used. This does not apply to Fig. 4 and 5 as the circuits do not use the gate diodes. At the other extreme, less than 10pF may cause trouble due to the c.m.o.s. input capacitance, see Fig. 6. The voltage at $V_a$ is provided at the negative by a negative transition of $V_a$, and this may not activate the Schmitt trigger. If the trigger is activated, the time constant will be much shorter than anticipated. Almost any resistor value above 1k can be used, and for long time constants reverse-biased diode is a useful high value resistance. The resistance limit of 10k is set by the input impedance of the gate.
As long as process has been pushed to the limit, the total current circulating around the conductor is not in series. The magnetic field in the space between conductors is given by the equation \( P = EH \). The Poynting vector of the magnetic field is given by \( dW = EH \cdot 2 \pi r \cdot dr \). In this case, the Poynting vector of the electric field is given by \( dW = \frac{1}{2} \pi r^2 \cdot \frac{d}{b} \cdot \frac{d}{a} \). The total power flow is then \( \frac{1}{2} \pi r^2 \cdot \frac{d}{b} \cdot \frac{d}{a} \). The electric field is greatest at the inner surface and decreases towards the outer surface, but its relationship to the distance between the two surfaces is not obvious. By using Gauss's theorem as the basis for a satisfactory alternative, power flow may be obtained at the expense of some of the background to the present state of audio equipment. The two introductory sections are concerned with musical sound and their reproduction, being followed by two sections on equipment, including loudspeakers and microphones. The book fulfills its purpose admirably and can be recommended. It is easily understood by engineers and students.

Simple alternatives to the monostable
Using low-cost gates for non-critical timing circuits

In comparison with other lcs, c.m.o.s. monostables are relatively expensive, the 4528 package costing around £1.00 for two circuits. In a non-critical situation, for example when a reset pulse is required, cheaper solutions are available. A 4093 NAND Schmitt trigger, costing 10p per gate, provides the basis for a satisfactory alternative. Referring to Fig. 1, the high input impedance of a c.m.o.s. gate ensures that the absence of other constraints, the voltage at B follows the voltage at A. However, gate protection diodes and the bias resistor modify the voltage performance in the following way. After a long quiescent period, the input voltage \( V_A \) will be high and the output low. If a negative pulse is applied to \( G_2 \), the input to \( G_2 \) will go low and the output will go high. If a pulse is applied to \( R_2 \) and \( C_2 \) is not equal to \( R_2 \), the output will fall. The input potential must be kept low for the duration of the pulse, otherwise the output will be permanently terminated. A good going excursion from \( G_2 \) will drive \( V_A \) above the power supply rail, but, as soon as a voltage of \( V_A = V_{CC} + 0.3 \)V is reached, the gate protection diode starts to conduct and discharges any excess charge. The circuit is therefore quickly reset. If the resistor is taken to the negative rail, all of the pulse directions are reversed.

The output pulse length is determined by \( R_2 \) and \( C_2 \). As an approximation, assume that the trigger point of the gate is such that the two power supplies are equal. Using the formula \( V = V_{CC} + 0.3 \pi \), the output voltage \( V_O = V_{CC} + 0.3 \pi \). Therefore, \( T = \frac{1}{2} \pi \).

This principle can be used with two inputs simultaneously as shown in Fig. 2, which gives two gated monostables. However, the NAND property of the gate will not allow the resistors to be connected to the negative rail. If a slow fall time can be accepted, which is often the case, an input can be used as shown in Fig. 3 where a three input NAND becomes a trio of gated monostables, costing about £2 each. If an inverted output is required, replace the NAND with an AND gate and take all of the resistors to the negative rail and use an NOR gate.

During the fall time of the gate, both output transistors are switched on and are dissipating power. For this reason, long time constants, i.e. slow transistions, should be avoided. Adding a diode to the external components of the above circuits produces a monostable which is activated while the input is low, and the RC time constant occurs after the input goes high, see Fig. 4. A somewhat more complex arrangement can provide two time constants as shown in Fig. 5. Although this circuit is not a conventional monostable, it is useful if, for instance, a delayed switch on and off is necessary.

A wide range of RC values can be used with c.m.o.s. but, to avoid excessive dissipation and possible damage to the gate protection diodes, capacitor values below 100pF should be used. This does not apply to Fig. 4 and 5 as the circuits do not use the gate diodes. At the other extreme, less than 1pF may cause trouble due to the c.m.o.s. input capacitance, see Fig. 6. The voltage \( V_{DD} \) is clipped at \( V_{CC} \) by a negative transition of \( V_A \) which is not activated. This will not activate the Schmitt trigger. If the trigger is activated, the time constant will be much shorter than anticipated.
New Racal company set to cash in on cheque-less banking

A further step in the trend to electronic banking methods has been taken with the formation of a new company, Racal-Transcom Ltd which, for the time being at least, will be a prime mover in eliminating the need for cheque books, and paperwork in many financial transactions.

The system which Racal Transcom intends to introduce will be designed to eliminate much of the paper work which possible users such as banks, credit companies, finance houses, airlines and retail organisations might have to go through.

Announcing the formation of the new company, Ernest Harriman, the managing director and chief executive of the Racal Electronics Group, said: "Electronic fund transfer will have a major impact on the retail world, and its international growth potential is extremely large. Eventually it could affect almost everyone who makes a purchase, pays a service or borrows money.

Racal-Transcom is a subsidiary of Racal-Datalink of Salisbury, Wiltshire and the design team responsible for the development of the new systems over the last two years will be located in separate premises on the same site.

Tens of millions of independent users will be needed to make the new system work satisfactorily, and the company estimates that about 100 million or more such users will be required to achieve a certain critical mass.

The system which Racal Transcom intends to introduce is called "Chequeless" and can be summarised as follows:

- Customers use standard cheque books containing magnetic tape strips. The tape is encoded with a unique code number

- The code numbers are input on to a data terminal and the transactions are sent to a central computer

- Chequeless makes use of a "self-policing" type of radio device which can be dealt with by the radio police

- The company say the system is capable of being expanded to cover the entire country

Chequeless will also have a number of other benefits for users such as:

- Chequeless will be more convenient and time-saving than traditional cheque books

- Chequeless will be more efficient and accurate than manual systems

- Chequeless will be more secure and less susceptible to fraud than traditional cheque books

- Chequeless will be more flexible and adaptable than traditional cheque books

Chequeless will be marketed as a "self-policing" type of system, and will be available to all users, regardless of whether they are cheque book users or not.

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Racal-Transcom is a subsidiary of Racal-Datacom of Salisbury. Wilshaw who is the design team responsible for the development of the new systems over the last two years will be located in separate premises on the same site.

“More work on spectrum utilization needed” says CCIR chief

Not enough effort is being put into finding better ways of utilizing the radio spectrum, according to Richard Kirby, director of the ITU, which is in charge of better ways of utilizing the radio spectrum, according to Richard Kirby, director of the ITU, which is in charge of international studies of spectrum utilization.

It is clear that there are not very many Ph.D. theses on spectrum utilization topics. Some of the best talent in communication science ought to be encouraged to explore and develop this field. It would seem to me that the CCIR is in a good position to foster this.

Earlier Mr Kirby had outlined the future work in the field, "The Commissions of the ITU (the permanent body of the ITU) will be doing in the aftermath of the 1979 World Administrative Radio Conference at Geneva. He indicated five main areas: bandwidth-efficient modulation, frequency re-use, domestic and regional satellite systems, the role of i.f. and improvement of equipment standards from the point of view of spurious emissions and unwanted responses.

"First, as regards bandwidth-efficient, interference-resistant modulation: the dominant trend to digital systems for terrestrial and space systems alike, mobile, fixed, and usually even television, is being greatly spurred by the rapid development of very large scale integrated circuitry...spread spectrum has already proven advantages for rejection of narrow-band interference and reduction of interfering power spectral density. It remains to be seen whether, by the additional processing gain of correlation codes, an ensemble of spread spectrum systems can share a given band of space more efficiently than narrow band signals. The new processing technology should have a great bearing on "multi-user communications", i.e. techniques by which one or more transmitters are simultaneously spaced with very narrow guard bands over a common channel in the radio spectrum. "Packet radio", a related random access concept, is promising not only for data, but also for speech. A resolution of the WARC has asked the CCIR to give special attention to the possibility of using techniques which could lead to a whole new approach to channel assignment and the possibility of interference. Given the spectrum compared with present-day frequency reuse, the use of more increased emphasis on bandwidth conservation. The spectrum utilization from interference and compression techniques are very promising. More conventionally, single-sideband is finally being seriously considered for forward broadcasting. The CCIR has been asked to initiate discussions on the economics of single-sideband broadcasting".

The coming C.IF broadcasting conference, while committed to double sideband for the next plan, also had on its agenda the specification of s.s.b. system suitable for future broadcasting.

"Frequency re-use is the objective of some of the most important developments in satellite systems for satellites and terrestrial communications alike. It is also the motivation for important propagation research, especially at high frequencies, where the main features of propagation are already known. Questions such as how much polarization discrimination can be achieved in practice, under rainfall conditions, and how small antenna beamwidths can be maintained through the atmosphere, might at one time have been considered second order questions. They are now central to frequency re-use, as are non-stationary propagation effects such as ducting and scintillation..." The Secretary of State for Industry, Sir Keith Joseph, officially opened the Plessey p.c.b. plant at South Shields on July 11th, and also formally introduced the new company – Plessey Circuits Ltd.

The course is intended to provide a clear insight into interference problems and to combat spurious emissions and unwanted responses. The course is intended to provide a clear insight into interference problems and to combat spurious emissions and unwanted responses.

"We must take every opportunity to stop this happening", he said. "I firmly believe that the type of legislation which is being introduced by the Home Office to stop this happening is the right one." He also said that he would be bringing forward proposals in the near future relating to the Wireless Telegraphy Act 1949 and at a later stage to identify other categories of radio wave use to be controlled with less bureaucratic control and greater freedom for individuals. Almost simultaneously with Whitehead's announcement was Timothy Raison's disclosure that the Home Office had received 7,800 letters on the subject of c.b. and 40 petitions carrying thousands of signatures. In reply to questions he said that the annual cost to the Post Office of investigations into complaints of interference is "very modest", while the annual cost of illicit use of 27MHz was not recorded. The cost incurred in dealing with illicit use of 27MHz were not recorded separately and "no figures are available for the cost of controlling imports of prohibited equipment." He also revealed that from 1 January to 30 April 1979, 194 persons were prosecuted in connexion with unlicensed installations or use of c.b. equipment at 27MHz, and a further 135 cases are pending. In 1978 a total of three persons were convicted of such offences and in 1979 the total had risen to 91. Minister of State at the Treasury, Peter Rees, disclosed that 721 sets were seized by Customs and Excise in the first quarter of 1980 and a total of 3,071 sets were seized in 1979. One interpretation of these official trends might well lead to greater realism on the part of people who want to organize a protest movement to stop the misuse of 27MHz. It remains to be seen whether, by the additional processing gain of correlation codes, an ensemble of spectrum systems can provide the kind of characteristics for both earth stations and satellites that will be required to satisfy the requirements of the future broadcasting.

"The only positive conclusion to be drawn from these government pronouncements is that some action may happen at some future date, having been duly considered and fully costed.

News in brief

South London College will be running a course of eight lectures, the first starting on November 26th, 1980 and the last on 2 December 1980, entitled "Optical Fibre Communications". The course will provide a comprehensive technical introduction to optical communication devices and systems and their applications to multi-channel telephone and wideband services. The course fee for attendance at all eight lectures should be made to A. R. Rowlands, South London College, Knights Hill, London SE22 0TX. Telephone 01-670 4488..."
Marconi to supply military equipment to China

A £40 million contract for the supply of electronics equipment "for defence purposes" has been signed by Marconi Antennas and China.

The contract calls for delivery of equipment and associated services under licence to China and includes the establishment of a manufacturing plant in China. The plant will be designed and supervised by British engineers and will be responsible for the manufacture of equipment under licence in China.

Marconi supplies avionics systems for 150 different aircraft types worldwide. The new contract, which forms part of the company's continuing programme to supply a wide range of electronic equipment for military and civil applications, has already established the production of this equipment under licence in China.

News in brief

Illegal C.B. operator Thomas Hanson, whose transmitter was located back from the Home Office, has been fined £80 and ordered to pay £20 recovery costs for an illegal CB radio.

The 32nd Annual Conference on Computer-Bashing will be held in London this month. The conference, which is attended by some of the most famous computer enthusiasts in the world, will provide an opportunity for those interested in computer technology to meet and share their experiences.

Giotto, the 14th century Italian painter, who was known for his innovative approach to painting, will be commemorated in an exhibition to be held in London next month. The exhibition, which will take place at the National Gallery, will feature some of Giotto's most important works.

Globefish and Another, Goffsthorpe Secondary School, Newcastle upon Tyne, have been appointed to the new £40-80,000 contract as part of the company's continuing programme to supply a wide range of electronic equipment for military and civil applications.

The International Broadcasting Convention (IBC) will be held from June 20 to 30 in Birmingham, at the Metropolitan Hotel. Further information is available from the IRC Secretary, EAV, Savoy Place, London WC2R 0BE.

Newcastle upon Tyne Education Authority is running a course which is designed to prepare pupils for the A-Level Art and Design Examination (A.R.A.E). The course begins in September 1987 and will be taught by 600 students at the University of Newcastle.

Two-way radio installed in caves

The network of caves below the site of Newcastle Castle is to be served by a two-way radio system, the equipment being supplied by Py-Telecommunications for the City of Newcastle's Technical Services Department.

These caves are open to the public for guided tours and as a result of difficulties experienced by elderly visitors negotiating the slopes and bends, as well as for security purposes, Newcastle's Technical Services Department decided to install a base station as ground level, coupled with a number of portable radio transceivers.

The scheme will enable guides, who are not permitted to leave the guided tour line, to contact other members of the party for help, to summon medical aid in an emergency.

Causing Halley's Comet to catch the tail

A spokesman of British Aerospace Dynamics pointed out that, important as the mission is, there is no guarantee that it will be approved, although the recent decision by the company to launch a working robot called Commander Bill will be welcomed by many.
Unsuspected gremlins at work in hospital computing

According to an item in Reports on Research (Massachusetts Institute of Technology), computer-based administrative and medical information systems in hospitals in the US are prone to interference by hospital staff. In some cases this interference, which is often accomplished through subtle processes such as non-co-operation in schemes to change from manual to automatic systems, is serious enough to make the system unworkable.

Dowling, a doctoral candidate in health management and management information systems at MIT's Sloan School of Management, says he was able to get his transmitter back from the Home Office in Wellington and that it had been in his car. Although he was fined £80 for illegal use of a radio callsign, he says it is the 'most serious' infringement of the law he had ever encountered, and warns that the situation is likely to become worse as the number of vehicles equipped with mobile telephones increases.

The International Broadcasting Convention (IBC) will be held at the Bridgewater Exhibition Centre at the Blake Museum, in the Twenty and Twenty hotel, in January 1980.

Newcastle upon Tyne Education Authority is running a course which is designed to prepare pupils for entry to universities. The course begins in September 1980 at Gosforth Secondary School and will run every Tuesday from 7 to 9 p.m. Candidates for the May/June examination may sit for the examination at any time and the course is intended to help students who have been identified as having special learning difficulties.

Two-way radio installed in caves

The network of caves below the site of the Nottingham Castle is to be served by a two-way radio system, the equipment being supplied by the Telecommunications Department of the City of Nottingham's Technical Services Department.

These caves are open to the public for guided tours and as a result of difficulties experienced by elderly visitors negotiating the steps and benches, as well as for security purposes, the city's administration has decided to install a base station at ground level, supplemented by two-way portable transceivers. The scheme will enable guides, who are not normally allowed into these caves, to leave their parties and operate out of doors, according to Dowling, and is likely to be used in other walks of life, such as search and rescue operations, and to help in the event of a disaster.
Flexible rate control

This circuit may be useful for digital tuning or a model control which requires reverse, stop, forward and speed functions from one potentiometer.

Resistor \( R_{\text{a}} \) controls digital outputs \( A, B \) and \( C \) via two comparators so that \( A = 1 \) when \( V_1 < V < V_2 \), \( B = 1 \) when \( V_1 < V < V_3 \) and \( C = 1 \) when \( V > V_2 \). The ratios of \( A, B \) and \( C \), shown on the graph, can be varied by \( R_{\text{a}} \) to control a RC oscillator.

Parallel binary multiplier

Binary multiplication is usually performed by repetitive addition using serial and/or parallel operations. Because parallel multipliers are faster, they are preferable for computing applications. This circuit is a 4X4-bit parallel multiplier which operates in a similar way to conventional written multiplication. The 8-bit product is generated in less than 60ns, and at around half the cost of dedicated circuits such as the 74254 and 285.

Imaddin Al-Bazz
University of Technology
Iraq

Asynchronous serial data transmitter

When information needs to be sent asynchronously using a start-stop bit format, but the application does not justify a standard UART, this data transmitter can provide a simple solution.

When data is available, the Data Ready line goes high, which resets the counter and clears the shift register. Data is loaded into the shift register, one byte at a time. At the same time, the clock of IC1 is started and data is shifted out one bit at a time. After each bit has been shifted, the clock is stopped and the Data Dump line goes high, indicating the start of the next byte.

J. B. Cole
Houston
Texas

Adding capacitance ranges to a multimeter

Capacitance ranges can be economically incorporated in 3½-digit L.CD multimeters based on the ICL7106. A 4066 is used to generate a square wave with the same frequency as the display backplane drive, and with a pk-to-pk amplitude defined by the internal 2.8V reference of the 7106. A second 4066 forms a full-wave synchronous rectifier. One inverter is required and is formed by an exclusive-OR gate because three gates are needed to drive the decimal points.

The circuit uses precision shunt resistors and offers good linearity up to about 100pF. Beyond this value the linearity deteriorates rapidly because the capacitors have a time constant which is the product of the time constant of the capacitor and the time constant of the shunt resistor. The integrator frequency should be adjusted or the backplane frequency should be reduced to prevent a f.1 Hz beat which would cause fluctuations of the capacitance reading. The clock frequencies listed below provide good stability, even when unscreened test leads are used.

J. B. Cole
Houston
Texas

Keyboard sounder

When using a keyboard it is helpful to have an audible indication that an entry has registered. This circuit was designed for the scientific computer, and gives a bleep through the television loudspeaker.

An input 555 is connected as a monostable and, when triggered, gives a 50ms pulse. The second timer is connected in the astable mode, and gives a burst of 2kHz when enabled by the monostable. The input requires a negative-going pulse, which is available from pin 17, NMI input, of the Z80.

M. A. Wheatley
Maidenhead
Berks.

WIRELESS WORLD. SEPTEMBER 1980

Flexible rate control

This circuit may be useful for digital tuning or a model control which requires reverse, stop, forward and speed functions from one potentiometer.

Resistor \( R_{\text{a}} \) controls digital outputs \( A, B \) and \( C \) via two comparators so that \( A = 1 \) when \( V_1 < V < V_2 \), \( B = 1 \) when \( V_1 < V < V_3 \) and \( C = 1 \) when \( V > V_2 \). The ratios of \( A, B \) and \( C \), shown on the graph, can be varied by \( R_{\text{a}} \) to control a RC oscillator.

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Houston
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The circuit uses precision shunt resistors and offers good linearity up to about 100pF. Beyond this value the linearity deteriorates rapidly because the capacitors have a time constant which is the product of the time constant of the capacitor and the time constant of the shunt resistor. The integrator frequency should be adjusted or the backplane frequency should be reduced to prevent a f.1 Hz beat which would cause fluctuations of the capacitance reading. The clock frequencies listed below provide good stability, even when unscreened test leads are used.

J. B. Cole
Houston
Texas

Keyboard sounder

When using a keyboard it is helpful to have an audible indication that an entry has registered. This circuit was designed for the scientific computer, and gives a bleep through the television loudspeaker.

An input 555 is connected as a monostable and, when triggered, gives a 50ms pulse. The second timer is connected in the astable mode, and gives a burst of 2kHz when enabled by the monostable. The input requires a negative-going pulse, which is available from pin 17, NMI input, of the Z80.

M. A. Wheatley
Maidenhead
Berks.
**Flexible rate control**

This circuit may be useful for digital tuning or a model control which requires reverse, stop, forward and speed functions from one potentiometer.

Resistor R2 controls digital outputs A, B and C via two comparators so that A is 1 when 0<V<V1, B is 1 when V1<V<V2, and C is 1 when V2<V. The ratios of A, B and C, shown on the graph, can be varied by R1, R2 controls the analogue output symmetrically about the centre of rotation. The control is non-linear and varies most rapidly at the extremes of rotation. In some applications it may be more useful for R2 to control a RC oscillator.

D.C. Hopkins

Newcastle

**Parallel binary multiplier**

Binary multiplication is usually performed by repetitive addition using serial and/or parallel operations. Because parallel multipliers are faster, they are preferable for computing applications. This circuit is a 4x4-bit parallel multiplier which operates in a similar way to conventional written multiplication. The 8-bit product is generated in less than 60ns, and at around half the cost of dedicated circuits such as the 74294 and 285.

Imaddin Al-Bazz

University of Technology

Iraq

**Asynchronous serial data transmitter**

When information needs to be sent asynchronously using a start-stop bit format, but the application does not justify a standard UART, i.e., this data transmitter can provide a simple solution.

When data is available, the Data Ready line goes high, which removes the reset from the counter and sets the shift register in the parallel mode. At the next positive-going clock edge, the start bit and seven data bits are loaded into the shift register. Q1 goes low, Q2 goes high.

**Keyboard sounder**

When using a keyboard it is helpful to have an audible indication that an entry has registered. This circuit was designed for the scientific computer, and gives a beep through the television loudspeaker.

An input 555 is connected as a monostable and, when triggered, gives a 50ms pulse. The second timer is connected in the astable mode, and gives a burst of 2kHz when enabled by the monostable. The input requires a negative-going pulse, which is available from pin 17, NMI input, of the Z80. The output is fed to the volume control of the v.d.u.

M. A. Wheatley

Maidenhead

Berks.

**Adding capacitance ranges to a multimeter**

Capacitance ranges can be economically incorporated in 3½ digit L.C.D. multimeters based on the ICL7106. A 4066 is used to generate a square wave with the same frequency as the display, and with a pk-to-pk amplitude defined by the internal 2.8V reference of the 7106. A second 4066 forms a full-wave synchronic rectifier. One inverter is required and is formed by an exclusive-OR gate because three gates are needed to drive the decimal points.

The circuit uses precision shunt resistors and offers good linearity up to about 10µF. Beyond this value the linearity deteriorates rapidly because the capacitor no longer has time to charge or discharge completely during each half cycle. The 7106 operates on the dual-slope principle and, for correct operation, the clock frequency should be adjusted or crystal controlled to reject mains pickup by making the integration interval an integer number of mains cycles. An important advantage of this circuit is that ripple, at twice the backplane frequency, across the 150µF capacitor is automatically rejected in the same way. However, the backplane frequency should be several Hertz removed from the mains frequency to prevent a LF beat which would cause fluctuations of the capacitance reading. The clock frequencies listed below provide good stability, even when unscreened test leads are used.

J. B. Cole

Houston

Texas

- Mains
  - Frequency: 50Hz
  - Clock frequency: 40kHz
  - Backplane frequency: 62.5Hz
- Readings
  - 50Hz: sec^{-1} 3.1
  - 40kHz: sec^{-1} 2.5
Video-line trigger
An individual video line or group of lines can be displayed on an oscilloscope by using this simple trigger circuit. The 550 monostable is triggered by a frame pulse derived from the mixed syncs, and generates a pulse of up to 20ms. The flip-flop synchronizes the end of this pulse with the next line sync, pulse to prevent display jitter. Current consumption is typically 30mA.

P. Newman and M. Tierney
Southern General Hospital
Glasgow

Efficient c.d.i. system
This capacitor-discharge ignition system is based on R. M. Carter's transistor converter. Circuit ideas, Nov. 1975. Tr 2 is biased on by current through R 5 , which causes collector current to pass through the primary winding of Tr 1 . Positive feedback from the secondary winding increases the collector current which causes collector current to pass through R 4 to operate Tr 2 on, which then inhibits Tr 1 .
The discharge circuit uses a conventional thyristor design. D 3 , C 3 and R 7 form a debounce circuit, and R 7 can also act as a rev. limiter. Because the current through C 3 is sufficient to switch Tr 3 on, which inhibits Tr 1 .

W. K. Todd
Colchester
Essex

Decimal to binary conversion
If it is necessary or convenient to load data via thumbwheel switches, this circuit provides a cheap method of conversion provided numbers from 0 to 99 are sufficient. The units thumbwheel is an ordinary b.c.d. type, and the tens thumbwheel is a decimal output version. Each decade feeds the appropriate number into the binary adders, which can be c.m.o.s. or t.t.l.

1. H. Math
Aberdeen
Dunbartonshire

Transistor recorder — 2
Control and timing signals
by G. J. Adams B.Sc., Ph. D.

The logic required for the address counter is shown in Fig. 9. The address lines A 1 to A 8 are set low by the reset button. When the counter is enabled, the address count is from 0 to 255 and IC 3 produces an end signal to mark the end of a single sweep. If the load signal is taken low, the address position to the external address input appears on A 1 to A 8 . Therefore, any memory location can be addressed by an external device.

For normal operation the manual/auto switch is set to the auto position. However, if the contents of the memory used to be examined one word at a time, the manual position is selected. After operation of the reset button, the contents of the turn counter will be displayed on the readout. Operation of the manual clock-switch advances the address by one and displays the contents of the next location.

The circuit shown in Fig. 10 provides timing signals for the sample, a-to-d conversion, word storage sequence and the clock signal required for the address counter. Clock 1 and clock 2 outputs which are t.t.l.-level square-wave signals at the same frequency as the sampling rate, are produced by the voltage-controlled function generator IC 30 . Five overlapping frequency ranges are provided and variation within each range is achieved by adjusting a 2kΩ potentiometer which is calibrated from 1 to 11 . Frequency variation is roughly linear with potentiometer variation, and a ten-turn potentiometer with a turns counter was used in the prototype. The low-frequency limit is adjusted first by setting the turns counter to 1 and setting the potentiometer to give the correct frequency. The upper line is set by turning the potentiometer to 10 and adjusting R 12 to give the correct frequency. The 470 Ω potentiometer may require trimming due to stray capacitance.

A separate +15V regulator supplies the oscillator l.c. to prevent modulation of the main +15V line by the clock. This additional regulator also improves the stability of the clock frequency. The main power supply in Fig. 11 uses two regulators to provide four supply rails.

Increasing the memory
If a larger memory is required, additional stages must be incorporated into the address counter so that the extra memory locations can be addressed. For example, if a third 74193 counter is connected to IC 31 , in the same way as IC 30 is connected to IC 31 , then 12 bits will be available which can address up to 4096 memory locations. IC 31 will need additional inputs so that the end output is in the low state only when the last memory location is addressed.

If pairs of 256 x 4-bit memory blocks are used to construct an 8-bit memory, the addresses of the memory blocks can then be driven by the outputs of a decoder whose inputs are the address lines of the additional counter stages. The decoding logic ensures that only one pair of memory blocks is active at a time. An alternative scheme, which is more expensive but reduces the amount of wiring required, is to use 1024 x 4-bit memory blocks.

Operation
To operate the transistor recorder, select auto mode and push the reset button. For recording, select a suitable input sensitivity and sampling frequency, and operate the arm button. In this state the input is continually sampled and the digital word is displayed by the l.e.d.s. With no input present, the a-to-d converter's full range can be observed by adjusting the offset control. With an input signal connected, the recorder is triggered manually or by a 5V high-tolow edge at the trigger input. Triggering may not occur immediately due to the free-running clock, however, it will occur within one sample period and the exact triggering point is identified by a positive edge at the trigger-acknowledge output. Information stored in the first memory location corresponds to the sample taken immediately before this output. Therefore, although the recorder may not trigger immediately, the stored data is valid from receipt of the trigger signal, and in some cases up to a sample period before this. When all of the memory locations have been filled with data, the recording l.e.d turns off.

To display the contents of the memory on an oscilloscope, select repetitive mode and a suitable playback rate, i.e. the sampling frequency. When the analogue output is connected to an oscilloscope, recorded data is displayed as a continuous periodic waveform. To plot the data on a chart recorder, operate the reset button, select the

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Fig. 9. Counter logic controls the 8-bit memory address.
Video-line trigger

An individual video line or group of lines can be displayed on an oscilloscope by using this simple trigger circuit. The 550 monostable is triggered by a frame pulse derived from the mixed sync, and generates a pulse of up to 20ms. The flip-flop synchronizes the end of this pulse with the next line sync, pulse to prevent display jitter. Current consumption is typically 30mA.

P. Newman and M. Tierney
Southern General Hospital
Glasgow

Efficient c.d.i. system

This capacitor-discharge ignition system is based on R. M. Carter’s transistor converter. Circuit ideas, Nov. 1975. Tr1 is biased on by current through R5, which causes collector current to pass through the primary winding of T1. Positive feedback from the secondary winding increases the collector current and, at saturation, insufficient base current turns Tr1 off. Energy stored in the magnetic field of T1 passes through D3 and into C1. This oscillation continues until the charge on C1 is sufficient to switch Tr1 on, which then inhibits Tr1.

The discharge circuit uses a conventional thyristor design. D3, C3 and R4 form a debounce circuit, and R3 can act as a rev. limiter. Because the inverter has a quiescent current of about 75mA, it will happily run from two alkaline cells.

W. K. Todd
Colchester
Essex

Decimal to binary conversion

If it is necessary or convenient to load data via thumbwheel switches, this circuit provides a cheap method of conversion provided numbers from 0 to 99 are sufficient. The units thumbwheel is an ordinary b.c.d. type, and the tens thumbwheel is a decimal output version. Each decade feeds the appropriate number into the binary adders, which can be c.m.o.s. or t.t.l.

J. H. Math
Alexandria
Dunbartonshire

The logic required for the address counter is shown in Fig.9. The address lines A0 to A7 are set low by the reset button. When the counter is enabled, the address counts from 0 to 255 and IC9 produces an end signal to mark the end of a single sweep. If the load signal is taken low, the address position to the external address input appears on A0 to A7. Therefore, any memory location can be addressed by an external device.

For normal operation the manual/auto switch is set to the auto position. However, if the contents of the memory need to be examined word at a time, the manual position is selected. After operation of the reset button, the contents of the words remaining in the memory will be displayed on the readout. Operation of the manual clock-switch advances the address by one and displays the contents of the next location.

The circuit shown in Fig.10 provides timing signals for the sample, a-0-d conversion, word storage sequence and the clock signal required for the address counter. Clock 1 and clock 2 outputs which are t.t.l.-level square-wave signals at the same frequency as the sampling rate, are produced by the voltage-controlled function generator IC9. Five overlapping frequency ranges are provided and variation within each range is achieved by adjusting a 2kilo-potentiometer which is calibrated from 1 to 11. Frequency variation is roughly linear with potentiometer variation, and a ten-turn potentiometer with a turns counter was used in the prototype. The low-frequency limit is adjusted first by setting the turns counter to 1 and setting the potentiometer to give the correct frequency. The upper limit is set by turning the potentiometer to 10 and adjusting R15 to give the correct frequency. The 470 pF capacitor may require trimming due to stray capacitance.

A separate +15V regulator supplies

the oscillator i.e. to prevent modulation of the main +15V line by the clock. This additional regulator also improves the stability of the clock frequency. The main power supply in Fig.11 uses two regulators to provide four supply rails.

Increasing the memory

If a larger memory is required, additional stages must be incorporated in the address counter so that the extra memory locations can be addressed. For example, if a third 74193 counter is connected to IC9, in the same way as IC9 is connected to IC6, then 12 bits will be available which can address up to 4096 memory locations. IC9 will need additional inputs so that the end output is in the low state only when the last memory location is addressed.

If pairs of 256 x 4-bit memory blocks are used to construct an 8-bit memory, the address inputs, data inputs and data output lines should be connected in parallel. The chip-enable and outputenable lines of each pair of memory blocks can then be driven by the outputs of a decoder whose inputs are the address lines of the additional counter stages. The decoding logic ensures that only one pair of memory blocks is active at a time. An alternative scheme, which reduces the amount of wiring required, is to use 1024 x 4-bit memory blocks.

Operation

To operate the transient recorder, select the auto mode and push the reset button. For recording, select a suitable input sensitivity and sampling frequency, and operate the arm button. In this state the input is continually sampled and the digital word is displayed by the l.e.d.s.

With no input present, the a-0-d converter’s full range can be observed by adjusting the offset control. With an input signal connected, the recorder is triggered manually or by a 5V high-to-low edge at the trigger input. Triggering may not occur immediately due to the free-running clock, however, it will occur within one sample period and the exact triggering point is identified by a positive edge at the trigger-acknowledge output. Information stored in the first memory location corresponds to the sample taken immediately before this output. Therefore, although the recorder may not trigger immediately, the stored data is valid from receipt of the trigger signal, and in some cases up to a sample period before this. When all of the memory locations have been filled with data, the recording l.e.d. turns off.

To display the contents of the memory on an oscilloscope, select the repetitive mode and a suitable playback rate, i.e. the sampling frequency. When the analogue output is connected to an oscilloscope, recorded data is displayed as a continuous periodic waveform. To plot the data on a chart recorder, operate the reset button, select the

By G. J. Adams B.Sc., Ph.D.

Transient recorder — 2

Control and timing signals

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Fig. 9. Counter logic controls the 8-bit memory address.

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Designing with microprocessors

4 - The synchronization problem

by D. Zissos and Laurene Valan. Department of Computer Science, University of Calgary, Canada

This article explains the need to synchronize the internal operation of the microprocessor chip with the response of peripherals. Software and hardware methods of doing this are outlined. Their step-by-step implementation will be discussed in later articles.

When data is to be transferred between two devices, the transmitting device, before it outputs the data, must ensure that the receiving device is able to accept it, otherwise the data will be lost. As communicating devices generally operate at different speeds, their operation must be synchronized, if system malfunction due to speed mismatch is to be avoided. The set of circuits and signals used for this purpose are referred to collectively as interfaces. The block diagram of an interface involving two devices, a data source and a data acceptor, is shown in Fig. 1. Its function is to monitor the status signals of the two communicating devices and to generate their command signals in the correct sequence to ensure that they operate in step with each other.

A clear understanding of the synchronization problem and of the available solutions is essential for the design and implementation of microprocessor-based systems, and indeed of any system. We shall start by first describing the nature of the synchronization problem in microprocessor-based systems.

The synchronization problem in microprocessor-based systems is probably best illustrated by considering the steps involved in using a character printer to produce a hard copy of a block of 32 characters stored as bytes in consecutive locations in memory.

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The synchronization problem in microprocessor-based systems is probably best illustrated by considering the steps involved in using a character printer to produce a hard copy of a block of 32 characters stored as bytes in consecutive locations in memory.

A simplified block diagram showing the flow of information through a microprocessor chip is shown in Fig. 2(a). The routing of the data through the microprocessor chip, instead of transmitting it directly to the printer, allows such functions as code conversion, formatting, parity checking and so on, to be performed on the data prior to printing. If no processing is required, a direct link (d.m.a. link) between memory and printer may be established, as we shall discuss in a future article.

The operation of our system, which consists of fetching each byte from memory into the microprocessor chip and printing it, is shown in Fig. 2(b). The flowchart of the software required to fetch and print each byte is shown in Fig. 3. Its implementation in the case of the Motorola 6800 (see instruction set in Appendix), is shown overhead.

Reference to the manufacturer's manual (1)* indicates that the execution time of a fetch/print loop (statements in locations 0005 to 000F) requires 24 machine cycles. If we assume the execution time of a machine cycle to be around 1µs, the characters will be output to the printer at the rate of around 40,000 per second -- far too fast for character printers, which typically will be operating at 30 characters per second. The outputting of data to the printer faster than it can accept will clearly result in a large proportion of it getting lost. It is therefore necessary for the designer not to output a character to the printer until it is ready to accept it. The most straight-forward, but the following pre-cautions should be noted.

If a metal case is used it should be connected to earth supply leads, including. Suitable l.e.d. types are available such as the TIL311 which can be driven directly by the data-output lines.

*See also Appendix

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Fig. 1. Block diagram of an interface.

Fig. 2. Block diagrams showing (a) data flow and (b) fetch/print cycle.

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single-sweep mode and a low playback rate suitable for the response time of the chart recorder.

Operation of the trigger button then produces a single sweep of the memory contents.

If the recorder is armed unintentionally the reset button can be used, but memory location 0 will have become contaminated.

Fig. 12 shows an input and output triangle waveform of the recorder and illustrates the smoothing effect obtained by switching in the low-pass filter. If a hexadecimal display is required, suitable i.e.d. types are available such as the TIL311 which can be driven directly by the data-output lines.

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Fig. 10. Clock and timing circuits provide signals for sampling, a-to-d conversion and storage.

Fig. 11. Power supply. The L129 regulator should be mounted on a heatsink, and a toroidal transformer is recommended.

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single-sweep mode and a low playback rate suitable for the response time of the chart recorder. Operation of the trigger button then produces a single sweep of the memory contents.

If the recorder is armed unintentionally the reset button can be used, but memory location 0 will have become contaminated.

Fig. 12 shows an input and output triangle waveform of the recorder and illustrates the smoothing effect obtained by switching in the low-pass filter. Fig. 13 shows a pressure impulse received by a microphone from a loudspeaker. This excitation pulse was obtained from a generator triggered by the trigger acknowledge output of the transient recorder.

Construction of this design is straightforward, but the following precautions should be noted. If a metal case is used it should be connected to earth and also to 0V from the power supply. Even with a low-field transformer, mains-frequency voltages are induced, in the chassis, so it is worthwhile to isolate the earth side of the a.c. input socket from the main chassis and connect it to the 0V rail of the input amplifier. This ensures that voltages induced in the chassis do not appear in series with the input signal. Because BNC sockets were used on the prototype, it was found more convenient to isolate the front panel. Separate power supply leads, including 0V, should be used for each board, with connections made to busbars on the power supply board. If a hexadecimal display is required, suitable I.E. types are available such as the TIL311 which can be driven directly by the data-output lines.

This article explains the need to synchronize the internal operation of the microprocessor chip with the responses of peripherals. Software and hardware methods of doing this are outlined. Their step-by-step implementation will be discussed in later articles.

When data is to be transferred between two devices, the transmitting device, before it outputs the data, must ensure that the receiving device is able to accept it, otherwise the data will be lost. As communicating devices generally operate at different speeds, their operation must be synchronized, if system malfunction due to speed mismatch is to be avoided. The set of circuits and signals used for this purpose are referred to collectively as interfaces. The block diagram of an interface involving two devices, a data source and a data acceptor, is shown in Fig. 1. Its function is to monitor the status signals of the two communicating devices and to generate their command signals in the correct sequence to ensure that they operate in step with each other. In practice an interface accepts external signals for such purposes as initiating a data transfer, putting the system on alert, and so on.

A clear understanding of the synchronization problem and of the available solutions is essential for the design and implementation of microprocessor-based systems, and indeed of any system. We shall start by first describing the nature of the synchronization problem in microprocessor-based systems.

The synchronization problem in microprocessor-based systems is probably best illustrated by considering the steps involved in using a character printer to produce a hard copy of a block of 32 characters stored as bytes in consecutive locations in memory. A simplified block diagram showing the flow of information through a microprocessor chip is shown in Fig. 2(a). The routing of the data through the microprocessor chip, instead of transmitting it directly to the printer, allows such functions as code conversion, formatting, parity checking and so on, to be performed on the data prior to printing.

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## Implementation of Fig. 3 processes in Motorola 6800

<table>
<thead>
<tr>
<th>Hex address</th>
<th>Hex listing</th>
<th>Mnemonics</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>C5</td>
<td>LDX #14350</td>
<td>Load the index register with the initial memory block address</td>
</tr>
<tr>
<td>0001</td>
<td>03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003</td>
<td>06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005</td>
<td>27</td>
<td>LDA B 12</td>
<td>Load the block length (hex 20 = decimal 32) into accumulator B. hex 12 = decimal 2</td>
</tr>
<tr>
<td>0006</td>
<td>08</td>
<td>BEO L2</td>
<td>Go to L2 if acc. B is zero</td>
</tr>
<tr>
<td>0007</td>
<td>A6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0008</td>
<td>00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0009</td>
<td>87</td>
<td>STAA 50400</td>
<td>Load the next byte to be printed into acc. A</td>
</tr>
<tr>
<td>000A</td>
<td>04</td>
<td>INX</td>
<td>Increment the memory block address</td>
</tr>
<tr>
<td>000B</td>
<td>08</td>
<td>DECB</td>
<td>Decrement the memory block length</td>
</tr>
<tr>
<td>000C</td>
<td>F6</td>
<td>BRA L1</td>
<td>Go to L1</td>
</tr>
<tr>
<td>000D</td>
<td>2D</td>
<td>SWI</td>
<td>End of interrupt (swi)</td>
</tr>
</tbody>
</table>

Software wait is implemented by means of a programming loop during which the status of the printer is read into the microprocessor chip and tested. If the printer is found to be busy, the process is repeated. When the printer becomes ready (indicated by its status signals), the microprocessor exits the software wait loop, as shown in Fig. 5. Note that the wait loop may be entered either before or after the print operation.

The step-by-step implementation of microprocessor-based systems using software wait will be discussed in the next article.

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### Appendix: Motorola 6800 instruction set

(continued on next page)

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### Fig. 5. Flowcharts of software wait loops (a) with wait loop entered before print operation, (b) entered after print operation.

### Fig. 4. Stretched fetch/print cycle.

### Fig. 6. Flowcharts of hardware wait loops implemented (a) before and (b) after print operations.

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forward method is to stretch the fetch/print cycle in Fig. 4. This delay can be implemented using either software or hardware; in the first case we shall refer to it as software wait and in the second case as hardware wait.

Software wait is implemented by means of a programming loop during which the status of the printer is read into the microprocessor chip and tested. If the printer is found to be busy, the process is repeated. When the printer becomes ready (indicated by its status signals), the microprocessor exits the software wait loop, as shown in Fig. 5. Note that the wait loop may be entered either before or after the print operation. The step-by-step implementation of microprocessor-based systems using software wait will be discussed in the next article.

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</tr>
</thead>
<tbody>
<tr>
<td>0000 C8</td>
<td>LDX # 4'350</td>
<td>LDA 00H</td>
<td>Load the index register with the initial memory block address</td>
</tr>
<tr>
<td>0001 03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004 20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005 27</td>
<td></td>
<td>BEQ L2</td>
<td>Load the block length (hex 20) into accumulator B - hex 20 = decimal 32</td>
</tr>
<tr>
<td>0006 08</td>
<td></td>
<td></td>
<td>Go to L2 if acc. B is zero</td>
</tr>
<tr>
<td>0007 A6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0008 00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0009 87</td>
<td></td>
<td>STA A</td>
<td>Print the byte to be printed into acc. A</td>
</tr>
<tr>
<td>000A 04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>000B 00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>000C 08</td>
<td></td>
<td>INX</td>
<td>Increment the memory block address</td>
</tr>
<tr>
<td>000D 9A</td>
<td></td>
<td>DECB</td>
<td>Decrement the memory block address</td>
</tr>
<tr>
<td>000E 00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>000F 9F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2:0010 3F</td>
<td></td>
<td>SWI</td>
<td>Go to L1</td>
</tr>
</tbody>
</table>

---

### Appendix: Motorola 6800 instruction set

(continued on next page)
remains in a wait state indefinitely. The wait state is entered by pulling a specified pin on an m.p.u. high or low.

Examples: Pulling pin 23 low puts the Intel 8080 into the wait state, and pulling it high brings it out of the wait state — see Fig. 3 in article 1.

In the case of the Motorola 6800 the wait state is entered at the end of the current instruction by pulling pin 2 low.

Pulling pin 2 high brings it out of the wait state. The Intel 8085 uses pin 35 in the same way as pin 23 is used in the case of the Intel 8080.


Design and implementation of test-and-ship systems will be the subject of the next article.

Table above is continuation of the Appendix.

Fig. 1. Sheffield terminal's 8-bit dish antenna with 4GHz feed in position. Fig. 2. 4GHz head unit. The GaAs f.e.t. stage is mounted near the top. Fig. 3. 11-12GHz feed system mounted at the prime focus point.
Hardware wait is implemented by causing the microprocessor chip to enter into an idle state, during which all the microprocessor activities are suspended without turning off the clock. As in the case of the software wait, the hardware wait may be implemented either before or after the print operation — see Fig. 6.

We shall refer to the idling state as a wait state. The microprocessor may remain in a wait state indefinitely. The wait state is entered by pulling a specified pin on an M.U. high or low.

Examples. Pulling pin 23 low puts the Intel 8080 in the wait state, and pulling it high brings it out of the wait state — see Motorola 768, Fig. 3 in article 1.

In the case of the Motorola 6800 the wait state is entered at the end of the current instruction by pulling pin 2 low.

Pulling pin 2 high brings it out of the wait state. The Intel 8085 uses pin 35 in the same way as pin 23 is used in the case of the Intel 8080.


Design and implementation of test-and-shift systems will be the subject of the next article.

Development of the author's satellite terminal started in 1975 with the introduction of instructional TV broadcasting to villages in India. The results of his original experiments were published in March 1976. This article describes how the terminal has been modified to receive microwave transmissions, and shows a selection of the author's more recent results.

During 1975 NASA's ATS-6 began a one-year S I T E experiment of instructional TV broadcasting to village communities in India. As the transmissions were at 560 MHz in the familiar U.H.F. broadcast band, the signals did not need specialized reception techniques, but just a suitable antenna, low noise amplifier and TV receiver equipped with a wideband FM demodulator. The SITE broadcasts began in August 1976, and ATS-6 was manoeuvred westward to a new geostationary location over the Pacific Ocean, out of sight of the UK, for further experiments with US terminals. Since I had been inspired by the ATS results, I was now eager to receive more satellite TV broadcasts. The USSR had a system known as Orbita which used Molniya satellites in 63° inclined orbits, but information was sparse. The Molniya-1 series used frequencies around 1000 MHz, and the locus of possible apogees (Molniyas were activated for a six-hour period around apogee, when their orbital characteristics made them appear almost stationary in the northern sky) arc northwards to east and west of a point almost overhead. Signals were received, but they carried F.A. data at a low bit-rate. It appeared that the Orbita TV service had been transferred to the Molniya-2 and -3 series, with downlinks in the 4.6 GHz band. At around this time there was news of Russian TV broadcasting tests from one of their first geostationary satellites, Skran, or Stations-7. The e.i.r.p. was quoted as 56.6dBW at 7165 MHz, but the satellite's longitude of 99° E put it well outside the eastern horizon.

It became clear that the best results would be achieved in the microwave part of the spectrum and that 3.7 to

Table above is continuation of the Appendix.
4.2GHz should be explored. The 5ft mesh dish used for ATS-6 was discarded, and I obtained a surplus 8ft solid-surface paraboloid, originally used for terrestrial radio links in the 7GHz region. To resolve pictures from the signals available on 4GHz, an overall system noise temperature of better than 400°K was required. The dish was fitted with a circular polarisation antenna feed, made from a piece of 2in. copper pipe, carrying the downconverter, a low-noise amplifier constructed from two HSN70101 devices on a microstrip, and 25dB of wideband u.h.f. i.f. amplification. The amplifier was included so that signals could be carried 50ft to the house without significant breakthrough of local u.h.f. vhf broadcast stations. The second converter was installed in the house together with the remainder of the receiver. A modified Vircap u.h.f. tv tuner was used, as for ATS-6, but with facilities for inserting sync., phase-locked to the transmitted signal, and for re-scanning narrow-band sync. pulse demodulators.

The receiver was aimed at the sun and aligned for maximum solar noise. A figure of 3.5dB above clear sky was achieved on the first day which, with an assumed value for solar noise flux of $8 \times 10^{-11} \text{W/m}^2/\text{Hz}$, translated to a G/T of 12.6dB/°K. This gave a predicted overall receiver noise figure of about 3.5dB, which was later confirmed by comparing ground noise with sky noise. When the antenna beam was lowered onto the geostationary orbit area, my efforts were rewarded by the appearance of RTVE's (Spain) first channel programme, via the leased half-transponder 6 of the new Intelsat-1VA (F2) at 29.5°W. This Canary Islands relay is 700 miles above the equator.

During the last three years the Soviet Union has begun to establish Intersputnik, a rival system to Intelsat, with 4GHz downlink satellites in geostationary orbit over the three main ocean regions. To date, two types of satellite have been launched. The Raduga (Rainbow) class, which carries a single tv channel and appear to be similar to the Molniya-3 type, and the Gorizont (Horizon) class with 5 or 6 tv channels in the 360 to 4000 MHz range. Their orbital stations are assigned Stationary numbers so the 14°W Atlantic slot, for instance, carried Stationary-4, is currently occupied by spacecraft Gorizont-2. Two channels on this satellite use higher power or spot beams and radiate almost 100m (in this direction) above the standard USSR 4GHz e.i.r.p. of about 28dBW. Stationary-4 is the most powerful satellite at this frequency, and can be received even with an indoor antenna.

As the accompanying photographs show, results have been improved since the early tests, due partly to the use of a Pleiades gallium arsenide f.e.t., type GAT, reduced the 4GHz system noise temperature to 185°K, a 3dB improvement in sensitivity.

Results have been further improved by the addition of another GaAs f.e.t. stage, a HFET-2202 device from Hewlett Packard. This half-micron gate length f.e.t has a noise figure only slightly above 1dB, and should produce a receiver noise temperature close to 100°K.

Fig. 9. Soviet tv received November 1979. News and information programme "Vremya". Stationary-4, channel 5, 3875 MHz, e.i.r.p. about 45dBW, c/n density 185dBHz.
Fig. 10. Italian tv via Sirio received January 1980. Carrier noise density about 65dBHz.
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The receiver was aimed at the sun and adjusted for maximum solar noise. A figure of 3.5dB above clear sky was achieved in the first day which, with an assumed value for solar noise flux of 8 \times 10^{-5} W/m^2/Hz, translated to a G/T of 12.6dB/K. This gave a predicted overall receiver noise figure of about 3.5dB, which was later confirmed by comparing ground noise with sky noise. When the antenna beam was lowered onto the geostationary orbit arc, my efforts were rewarded by the appearance of RTVE's (Spain) first television programme via the leased half-transponder 6 of the new Intelsat-IVA (F2) at 29.5°W. This Canary Islands relay is at present carried on the Major Path 1 Intelsat at 34.5°W. Since receiving RTVE, many other 4GHz satellite tv downlinks have been observed. In addition to carrying the world news and sports events, many nations lease capacity on the Intelsat system for their own use, such as internal tv distribution from studio centres to transmitters, and tv relay to overseas territories. Because Intelsat's constitution precludes broadcasting activities, reception of their transmissions by private terminals can only be made for experimental purposes to prove equipment performance. However, a rather different situation exists in the USA where a private terminal beam is taking place. Home use of the common carrier traffic on domestic communications satellites is permitted, provided the programme supplier's permission is obtained. For about $3000 a person can purchase the principal elements of a 10ft satellite terminal, and have access to around 30 full-time tv channels without the video and colour distortions which occur on long distance terrestrial distribution.

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As the accompanying photographs show, results have been improved since the early tests, due partly to the use of another GaAs f.e.t. at the receiving end, a 3dB improvement in sensitivity. Results have been further improved by the addition of another GaAs f.e.t. stage, a HFET-2202 device from Hewlett Packard. This half-micron gate length f.e.t. has a noise figure only slightly above 1dB, and should produce a receiver noise temperature close to 100K.
part of the 4GHz band between 3.85 and 4.2GHz while a Russian Molniya satellite was being received. The level read from left to right and frequency from top to bottom of the screen.

Later this year the first Intelsat V should be launched for operation over the Atlantic with 4 and 11GHz downlink transponders. The first Soviet "Louch" 11-12GHz spacecraft is also anticipated. Both satellites will have high e.i.r.p. to allow for periods of high attenuation caused by atmospheric water vapour in the downlink path, and should be easy to receive in clear weather. Within three or four years Europe may have direct TV broadcasting satellites, and the development of comparatively low-cost terminals for home use will take place.

Plessey and Mullard (Philips) are already working on monolithic low-noise downconverters on gallium arsenide chips. The Japanese "Broadcasting Satellites for Experimental Purposes". It is anticipated that the European broadcasting satellites will operate with an e.i.r.p. 15 or 20dB higher than OTS. This should allow reception at the Sheffield terminal, even though their beams will not be directed at the UK.

In our next issue

Acoustically small loudspeaker

To reduce colouration and cabinet resonances, the mid-range and high-frequency drivers of this active crossover design are mounted in an oblate cylinder, made of modelling clay. The enclosures are operated below lowest resonance, and the unusual shape gives an exceptionally solid stereo image.

Floppy disc store

Because most home computers use audio cassettes for storing information, the location and transfer of data is very slow. Our floppy disc system comprises a controller and an 8in drive, which can store 400K bytes and transfer data at 500 bytes per second. The disc store has been designed by John Adams for the Wireless World scientific computer, but can be adapted for other systems bases on the Z80.

Frequency meter for radio receivers

A versatile digital frequency meter, usable from low frequencies to V.H.F. with a pre-scaler, and primarily intended for use in radio receivers to identify stations. John Linsley Hood has avoided the large-scale chips and, with the aim of achieving a more flexible design, has used c.m.o.s. logic, together with low-power Schotky elements.

On sale 17 September
With the launch of the European Space Agency’s OTS satellite in May 1978, I decided to explore a new satellite TV frequency band of 11-12GHz. The sub-bands in this region were destined for future direct-broadcast international and domestic systems in the 11-12GHz band, and provide the new regional (ECS) system for Europe as well as the allocations already made at WARC-77 for satellite TV broadcast downlinks. A second region was destined to ease the congestion experienced by sub-bands in this region were destined for future direct-broadcast international and domestic systems in the 11-12GHz band to be tuned for any part of the frequency spectrum from left to right and frequency from top to bottom of the screen.

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Bibliography


The 11MHz to 12GHz band was built around the feed horn, which was made capable of handling either linear (plane) or circular polarisation. The downconverter comprises a single unbalanced diode mixer in stripline, with a Gunn device in a coaxial cavity as the local oscillator. To improve performance, GaAs f.e.t. stages in microstrip construction were subsequently added. Mid-band noise temperature of the 11-12GHz system is around 47°C and, with an antenna gain of around 47dB, this gives a G/T of 25dB/°K (clear sky) washdown system which enables a G/T of 25dB/°K (clear sky) with an antenna gain of around 47dB, this gives a G/T of 25dB/°K (clear sky) with an antenna gain of around 47dB, this gives a G/T of 25dB/°K (clear sky) with an antenna gain of around 47dB, this gives a G/T of 25dB/°K (clear sky) with an antenna gain of around 47dB, this gives a G/T of 25dB/°K (clear sky)...

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The next section of this article will be devoted to the caption on the picture portion of the video signal, which may still exceed the f.m. density, reducing the bandwidth to 5MHz would only recover a 5dB c/n ratio. Therefore, bandwidth must be set to achieve the greatest possible c/n ratio, and an 8in drive, which can store 400K bytes and transfer data at 500 bytes per second. The disc store has been designed by John Adams for the Wireless World scientific computer, but can be adapted for other systems bases on the Z80.

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On sale 17 September

The TM8 is a new autoranging analogue true r.m.s. millivoltmeter with a specified operating range of 10kHz to 1GHz and useful indication of 4MHz. It measures r.f. voltage from 1mV to 3V (or 300V using the 100:1 precision divider) and also has a logarithmic range which spans four decades—useful in setting up tuned circuits. Careful consideration of the circuit design resulted in the use of CMOS low power IC’s for the whole unit only uses five watts of power and has minimal temperature drift as well as high reliability.

The meter is provided with damping so that fast changes in amplitude of the signal can be filtered out without either registering on the meter or on the pen recorder output. This output socket gives a 0 to 1V output for zero to full scale reading on the meter.

Like most Farnell r.f. test gear, the TM8 is b.c.d. programmable and will soon be ‘busable’ using the Farnell Omnibus IEEE488 interface. A final touch of refinement to the design is the ‘hold-reading’ switch on the probe which will, as its name suggests, hold the reading that appears in the meter to within 1% for at least 3 minutes.

The TM8 is supplied complete with probe (integral with input lead) probe to b.c.d. adapter, ‘T’ connector and 100:1 high impedance divider.

Leaflet available.

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Graphical communication with microcomputers — 2

Character generation and graphics

by I. H. Witten, M.A., M.Sc., Ph.D., M.I.E.E. Department of Electrical Engineering Science, University of Essex

Dr Witten continues his article on interacting with a microcomputer. This final part goes on with the discussion of raster-scanned displays, finishing with a look at the light-pen and tablet method of input.

Cell-organized displays. To make a display system easily manageable by the programs that generate the pictures, it is necessary to impose a structure on them that allows the raw picture data to be compressed and stored. For example, we saw earlier how line-generating hardware in a point-plotting display processor permits a whole line to be specified by its two end points. The natural structure to impose on a raster-scanned display is a pattern of rectangular cells. Figure 15 shows a 256 × 256 bit-per-point screen, organized as a 32 × 32 array of cells, each one being 8 × 8 dots. There are 64 bits in each cell, so 2^64 possible patterns can occupy one cell alone. However, most of these patterns are unlikely to be used in a simple picture. Suppose we sacrifice flexibility for convenience and low cost by defining a small repertoire — say 256 — of patterns which may occupy each cell. Then to hold the complete set of patterns we need 256 × 8 × 8 bits — 2 Kbytes, and now a particular pattern can be indicated by an 8-bit pattern number. Since there are 32 × 32 cells on the screen, only 1024 of these numbers, or 1 Kbyte, are needed to hold the screen contents. This certainly saves some storage. Previously, 8 Kbytes were needed to hold the screen contents on a bit-per-point basis. Now only 1 Kbyte specifies the screen contents, together with 2 Kbytes for the pattern dictionary. The price paid is heavy, though: only a tiny fraction of possible pictures can be displayed. (You may care to verify that the fraction is 1/2^224, which is small indeed!) But the real advantage is one of convenience: now the computer need only wrestle with a 32 × 32 array of cells instead of a 256 × 256 array of dots. Since its storage and bus structure is in terms of bytes and not bits anyway, it is actually easier to handle cell pattern numbers than individual dots. (Recall the difficulty of generating straight lines on a bit-per-point display.)

Figure 17 shows the connection of a memory-mapped, cell-organized dis-
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Figure 17 shows the connection of a memory-mapped, cell-organized display interface and scan generator.
play to the computer bus. As with the bit-per-point system of Fig. 13, the display system is called memory-mapped because the screen contents appear to the processor as ordinary store. The connection between the bus and the pattern dictionary is dashed because it is often not there at all; the patterns are fixed and cannot be changed by the processor.

The success of a cell-organized display in practice depends on the match between the patterns in the cells and the kind of pictures that are drawn on the screen. General cell displays which are intended for line drawings have been built, in which the cell repertoire naturally consists of line segments. However, the number of possible line segments through an $8 \times 8$ dot cell is unreasonably large, and rotational and axial symmetry is called into play to reduce this excessive size. Then, the display interface must be able to perform rotation and symmetry transformations, and become a display processor which treats the screen contents more as a program than as a list of pattern numbers. This parallels precisely the development of the display processor for point-printing displays.

Let us instead examine some rather less ambitious pattern repertoires for cell-organized displays.

Character generation. One obvious use for the standardized display alphabets is to show text. Cell-organized character displays are called v.d.u.s (visual display units) — a name unfortunate to use, because it gives no indication that only characters can be shown. The screen of Fig. 15 can accommodate 32 lines of 24 characters; each one being on an $8 \times 8$ grid. Of course, space must be left between neighbouring characters and between successive lines, so the actual character density is rather low.

Character storage. A $7 \times 5$ dot matrix is quite adequate for upper-case characters, digits, and some special symbols. The standard for lower-case character upper-case alphabet is shown in Fig. 18, along with the characters that augment it to the standard 96-character upper- and lower-case alphabet. Although lower-case characters can be written satisfactorily with a $7 \times 5$ matrix, five of them — j, p, q, and y — have tails which should be curved and blended in if transmission is to be properly. This needs a $9 \times 5$ dot matrix with any one character occupying either the upper or the lower $7 \times 5$ section; this works because there aren't any characters with both descenders and "risers." Higher-quality text can be obtained with a $11 \times 7$ matrix, with any given character occupying either the upper or lower $9 \times 7$ section. The possibilities are summarized in Fig. 19, where a dotted outline shows the cell containing the character, including inter-character and inter-line space, and the solid line shows the actual size of the characters.

Read-only memory chips with the character patterns already in them are available in a variety of manufacture. When addressed with the ASCII code of a character, the appropriate dot pattern appears on the output pins. The address of a particular row of dots is usually provided to the character generator by the bits comprising only that row that appear at the output. Thus, with 15 characters of $7 \times 5$ dots each 8 bits are required to address a particular row of a character and there are 8 output pins giving the dots in that row. This arrangement is especially suited to raster-scan displays, because one line of the raster is generated at a time. In some character generators, the action of "lowering" the characters with descenders must be done externally to the chip, the user providing circuitry to detect these five bits and adjust the character accordingly. The amount of storage required in a character generator, therefore, can be very small. For a typical character, the user needs 512 words of 8 bits to produce the 64-character upper-case alphabet.

A $128 \times 256$ screen accommodates 32 lines of characters if the character cell is $8 \times 8$, 21 lines of 42 characters if it is $12 \times 8$, and only 17 lines of 28 characters if it is $15 \times 9$. All of these sizes are denoted in a "bit-joey" small as a typical printed book page. A normal sheet of typed paper can comfortably hold about 57 lines of 80 characters, so the full $80 \times 80$ display would require a 644 $\times 480$ screen, which is not possible within the British 625-line standard. Many displays will have a maximum with about 24 full-length lines of 80 characters, which is only a 640 $\times 480$ screen. There is currently a great deal of commercial interest in high-quality v.d.u.s and special high-resolution displays are being built for them, but they don't have the advantage of the mass TV market to bring down the price. However, it is worth noting that a 112-line high-resolution graphics system is under development in Japan, which should accommodate up to 75 lines of high-quality graphics, with a $11 \times 15$ character cell ($17 \times 25$ cell).

The v.d.u.s are not in general, memory-mapped. It is far more convenient, with the current state of the art, to type his text as a linear string, sending one character at a time to the display device. Usually the processor reads the character from a parallel-to-serial converter attached to the bus, as shown in Fig. 20. The v.d.u. must provide the store for the screen contents, but this only needs one byte per character displayed — say 2 bytes for 24 lines by 80 characters. In fact, local storage is sometimes provided for a good deal more than this, so that the v.d.u. can retain several screens of text and you can look back to see what was presented a few moments ago.

The v.d.u. itself has to decide what to do when the screen fills up. A scrolling feature is almost universally provided, where the entire screen contents may move up as necessary. Continuous rapid jumping of the text is irritating and tiring for the reader, and so several lines are scrolled at a time. Smooth scrolling, where the contents move up a dot at a time rather than jumping whole lines is unfortunately rather rare at present, although it does not cause any particular technical problems. Other features which are often provided are blinking of the text on the selected area of screen, reverse video (black text on a white background), half-intensity or double-intensity display, and underlining of parts of the text. These options are set on and off by special character codes (ASCII 00000000-00111111) and sent down the line as part of the text, which can unfortunately alter all subsequent characters if a text character is corrupted by noise into a control character.

One really useful feature is the ability to provide the current position on the screen, so that characters to be sent in any point on the screen may be properly typed. The ability to show the position of the "cursor" is usually made on the screen at the current writing position, and any input typed on the keyboard appears at the cursor position which is moved along with each successive character. Thus, a questionnaire can be displayed and the cursor moved to the places where the user enters his answers. Straining him to write in the space provided, Cursor control is provided by a special character which signals the v.d.u. to interpret the next character as a cursor control character. Thus, that it reinstates the flexibility of a memory-mapped display where a character can be placed at any position of the screen.

Most v.d.u.s operate at speeds up to 9600 baud. Unlike printers, no extra effort is needed to make a v.d.u. go fast. 9600 baud allows all full-size 80 characters to be sent in 2 seconds, which is certainly a comfortably rapid rate. However, people read faster than this — how quickly do you read The Bell Telephone Journal? — but the transmission speed is limited by the speed of the data input. If you want to do any kind of word processing, the v.d.u. should be able to type clearly at the speed of the human voice.

Limited graphics. Pressure to provide limited graphics facilities based on inexpensive raster-scanned displays has come from two directions: home computers and the teletext and viewdata information services. The character-generating read-only memories of most home computers contain an assortment of graphic symbols to draw primitive pictures, Figure 21, for example, shows the 64 symbols of PET, a typical low-priced domestic computer. In order that these symbol symbols can abut to form pictures, the inter-word and inter-character spaces are determined by the character generator and not provided by external hardware. As in most v.d.u.s, PET uses an 8 x 8 cell. The standard 64-character upper-case alphabet of Fig. 18 is provided, together with the 64 graphic symbols or the lower-case letters — software can select which of these latter groups is used. Some of the graphics reflect the game-playing orientation of PET, but the lack of coherent structure of the other makes constructing appropriate pictures or charts a rather tedious task. There is no standardization of graphic alphabets in the home computer industry.

Teletext. The teletext scheme for broadcast information defines a graphics standard, and is it possible that this might spread to the microcomputer industry. It uses 64 codes in a systematic way to provide a refinement of its basic cell of 24 x 40 character grid. Each cell is split into the six regions shown in Fig. 22, and a 6-bit word specifies a different shade of white and black ones. Thus, an effective 72 x 80 grid is available for graphics, and the picture of Fig. 6 gives an example of the resolution obtained. The teletext cell is not square but has 10 x 8 dots, with a 9 x 5 upper-and-lower-case character matrix. The problem of dividing a cell 10 rows high into three sections for the graphic symbols is a continuing challenge for teletext receiver designers! Teletext also has a defined protocol for coping with colour displays by inserting colour-change control characters into the text stream.

User-defined graphics. An unusual and interesting limited graphics facility is provided in the Sorcerer home computer. 256 character code words can be used instead of the usual 64 or 96. Of these, 128 correspond to the standard pattern, which include the 96-character basic alphabet of Fig. 18 together with 32 extra codes. For the others, the character-generating memory can be altered by the processor, so that the user can create his own graphic symbols. Since the character matrix is 8 x 8, 8 bytes serve to define one character,
Fig. 19. Common character sizes.

Character generation. One obvious use for the 32 x 12 characters is to show text. Cell-organized character displays are called v.d.u.s (visual display units) - a name fortunate to be chosen because it gives no indication that only characters can be shown. The screen of Fig. 15 can accommodate 32 lines of 32 characters each, one being on an 8 x 8 grid. Of course, space must be left between neighboring characters and between successive lines, so the actual character storage is really much smaller.

Character storage. A 7 x 5 dot matrix is quite adequate for upper-case characters, digits, and some special symbols. A standard 32 x 12 character upper-case alphabet is shown in Fig. 18, along with the characters that augment it to the 96-character upper- and lower-case alphabet. Although lower-case characters can be written satisfactorily on a 7 x 5 matrix, five of them - e, f, g, p, and t - have tails which should not be mixed up if the printout is to be legible. This needs a 9 x 5 dot matrix, which is shown in Fig. 19.

Read-only memory chips with the character patterns already in them are available in a variety of manufactur-ers. When addressed with the ASCII code of a character, the appropriate dot pattern appears on the output pins. The address of a particular row of dots is usually provided to the character generator in the form of 5 bits comprising only that row that appear at the output. Thus, with 32 characters of 5 x 7 dots each, 5 bits are required to address a particular row of a character and there are 5 output pins giving the dots in that row. This arrangement is especially suited to raster-scan displays, because one line of the raster is generated at a time. In some character generators, the action of "lowering" and adjusting the mask that goes with descent is done externally to the chip, the user providing circuitry to detect these five bits and adjust the position and intensity accordingly. The amount of storage required in a character generator is considerable. For one 32 x 12 character, the skill must be 512 words of 5 bits to provide the 64-character upper-case alphabet. A 256 x 256 screen accommodates 32 lines of 32 characters if the character cell is 8 x 8, 21 lines of 42 characters if it is 12 x 8, and only 17 lines of 48 characters if it is 15 x 8. All of these sizes are approximately small enough. A normal sheet of typed paper can comfortably hold about 57 lines of 80 characters. To achieve this with a 12 x 8 character as the cursor position. Notice that the character occupying either the upper or the lower 7 x 5 section of a character is corrupted by noise into a control character!

One really useful feature is the ability to "jump" the current position to any point on the screen, so that characters can be placed at any position on the screen. To do this, however, is currently a great deal of noise and adjusting the position accordingly. The amount of storage required in a character generator is considerable. For one 32 x 12 character, the Skill must be 512 words of 5 bits to provide the 64-character upper-case alphabet. A 256 x 256 screen accommodates 32 lines of 32 characters if the character cell is 8 x 8, 21 lines of 42 characters if it is 12 x 8, and only 17 lines of 48 characters if it is 15 x 8. All of these sizes are approximately small enough. A normal sheet of typed paper can comfortably hold about 57 lines of 80 characters. To achieve this with a 12 x 8 character as the cursor position. Notice that the character occupying either the upper or the lower 7 x 5 section of a character is corrupted by noise into a control character!

The v.d.u. must provide store for the screen contents, but this only needs one byte per character displayed - say 2 bytes for 24 lines by 80 characters. In fact, local storage is sometimes provided for a good deal more than this, so that the v.d.u. can retain several screen segments of text and you can look back to see what was presented a few moments ago.

The v.d.u. itself has to decide what to do when the screen fills up. A scrolling feature is almost universally provided, where the entire screen contents move up as necessary. Continuous rapid jumping of the text is irritating and tiring for the reader, and so several lines are scrolled at a time. Smooth scrolling, where the contents move up a dot at a time rather than jumping whole lines is unfortunately rather rare at present, although it does not cause any particular technical problems. Other features which are often provided are blinking of the text on the selected area of screen, reverse video (black text on a white background), half-intensity or double-intensity display, and underlining of parts of the text. These options are normally selected on and off by keys. In some character generators (ASCII codes 00000000-00111111) and is sent down the line as part of the text. In this way, the character set to be displayed is adjusted to the user's requirements.

User-defined graphics. An unusual and interesting limited graphics facility is provided in the Sorector home computer. 256 characters are used instead of the usual 64 or 96. Of these, 128 correspond to the 34-character pattern which include the 96-character basic alphabet of Fig. 18 together with 32 extra symbols. For the others, the character-generating memory can be altered by the user, so that the user can create his own graphic symbols. Since the character matrix is 8 x 8, 8 bytes serve to define one character, directions: home computers and the teletext and viewdata information services. The character-generating read-only memories of most home computers contain an assortment of graphic symbols to draw primitive pictures. Figure 21, for example, shows the 64 symbols of PET, a typical low-priced domestic computer, in order that graphic symbols can be used to form pictures, the inter-word and inter-character spaces are called memory-mapped because it gives no indication that only characters can be shown. The screen of Fig. 15 can accommodate 32 lines of 32 characters each, one being on an 8 x 8 grid. Of course, space must be left between neighboring characters and between successive lines, so the actual character generator is really much smaller.

Character storage. A 7 x 5 dot matrix is quite adequate for upper-case characters, digits, and some special symbols. A standard 32 x 12 character upper-case alphabet is shown in Fig. 18, along with the characters that augment it to the 96-character upper- and lower-case alphabet. Although lower-case characters can be written satisfactorily on a 7 x 5 matrix, five of them - e, f, g, p, and t - have tails which should not be mixed up if the printout is to be legible. This needs a 9 x 5 dot matrix, which is shown in Fig. 19.

Read-only memory chips with the character patterns already in them are available in a variety of manufactur-ers. When addressed with the ASCII code of a character, the appropriate dot pattern appears on the output pins. The address of a particular row of dots is usually provided to the character generator in the form of 5 bits comprising only that row that appear at the output. Thus, with 32 characters of 5 x 7 dots each, 5 bits are required to address a particular row of a character and there are 5 output pins giving the dots in that row. This arrangement is especially suited to raster-scan displays, because one line of the raster is generated at a time. In some character generators, the action of "lowering" and adjusting the mask that goes with descent is done externally to the chip, the user providing circuitry to detect these five bits and adjust the position and intensity accordingly. The amount of storage required in a character generator is considerable. For one 32 x 12 character, the skill must be 512 words of 5 bits to provide the 64-character upper-case alphabet. A 256 x 256 screen accommodates 32 lines of 32 characters if the character cell is 8 x 8, 21 lines of 42 characters if it is 12 x 8, and only 17 lines of 48 characters if it is 15 x 8. All of these sizes are approximately small enough. A normal sheet of typed paper can comfortably hold about 57 lines of 80 characters. To achieve this with a 12 x 8 character as the cursor position. Notice that the character occupying either the upper or the lower 7 x 5 section of a character is corrupted by noise into a control character!

One really useful feature is the ability to "jump" the current position to any point on the screen, so that characters can be placed at any position on the screen. To do this, however, is currently a great deal of noise and adjusting the position accordingly. The amount of storage required in a character generator is considerable. For one 32 x 12 character, the Skill must be 512 words of 5 bits to provide the 64-character upper-case alphabet. A 256 x 256 screen accommodates 32 lines of 32 characters if the character cell is 8 x 8, 21 lines of 42 characters if it is 12 x 8, and only 17 lines of 48 characters if it is 15 x 8. All of these sizes are approximately small enough. A normal sheet of typed paper can comfortably hold about 57 lines of 80 characters. To achieve this with a 12 x 8 character as the cursor position. Notice that the character occupying either the upper or the lower 7 x 5 section of a character is corrupted by noise into a control character!

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and the read-only and writeable parts of the character generator are each 1 Kbyte. The circuitry required to generate characters from a read/write memory is a little more complex than dot in the centre, at different heights. defining eight patterns each with one attentions will occur when the display is enormous, for the segments which are needed in a circular picture.

adding the hardware shown by dashed lines which includes all the line segments which are needed in a particular picture. Or, a Cyrillic alphabet for text in Russian. This combines much of the flexibility of the memory-mapped bit-per-point display with a structure that can show text sensibly and stylized systems like PET and teletext.

The the light-pen and tablet

Turning now to graphical input, a light-pen is a device that detects whether or not there is a spot of light on the screen at the place it is pointing. It can also signal the exact time the light appears. Recall that the picture is refreshed every 40 msec or so, so that if the pen points at a spot which is brightened up a signal will appear during every refresh cycle. The interrupt mechanism is ideally suited to talking to the processor at the time a hit occurs.

The time-of-hit information provided naturally by a light-pen can easily be converted into the position of the hit by adding the hardware shown by dashed lines in Fig. 23. The x and y signals from the output port are routed back to an input port — practice, this will before they converted from digital to analogue form — and loaded into two registers there when a hit occurs. Then the processor can examine these registers at leisure to ascertain the position of the last hit.

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Simple active filters for equalizers

Design examples using simulated inductors

by D. W. Protheroe, B. Sc.

Simple design rules allow construction of filters having any desired value of centre frequency, Q and gain, using simulated inductors. Examples illustrate provision of a symmetrical bandpass to band-stop characteristic, varied with a single control.

The majority of designs published as octave or graphic equalizers feature a number of independently controllable filters allowing boost or cut of specific frequencies within a audio band. These designs fall into two main categories:

- RC bandpass/bandstop filters
- Active filter enclosed in a box

For the active filters, the signal-to-noise ratio decreases as number of sections increases. It is avoided in Fig. 2, but the component values must be carefully calculated to give a symmetrical cut/boost characteristic. Many designs have been published giving only bandpass characteristics, so the notch depth is variable.

To duplicate the impedance versus frequency characteristic of the RC network, the input impedance of R 1 and R 2 incorporate a potentiometer. Thus f n varies only the control law. The buffer amplifier used in Fig. 4 can be an emitter follower depending on the load to be driven (values of C 1, R 1 and R 2), and R 1 incorporates a potentiometer. Thus f n and the notch depth are independently variable.

The value of the potentiometer used in the cut-off control is non-critical, varying only the control law. The buffer amplifier used in Fig. 4 can be an emitter follower, a Darlington follower, or a 741 follower depending on the load to be driven (values of C 1, R 1 and R 2), and the performance required. Signal-to-noise ratio and distortion level for the system depend mainly on the differential
amplifier used; for most purposes the 741 is sufficient, though increased performance may be achieved with a more specialized amplifier.²,³

Practical applications of this circuit have varied (in frequency) from f1. variable filters for electrophysiological research, to a fine-section tone control. High frequency operation is dependent only upon the characteristics of the amplifiers used. However, as the frequency of operation is increased, the value and size of a discrete inductor must reach measurable proportions.

References

Dave Protheroe was an electronics technician in the psychology department of the City of London Polytechnic, where he constructed prototypes of this filter. Since then he has graduated in electrical engineering and is now lecturing in electronics at Thames Polytechnic. Researching into digital systems design, recent work has centered around applications of digital devices, especially the hardware and software design of a 16-bit microcomputer system.

Appendix

A voltage Vc is applied to the input terminal of Fig. 4. Then

\[ V_1 = V_c - V \]

where \( V = V_1 \)

Thus

\[ V_1 = V_c - V \]

This is of the form required and assumes the amplifier has a gain of unity, a high input impedance, and a low output impedance conditions easily satisfied.

American letter

from George Tillett in Chicago

At the Chicago Summer Show CBS was about $5,000, some 15% less than last year — although the advance bookings were at a record high. The reason, of course, had to do with the uncertain economic situation, but the growing popularity of the January Las Vegas Show might have had an effect too. If there is a recession, some of the exhibitors seem unaware of it, judging from the number of high-priced luxury items on show. Infinity had a $20,000 loudspeaker system and Lux were showing a $3,000 turntable, while there were several photo cartridges coming over $250. One was priced at $500 and a precision tonearm could be had for a mere $1300. If you are tired of ordinary TV, you can spend anything between $16,000 and $30,000 for a dish antenna so you can watch satellite transmissions.

Audio

Two or three years ago, receiver makers were committed to a kind of 'power race' to see how many watts they could cram in, but not too many buyers were enthusiastic about the cumbersome 400 watts jobs. So these days the accent is on features such as automatic scanning, Infinity's 'Remote Standard'.

American Radio History
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Practical applications of this circuit have varied (in frequency) from l.f. variable filters for electrophysiological research, to a five-section tone control for audio systems. Although developed for use in audio and sub-audio frequen-
cies, high frequency operation is dependent only upon the characteristics of the amplifiers used. However, as the frequency of operation is increased, the size and value of a discrete inductor can reach measurable proportions.

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WIRELESS WORLD, SEPTEMBER 1980

The Age of Electronic Temperature Regulation

Today's precision world of electronic equipment demands perfection of components and equipment. The British company of Antex' sieldin systems is being constantly improved to meet the demands of today. The only the Giusul electronic engineering

There are now alternative systems available with the standards for all-day energy-saving work. No, it should be capable of saving energy for the whole day, but it is all time made by

Garrulous gadgets

Talking clocks, calculators and micro-wave ovens are becoming commonplace and space quality is improving. A new one is the use of new chips that can synthesize phone numbers. It is said there are at least 40 uniquely different phone numbers. But the result is a total of 64 phone numbers. The duration of each phone is fixed, the slowest being 40ms and the fastest 200ms. Pitch variation varies automatically, or it can be controlled by an electronic "clock". Continuous electronic speech is created by sequenced sounds into recognizable words. For example, "phone" becomes F-01-N-x-EL-M.

Panasonic were showing a talking calculator which had a female voice with an impeccable British accent. - Rogash, if I'm not mistaken. Casio had another which also contained a clock, date memories, a calendar and 12 recorded tunes. The user could change the clock, and the clock changes a sequence of tunes for special occasions such as "Happy Birthday" or "The Wedding March", but one tune could not be changed. The thing plays "Jingle Bells" every Christmas...

For further details...
present station selection, bar-graphs and so on. Onkyo scooped its competitors with a built-in “snap, crank and pop” remover that works like the SAE and Garrard units, which reverse the phase of the signal before removing needle marks. A few genuine Class A amplifiers and receivers were to be seen but there is a definite trend towards a modified Class A circuit where the output stage is biased so it is really flat.

Designs, although Technics still use coming more common, and among other drawbacks have been claimed to be comparable with Class B without the switching or crossover problems. Variations are known by such names: Kenwood use the term “Zero Switching” and JVC use the description “Super A”, while Fisher prefer “Class-I” and Technics call their arrangement “synchrostats”.

All manufacturers are aware of the problems caused by too much negative feedback and designers have abandoned the use of “brute force” loops of 50 to 60 dB to get some impressive figures. In other words, amplifiers are designed for low distortion before the loop is closed, so that only 15 to 20 dB is necessary. Yet another approach will, I believe, come quite popular — for at least for the more expensive models. This is the “feedforward” circuit which involves the use of a separate amplifier to balance out the inherent distortion in the main amplifier. Threshold were the first to use it in their Stasis model, but others now Sansui have developed a similar circuit. They introduced the first model at the $3500 Al-Dual rated at 120 watts per channel at a distortion less than 0.004%. Frequency response is within 4 Hz to 20 kHz.

Cassette decks now offer better value for money than ever and several models were to be seen priced at well below $120. Both head unit and tape drive are massive and the selection consists of a vertical stack of 12 planar electromagnetic induction units arranged as a dipole. High frequencies are handled by another stack of 36 planar units. The cabinets are 1 inch thick and some of the sections are sand-filled (remember the Wharfedale baffles?) and the total weight is 1200 lbs. How did it sound? Well, it was unquestionably very, very good and the low frequencies were particularly impressive. After all, a dozen 12 inch speakers can move a lot of air! Although the system is not a true line source, the stereo image was outstanding, but it must be said that the overall gain over a really good pair of $1000 systems is quite small — at least at “normal” listening levels. It’s the law of diminishing returns.

Cerwin-Vega were demonstrating a new model, designed to meet the “challenge of the new digital super-cd’s”. It is a three-way system with an 18 inch bass driver and a 12 inch co-axial unit, plus a compression tweeter. An unusual feature of this model is the use of a device to effectively increase the volume of the bass compartment of the enclosure. No, the gas can’t escape: it is contained in plastic bags. The system stands 53 inches high and it will handle 1000 (yes, one thousand) watts continuously.

The Ionophone is back again: its new jeans are $180. It will work in any car, up to a speed of 120 mph. The Ionophone was switched in, the feeling of strain simply vanished. Some of the sections are thick and some of the sections are really good pair of $1000 systems.

For SAR, we have a selection of direct-drive models under $180. Slow tours seem to have almost superseded the old familiar S-shaped designs, although Technics still use them in most of their range. Linear tracking or straight-line arms are becoming more common, and among those seen were models from Technics, Harman-Kardon, Mitsubishi, Yamaha, Phase-Liner and Denon. The last named turntable uses a moving air-core to float the phonograph cartridge. Lux also have a turntable which employs a pump but this one uses a valve, and it is driven by four speech coils, positioned to “ensure a piston movement without flexing”. Jumellette, a Canadian manufacturer, were demonstrating the latest version of their system, which uses a horn-loaded ribbon transducer from 600 Hz up to some of the best sound heard at the Show.

The VSC company introduced several low-priced cassette players using a new chip to produce an 8 kHz bit stream, intelligible audio playback at speeds up to three times normal. According to the makers, there is a saving of $50 in the design and at least four manufacturers of c.r.s. that can operate in the six-hour mode.

Crown introduced the unique PZM microphone at the January Show and again, it was attracting a lot of attention. It uses a new principle of sound detecting, using the pressure zone at an acoustic boundary to eliminate distortion problems common to other microphones — so say the inventors.

The active element is a pressure- and velocity-compensated electret capsule and it is mounted on a plate measuring 5 x 5 inches. One of the advantages of the PZM is that the frequency response is independent of distance, but the gain in clarity is almost unbelievable. In one demonstration, it was compared with a very expensive German studio microphone in a recording session with a large orchestra. As soon as the PZMs were switched in, the feeling of strain simply vanished. Various models are available and they can be put inside the cabinets, but bass drum or piano, since inputs as high as 150 dB can be handled.

Garrulous gadgets

Talking clocks, calculators and micro-wave ovens are becoming common-place and speech quality is improving. One reason is the use of new chips that can synthesize phonemes. It is said there are at least 40 uniquely different sounds needed to phonetically create words in the English language. These, plus 16 other durational alternatives are produced by a new l.s.i. chip made by Votrax. There are also three “pause” phonemes often necessary in sentences to separate phrases in continuous speech, so the result is a total of 64 phoneme symbols. The duration of each phoneme is fixed, the slowest being 40ms and the fastest 200ms. Pitch variation varies automatically, or it can be controlled by an external “clock”. Continuous synthetic speech is created by sequencing sounds into recognizable words. For instance, “phome” becomes F-O-N-E.

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THE RANGE HAS INCREASED
THE PRICES ARE DOWN

THE CS1830 30 MHz + Sweep Delay

The CS1830 is a completely new 30 MHz dual trace oscilloscope employing a square format, integral phosphor. PDA tube for accurate bright display. A new feature is the instrument of cathode ray sweep delay with a range of 1-500 ms and trace height up to 150 mv. If you can see from close-up of the photograh, the CS1830 has all the facitilies you could want in a performance instrument but for more detail, simply ask for a comprehensive leaflet.

Brief specification

Rectangular PDA type 100 x 96 mm. 5S phosphor.
Sensitivity
5 mv/cm (20 MHz)
10 mv/cm (20 MHz)
Input R.C. 1000 M Hz)
Trip bandwidth DC-30 MHz
Sweep Delay 1.5 x 1000 mv.

CS1830 only £455 + VAT, includes 2 probes

THE CS1572 30 MHz for the VTR Lab

If you are in Video, you need the CS1572

The CS1572 is a dual trace 30 MHz oscilloscope designed for the video tape recorder engineer. Video derived sweep facilities are provided to allow magnification and analysis of any point in a single video frame together with separation of video and sync fields. A unique feature for anyone concerned with video measurements as it is the only dual trace oscilloscope specification dual trace wide band oscilloscope for general lab use. The complete range of video facilities is too great to explain in a small advertisement so why not call us and ask for the full story on the CS1572.

Brief specification

Rectangular PDA type 100 x 96 mm. 5S phosphor.
Sensitivity
100 mv/cm (3 MHz)
10 mv/cm (3 MHz)
Input R.C. 1000 M Hz)
Trip bandwidth DC-30 MHz
Sweep Delay 1.5 x 1000 mv.

CS1572 only £425 + VAT, includes 2 probes

THE CS1577 30 MHz at 2 mv + Signal Delay

The most popular scope in the range.

The CS1577, a popular dual trace oscilloscope, our most popular instrument and hundreds of satisfied users in all sections of the electronics industry will confirm this. The CS1577 contains a 30 MHz bandwidth oscilloscope with movable sweep and marker facilities for wider bandwidth applications (DC-40 MHz) and 2 mv sensitivity over the full bandwidth.

Fixed signal delay is provided by a delay delay line which allows viewing of the leading edges of fast pulses for accurate rise time measurement. and the 130 mm PDA tube gives rise time of 10 nS to the highest sweep speeds (50 mV/cm using a square wave input).

Good triggering, even at low levels has always been an outstanding feature of Trio oscilloscopes and the CS1577 conforms to this tradition.

Triggering, as always, is automatic, the user is not asked to sort out which width of pulse should go to which section of circuitry.

1. Sandcastle pulse on pin 7 of TDA 2566. The narrow top part of the pulse is used to clamp the luminance signal at black level during the back porch. The actual voltage of this black level is determined by the position of the brightness control. The wider lower part is used to gate the gain-controlled amplifiers which control the saturation and contrast (saturation tracking). During this time (the burst interval) the phase-locked loop has to be switched to maximum gain to prevent distortion to the a.c. signal. This pulse will be wide enough to cater for tolerances in broadcast burst position.

2. Sandcastle pulse on pin 15 of TDA 2532. The narrow pulse gates in the burst for use in the subcarrier regenerator section of the i.c. This pulse must be as narrow as possible for optimum noise performance. However, due to the tolerances on broadcast burst position, some degree of adjustment is necessary to the leading edge of this pulse to ensure that all the burst is gated in. If part of the burst is lost, the pulse range of the subcarrier regenerator a.p.c. loop will be impaired.

The wider part of the pulse is used for blanking the chrominance signal for the whole of the line and field flyback periods. This is needed because the process of gating the gain-controlled amplifiers producescolourful noise during these periods and this would show on the screen.

3. Luminance blanking. After the narrow pulse (1) has clamped the black level to the voltage set by the customer brightness control, line and field pulses blank the signal during the whole of the line and field flyback periods. Thus these pulses must be derived from the line and field timebases.

The luminance signal is blanked to a reinserted level of +1.5V. This luminance signal is then d.c. coupled throughout the remainder of the decoder.

4. Output clamp. A pulse wider than that of the chroma gain switch but narrower than the chroma blanking is required for clamping the colour difference signals before they are added to the luminance signal. The control for each of these clamps is derived from a sample of the video output signal, thus ensuring that the d.c. level of the output signal (and hence the black level on the c.r.t.) is closely controlled within a feedback loop.

The background controls, for presetting the black level of each colour, are also included in this loop.

Video outputs

Video output stages need to drive up to 0.5V p-p of video at a reasonable bandwidth into a load (the c.r.t. cathode) which has a substantial capacitance. The amplifier output needs to present a low output impedance to this load and a simple class A amplifier for this application would dissipate an appreciable amount of power. Consequently, several types of low-disipation circuit have been developed to overcome this problem. The 70 series chassis uses a class A amplifier with an active load (Fig. 11).

In this circuit the drive is applied to a transistor operating as a high class A amplifier with a high-resistance load thus keeping the dissipation down. As long as this transistor is being turned on (i.e. the signal at its collector is going towards the 8V line) the output impedance is effectively low. However, if the drive to the class A transistor starts to go in a negative direction, trying to turn it off, then the output impedance would effectively be the high resistance collector load. Hence the reason for the second transistor, which acts as an emitter follower for positive going output signals and consequently presents a low output impedance to the c.r.t. cathode.

To ensure good linearity of the output waveform, feedback is applied over the whole stage, part of which in this case. Here, a sample of the blanking level is also taken and the d.c. level offset from the output corrected as necessary. The c.r.t. background controls are d.c. potentiometers acting in this part of the circuit.

Sync processor

The purpose of the sync processor or "jungle" is to select the sync pulses from the video waveform, and use them to phase lock an oscillator running at the same frequency. By careful choice of time-constants the phase locking process reduces the effect on the picture of noise and disturbances on the video waveform. The resulting line drive pulses can then be compared in another phase locked loop with flyback pulses derived from the line output stage and the resulting pulses amplified to drive the line output transistor. The processor circuit is may also be self field sync pulses and may produce gating/blanking pulses for the colour decoder.

The TDA2571 used in the 70 series chassis does not contain the second phase-locked loop which compares the line oscillator output with the line drive pulses. This loop, as we shall see, is contained in the power supply control circuit. The TDA 2571 contains two major innovations, an adaptive sync separator and a count-down field counter field sync system. Conventional sync separators are based on the d.c. restoring circuit shown in Fig. 12(a). Tr, is biased by R3, so that it is just on the point of conducting. As such sync pulse comes along it drives Tr hard on, producing the output pulses shown. The time constant 10R, is chosen so that sufficient charge leaks away between pulses to enable each pulse to turn Tr on. This type of circuit is particularly susceptible to noise on the sync pulses and also to "ghosts" or cross-modulation on the received signal. The principle of the adaptive sync separator used in the 70 series chassis is shown in Fig. 12(b).

The video signal is applied to a gain controlled amplifier which amplifies the sync pulse and sets the black level and sync tip level at the two levels shown. A level corrector takes a sample of each of
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THE

Brief specification

Rectangular P.C.B. 120 x 90 mm. P.S. phosphor.

Overvoltage less than 3%

Safety factor 500 V (20 MHz)

Linearly better than 3%

Trip bandwidth DC-30 MHz

Sweep Delay 1 x 1/1000 s

CS1830 only £455 + VAT, includes 2 probes

THE CS1830 30 MHz + Sweep Delay

The CS1830 is a completely new 30 MHz dual trace oscilloscope employing a square format, integral positive P.D.A. rule for accurate bright display. A new feature is the inclusion of cathode ray sweep delay with a range of 1/1000 s and brightness up to show the test point position. As you can see from close-up shots of the photograph, the CS1830 has all the features that you have come to expect from a comprehensive oscilloscope.

THE CS1572 30 MHz for the VTR Lab

If you are in Video, you need the CS1572

The CS1572 is a dual trace 30 MHz oscilloscope designed for the video tape recorder engineer. Video derived sweep facilities are provided to allow magnetic transfer and analysis of any point in a single video frame together with separate display of video odd and even fields. A unique feature for those concerned with video measurements as standard, is a new scope specification: dual trace wide band oscilloscope for general lab use. The complete range of video facilities is not to explain in a small advertisement so why not call us and ask for the full story on the CS1572.

CS1572 only £245 + VAT, includes 2 probes

THE CS1577 30 MHz at 2mV + Signal Delay

The most popular scope in the range.

The CS1577 30 MHz dual trace oscilloscope features our most popular specifications and hundreds of specialised uses in all sections of the electronics industry will confirm this. The CS1577 combines a 30 MHz bandwidth and 100 MHz/s sweep rate with an incredibly low level of 2mV per division sensitivity. The dual trace wide band oscilloscope is the perfect choice for many applications.

CS1577 only £510 + VAT, includes 2 probes

THE CS1757, unique dual trace 4 function Audio Scope

The CS1757 is a test tool for the audio engineer. It features the normal facility of dual trace display with sensitivity to 1 mV/cm but not only can it display the input signal on two channels side by side, but also the phase angle between them and measure the phase angle referenced to a zero phase display calibration. In addition toLR, metering, tone and also have independent triggering from either channel to give any one of the following: 2x, 4x, matrix display, stereo or total audible output.

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colour tv receiver design

3 - More on the colour decoder; also video outputs, sync processor and timebases

by R. Wilkinson, B.Sc. (Hons), M.I.E.E., Decca Radio & Television Ltd

The previous article, in the August issue contained a description of the three-chip colour decoder. The present article continues with further developments of this decoder, and concentrates on the output circuits of the receiver.

Various sections of the circuit require a number of pulses for the purposes of gating, blanking and clamping. Fig. 10(a) shows the various pulses required and their relative timing and Fig. 10(b) shows how the signals are affected by them.

The "sandcastle" pulse is a convenient way of applying the correct phase to one pin of an i.c. Level sensors in the i.c. sort out which width of pulse should go to which pin of the decoder.

1. Sandcastle pulse on pin 7 of TDA 2566. The narrow top part of the pulse is used to clamp the luminance signal at black level during the back porch. The actual voltage of this black level is determined by the position of the brightness control. The wider lower part is used to gate the control-amplifiers which control the saturation contrast (saturation tracking). During this time (the burst interval) the burst is sent to the decoder at the highest sweep speeds (200 mV/cm using a linear response. Good triggering, even at low levels has always been an outstanding feature of Tristar oscilloscopes and the CS1577 continues this in perfection. Triggering, as always is critical. Also, the output of the trace even at the highest sweep speeds will be impaired. As each sync pulse comes in these amplifiers are switched to maximise their gain to prevent disturbance to the a.c. signal. This pulse must be wide enough to cater for tolerances in broadcast burst position.

2. Sandcastle pulse on pin 15 of TDA 2532. The narrow pulse gates in the burst for use in the subcarrier regenerator section of the i.c. This pulse must be as narrow as possible for optimum noise performance. However, due to the tolerances on broadcast burst position, some degree of adjustment is necessary to the leading edge of this pulse to ensure that all the burst is gated in. If part of the burst is lost, the pulse range of the subcarrier regenerator a.p.c. loop will be impaired.

The wider part of the pulse is used for blanking the chrominance signal for the whole of the line and field flyback periods. This is needed because the process of gating the gain-controlled amplifiers to produce the chrominance produces coloured noise during these periods and this would show on the screen.

3. Luminance blanking. After the narrow part of the pulse 1 has clamped the black level to the voltage set by the customer brightness control, line and field pulses blank the signal during the whole of the line and field flyback periods. Thus these pulses must be derived from the line and field timebases. The luminance signal is blanked to a reinserted level of +1.5V. This luminance signal is then d.c. coupled throughout the remainder of the decoder.

4. Output clamp. A pulse wider than that of the chroma gain switch but narrower than the chroma blanking is required for clamping the colour difference signals before they are added to the luminance signal. The control for each of these clamps is derived from a sample of the video output signal, thus ensuring that the d.c. level of the output signal (and hence the black level on the c.r.t.) is closely controlled within a feedback loop.

The background controls, for presetting the black level of each colour, are also included in this loop.

Video outputs

Video output stages need to drive up to 85 mV p-p of video at a reasonable bandwidth into a load (the c.r.t. cathode) which has a substantial capacitance. The amplifier stage needs to present a low output impedance to this load and a simple class A amplifier for this purpose would dissipate an appreciable amount of watts. Consequently several types of low-distortion circuit have been developed to overcome this problem. The 70 series chassis uses a class A amplifier with an active load (Fig. 11).

In this circuit the drive is applied to a transistor operating as a high class A amplifier with a high-resistance load thus keeping the dissipation down. As long as this transistor is being turned on (i.e. the signal at its collector is going towards the 8V line) the output impedance is effectively low. However, if the drive to the class A transistor starts to go in a negative direction, trying to turn it off, then the output impedance would effectively be the high resistance collector load. Hence the reason for the second transistor, which acts as an emitter follower for positive output signals and consequently presents a low output impedance to the c.r.t. cathode.

To ensure good linearity of the output waveform, feedback is applied over the whole stage, part of which is in the i.e. Here, a sample of the blanking level is also taken and the d.c. level off the output corrected as necessary. The c.r.t. background controls are d.c. potentiometers acting in this part of the circuit.

Sync processor

The purpose of the sync processor or "jungle" i.c. is to select the sync pulses from the video waveform, and use them to phase lock an oscillator running at the same frequency. By careful choice of time-constants the phase locking process reduces the effect on the picture of noise and disturbances in the video waveform. The resulting line drive pulses can then be compared in another phase locked loop with flyback pulses derived from the line output stage and the resulting pulses amplified to drive the line output transistor. The sync processor i.c. may also separate out field sync pulses and may produce gating/blanking pulses for the colour decoder.

The TDA2571 used in the 70 series chassis does not contain the second phase-locked loop which compares the line oscillator output with the flyback pulses. This loop, as we shall see, is contained in the power supply control circuit.

The TDA 2571 contains two major innovations, an adaptive sync separator, and a count-down field sync separator with its own innovations, an adaptive sync processor. Conventional sync separators are based on the d.c. restoring circuit shown in Fig. 12(a), Tr, bistable by itself, it is just that it is just on the point of conducting. As each sync pulse comes along it drives Tr hard on, producing the output pulses shown. The time constant 10R, is chosen so that sufficient charge is leaked away between pulses to enable each pulse to turn Tr on. This type of circuit is particularly susceptible to noise on the sync pulses and also to "ghosts" or cross-modulation on the received signal. The principle of the adaptive sync separator used in the 70 series chassis is shown in Fig. 12(b).

The video signal is applied to a gain-controlled amplifier which amplifies the sync pulse and sets the black level and sync tip level at the two levels shown. A level corrector takes a sample of each of
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these levels and corrects the gain of the amplifier as necessary. With the sync pulse having been closely defined, a small slice is taken out of the centre of it and amplified, thus producing a very stable, closely defined sync pulse. This type of circuit has been demonstrated to be markedly superior to the older type of circuit, especially under noisy, "ghosty", or cross-modulated signal conditions.

Once the mixed sync pulses have been separated out, a further circuit separates out the field sync pulses. Often simple integration is sufficient, but again poor signals can result in poor or even no field pulses. Obviously the mixed sync pulses from the adaptive type of sync separator give improved field pulses but certain signals can be improved by the use of a field pulse count-down system.

A set of dividers counts down from the line oscillator frequency (in this case 2x line frequency = 31.25kHz) to the field frequency of 50Hz and produce an output pulse at this frequency. A normal integrating sync separator produces a field sync pulse directly from the mixed sync waveform and this is compared with the count-down pulse. If the two are completely in phase for a sequence of complete fields, the counted-down pulse is fed out to the field timebase. If the pulses are not in phase, the integrated pulse is fed out. This procedure guards against incorrect processing of signals which do not have a defined count-down ratio between line and field sync pulses (e.g. some CCTV cameras, video games, etc.).

The necessary delay in deciding which pulses to feed out causes a noticeable though not objectionable effect on the picture — on changing sync sources (e.g. changing channels) the picture locks momentarily with the field blanking interval in the centre of the screen before locking normally.

Direct frame sync

It was discovered, early on in the development of the 70 series chassis, that if the CCTV camera or video game, or whatever was the non-counted-down source, had a line/field frequency ratio close enough to the true counted-down one, then the i.c. sent out a proper indirect count down pulse. However, a few fields later it would "realise the error of its ways" when the direct pulse had drifted out of phase with the indirect pulse. It then momentarily supplied the direct field sync pulse while it "considered" the situation. Eventually for a few fields, the unlocked source would appear to have a locked line/field relationship and so the i.c. would revert to supplying the counted down pulse. This sequence would repeat itself ad infimum and the picture would exhibit an irritating slow vertical jitter. For this reason a small sub-panel was fitted to the 70 series main panel to supply direct

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**Fig. 10(a). Simplified block diagram of decoder, showing relationship of pulses to video signals.**

**Fig. 10(b). Details of waveforms in decoder (Fig. 10(a)).**

**Fig. 11. Video output amplifier (simplified).**

**Fig. 12. (a) Conventional sync separator. (b) Adaptive sync separator.**

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www.americanradiohistory.com
This page discusses decoder circuits and sync separation. It explains the relationship between pulses and video signals, showing a simplified block diagram of a decoder. The text describes the process of combining mixed sync pulses and the use of a field sync pulse. It also covers the adaptive sync separator, comparing it to conventional sync separators. The page includes diagrams illustrating the relationship between pulses and video signals.
The requirements of the main output of the power supply are largely governed by those of the line output stage. The devices, the transformer is also simpler, less high-impedance supply choke as far as least losses (and hence lowest dissipation) are concerned. There is no doubt that it has a substantial improvement.

2. A number of the spectrum 'holes' referred to in the first paper are actually used most Sundays by the present generation of pirate stations. In general, the medium wave operators start around midday and close down before the dusk brings extended propagation and the VHF stations tend to come on in the evening, although one well-established VHF pirate who sometimes starts around 12 midday to 3 p.m. Readers with the right sort of equipment may like to monitor scan. The results of these stations can be quite interesting.

3. Let us be clear: Estimating the width of a radio spectrum, for all the obvious reasons. But, faced with the poor record of the Home Office Radio Regulatory Department in pre-empting "infestations", it is unlikely that the availability of frequency spectrum space and the politician's lack of vision in restricting broadcasting. Hence the need for a standard scan. The need for a standard scan may be obvious which is double that during scanning. Thus fast flyback is achieved with lower dissipation.

To be continued

Field timebase

This uses the well-established TDA1170 which has operated successfully for several years in the 86 series chassis. The TDA 1170 is a complete timebase with oscillator, sawtooth generator and output amplifier (Fig. 14). The output circuitry incorporates a flyback circuit which helps to reduce power consumption. In some circuits the field flyback is contained within the supply rails and consequently a good deal of power is wasted (Fig. 15). In the TDA 1170 the supply is only sufficient to contain the scan waveform. During flyback, the supply is switched to a value which is double that during scanning. Thus fast flyback is achieved with lower dissipation.

Notes on Part 2

For space reasons we deleted a few lines from the text under the section "Sound, I.T., and output" on page 64 of the August issue. As the author feels the matter is of importance to the design we are printing them here.

The HV supply for the TDA 1170 is taken from the switched-mode power supply with the large current pulses which the audio output wants during bass clipping. My experience with this type of data driver required by IEEE-488 (1978) Mr Effiean is impressive in his interpretation of the standard. He writes in allowing one device to control the state of a bus line has to be provided. The available options are twofold: three-state logic, and wired-or. The more universal, and cheaper, wired-or solution is adopted.

The GPIB uses binary logic. It is optional to use three-state output stages on gates driving the ATN, EOI, HAND, and DACC lines. It is, however, clear that wired-or of DACC (for example) is equivalent to wired-or of NRFB, and Wired-and the speed of the line is increased.

(Effiean means "open collectors". The RFB and DAC, messages are a "wired-and" combination of all the open-collector gates connected to the NRFB and DACC lines. The SRQ message is a "wired-or" combination of all the open-collector gates connected to the SRQ line.

1. E slipped from the point output stage in the Parallel-Poll Active State if there are three-state or open-collector outputs. In the Parallel-Poll Active State these lines must be open-collector.

If three-state devices are selected for DAV and DI03-DI06 then the GPIB data rate can be up to 1Mbyte/second to say that a "faulty agreement limit of 250 kbyte/second is therefore normally accepted" is a serious misinterpretation of IEEE 489.

The maximum data rate permissible on the GPIB is:

(a) 250kbyte/s using open collector data drivers.
(b) 500kbyte/s using three-state drivers for DAV, DI01-DI08 and E01.
(c) 1Mbyte/s using three-state drivers for DAV, D02-D05, EO1 and ATN, provided that the data rate is not more than 16k of data is used (if there is at least one standard termination network, 160 data is used). The power-off condition of the instrument on the bus, and (iv) the device capability is less than 50pF.

Instead of these limitations, one is free to design one's own scan waveform. The GPIB Parallel Poll Function is a source of frequent confusion. In the Parallel Poll Enquiry Command (PPC) the Controller instructs the current Listener to respond to a request. It is impossible to predict accurately what message will arrive on the most frequent case (LST) on the medium. The standard state of the bus is "off". The listener is "on" state when referring to the standard PS-0. However, some devices are selected for DA V.

For example, it was expected that if a speed-enhanced bus talker is used to achieve 1Mbyte/s data rates, with standard talkers, problems may be experienced even when the interface is not being used at all.

Mr Effiean's section on Parallel Poll is extremely lucid, and I thank him for it.

Finally, I should emphasise that with microwave or microsecond, the microwave or microsecond is not a mistake which somehow crept into my manuscript.

Let us be clear: Estimating the width of a radio spectrum, for all the obvious reasons. But, faced with the poor record of the Home Office Radio Regulatory Department in pre-empting "infestations", it is unlikely that the availability of frequency spectrum space and the politician's lack of vision in restricting broadcasting. Hence the need for a standard scan. The need for a standard scan may be obvious which is double that during scanning. Thus fast flyback is achieved with lower dissipation.

Note...
field when required. The customer channel-select switches are arranged to switch in this feature in conjunction with the a.v. time constant switching for v.c.rs etc.

**Line timebase**

The requirements of the main output of the power supply are largely governed by those of the line output stage. The least losses (and hence lowest dissipation and highest reliability) occur with the constant, high voltage line output devices. The transformer is also simpler in this configuration, acting just as a high impedance supply choke as far as the line connectors are concerned (Fig. 13). Hence the line coils are switched directly across the supply and, consequently, their impedance (which, at 50kHz, is largely comprised of their inductance) and their sensitivity determine the supply voltage. The basic form of a.c./d.c. flashover and extra volts must be allowed for the drop across this resistor. The line output stage is often a secondary power supply itself, the overlap on the i.f. being the source of d.c. and form controls for the c.r.t. Sometimes tapped windings, scan rectifiers, are used to provide line supply voltages for the signal circuitry. All these sources add to the current through R and contribute to the volt drop across it.

In the 70 series chassis all the supply lines except one, the -12v line from the s.m.a.p. transformer. This avoids any restrictions on the a.c. component in the line output stage. The field timebase h.t. is taken from the line output stage because of the high accuracy of the main supply, which helps to reduce power consumption. In some circuits the field flyback is contained within the supply rails and consequently a good deal of power is wasted (Fig. 15). In the TDA170 the supply is only sufficient to contain the scan waveform. During flyback, the supply is switched to a voltage which is double that during scanning. Thus fast flyback is achieved with lower dissipation.

![Fig. 14. Block schematic of the TDA170 line output stage.](image1)

![Fig. 15. Field output waveform with and without a flyback generator.](image2)

**COMMUNITY RADIO**

Norman Macleod could have strengthened his argument by visiting a community radio station (June—July issue) by reference to the experience of the surprisingly lively pirate broadcast radio in the nation's capital.

1. The BBC frequency is a standard radio station. For about fifteen months until it finally collapsed (in December 1977), it was a pirate station. The RADIO AMERICA (Alternative Media for You) attempted a service for the six north London boroughs of Crouch End, Haringey, Hackney, Enfield, Barnet, and Hackney. The rather idealistic collective that ran it had a vision of London divided into five manageable radio communities, the city divided into two, and both south. The six hours of programming included much local news and interviews, even some local production material.

It was the very scope of their ambitions which was their undoing—quite different from the usual deus ex machina of the conventional community radio phenomenon. The line output stage is often a simplified line output stage. The field timebase is an integral part of the picture. Hence the height to be corrected in the output stage is often a function of the various components of the i.f. which generate the height signal.

- "Foiled" Mr Ellefson means "open-collector". The RDF and DAC messages are a "two-input" combination of all the open-collector gates connected to the RDF and DAC bases. The RDF combination is a "one-way" combination of all the open-collector gates connected to the RDF line. The DIO-DIO-DIO-DIO-DIO-DIO line may have three-state or open-collector outputs. In the Parallel-Poll Active State these lines may be open-collector drivers.

WHAT’S SO NATURAL ABOUT it?
Die ganzen zahlen hat Gott gemacht, alles andere ist menschenwerk.

I do not understand why Dr Finlay (December, February, April) wishes to dismiss the essence of rules and two jam-jars. The memoir which he made was clearly not completed with a purpose in mind. It has always been my wish, however, that these columns should bring light and understanding into the minds of others, especially my bank manager.

Three jam-jars, I think, will be better, and nothing you can’t find, if desperate enough, in the ordinary home. I do not possess a more rule, but some quick hammering on the ceiling has provided a lath just over a metre long. I thereby measure, some sand of it, of course, of your grocer’s old-fashioned, a mixture, and like.

The jam-jars are best replaced by those revolving plastic bottles, with string handles, a bucket to get a short cut the value is always low, and I was already had already found that in a short time, more than a metre, hastily done, the total path A, B, C, D, E, a cam to 32cm.

We shall draw another form, producing tangents. This gives a high value, again sufficiently close. The corresponding approach to a is to start with the standard length, and the new formula:

\[ \frac{1}{a} + \frac{1}{b} = \frac{1}{c} \]

The video display remains memory-mapped from 8000 onwards, although the computer can handle integers by 46 characters per page, with some help of the programatically unhandled and manually selectable.

A student mistake makes use of the area, 1600 to 1700 without memory protection. It has transferred the commencement memory-mapped from 1000 onwards, and in the position presents long or sequenced BURP programs.

With reference to the article by the late Mr Butler in the February 1975 issue on Pseudo Random Binary Sequence Generators, I think your readers may be interested in the full criteria for feedback selection. Careful choice must be made to ensure the full sequence length of P = 2n is achieved. In this case the total shift register length is 2n + 4 bits, and the feedback connexion table generated from these equations is given below.

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The basic experiment can be elaborated.

The effect of taking fewer large steps, and more steps, can be studied by the addition of the area, \( x_0 \) to 0.5 where, 0.5 up to 0.9 can be recorded. With about the area, the explosive growth of \( a \) as it goes on is obvious.

Out of my one feature of this system which I find particularly attractive: you don’t need to know all at all, or in order. Any way, you can repeat the operation on your own device.

Moreover, it is difficult to comment on technical communications without referring to the notorious inability of the majority of engineers to communicate effectively. It is a point which has been made time and again - but one which the educationalists seem reluctant to accept.

Ronald C. Slater

FEEDBACK FOR R.B.S. GENERATORS

With reference to the article by the late Mr Butler in the February 1975 issue on Pseudo Random Binary Sequence Generators, I think your readers may be interested in the full criteria for feedback selection. Careful choice must be made to ensure the full sequence length of \( P = 2^n \) is achieved. In this case the total shift register length is \( 2^n + 4 \) bits, and the feedback connexion table generated from these equations is given below.

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The techniques used in the area, 1600 to 1700 without memory protection. It has transferred the commencement memory-mapped from 1000 onwards, and in the position presents long or sequenced BURP programs.

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The effect of taking fewer large steps, and more steps, can be studied by the addition of the area, \( x_0 \) to 0.5 where, 0.5 up to 0.9 can be recorded. With about the area, the explosive growth of \( a \) as it goes on is obvious.

The techniques used in the area, 1600 to 1700 without memory protection. It has transferred the commencement memory-mapped from 1000 onwards, and in the position presents long or sequenced BURP programs.
WHAT'S SO NATURAL ABOUT IT?

Die ganzen zahlen hat Gott gemacht, alles andere ist menschenerarbeit.

I do not understand why Dr Finlay (December, February, April) wishes to determine

The process corresponds to finding $e$ by the converse of Fig. 1. As each step short the cut value is always low, and I was up to a point that an

The basic experiment can be elaborated.

The effect of taking fewer large steps, or steps, can be studied by examining goods from $ax_1 < 0$ through $a = x, rac{1}{3}, x_1$ and $0$ can be recorded. With a..energetic expansion of growth as it goes on as can be shown.

We can draw another form, producing

We give leave of absence, the suspended sentence.

I would like to thank John Adams and the morning.

The technical author surely deserves - together with that

The provision of operating, maintenance and

The provision of operating, maintenance and

The problem of the technical author surely deserves - together with that

With reference to the article by the late Mr Adams in his book on my April to Sep-

I have added the use of REM for remarks, LINK N as

Finally, there is one feature of this system

We consider the total sequence length is

On to another band. Certainly, rigs will

II LICIT CB ON 27MHz

A number of people have urged the Govern-

The authorities will never catch these

I was interested to read the letter from Mr D.J. Croydon in the March issue since I have been a subscriber for

1. The capacitor discharge unit itself is not always to blame for spurious faults, although carelessness is often given to the class of suitable components; in particular, the thyristor circuit which is more

2. The high output voltage from the coil acting as a high frequency source to

3. C-d ignition does not appear to be too badly designed for broadcast, but one

4. Notes that it is simple to write using these devices in microprocessor systems. I have

5. It is difficult to see what will entice these

6. My system comprises $1000, $500, $250, $100, $50, $20, $10, $5, $2, $1, $0.50, $0.25, $0.10, $0.05, $0.01, $0.005, $0.0025, $0.00125, $0.000625, $0.0003125, $0.00015625, $0.000078125, $0.0000390625, $0.00001953125, $0.000009765625, $0.0000048828125, $0.00000244140625, $0.000001220703125, $0.0000006103515625, $0.00000030517578125, $0.000000152587890625, $0.0000000762939453125, $0.00000003814697265625, $0.000000019073486328125, $0.0000000095367431640625, $0.00000000476837158203125, $0.000000002384185791015625, $0.0000000011920928955078125, $0.00000000059604644775390625, $0.0000000002980232238769531, $0.0000000001490116119384765, $0.0000000000745058059692382, $0.0000000000372529029846191, $0.0000000000186264514923095, $0.0000000000093132257461547, $0.0000000000046566128730773, $0.0000000000023283064365386, $0.0000000000011641532182693, $0.0000000000005820766091347, $0.0000000000002910383045673, $0.0000000000001455191522787, $0.0000000000000727595761393, $0.0000000000000363797880697, $0.0000000000000181898940348, $0.0000000000000090949470174, $0.0000000000000045474735087, $0.0000000000000022737367544, $0.0000000000000011368683772, $0.0000000000000005684341886, $0.0000000000000002842170943, $0.0000000000000001421085471, $0.0000000000000000710542736, $0.0000000000000000355271368, $0.0000000000000000177635684, $0.0000000000000000088817842, $0.0000000000000000044408921, $0.000000000000000002220446, $0.000000000000000001110223, $0.000000000000000000555111, $0.000000000000000000277556, $0.000000000000000000138778

Fig. 1. Determination of $e$. Each chord, AB, BC, DC, etc., is equal to 4. Rather badly drawn, this gives $e = 3.14$.
Long-path and simple aerials

The ability of amateurs using only simple aerials to work long distances by taking advantage of the extremely reliable morning choral-hop, long-path to Australia, via the dawn and dusk frequencies using complex digital data processing to represent about 4 to 5 dB).

Local courses for RAE

Classroom education centres, with enrolment again starting soon in many local education centres, with enrolment being given during early September. Among the towns where courses have been notified to R.S.G.B. are Bath, Belfast, Birkenhead, Birmingham, Bracknell, Gosforth, Tufnel Park in London, Huddersfield, Langley near Slough, Manchester, Mel­ton Mowbray, Newport, Northampton, Orpington, Stourport, Stockport, Torquay, Walsall, Weymouth. As this has been completely, enquiries should be made at local education centres.

A second training course for elec­tronics amateur radio was held in Colombo, Sri Lanka recently with the co-operation of the German national amateur radio society, DARC. There were 29 participants, including students from Colombo and Bangladesh (amateur licences are not yet available in Bangladesh).

Around the bands

The IARU Region 1 Executive Commit­tee has recommended that the new 10 and 15 kHz bands be added to the existing 16 MHz, each unit being provided with thermal isolation. The terminals of which fully provides load isolation. The 85-1 units are in standard d.i.l. package provide thermal construction for the LRO, which has full thermal protection and a power supply, and is protected by a fuse in the amateur radio. The club has an RA, version which is available in a frequency range from 1 to 10 MHz, for a cost of $150.

In brief

Kenyas has introduced a "type approval" system whereby each new amateur radio charging a fee of $150 which has to be paid each time new amateur radio chargings are made.

Four-channel drive r.f.

The LRO is designed to drive additional lines and current of up to 0A (2A effective drive) at the receiver, up to 10 MHz, enabling driving of relays, solid-state micro-processors and other circuits.

The logic scheme of the device, when construction, can usually be operated by a separate low-voltage supply, and is therefore very economical. The module is provided with six inputs, one for each of the channel inputs, each serving two channels.

The four centre pins of the 16 pin d.p. package provide thermal conduction for the LRO, which has full thermal protection and a power supply, and is protected by a fuse in the amateur radio. The club has an RA, version which is available in a frequency range from 1 to 10 MHz, for a cost of $150.

P.t.f.e. / woven glass laminate

Two new types of laminate have been introduced by the 3M (UK) Ltd., namely Curado 217, which has a dielectric constant of 2.17 ± 0.04 and a dissipation factor of 0.006 < at X-band, and Curado 233, which has a dielectric constant of 2.3 ± 0.04 and a dissipation factor of 0.0015 ± X-band.

The 217 type is available in the standard thicknesses of 0.125 mm, and the 233 type from 0.0625 to 0.125 mm, having a standard size of 10 x 10 inches and cut to size. The 3M information on various products is distributed on a 4x6 inch sheet, with a minimum power gain of 3600 at 175 MHz. The units can be used in either class A or B circuits, with a nominal impedance of 50 ohms.

New microprocessor

All of the single-chip microcomputers are out performed by the 8051, class GEC or amcoms. It fits in at the top of the market, its price falls well below £500, and its instruction set which includes multiply, divide, subtract, compare and non-paged jumps. Another feature of its instruction set is the "string Processor" which is very high speed implementation of the microprocessor which allows for decision-making operations.

The 8051 is suitable for stand­alone small single-chip computer applications requiring up to 4K of memory, and has a maximum speed of 1MHz. It has 36 pins, 4k bytes of program memory, and 128 bytes of data memory. The 8051 is not suited for full serial communication, complete with oscillator and clock circuits. For distributed systems the serial I/O provides an Inbuilt, high-speed serial communication port. Two 8-bit timer counters and four 8-bit input/output pins are also included.

The 8051 will be available in three versions, the 8051, the 8051L and the 8051K. The 8051L has a mask-programmed microprocessor, which has no user-programmable memory, the 8051K has a user-programmable memory, GEC Semiconductors Ltd., Slough, Buckinghamshire, WB, Middlesex, BN6 8PP.
Long-path and simple aerials

The ability of amateurs using only simple aerials to work the world by taking advantage of the extremely reliable morning choral-hop, long-path to Australia, via the dawn relay, "CFL", in the ionosphere, rather than multi-hop paths, is underlined by the work of Sir Roland Fisher, VK3OM of Glen Waverley, Victoria. He reports working on 14 MHz s.s.b. some 140 British amateurs under "long-path" conditions during the past year. Of these, 35 of the British stations were using simple aerials, 32 were using ground planes and one station had a nearly monopole "mobile whip", representing a total of 91 with simple aerials, compared with 56 using beam arrays of various types. He writes: "It is interesting to note that some of the more constant British stations heard in Australia at the time of day use dipoles; they are not necessarily the strongest signals but often the difference between them and the stronger signals heard at the same time is small, perhaps 1.15 dB. At point calibration varies widely between different receivers but this probably represents about 4 to 5 dB.

US reply to the Pecker?

An American f.i. over-the-horizon radar system in Colombo, Sri Lanka recently with the cooperation of the German national amateur radio society, DARCE, There were 29 participants, including students from Colombo and Bangalore (British amateur licensees are not yet available in Bangalore). Around the bands

The IARU Region 1 Executive Committee has recommended that the new VHF band between 330 and 390 kHz (which is expected to become available about 1982) should be for c.w. operation only. This is to enable as many amateurs as possible to make effective use of this band which will be available to all and at all stations.

The transmitting aerial array comprises 48 elements, 12 each for the four bands: a ground screen stretches 700 ft in front of the array to improve low-angle radiation. Here, the band plan to have already spent some $100,000 on over-the-horizon development, although the over-the-horizon radar at Orfordness in England was taken out of commission some years ago and the station is now owned by BBC External Services.

It is stated that the OTH-B signals will cause much less interference to other services than the shortwave Russian "Woodpecker", there are fears that the growth of such systems, if they prove successful, may become world-wide and with inevitably affect low-power amateur transmis-
sions. OTH-B signals will have a faster "knocking" rate than the Pecker, varying from about 20 to 60Hz and sounding rather like "mains hum". The system is being operated on a "non-
commercial" basis and areas where this will be achieved in practice. Amateur frequencies are to be avoided.

Local courses for RAE

During the past year. Some 100 amateurs working as rescue crews and another 100 at the communications centres, it is claimed that radio proved more effective than the telephone.

W. A. Scar, G2WS, chairman of the Radio Amateur Invalid and Blind Club, has called for a wider interest and appreciation of the club's aims and activities. RARC exists to help handicapped members to make full use of existing facilities in amateur radio. The club has an RAE training course on tape cassettes for blind candidates and this has recently been revised; a number of Datong Morse tutors have been donated by the club and are proving successful. Some 50 copies of the club newsletter "Radius" are distributed on tape.

In brief

Kenya has introduced a type "approval" system where an applicant has to pay a fee of $150 which has to be paid each time any alterations are made to a licensed amateur radio station. The new National Amateur Radio Exhibition at Alexandra Palace last May was over 6000. Dates for the ARRA amateur radio exhibition at Leicester have been changed to November 6, 7 and 8. Sixty years ago -- summer 1920 -- saw the issue of the first post World War I British Amateur licenses, including "JF", as the callsign of the Manchester Washington Society. It was in June that the weekly concerts for British listeners began from The Hague: PCGG. As this list is now 25 participants, including students and Weybridge. As this list is now 25 participants, including students and many amateurs as possible to make effective use of this band which will be available to all and at all stations.

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allow touch-reading, and "pep­
tones" are given to tell the user when the controls are operated
correctly and when the radio is
scanning. At each receivable sta­
tion, the scanning stops automatically, and the radio has a memory in which up to seven
stations on m.w. can be stored
and recalled by one touch opera­
ation.

Dimensions of the ICF-M20L
are 179 x 65 x 30mm, and its
weight is 300g, including batteries. Sony (U.K.) Ltd, 134
Queensway, London W2.

Wide-range
measuring
amplifier

Comprehensive measurement
of sound, vibration and voltage is
possible with the new wide-range
amplifier/voltmeter Type 2401,
from B&K Laboratories, Ltd, in
which d.c. displays are incorp­
ated for the gain-measuring range
and overload indications, and accurate t.r.m.s. and
peak value is
sound, vibration and voltage is
referred by one touch opera­
ation.

Universal vacuum
test fixture

Test heads which are
interchangeable and a universal
receiver, the section upon which the
test heads are mounted, are
the main components of this
p.c.b. test fixture, the U3000,
which holds the circuit under
test in position and against the
spring-loaded contacts using a
vacuum. It is claimed that the
"bed of nails" test-heads can be
changed in a matter of seconds,
an important feature where pro­
duction costs are to be minimised
in the testing of p.c.b.s of varying
nature and size.

The receiver, which is available for
either 30 or 60° test head mounting,
in either demonstrator, in which case a Cannon 150 way
terminal connector is usually fit­
ted, or semi-permanently instal­
led into an a.c. system.

Each spring-loaded contact consists of a probe, which is made from beryllium copper, plated with either gold or t.i.dium, and a mating socket. Constant con­
tact between probe and socket is
ensured by using a patented
"blasting-ball" construction which also provides an internal passage through the pressure spring. The contacts are replace­
able. The U3000 is made by Pylion
and distributed in the U.K. by
Tyco Ltd, Tyco House, Meadow­
row, Godalming, Surrey GU7
W2312

Click-stop pots

Industrial-standard potenti­
ometers in either single or tandem-stereos, de­
nominated Radionix P200 and P300 repre­
tated by East Grinstead Elec­
tronic Components Ltd. They are
produced in a choice of 12 dif­
ferent linear and non-linear law
patterns ranging from 1982 to 2.3MΩ, and are available in
centres, 11. and 33-8000 tap variation
and with either linear or
non-linear spindles.

Standard track-diapason
ratings at 40°C are 0.4% and
0.3% for linear and non-linear versions respectively, with a
minimum limiting element vol­
tage of 900 V d.c. and insulation
breakdown voltage of 100V a.c.
Normal rotating torque over the
full 360° rotation is 0.4Ncm, and
terminal torque is in the range
between 60 and 80NCm, depend­
ent upon size and maximum
spindle load is 100N for Snec.

Various p.c.b. and hard-wiring
solder tag terminals are also available, as are integral support
mounts, enabling assembly to be
achieved. East Grin­
Stein Elec­
tronic Components Ltd. they can be
used to advantage in pulse systems, accurate feedback
works can be used to advantage
in test systems of varying
type; a.e.t. systems.

Universal microphone
modulator

A series of low-cost, high-
accuracy modulators with up to
±1% linearity has been intro­
duced by the Telecommunications Corporation. The Com­
puter Conversion Corporation's
model 993 modulator conver­
tes d.c. input signals to linear,
proportional a.c. output signals
which accept ±10 V d.c. or ±100V d.c. inputs and provides a.c.
outputs of 6 to 10 v r.m.s. It has an
output impedance of 15mmax.

Distributed networks are identi­
cal in pattern, shape and elec­
trical characteristics, offering a
more consistent performance
than can be obtained with dis­
crete resistors. Substrate sizes
range from the 0.65mm to
25x0mm, Welsby Electric Ltd, Bed­
lington, Northumberland NE22
7AA.

Universal vacuum
test fixture

Test heads which are
interchangeable and a universal
receiver, the section upon which the
pkc. test fixture, the U3000,
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tones" are given to tell the user when the disc is perfectly aligned correctly and when the radio is scanning. At each receivable sta­tion, the scanning stops automatically, and the radio has a memory in which up to six stations on f.m. and seven sta­tions on m.w. can be stored and recalled by one touch opera­tion.

Dimensions of the IFCS-M38 are 179 x 65 x 36mm, and its weight is 30g, including batteries. Sony (U.K.) Ltd., 134 Regent St., London W1.

WV308

Wide-range measuring amplifier

Comprehensive measurement of sound, vibration and voltage is possible with the new wide-range amplifier/voltmeter Type 2610, from B&K, Laboratories Ltd., in which i.d. displays are incorpor­ated for the gain-measuring range and overload indications, and accurate true m.s. and peak level detectors plus a maximum hold facility enable it use as a precise voltmeter.

High-pass filter and 'A' weight­ing system for sound measurement, provisions to enable con­nection of external Eitters for frequency analysis, and two ver­sions providing either a.c. or d.c. output are also featured. Various microphones, for which polarizing voltages are provided, and vibration transducers, can be used in conjunction with the low-noise amplifier/voltmeter, which complies with the IEC, ANSI and DIN standards for precision sound level meters. B&K Laboratories Ltd., Cross Lances Road, Hounslow, Middlesex TW3 4AS.

WV310

Conducting elastomer connectors

Conductive elastomer connectors which have contact pads as close as 0.018in is possible with the Max Series 22 interconnection system which uses alternate layers of conducting and insulating silicone-rubber, each 0.002in thick, that are bonded together to form a "block." Clamping of the block to the mating conductors is required to ensure good contact, the press­ure being sufficient to allow which causes the block to deflect by less than 0.002 and 0.003.

Elastomer connectors can be mated to the interconnection components such as displays, i.e. chip­carriers, p.c.b. leads, hybrid circuits and foil-cables, and as soldering is required, is a greater tolerance to misalign­ment is available with conventional connectors, time savings can be made where large-scale production is con­cerned.

Stax 405/2 low-profile connect­ers are manufactured by Hi-­Fi electrics Inc., U.S.A., and have a temperature range of -50 to +125°C, Symce Ltd., 22A Reading Rd, Henley on Thames, Oxon RG9 1AG.

WV312

Universal vacuum-test fixture

Test heads which are inter-changeable and a universal receiver, the section upon which the test heads are mounted, are the main components of the p.c.b. test fixture, the UH300, which holds the circuit under test in position and against the spring-loaded contacts using a vacuum. It is claimed that the "bed of nails" test-heads can be changed in a matter of seconds, an important feature where production costs are to be minimized in the testing of p.c.b. of varying nature and size.

The receiver, which is available for either 30 or 60" test head mounting, is, in either demonstration, in which case a Cannon 156 way terminal connector is usually fitted, or semi-permanently installed into an a.c. system.

Each spring-loaded contact consists of a probe, which is made from beryllium copper, plated with either gold or nickel, and a mating socket. Constant con­tact between probe and socket is ensured by using a patent "blazing-ball" construction which also prevents current passage through the pressure spring. The contacts are replace­able. The UH300 is made by Pyron and distributed in the U.K. by Tekels Ltd, Tokiba House, Meadow­ford, Godalming, Surrey GU7 1BN.

WV312

Click-stop pots

Industry-standard potentiometers in either single or tandem形式, de­nominated Rad incompet 39 X 2 and JR9 requirements are manu­factured by East Grimstead Electric Components Ltd. They are produced in a choice of 12 differ­ent linear and non-linear law patterns ranging from 1982 to 2.25kV, and are available in various values to suit specific applications and with either linear or non-linear spindles.

Standard track-dissipation ratings at 46°C are 0.4W and 0.25W for linear and non-linear versions respectively, with a minimum limiting element voltage of 960V and insulation breakdown voltage of 1000V a.c. Normal rotating torque over the full 360° rotation is 0.4Nm, end stop movement torque is between 50 and 80Nm, dependent upon type and maximum spindle load is 1000N for Spec.

Various p.c.b. and hard-wiring solder tag terminals are also available, as are integral support and interconnector terminals.

Prices per our

Cannon 156 way £1.16
DIN 20 way £1.46

High-accuracy modulator

A series of low-cost, high-accuracy modulators with up to ±0.1% linearity has been intro­duced by Technical Controls Corp. The Computer Conversion Corp­oration model 203 modulator converts direct current signals to linear, proportional a.c. output signals. It accepts ±10V d.c. or ±100V d.c. inputs and provides a.c. outputs of 6 to 4V r.m.s. It has an output impedance of 13 max.

Click-stop pots

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The New FM/AM 1000s with Spectrum Analyser—we call it the SUPER-S
A portable communications service monitor from IFR, light enough to carry anywhere and good enough for most two-way radio system tests. The FM/AM 1000s can do the work of a spectrum analyser, oscilloscope, tone generator, deviation meter, modulation meter, signal generator, wattmeter, voltmeter, frequency error meter—and up to five service engineers who could be doing something else!

For further information contact Mike Taylor
FieldTech Ltd
Heathrow Airport
London HA4 9UR
Tel: 01-759 2811
Telex: 23734
FREE SAMPLES
and catalogue on request.

Heyco Nylon Hole Plugs
snap-lock into panels to provide quick, neat entrance seals. Low cost, finger-tip assembly. 20 sizes for holes 3/16" to 2".
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Heyco Nylon Snap Bushings
convert sharp edges to smooth, insulated holes quickly and easily. Snap-fit with finger pressure. 44 sizes —1/8" to 2¼".

Heyco have got it made for communications service monitors—compact, versatile field service monitors for two-way radio maintenance.

£11.92

Logic Probe...YOU! for only £11.92

With this easy-to-build Logic Probe Kit from CSC and just a few hours of easy assembly—you have a full performance logic probe! Complete, easy-to-follow instructions help make this a one-night project.

WIRELESS WORLD, SEPTEMBER 1980
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A portable communications service monitor from IFR, light enough to carry anywhere and good enough for most two-way radio system tests. The FM/AM 1000s can do the work of a spectrum analyser, oscilloscope, tone generator, deviation meter, modulation meter, signal generator, wattmeter, voltmeter, frequency error meter—and up to five service engineers could be doing something else!

For further information contact Mike Taylor

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Testing... Testing... Testing...

anywhere!

The New FM/AM 1000s with Spectrum Analyser—we call it the SUPER-S

Compact, versatile field service monitors for two-way radio maintenance

CE-50A: FM/AM Field Service Monitor
CE-50A-1: FM/AM Field Service-Spectrum Monitor

Exclusive representative:
Aspen Electronics Limited
Communications Equipment and Components
2 Kildare Close, Euston, Ruislip, Middlesex HA4 9UR
Telephone: 01-868 1188
Telex: 8812727

Guess who builds this great Logic Probe...YOU! for only £11.92

With this easy-to-build Logic Probe Kit from CSC and just a few hours of easy assembly—thanks to our very descriptive step-by-step manual—you have a full performance logic probe.

With it, the logic level in a digital circuit is indicated by light from the Hi or Lo LED; pulses as narrow as 300 nanoseconds are stretched into blinks of the Pulse LED, triggered from either leading edge. You’ll be able to probe deeper into logic with the LPK-1, one of the better tools from CSC.

C.S.C. (UK) Limited
Dept. TZ Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AD
Tel: Saffron Walden (STD) 21682
Telex: 817477

CONTINENTAL SPECIALITIES CORPORATION, DEPT. TZ
Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex.

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Compact, versatile field service monitors for two-way radio maintenance

CE-50A: FM/AM Field Service Monitor
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- CH. SEPARATION: 60 dB from 100Hz to 10kHz, maximum
- INPUT IMPEDANCE: 3k, nominal
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<table>
<thead>
<tr>
<th>Model</th>
<th>Output Power (W RMS)</th>
<th>Distortion (Typical at 1kHz)</th>
<th>Minimum Signal Noise Ratio</th>
<th>Power Supply Voltage</th>
<th>Size (in mm)</th>
<th>Weight (in g)</th>
<th>Price</th>
<th>V.A.T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HY20</td>
<td>15</td>
<td>0.02%</td>
<td>70 dB</td>
<td>12 V</td>
<td>105x50x25</td>
<td>155</td>
<td>£4.24</td>
<td>£0.68</td>
</tr>
<tr>
<td>HY50</td>
<td>30</td>
<td>0.02%</td>
<td>70 dB</td>
<td>12 V</td>
<td>114x50x85</td>
<td>575</td>
<td>£12.20</td>
<td>£1.98</td>
</tr>
<tr>
<td>HY120</td>
<td>60</td>
<td>0.01%</td>
<td>70 dB</td>
<td>12 V</td>
<td>114x50x95</td>
<td>156</td>
<td>£27.58</td>
<td>£4.14</td>
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<tr>
<td>HY200</td>
<td>120</td>
<td>0.01%</td>
<td>70 dB</td>
<td>12 V</td>
<td>114x50x85</td>
<td>575</td>
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<td>HY400</td>
<td>240</td>
<td>0.01%</td>
<td>70 dB</td>
<td>12 V</td>
<td>114x50x85</td>
<td>156</td>
<td>£37.20</td>
<td>£5.58</td>
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</tbody>
</table>

- **LOAD IMPEDANCE**: all models 4 Ohms only.
- **INPUT SENSITIVITY**: all models 500 mV.
- **INPUT IMPEDANCE**: all models 10K Ohms.
- **FREQUENCY RESPONSE**: all models 10Hz - 45KHz - 3dB.

**POWER SUPPLY UNITS**

ILP Power Supply Units with transformers made in our factory are designed specifically for use with ILP power amplifiers and apart from PSU50 and 78 which are smaller PSUs, all the other ILP's own manufactured power transformers are used which have the same size and weight of axial equivalents. They are also more efficient and have greatly reduced fields of radiation.

PSU30 - 15V at 100mA to drive up to 12 x HY6 at 6 x HY60. £5.40 + £0.68 VAT.
THE FOLLOWING WILL ALSO DRIVE ILP PRE-AMPS.
PSU100 for 1 x HY30 or 2 x HY50. £10.80 + £1.22 VAT.
The following include toroidal transformers.
PSU50 for 1 x HY50. £9.76 + £1.48 VAT.
PSU70 for 1 x HY100. £9.76 + £1.48 VAT.
PSU90 for 1 x HY120. £13.81 + £2.04 VAT.
PSU100 for 1 x HY200. £13.81 + £2.04 VAT.
PSU180 for 2 x HY200. £23.02 + £3.45 VAT.

**HY6 MONO HY66 STEREO**

When ILP added a new design to its audio module range, there were to be very special transformers designed to meet the requirements. We have achieved remarkable results. We have achieved results we could not have achieved with the new pre-amplifiers - HY6 for mono operation. HY66 for stereo. We have simplified connections, and measured improvements are around 12%. Our new pre-amps are short circuit and polarity protected; mounting boards are available to simplify construction.

**HY6** - 30W x 400. HY66 - 60W x 400. Active Tone Control provides +5kHz cut and -15kHz boost. Input Sensitivity - 1V Kenprob ADG-1V, 5V - selectable 1-12V, All others 100V. Tape IN/OUT - 500V.

**NO DISCOUNT**

**GUARANTEE**

NO QUIBBLE 5 YEAR GUARANTEE 7 DAY DELIVERY ON ALL ORDERS.

**ORDER FORMS**

FREEPOST 5 - 5th Burren House, Hove, Bexhill, East Sussex. £49.00 + £4.00 VAT.

TERMS OF SALE: PAYMENT MUST BE Made within 14 days of order. We accept cheques and postal orders. All our products are guaranteed. Failure to return faulty goods within 14 days is subject to our guarantee. Returns on goods must be pre-paid. Returns are only accepted if goods are in original condition. We reserve the right to reject returns if they are not in original condition. Returns will be subject to a 10% restocking charge. Returns must be accompanied by a copy of your receipt.

**NAME:***

**ADDRESS:**

**Signature:**
POWER AMPLIFIERS

ILP Power Amplifiers are encapsulated within heatsinks designed to meet total heat dissipation needs. They are rugged and made to last a lifetime. Advanced circuitry ensures their suitability for use with the finest loudspeakers, pickups, tuners, etc. using digital or analogue sound sources.

<table>
<thead>
<tr>
<th>Model</th>
<th>Output Power</th>
<th>Distortion Typical at 1KHz</th>
<th>Minimum Signal/Noise Ratio</th>
<th>Power Supply Voltage</th>
<th>Size in mm</th>
<th>Weight in gms</th>
<th>Price + VAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HY30</td>
<td>15 W</td>
<td>0.02%</td>
<td>100dB</td>
<td>+20 dB</td>
<td>105 x 25s</td>
<td>155</td>
<td>£6.34</td>
</tr>
<tr>
<td>HY60</td>
<td>30 W</td>
<td>0.02%</td>
<td>100dB</td>
<td>+20 dB</td>
<td>114 x 50s</td>
<td>155</td>
<td>£7.24</td>
</tr>
<tr>
<td>HY120</td>
<td>60 W</td>
<td>0.01%</td>
<td>100dB</td>
<td>+20 dB</td>
<td>114 x 50s</td>
<td>155</td>
<td>£11.20</td>
</tr>
<tr>
<td>HY200</td>
<td>120 W</td>
<td>0.01%</td>
<td>100dB</td>
<td>+20 dB</td>
<td>114 x 50s</td>
<td>155</td>
<td>£13.66</td>
</tr>
<tr>
<td>HY400</td>
<td>240 W</td>
<td>0.01%</td>
<td>100dB</td>
<td>+20 dB</td>
<td>114 x 50s</td>
<td>155</td>
<td>£27.68</td>
</tr>
</tbody>
</table>

Low impedance - all models 4Ω or more.
Input sensitivity - all models 500 mV.
Power impedance - all models 100KΩ.
Frequency response - all models 10Hz - 45KHz - 3dB.

POWER SUPPLY UNITS

ILP Power Supply Units with transformers made in our own factory are designed specifically for use with ILP power amplifiers and apart from PSU 30 and 38 which are smaller PSUs, all the other ILP's own manufactured toroidal transformers are used which are half the size and weight of conventional equivalents. They are also more efficient and have greatly reduced fields of radiation.

- COMPATIBLE WITH ALL ILP POWER AMPS AND PSUS.
- REQUIRES ONLY POTS, SWITCHES, PLUGS.
- LATEST DESIGN HIGH QUALITY CONNECTORS.
- HIGH OVERLOAD FACTOR 100%.
- LOW DISTORTION - Typically 0.005%.
- NO QUIBBLE 5 YEAR GUARANTEE.
- NO QUibble 7 DAY DESPATCH FOR ALL ORDERS.
- BRITISH DESIGN AND MANUFACTURE.
- FREESTOP SERVICE - SEE BELOW.

HY6 mono HY66 stereo

When ILP add a new design to their audio-module range, there have to be very special reasons for doing so. You see, we're a bit perfectionists. We have achieved that with our two new pre-amplifiers - HY6 for mono operation, HY66 for stereo. We have simplified connections, improved performance figures all round.

Our new pre amps are short circuit and polarity protected; output boards are available to simplify construction.

Suits HY6 - 45 x 240 x 40mm. HY66 - 50 x 240 x 40mm. Actie Tone Control provides ± 13dB cut and boost. Inputs Sensitivity - 50dB. Input Voltage ± 12mV. All others 100V. Tape Out ± 12mV. Main Out ± 500V. Frequency response: 10Hz-100KHz - 3dB.

- NO QUIBBLE 5 YEAR GUARANTEE.
- NO QUibble 7 DAY DESPATCH FOR ALL ORDERS.
- BRITISH DESIGN AND MANUFACTURE.
- FREESTOP SERVICE - SEE BELOW.

No Quibble 5 YEAR GUARANTEE.

No Quibble 7 DAY DESPATCH FOR ALL ORDERS.

No Quibble 5 YEAR GUARANTEE.

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No Quibble 7 DAY DESPATCH FOR ALL ORDERS.

No Quibble 5 YEAR GUARANTEE.

No Quibble 7 DAY DESPATCH FOR ALL ORDERS.
### Integration Circuits

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8559</td>
<td>IC</td>
<td>Quad 2-input positive AND gate</td>
</tr>
<tr>
<td>8555</td>
<td>IC</td>
<td>4-channel 2,4,6-bit multiplexer</td>
</tr>
<tr>
<td>8556</td>
<td>IC</td>
<td>4-channel 2,4,6-bit multiplexer</td>
</tr>
<tr>
<td>8557</td>
<td>IC</td>
<td>4-channel 2,4,6-bit multiplexer</td>
</tr>
<tr>
<td>8558</td>
<td>IC</td>
<td>4-channel 2,4,6-bit multiplexer</td>
</tr>
</tbody>
</table>

### Valves

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECC82</td>
<td>Medium power dual triode</td>
</tr>
<tr>
<td>ECC83</td>
<td>Medium power dual triode</td>
</tr>
</tbody>
</table>

### Supplies

- **Complete Kit**
  - **Cost:** £225 + VAT
  - **Description:**
    - **PSI COMP 80**
      - **Base on:** Z80 processor
      - **Design:** Scientific computer
    - **Complete Kit**
      - **Price:** £195 + VAT

**Additional Information**

- **Tested**
- **Complete Kit**
- **Subject to 15% surcharge for VAT**
- **U.K. Contracts**
- **Prices valid at time of printing**
- **Prices are subject to change without notice**
- **Telephone:** 01-677 2424
- **Telex:** 946708
- **Terms of Business:** C.O.D. Final packing and valences and semi-conductors 30p per order. CRTs £1. All prices include VAT.
- **Prices are subject to change without notice**
- **Telephone:** 01-677 2424
- **Telex:** 946708

---

**Remark:**

- The table above provides a summary of the various components and parts available from Langrex Supplies Ltd., including semiconductors, valves, and integration circuits. For detailed specifications and pricing, please refer to the original document or contact Langrex Supplies Ltd. directly.
SK ON BOARD MEMORY! 16K Word 32K RAM in one unit. 32K ROM on one IC. 16K ROM, 34K ROM. System expandable to 64K memory.

2 KEYBOARDS! For key application in your lab. Designed for entering high level language plus 16 key panel easy entry of machine code.

GRAPHICS! 13" Crt television picture output — includes standard controller. Only £15.50 extra!

MEMORY MAPPED High resolution VDU display using national type 1702, 16K RAM readout. Also available with a memory to give 64K for 68000.

KANSAS CITY

Live into new type interface.

PSI COMP 80 Z80 Based powerful scientific computer. Design as published in WIRELESS WORLD

Cabinet size 19.0" x 15.7" x 3.3"

COMPLETE KIT

NOW ONLY £225+VAT!

These is for the sensational practical design by John Adams published in a series of articles in WIRELESS WORLD. A complete system.

Included in the PSI COMP 80 scientific computer kit is a professionally designed circuit. Complete instructions are included. Printed circuit board, 2 keyboards, 2 PCB mounted for ease of construction. ICs allow high density assembly. Power supply unit, complete with line filter. All components are mounted on the PCB board. It also includes a 16K RAM expansion plus a large, fully double sided circuit board which can be expanded to 64K.

KIT ALSO AVAILABLE AS SEPARATE PACKS

For those who prefer the individual packs, the following design is available as separate packs: 4 PCBs (19 x 15 x 1") £45.00. Power supply board £50.00. Printed circuit board and power supply £77.00. Complete line filter £25.00.

PSI COMP 80 Memory Expansion System

Expansion upto 32K All inside the computer's own cabinet.

Easy to follow instructions giving a thorough board with buttons and to programming. The computer is transformed enabling up to 32K memory to be added.

All components are mounted on the PCB board which is secured with a metal strip.

Mother board: One glass double sided plated through holes PCB 8.7 x 2.5" set of all components including all transistors, being parts and rubber with cleaner is printed on top edge. £58.50

RAM Board: Glass double sided plated through holes PCB 5 x 1.5" set of components including IC sockets, RAM, etc. £58.50

RAM Board: Glass double sided plated through holes PCB 2 x 1.5" set of components including IC sockets, RAM, etc. £58.50

RAM Board: Glass double sided plated through holes PCB 1 x 1.5" set of components including IC sockets, RAM, etc. £58.50

Etched 14-18cm board, £5.00

Power Supply: Complete with power supply filters. £35.00

Kits include FREE foot control and test oscillator!

List all our kits, the ETI Vocoder really is complete — fully finished mechanism, professional quality components (all resistors 1%, metal coated, resist, coils, etc. — even a 12 plug!)

MANY MORE KITS

ON PAGES 103, 105

OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

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COMPLETE KIT

NOW ONLY £195+VAT!

Being published in Electronics Today International

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Tel. 277 5641 Telex 261306

SPECIAL OFFER OF BRAND NEW USSR MADE MULTIMETERS

TYPE U4312

- Sensitivity: 0.2000 V
- Range: 2000 mV
- Input impedance: 10 MΩ
- Resolution: ±1% of reading
- Accuracy: ±1% of reading

Price: £10.50

Carrying case and test leads

Packaging and postage (UK): £1.00

TYPE U4323

- Sensitivity: 0.1670 V
- Range: 10 A
- Input impedance: 1 MΩ
- Resolution: ±1% of reading
- Accuracy: ±1% of reading

Price: £15.00

Packaging and postage (UK): £1.00

**SPECIAL OFFER OF BRAND NEW USSR MADE MULTIMETERS**

- Sensitivity: 0.0606-0.6000 V
- Range: 30 A
- Input impedance: 200 kΩ
- Resolution: ±1% of reading
- Accuracy: ±1% of reading

Price: £16.95

Packaging and postage (UK): £1.20

**MONEY SAVING BARGAIN**

Ex-Stock from USSR

**J.V.C. BELT DRIVEN**

With Stereo Magnetic Audio Technica Cartridge

**LIST PRICE OVER £80**

- AM/FM stereo tuner
- AM/FM stereo cassette player
- AM/FM stereo cassette recorder
- Phono pre-amplifier
- Line output
- Speaker output
- Headphones output
- AC power supply

**Belt Drive**

Power Output: 10 watts R.M.S into 8 ohms at 1% THD.
Frequency Response: 20-20,000 Hz.
S/N ratio: 60 dB.
Channel separation: 40 dB.

**Low Price Offer**

Only £79.99

Packaging and postage (UK): £1.00

**CAR STEREO CASSETTE MECHANISM made for MOTOALA**

- Front loading 12 volt transistorised
- Speed and voltage control
- Ex-equipment tested — guaranteed

Only £7.50

Packaging and postage (UK): £1.00

**TRANSCENDENT DPX**

DIGITALLY CONTROLLED, TOUCH SENSITIVE, POLYPHONIC, MULTI-VOICE SYNTHESIZER

Another superb design by synthesizer expert Tim Orr — published in Electronics Today International

The TRANSCENDENT DPX is a really versatile 8 voice digital keyboard instrument. There are two audio outputs which can be used simultaneously. On the front there is a beautiful keyboard and an easy-to-read LCD display with many notes and basic information. On the back there is a wide array of digital controls, all fully programmable. It can be a synthesiser/piano or piano/synth to play a traditional or modern style jazz or pop music. To play it is surprisingly easy and if the keyboard is electronically off at the back then two keys can be used as a facility for producing the kind of sound you want. The back panel has all the usual connections and there is a two voice filter and a multisonic. There are many opening and tone controls, a separate control for each voice and a separate tone control for each voice. The synthesizer has a 100 note range of different voices, each voice can be programmed in a variety of different ways, the synthesizer can be used in many different ways.

**COMPLETE KIT ONLY £299 + VAT**

To add to the sounds and make them more natural there is a chorus reverb unit which is a complex stereo reverb very good sound quality. The synthesizer has also a very good high quality speaker which can be used for home entertainment or in a studio environment. The synthesizer can be used as a good instrument for a synthesizer player or in a music school. The synthesizer is made for all ages and can be used in any kind of music. The synthesizer is made of very high quality parts, very well put together, fully adjustable and very stable.

**POWERTRAN**

MANY MORE KITS ON PAGE 105. MORE KITS AND ORDERING INFORMATION ON PAGE 101

**TRANSCENDENT 2000**

SINGLE BOARD SYNTHESIZER

Live Performance Synthesizer Designed by Consultant Tim Orr (formerly Synthesizer Designer for EMS Limited) and Featured as a Constructional Article in Electronics Today Internationals.

The TRANSCENDENT 2000 is a simple instrument that is compact and compactly designed. It is a musical and tonal range. There is a continuous, unbreakable function, a C10 with volume and pitch modulation. The C10 is used with the high pitch and low pitch units, the C10 is used with the middle pitched voices. The TRANSCENDENT 2000 is a complete kit, it can be assembled in any kind of environment. It is a simple and elegant design.

**COMPLETE KIT ONLY £168.50 + VAT**

Comprehensive handbooks supplied with all complete kits. This makes it possible for anyone to set up your synthesizer with nothing more elaborate than a multimeter and a pair of leads.
Z & I AERO SERVICES LTD.
Head Office: 42-44A-48 WESTBOURNE GROVE, LONDON W2 5SF
Tel. 727 5661 Telex 261306

SPECIAL OFFER OF BRAND NEW USSR MADE MULTIMETERS

**TYPE U4312**
- Sensitivity: 20 nV/V
- A.C. Current: 200 nA
- D.C. Current: 200 nA
- Frequency Range: 10 Hz to 100 kHz
- Resistance: 10 MΩ

**TYPE U4315**
- Sensitivity: 20 μV/V
- A.C. Current: 200 nA
- D.C. Current: 200 nA
- Frequency Range: 10 Hz to 100 kHz
- Resistance: 10 MΩ

**PRICE**
- £15.00

**TYPE U4323**
- Sensitivity: 20 μV/V
- A.C. Current: 200 nA
- D.C. Current: 200 nA
- Frequency Range: 10 Hz to 100 kHz
- Resistance: 10 MΩ

**PRICE**
- £15.00

**TYPE U4341 COMBINED MULTIMETER AND TRANSISTOR TESTER**
- Sensitivity: 16.7 kHz, 3.3 kHz, 300 kHz
- A.C. Current: 200 nA
- D.C. Current: 200 nA
- Frequency Range: 10 Hz to 100 kHz
- Resistance: 10 MΩ

**PRICE**
- £15.00

**Descriptions and Options**
- Electronic tests can be used on a variety of components.
- Electronic tests can be used on a variety of components.
- Electronic tests can be used on a variety of components.
- Electronic tests can be used on a variety of components.

**Car Stereo Cassette Mechanism made for MOTOROLA**
- Front loading 12-volt transistorised
- Speed and voltage control
- E.g. equipment tested
- Guaranteed

**Car Stereo Cassette Mechanism made for MOTOROLA**
- Front loading 12-volt transistorised
- Speed and voltage control
- E.g. equipment tested
- Guaranteed

**GEC HIGH QUALITY STEREO 10+10 watt AMPLIFIER WITH AM/FM STEREO TUNER IDEAL FOR THE HOME**

A cancelled export order brings this offer from the world-famous firm of GEC.

**LIST PRICE OVER £50**
J.V.C. Belt Drive Turntable with Stereo Magnetic Audio Technica Cartridge

**LIST PRICE OVER £50**
J.V.C. Belt Drive Turntable with Stereo Magnetic Audio Technica Cartridge

**MONEY SAVING BARGAIN EX-STOCK FROM J.V.C.**
Belt Drive Turntable with Stereo Magnetic Audio Technica Cartridge

**LOW PRICE OFFER**
- Headphone: £15.00
- Speaker: £20.00

**CAR STEREO CASSETTE MECHANISM made for MOTOROLA**
- Front loading 12-volt transistorised
- Speed and voltage control
- E.g. equipment tested
- Guaranteed

**CAR STEREO CASSETTE MECHANISM made for MOTOROLA**
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Belt Drive Turntable with Stereo Magnetic Audio Technica Cartridge

**LOW PRICE OFFER**
- Headphone: £15.00
- Speaker: £20.00

**CAR STEREO CASSETTE MECHANISM made for MOTOROLA**
- Front loading 12-volt transistorised
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- Guaranteed

**CAR STEREO CASSETTE MECHANISM made for MOTOROLA**
- Front loading 12-volt transistorised
- Speed and voltage control
- E.g. equipment tested
- Guaranteed
NEW PRICES ON MEMORIES

STRUFTS prices down again

2114-300ns 1K x 4 SRAM $3.33 $2.77 $2.40
2116-200ns 1K x 1 DRAM $3.00 $2.50 $2.40
2708-450ns 1K x 8 EPROM $4.39 $4.00 $3.70
2516-2K x 8 EPROM $9.99 $8.62 $7.47
2532-4K x 8 EPROM $29.90 $28.40 $24.70

Please add 50p Postage and 15% VAT to all orders.

STRUFT LTD.
(ELECTRONIC COMPONENTS DISTRIBUTORS)
3C Barley Market Street
Taunton, Devon PL19 1QF
Tel: Taunton 0822-5439/5648
Telex 45263 OJF

POSITIVE RESIST
COATED LAMINATE
Direct from MANUFACTURER

for high quality printed circuit production - compatible with all positive working systems.

Ex Stock Delivery

PRICE
SINGLE
DOUBLE

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$0.99
$0.89
$1.23
$1.38

"4" x 6"
$2.59
$2.93

6" x 8"
$1.08

8" x 9"
$1.10

All packed individually. Cash with order only.
All prices inclusive of V.A.T. and Delivery.

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AT ONLY
£127 + VAT
P. & P. FREE
TILL OCT. 10
ST-45 SIMPLY SUPERIOR

FEATURES
- 10mV/div. • 5mV/div. • 4" CRT • 1 YR. GUARANTEE
- TIME BASE: 200ns/div-250 4" EACH
- TRIGGER LEVEL: SLOPE BRIGHT LINE AUTO-SENSITIVITY INT. 0.5 div. EXT 100mv
- SIZE: H. 215mm W. 165mm D. 280mm. WEIGHT 4kg (10lbs)

STROBE switch (X-REF-XIO) • SINGLE TRACE AT TRIGGER LEVEL; TIME BASE: 200ns/div-250 4"

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56 Bishop's Wood, St. John's, Woking, Surrey GU21 3GB
Tel: Woking 6823 or Woking 69660 till 1 p.m.

SPECIAL OFFER MARCH 1980

CHROMATHEQUE 5000
5 CHANNEL LIGHTING EFFECTS SYSTEM

This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequencies channels with individual level controls on each channel, Control of the lights accompanied by a view of the music, you can not only visualise sound at night but to a considerable degree control it to your taste. Design and UK made this kit is really a versatile and interesting project. The kit includes all the preamplifiers, power supplies, control panels, etc. etc. etc. and as the kit is a simple board design it is a real treat to build and from the kit you will build three types of lighting effects: A strobe effect, a double strobe effect and a colour changeover board. Each kit is supplied with two complete sets of instructions. The kit is complete with everything you need including a high powered, rugged heat resistant panel and all circuitry is waterproofed. It is a great project to build and gives you complete control of the lighting effects and also offers a great use for the amateur as well as the professional for entertainment purposes.

DE LUXE EASY TO BUILD LINSLEY HOOD
79W STEREO AMPLIFIER £99.30 + VAT

This top quality, bass enhanced unit is a low priced unit offering superb performance and quality amplifiers. It is a very easy kit to build and gives you complete control of the lighting effects and also offers a great use for the amateur as well as the professional for entertainment purposes.

MUSLCE EFFECTS DEVICE - AS FEATURED IN ELECTRONICS TODAY INTERNATIONAL!

ThisBlack Hole music effects device is a low priced unit offering superb performance and quality amplifiers. It is a very easy kit to build and gives you complete control of the lighting effects and also offers a great use for the amateur as well as the professional for entertainment purposes.

MUSLCE EFFECTS DEVICE - AS FEATURED IN ELECTRONICS TODAY INTERNATIONAL!

ThisBlack Hole music effects device is a low priced unit offering superb performance and quality amplifiers. It is a very easy kit to build and gives you complete control of the lighting effects and also offers a great use for the amateur as well as the professional for entertainment purposes.
NEW PRICES ON MEMORIES

STRU Tracy prices down again

2114-300ns 1K x 4 SRAM
2116-200ns 16K x 1 DRAM
2708-450ns 1K x 8 EPROM
2716-2X K x 8 EPROM
2516-4K x 8 EPROM
2532-450ns 4K x 8 EPROM
Carter ASCII Keyboard

Please add 50p Postage and 15% VAT to all orders.

STRU TRUST LTD.
(ELECTRONIC COMPONENTS DISTRIBUTORS)
3C Bailey Market Street
Tavistock, Devon PL19 0JF
Tel. Tavistock 0822-5439/5648

CHROMATHEQUE 5000
5 CHANNEL LIGHTING EFFECTS SYSTEM

This versatile system featured as a construction article in ELECTRONICS TODAY INTERNATIONAL has 5 frequencies channels with individual level controls on each channel. Control of the lights accompanied by the sound. You can set the unit as a strobe light or light up a video or sound at any speed. The sounds are programmed with special effects. Enjoy this unique kit which includes every component part, and is the type of design which is unique in its own class. The kit includes fully finished metalwork, fibreglass PCBs, wires, etc. — complete right down to the last nut and bolt.

COMPLETE KIT ONLY £49.90 + VAT!

T20 + 20 20W STEREO AMPLIFIER £33.10 + VAT

This 3 way, 20 watt kit described in Practical Wireless, is a very stylish looking board and offers a very new way. Use of construction and the latest parts found with microcircuits, enabling small size and high power output. All parts ready to assemble and is superbly finished at a very low price.

COMPLETE KIT ONLY £49.80 + VAT (single delay line system)

De Luxe version (dual delay line systems) also available for £59.80 + VAT.

Callus cabinet 10" x 8.5" x 1.5" (max) 1.5" (min)

POWERTRAN SYNTHESIZER KITS ON PAGE 103. MORE KITS AND ORDERING INFORMATION ON PAGE 101.

BLACK HOLE MUSIC EFFECTS DEVICE — AS FEATURED IN ELECTRONICS TODAY INTERNATIONAL!

The BLACK HOLE is a device that adds a music effect to your voice or any sound source. It contains a variety of effects including echo, reverb, and other musical effects. It is ideal for adding musical effects to any audio source, whether it be a microphone or an instrument. The effects can be controlled to create a wide range of musical sounds, from subtle to dramatic.

COMPLETE KIT ONLY £49.80 + VAT (single delay line system)

De Luxe version (dual delay line systems) also available for £59.80 + VAT.

Cabinet size 10" x 8.5" x 1.5" (max) 1.5" (min)
OEM — let Drake Transformers advise you on component specification and design to solve that special problem. Pre-production prototypes and development undertaken as necessary.

Well known over a quarter century for personal service and high-quality products, Drake specializes in the design and manufacture of transformers and other wound components for large and small quantity production.

Expertise and service put DRAKE TRANSFORMERS in a class of their own.

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South Green Works - Kennel Lane
Billencote - Essex CM1 2SP

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Telex: 99426 (prefix Drake)

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<tr>
<td>DEC LA-11PD 180cps</td>
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<tr>
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<td>£45.00</td>
</tr>
<tr>
<td>KB756MF 56-station ASCII keyboard</td>
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- **Dialed Number:** £6.50.
- **Receive:** £6.50.
- **Transmit:** £6.50.
- **Receive:** £6.50.
- **Transmit:** £6.50.

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- **14p:** £0.14.
- **40p:** £0.40.
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- 440: 3.5 x 2.0 x 1.5
- 450: 3.5 x 2.0 x 1.5
- 460: 3.5 x 2.0 x 1.5
- 470: 3.5 x 2.0 x 1.5
- 480: 3.5 x 2.0 x 1.5
- 490: 3.5 x 2.0 x 1.5
- 500: 3.5 x 2.0 x 1.5
- 510: 3.5 x 2.0 x 1.5
- 520: 3.5 x 2.0 x 1.5
- 530: 3.5 x 2.0 x 1.5
- 540: 3.5 x 2.0 x 1.5
- 550: 3.5 x 2.0 x 1.5
- 560: 3.5 x 2.0 x 1.5
- 570: 3.5 x 2.0 x 1.5
- 580: 3.5 x 2.0 x 1.5
- 590: 3.5 x 2.0 x 1.5
- 600: 3.5 x 2.0 x 1.5
- 610: 3.5 x 2.0 x 1.5
- 620: 3.5 x 2.0 x 1.5
- 630: 3.5 x 2.0 x 1.5
- 640: 3.5 x 2.0 x 1.5
- 650: 3.5 x 2.0 x 1.5
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- 840: 3.5 x 2.0 x 1.5
- 850: 3.5 x 2.0 x 1.5
- 860: 3.5 x 2.0 x 1.5
- 870: 3.5 x 2.0 x 1.5
- 880: 3.5 x 2.0 x 1.5
- 890: 3.5 x 2.0 x 1.5
- 900: 3.5 x 2.0 x 1.5
- 910: 3.5 x 2.0 x 1.5
- 920: 3.5 x 2.0 x 1.5
- 930: 3.5 x 2.0 x 1.5
- 940: 3.5 x 2.0 x 1.5
- 950: 3.5 x 2.0 x 1.5
- 960: 3.5 x 2.0 x 1.5
- 970: 3.5 x 2.0 x 1.5
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<table>
<thead>
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<th>OUTPUT VOLTAGE</th>
<th>9.1</th>
<th>9.2</th>
<th>9.3</th>
<th>9.4</th>
<th>12.1</th>
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<th>12.4</th>
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<th>15.2</th>
<th>15.3</th>
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<td>0.5</td>
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<tr>
<td>TOTAL OUTPUT</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
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8 Maritime Radio Services Division, WW18, SHIL12, Room 504, London, House, 23 New Ferrer Lane, London EC4A 9LA.

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(to up to £8350 p.a. under review)

To be responsible for implementing a programme of preventive maintenance for transmitting and receiving aerials, feeders, combining units and RF filters at TV, Radio and Link Stations. To provide a specialist corrective maintenance service, as necessary.

You should be qualified to degree/HNC level (or equivalent) and have substantial relevant experience (at the senior level supervisory ability is essential). We would also be happy to consider new graduates or those with little experience with a genuine interest in engineering to start at a trainee level.

You must be fit and able to climb tall structures; you must also hold a current driving licence and be prepared to travel within the U.K. Starting salaries will be according to experience — the figures quoted above are under review. Generous re-location, car and travelling allowances are payable together with free life assurance and personal accident scheme and an excellent contributory pension scheme.

Most of these posts will be based at our Engineering Headquarters here in Hampshire, although there may be opportunities for appointments at our Regional Engineering bases.

Applicants (male or female) should send full details of qualifications and experience as soon as possible to Glynn Powell, Independent Broadcasting Authority, Winchester, Hampshire, SO21 2QA.


**Opportunities in Digital Electronics**

Datek Systems Ltd., a subsidiary of the Mengenthal-Linotype Group, are leading manufacturers of advanced intelligent terminals for the printing industry. We are a small, dynamic company, based in Wembley, and we need the following key personnel.

### Software Development Engineer

Here is a unique chance to be in at the beginning of an exciting new project, as our design team commences work on a new-generation machine. Candidates should have a minimum of two years experience in applications software. Salary will be up to £9000 p.a.

### Senior Test Engineer

This post affords an opportunity for an engineer to further his/her career and extend his/her technical skills, by becoming involved in the design and testing of highly sophisticated systems. Several years' experience in testing digital equipment is essential, and we need the ability to direct and motivate others. The salary will be around £7500 p.a.

Both the above posts are open to men and women and offer generous terms and conditions of employment. Relocation expenses may also be available for the right candidates, if appropriate.

### Electro-Nics Engineers

**Submarine Cables**  
QATAR  circa £10,000 + bonus

The Ministry of Communications and Transport, Qatar, are seeking 2 Electronic Engineers with experience in digital communications and specialist communications experience, of which have been in the operation and maintenance of submarine cables.

Applications should preferably hold an engineering degree and be aged between 28-45. They are responsible and secure positions based in a pleasant and stable part of the Arabian Gulf. The successful candidates will be offered three year medical treatment.

### Senior Resettlement Officer

Working in one of the largest resettlement schemes in the world, you should have experience and qualifications in resettlement work and the care and support of disabled people. A valid UK driving licence is required for this position, which is responsible for the work of the resettlement officers in the field, and for co-ordinating their activities. A salary of £5547-£6918 p.a. (including average pay award) will be negotiable. Applications should be sent to Miss L. Tarbox, Application forms from WIRELESS WORLD, SEPTEMBER 1980

### Electronics Technician

**Lansdowne**  Middle East

Other countries in the Middle East

### Electronics Technician

**Lansdowne**  Middle East

Other countries in the Middle East

### Electronics Technician

**Lansdowne**  Middle East

Other countries in the Middle East

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**INCENTIVE PAYMENTS**

For anyone who can re-christen our hard-working computer equipment, as well as the operational services.

A vacancy is now open to anyone who can re-christen our hard-working computer equipment. As well as the operational services.

### Electronics Technician

**Lansdowne**  Middle East

Other countries in the Middle East
**Digital Electronics**

**Software Development Engineer**

Here is a unique chance to be at the beginning of an exciting new project, as our design team commences work on a new-generation machine. Candidates should have a minimum of two years’ experience in applications software. Salary will be up to £8,000 p.a.

**Senior Test Engineer**

This post offers an opportunity for an engineer to further his/her career and extend his/her technical skills, by becoming involved in a small, highly sophisticated team. Several years’ experience in testing digital equipment is essential, and we need the ability to direct and motivate others. The salary will be around £7,500 p.a.

Both the above posts are open to men and women and offer generous terms and conditions of employment. Relocation expenses may also be available for the right candidates, if appropriate.

For further information and an application form, please contact: Miss Linda Bux, Datek Systems Ltd, 849 Harrow Road, Wembley, Middlesex. Tel. 01 904 0081.

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**Opportunities in Digital Electronics**

Datek Systems Ltd., a subsidiary of the Mergenthaler-Linotype Group, is leading manufacturers of advanced intelligent terminals for the printing industry. We are a small, friendly company, based in Wembley, and we need the following key people:

**Electronics Engineers**

**Submarine Cables**

QATAR circa £10,000 + bonus

The Ministry of Communications and Transport, Qatar, are seeking 2 Electronic Engineers to join their team of specialist communications engineers, of which have been in the operation and maintenance of submarine cables.

Applicants should preferably hold an engineering degree and be aged between 25-45 years old. These are responsible and secure positions based in a pleasant and stable part of the Arabian Gulf. The successful candidates will be offered three year renewable contract, free furnished accommodation and services, 4 weeks vacation and 60 days U.K. leave per annum, family security, interest free car loan and free medical treatment.


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**Applications**

**Appointments**

**WIRELESS WORLD, SEPTEMBER 1980**

**Opportunities in Digital Electronics**

**Software Development Engineer**

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**Wireless World, September 1980**

**Opportunities in Digital Electronics**

**Software Development Engineer**

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Both the above posts are open to men and women and offer generous terms and conditions of employment. Relocation expenses may also be available for the right candidates, if appropriate.

For further information and an application form, please contact: Miss Linda Bux, Datek Systems Ltd, 849 Harrow Road, Wembley, Middlesex. Tel. 01 904 0081.
Radio Technicians

Work in Communications R&D
and add to your skills

At the Government Communications Headquarters we carry out research and development in radio communications and their security, including related computer-applications. Particularly if you're interested in the study of a specific type of system, you may be involved in the design and manufacture of components and electronic equipment. You will be working in a team of at least two or three people, with the opportunity to meet the requirements of various projects.

Your job as a Radio Technician will concern you in developing, constructing, installing, commissioning, testing, and maintaining equipment. In performing these tasks you will become familiar with a wide range of processing equipment in the audio to microwave range, involving modern techniques, microprocessors, and computer systems. Such work will take you to the froniers of technology on a broad front and widen your area of expertise — positive career assets whatever the future brings. In the rapidly expanding field of digital communications, you will experience work in modern logic and software techniques will be gained.

Training is comprehensive: special courses, both in-house and with manufacturers, will develop particular aspects of your knowledge and you will be encouraged to take advantage of appropriate day-release facilities.

You could travel — we are based in Cheltenham, but we have other centres in the U.K. most of which, like Cheltenham, are situated in environmentally attractive locations. All our centres require Radio Technicians and we can call for others to make working visits. There will also be some opportunities for short trips abroad, or for longer periods of service overseas.

You should be at least 19 years of age, hold or expect to obtain shortly the City and Guilds Telecommunications Technician Certificate Part I (Intermediate), or its equivalent, and have a sound knowledge of the principles of telecommunications and radio, together with experience of maintenance and the use of test equipment. If you are, or have been in HM Forces your Service trade may allow us to dispense with the need for formal qualifications.

Registered disabled people may be considered.

Pay scales for Radio technicians start at £4,640 per annum, rising to £6,525, and promotion will put you on the road to posts carrying substantially more. There are also opportunities for overtime and on-call work, paying good rates.

Get full details from our Recruitment Office, Robby Robinson, at Cheltenham (0242) 21491, Ext 2269, or write to him at GCHO, Oakley, Priory Road, Cheltenham, Glos GL52 5AJ. We will invite suitable applicants (expenses paid) for interview at Cheltenham.

GCHO

Recruitment Office

Government Communications Headquarters

Priory Road, Cheltenham, Glos GL52 5AJ

Radio Communications

Engineers and Software Designers

Mid-Sussex — S.W. London

Salaries up to £8,000

To join our expanding R&D laboratories covering a wide range of R & D spectrum, from L.F. to V.H.F., we are looking for Electronics Engineers and Software Designers. You will be working on a wide variety of projects including receivers and transmitters for telecommunications and radio equipment. You will have the opportunity to work on advanced systems and equipment, and you will be responsible for work in the laboratory and on site. You will be working in an atmosphere of innovation, and you will have the chance to work on new and exciting projects.

Experience in the design and manufacture of electronic equipment is essential. You should have a sound technical background and be able to work in a team. A good knowledge of electronics and an interest in the latest developments in telecommunications and radio equipment is also required. You should be a self-starter with a good understanding of the latest developments in the field.

Applicants should have a degree or equivalent qualification in Electronics Engineering and should have experience of working in a similar environment. You should be able to write clear and concise reports, and be able to work unsupervised.

Please apply to Lecturer in Electronic Engineering

None

College/University

Applications are invited for the post of Lecturer in Electronic Engineering. The successful applicant will be able to lecture in the fields of electronics and instrumentation and will have experience in the above areas. The candidate should have a good knowledge of electronics and be able to present material in an interesting and motivating way.

Salary Scale

Lecturer Grade 11 (£3,774-£4,980)

Applications should be sent to the Dean, School of Technology, Nene College, St. George's Avenue, Northampton, to be returned within fourteen days of the date of appearance of this notice.
**RADIO TECHNICIANS **

**COMUNICATIONS ENGINEERS**

Glaxo Plessey design, install and maintain communications systems for the oil industry, at home and abroad.

Due to rapid and continuing expansion in our activities, we constantly require Radio Technicians, with experience of HF, MF, VHF and UHF, and Engineers (preferably qualified to HNC level or above) in the fields of Microwave, Multiplex and Terminoplastic Scatter.

In the North Sea, earnings are in the range £9,000 to £12,000 p.a. Overseas earnings could be up to £20,000 – plus tax concessions and generous home leave. The work is demanding, but rewarding, offering you the chance to use your skills and your initiative to the full.

The company is based in Great Yarmouth, with offices in Aberdeen and Lerwick – but where relocation is necessary, we will give generous assistance with removal, legal and temporary accommodation, and all other expenses.

Please apply, with details of your career to date, to: Personnel Manager, Glaxo Plessey E.A. Limited, Dept WW, Offshore House, 284/285 Southtown Road, Great Yarmouth, Norfolk NR31 OUB. Telephone 0463 85841.

**Experimental Officer (Electronics)**

**Greenford Middx.**

Our Research Central Services Unit is undertaking an increasing amount of design and constructional electronics work. The application of microcomputer technology to the scientific effort is particularly important. Whilst routine construction work is undertaken elsewhere there is a great need for a technical officer to assist in constructing prototype equipment during the development phase.

Applicants qualified ONC/HNC or equivalent should have previous experience in electronic construction. Some experience with printed circuit boards and an ability to translate circuit diagrams into practice is essential. An interest in the construction of experimental equipment, making use of microprocessors and needing some degree of innovation is required.

Starting salary within the range £4270 to £6450 according to qualifications and experience. Bonus and non-contributory pension scheme.

Please apply to: Miss E. M. Butler, Personnel Department, Glaxo Group Research Ltd., Greenford Road, Greenford. Middlesex UB6 8HE. Tel: 01-422 3434, ext. 180, quoting ref. ZH.334.

**Radio Communications Engineers and Software Designers**

**Mid-Sussex – S.W. London**

**Salaries up to £8,000**

To join our expanding R&D Laboratories covering a wide range of RF, signal processing, communications and their support, including related computer applications. You should have a degree or a good honours in any relevant science, eg electronics, physics, communications, computer science or related subjects.

Starting salary is in the range £4,851-£7,794 according to qualifications and experience. Bonus and non-contributory pension scheme.

Applicants should be able to handle problems under supervision and under pressure of time. To join the School of Electronics, Communications and Computing to work on a range of computer applications. A demonstrable ability to program in a suitable computer language is essential. The work is based in the United Kingdom with opportunities for short trips abroad, or for longer periods for service overseas.

You should be at least 19 years of age, hold or expect to obtain shortly the City and Guilds Telecommunications Technician Certificate Part I (Intermediate), or its equivalent, and have a sound knowledge of the principles of telecommunications and radio, together with experience of maintenance and the use of test equipment. If you are, or have been in HM Forces your Service trade may allow us to dispense with the need for formal qualifications.

Registered disabled people may be considered.

Pay scales for Radio technicians start at £4640 per annum, rising to £5525, and promotion will you on the road to carrying substantial salaries. There are also opportunities for overseas and on-call work, paying good rates.

Get full details from our Recruitment Officer, Robby Robinson, on Cheltenham (0242) 21461, or write to him at GCHQ, Oakley, Priory Road, Cheltenham, Glos GL52 2AJ. We will invite suitable applicants (expenses paid) for interview at Cheltenham.

**None**

None College Northampton

Applications are invited for the post of Lecturer I/II in Electrical Engineering

Candidates should be graduates or Chartered Engineers with recent industrial experience.

The successful applicant will be able to lecture in the fields of electronics and instrumentation.

Salary Scale: Lecturer I £2,777 (£6,498)

Lecturer II £4,851 (£7,794)

point of entry depending on previous experience.

Application forms and further particulars are available from The Dean, School of Technology, Nene College, St. George’s Avenue, Northampton, to be returned within fourteen days of the date of appearance of this notice.
Test Engineers & Test Gear Engineers
Move into new areas of Electronics Development and an assured quality of life...

EMI Electronics Ltd. builds quality and reliability into every product. Our reputation for excellence is long established and is a major factor in generating new orders.

The growth of our business here in historic Wells creates the need for more Test Engineers to take us through the 1980s. As one of the world's leaders in specialised defence electronics systems - particularly the fields of radar, proximity fusing, telemetry and radar modelling - we maintain stringent quality standards. You will join one of our professional teams responsible for ensuring that our wide range of "State of the Art" electronics systems on test equipment meet our exacting standards.

We are looking for people with either ONC or HNC Electronics and varying levels of experience of testing or twin-lead and microstrip detection systems in the electronics industry or armed forces.

We offer competitive salaries, comprehensive benefits and assistance with your relocation to this beautiful part of Somerset.

For further information fill in the coupon and send it to P. M. Taylor, Assistant Personnel Manager, EMI Electronics Ltd., Pensthorpe House, Wells Road, Wells, Somerset, BA8 1AA or phone him for more information on (0749) 72081.

Name
Address
Tel: ________________________
Age: ________________________
Current position: ________________________
Qualifications: ________________________

Ref: W/W.188

PSYCHOLOGY TECHNICIAN
(NJC/APTC Grade 2)

We have a vacancy on a salary of £730 per week.

Required at STOKE Gifford College as soon as possible to help students with their work and to assist in the administration of the Psychology Department, which is expanding from 10 to 30 places in the Autumn term. The successful applicant will have some experience of working with Psychology students. 

Salary £730 per week.

STOKE Gifford College
A Member of the THORN TV Group

T.B.J.

Electronics Engineers - What you want, where you want!

T.B.J. Electrotechnical Personnel Services is a specialised appointments service for electrical and electronic engineers. We have clients throughout the UK who urgently need technical staff at all levels from Junior Technician to Senior Management. Vacancies exist in all branches of electronics and allied disciplines - right through from design to marketing - at salary levels from around £4000 to £8000 p.a.

If you wish to make the most of your qualifications and experience and move another rung or two up the ladder we will be pleased to help you. All applications are treated in strict confidence and there is no danger of your present employer (or other companies you specify) being made aware of your application.

Please send me a T.B.J. Appointments Registration form:

[Address]

T.B.J. ELECTRICAL PERSONNEL SERVICES, 12 Mount Ephraim, Tunbridge Wells, Kent. TN4 8AS.

Tel: 0392 93368

Electronics Workshop Engineer

(INSTRUMENT MAKING)

We are looking for an energetic and technically sound man or woman to join us in this specialist/assistant management post.

You should have proven skills in the fabrication and wiring of control panels and in the making of scientific instruments. You must have the ability to carry out development work without supervision and will preferably have a knowledge of solid state technology and microwave techniques.

We see you as holding an appropriate ONC/HNC but would be prepared to offer day release facilities if you are still in the process of gaining your qualification.

We offer a progression salary, pensions and life assurance. Flexible working hours and assistance with relocation expenses in an appropriate case.

INTERESTED?

Then write or phone for an application form to the Recruitment Officer, Unilever Research Port Sunlight Laboratory, Quarry Road East, Beigginning, Wirral, Merseyside, L63 2JW. Tel: 061-645 2000, ext. 8488. Please quote ref. PS115AC.

TOP JOBS IN ELECTRONICS

Posts in Computers, Medical, Comms, etc. ONC to Ph.D. to Free service.

Phone or write: BUREAUTECH,
AGY 56 SELWYN LONDON,
NW1. 0749 2251.

FOREIGN AND COMMONWEALTH OFFICE TELECOMMUNICATIONS

We have vacancies for:

TECHNICIANS

on duties involving the testing, maintenance and repair of machine telegraph and associated electronic equipment in London, and also on the installation of FAX/FMT telegraph systems in British Government overseas offices. Staff employed on the latter duties are based at Hanslope, near Milton Keynes. Although initially you may be required to possess a sound knowledge of basic equipment, some knowledge of the apparatus in the Departments concerned is advantageous. All applicants are in the grade of Radio Technician. Candidates are required to arrive within the next 8 weeks.

QUALIFICATIONS REQUIRED:

A City and Guilds Intermediate Certificate in Telecommunications or an equivalent or higher qualification.

An Ordinary National Certificate in Electrical Engineering and a minimum salary of £9000.

Applicants must be prepared to work anywhere in Britain for periods which do not normally exceed four weeks at a time.

Salary: £9000 p.a. plus annual leave of 6 weeks and 2 days. The successful applicant will be required to live in London, or near it.

Applications, with full details of age, qualifications, work experience and present and past addresses, must be sent to:

S. A. Fairclough, Assistant Secretary, Department of Higher Education, Establishment Building, High Street College, Hatfield College Lane, London NW1 9HY, to arrive not later than 8 September, 1980.

Applications should state that, although no interview is an essential part of this appointment, it may be required to work elsewhere within the Foreign and Commonwealth Office.

Ref: W/W. 158

B.B.C.

INSTALLATION TECHNICIAN

We have a vacancy in the Unit which deals with the supply, installation and commissioning of television studio lighting and mechanical equipment. This includes lighting control systems, dimmers, luminaires and their mechanical suspension systems, camera mountings and lens systems and their controls.

The successful applicant will assist professional engineers in this work and the duties will include supervision of craftsmen, liaison with contractors and other specialists.

Applicants: male or female must have a good practical understanding of work in at least one of the following fields:

Electrical Power Control
Mechanical Mechanisms
Electronic Control Systems

The successful candidate will be based in the London area but may be prepared to work elsewhere in Britain for periods which do not normally exceed four weeks at a time.

Salary: depending on experience and qualifications, will initially be in the range of £355 to £500 plus per annum addition of £225 for every product of the same type. Current position is anticipated to require a minimum of £450 plus per annum addition of £225 for every product of the same type.

Applications should be addressed to: Assistant in Electrical Engineering Recruitment Officer, B.B.C., Broadcasting House, London W1H 9AE quoting reference 80.E 2302. Please enclose address envelope with your application. Closing date for completed application forms is 14 days after publication.

Appointments
**Electronic Engineers - What you want, where you want it!**

TJB Electrotechnical Personnel Services is a specialised appointments service for electronic and electronic engineers. We have clients throughout the UK who urgently need technical staff at all levels from Junior Technician to Senior Management. Agencies exist in all branches of electronics and allied disciplines - right through from design to marketing - at salary levels from around £4000 to £8000 p.a.

If you wish to make the most of your qualifications and experience and move another rung or two up the ladder we will be pleased to help you. All applications are treated in strict confidence and there is no danger of your present employer (or other companies you specify) being made aware of your application.

**TJB ELECTROTECHNICAL PERSONNEL SERVICES, 12 Mount Ephraim, Tunbridge Wells, Kent. TN4 8AS.**

Tel: 0892 39358

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**ELECTRONICS WORKSHOPS ENGINEER (INSTRUMENT MAKING)***

We are looking for an energetic and technically sound man or woman to join us in this specialist/assistant management post.

You should have proven skills in the fabrication and wiring of control panels and in the making of scientific instruments. You must have the ability to carry out development work without supervision and will preferably have a knowledge of solid state technology and microcircuits.

We see you as holding an appropriate OCN/ONC but would be prepared to offer a six month release if you are still in the process of gaining your qualification.

We offer a progressive salary, pension and life assurance. Flexible working hours and assistance with relocation expenses in an appropriate case.

**INTERESTED?**

Then write or phone for an application form to the Recruitment Officer, Unilever Research Port Sunlight Laboratory, Quarry Road East, Bebington, Wirral, Merseyside, L63 2JW. Tel: 051-645 2000, ext. 8408. Please quote ref. P2154AC.

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**FOREIGN AND COMMONWEALTH OFFICE TELECOMMUNICATIONS**

We have vacancies for

**TECHNICIANS**

on duties involving the blocking, maintenance and repair of a machine telephone system and associated electronic equipment in London, and also on the installation of [PBX] telephones in British Government overseas offices. Staff appointed on the latter duties are based at Halsford, near Milton Keynes. Requirements:

You must possess a sound knowledge of basic electronic principles and preferably have some experience with the apparatus under consideration. Full technical support is provided.

Salary is in the range £1000 to £1500 depending on age and experience. Please write giving full details of age and qualifications to: Assistant Recruitment Officer, Foreign and Commonwealth Office, Whitehall, London, SW1 2AA. Code: 221/70.

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**ROYAL COLLEGE OF ART**

School of Fine and Television Electronics Engineers required for the operation and maintenance of equipment. Essential: City \& Guilds of London Institute (579), or equivalent. Salary £7164 depending on qualifications and experience.

The college is equipped with Philips TR60 quadraplex television equipment. Application forms may be obtained from: Director of Professional Development, Royal College of Art, Kensington Gore, London SW7 2SB.

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**APPOINTMENTS IN ELECTRONICS**

**£5 - £10,000**

The pursuits of theIMPORTANT posts are given below.

**MISCELLANEOUS**

RADAR

COMMUNICATIONS

ELECTRONICS (MILITARY)

For the post, expert advice and information are required about career prospects, payment, etc. (details may be obtained from Mike Gernat, BSc, 3 trouser road, Billingshurst, West Sussex, 01-906 9239.)

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**ROEHAMPTON INSTITUTE, Diggby Stuart Building, London, SW15 SHP**

**PSYCHOLOGY TECHNICIAN**

(NJC/APTC Grade 2)

Required at DIDDY STUART COLLEGE as soon as possible to help implement key objectives. Will assist professional engineers in this work and the duties will include supervision of craftsmen, liaison with contractors and other specialists.

Applicants, male or female, must have a good practical understanding of work in at least one of the following fields:

1. **Electrical Power Control**
2. **Mechanical Mechanisms**
3. **Electronic Control Systems**

The successful candidate will be based in the London area but must be prepared to work anywhere in Great Britain for periods which do not normally exceed four weeks at a time.

Salary, depending on experience and qualifications, will initially be in the range of £2525 to £2958, subject to periods of increments of £225 to a maximum of £745 per annum. Additional allowances are paid for overtime work in excess of 16 hours per week, and for periods of 4 weeks and 2 day annual leave.

Applicants in writing, with full details of age, qualifications, experience and personal preferences should apply to: E. A. Fawcett, Assistant Secretary, Rotherhithe Institute of Higher Education, Education Building, Diddy Stuart College, Billingshurst Lane, London SW15 1SH, to arrive not later than 6 September 1980.

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**EMI Electronics Ltd. builds quality and reliability into every product. Our reputation for excellence is long established and is a major factor in generating new orders.**

The growth of our business here in historic Wells creates the need for more Test Engineers to take us through the 1980s.

As one of the world’s leaders in specialised defence electronics systems – particularly the fields of radar, proximity fusing, telemetry and radar modelling – our stringent quality standards. We will join one of our professional teams responsible for ensuring that our wide range of “State of the Art” electronics systems on test equipment meet our exacting standards.

We are looking for people with either ONC or HNC Electronics and varying levels of experience of testing or maintaining radar detection systems in the electronics industry or armed forces.

We offer competitive salaries, comprehensive benefits and assistance with your relocation to this beautiful part of Somerset.

For further information fill in a coupon and send it to F. M. Taylor, Assistant Personnel Manager, EMI Electronics Ltd., Pericliter Road, Wells, Somerset, BA8 1AA, or phone him for more information on Wells (0749) 72081.

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**B.B.C. INSTALLATION TECHNICIAN**

We have a vacancy in the Unit which deals with the supply, installation and commissioning of television studio lighting and mechanical equipment. This includes lighting control systems, dimmer luminaires and their mechanical suspension systems, camera mounting and lighting systems, etc.

The successful applicant will assist professional engineers in this work and the duties will include supervision of craftsmen, liaison with contractors and other specialists.

Applicants, male or female, must have a good practical understanding of work in at least one of the following fields:

1. **Electrical Power Control**
2. **Mechanical Mechanisms**
3. **Electronic Control Systems**

The successful candidate will be based in the London area but must be prepared to work anywhere in Great Britain for periods which do not normally exceed four weeks at a time.

Salary, depending on experience and qualifications, will initially be in the range of £2525 to £2958, subject to periods of increments of £225 to a maximum of £745 per annum. Additional allowances are paid for overtime work in excess of 16 hours per week, and for periods of 4 weeks and 2 day annual leave.

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All the others are measured by us...

At Marconi Instruments we ensure that the very best of innovative design is used on our range of communications test instruments and A.T.E. We have a number of interesting opportunities in our Design, Production and Service Departments and we can offer attractive salaries, productivity bonus, pension and sick pay schemes together with help over relocation. If you are interested to hear more, please fill in the following details:

Name ______________________ Age ______________________
Address ____________________________________________________________
Telephone Work/Home (if convenient) ________________________________
Years of experience
0-1 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 10-12 12-14 14-16 16-18
Present salary £______-£______-£______-£______-
Qualifications
None C G HNC Degree

Present job ______________________

Please apply for further details and application forms to Jean Smith at the address given below.

Return this coupon to John Proctor, Marconi Instruments Limited, FREPOST, St. Albans, Herts, AL4 0BR. Tel St Albans 59522

Link Electronics is a successful British Company active in the international sales of Broadcast television and radio equipment. We manufacture a range of studio products from colour cameras to simple D.A.'s. We are also one of the largest suppliers of Outside Broadcast vehicles, television and radio studios, all designed and built in Andover for a worldwide market.

TECHNICAL SALES ENGINEER

To be involved in the active selling of television broadcast equipment.

The successful applicant should have a sound technical electronic background, preferably with at least three years' experience within the Broadcast Industry, but not necessarily in Sales.

TV SYSTEMS ENGINEERS

Experienced senior engineers to work on the design and project management of Outside Broadcast vehicles and television studios. This is an opportunity for engineers to become involved in projects from their initial design concept through manufacture to delivery and installation.

Our custom-built systems require a high degree of customer contact at engineering level from the initial design, to customer training after completion of the contract, both within the U.K. and overseas.

Applications are invited from engineers with a knowledge of T.V. studio engineering gained from experience in this type of work or from experience in the operation side of television.

Employment benefits include excellent salary, generous holidays, free life and health insurance, pension scheme, subsidised meals and relocation expenses.

Please apply for further details and application forms to Jean Smith at the address given below.

Nene College

Northampton

MICROPROCESSOR TECHNOLOGY

A range of one-day and three-day courses covering both hardware and software aspects.

Full details on application.

Microprocessor Course Tutor

School of Technology

New College

St. George's Avenue

Northampton

NN1 6JB

Telephone: (0264) 61345

Broadcast Engineers £14,000

Prog. Personnel positions available. For the right candidates, we will consider 6 month contract appointments. Please complete the application form, with referees, and return it to our Personnel Department, University of Northampton, West Street, Northampton NN5 5BD. 

Nene College requires an experienced lecturer in Aeronautical and Marine Electronics Engineering.

The successful candidate should have a sound background in electronic and mechanical engineering. Experience in one or more of the following fields would be an advantage: Automation, Control Systems, Marine Electrical Engineering.

Salary will be in the range £8,600-£12,000 per annum. This is a non-approved further education scheme.

Application forms from: The Personnel Officer, Nene College, Uppingham Road, Uppingham, Oakham, LE15 8BP. Application forms should be returned by 1 September 1980.

Take your pick

HF-VHF-UHF:

Microwave Optics & Acoustics

A challenging and full career in Government Service.

Minimum qualification — HNC.

Starting salary up to £6,737 (under review).

Please apply for an application form to the Recruitment Officer (Dept. WW9)

H.M. Government Communications Centre, Hanslope Park, Milton Keynes MK19 7BH.

ROYAL OBSERVATORY, EDINBURGH

PROFESSIONAL AND TECHNOLOGY OFFICER

GRADE I

There is a vacancy in the Technology Unit at the Royal Observatory, Edinburgh, for an electronics engineer to work on the development of prototype astronomical instruments such as photometers, polarimeters, measuring machines and guidance and acquisition systems.

The Observatory provides Technological support to several major national astronomical facilities in the UK and overseas.

Initially the successful candidate will work with Officers at PTO III, IV and V levels designing, developing and commissioning acquisition and guidance systems and other instruments for use on the 3.8-metre Infrared Telescope situated in Hawaii.

These systems incorporate a variety of detectors including cooled SiT TV cameras, and microprocessor controlled digital image storage and display. Special techniques are being developed to present complex information in a simplified form to assist astronomers working in a difficult environment.

The successful candidate may be required to work abroad on short term detached duty or on postings of up to three years. It is a pre-requisite of working in Hawaii that a special high-altitude medical examination be taken and passed.

Applicants are expected to have qualifications at degree level in the appropriate subjects leading to corporate membership of an appropriate professional body.

Experience in one or more of the following fields would be an advantage: Detectors, Detector Arrays, CCDs and associated amplifiers, low light level TV Systems. Integration and digital image storage techniques; application of microprocessor hardware and software.

MARINE ELECTRONICS ENGINEER

Also in demand with all aspects of marine engineering, including aerials, receiver/transmitter and wide range of applications. Must live on site.

Royal Navy, HMS Winchelsea, Aldeburgh, Suffolk.

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**Professional Careers in Electronics**

Link Electronics is a successful British Company active in the international sales of Broadcast television and radio equipment. We manufacture a range of studio products from colour cameras to simple D.A.s. We are also one of the largest suppliers of Outside Broadcast vehicles, television and radio studios, all designed and built in Andover for a worldwide market.

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To be involved in the active selling of television broadcast equipment. The successful candidate should have a sound technical electronic background, preferably with at least three years' experience within the Broadcast Industry, but not necessarily in Sales.

**TV SYSTEMS ENGINEERS**

Experienced senior engineers to work on the design and project management of Outside Broadcast vehicles and television studios. This is an opportunity for engineers to become involved in projects from their initial design concept through manufacture to delivery and installation.

Our custom-built systems require a high degree of customer contact at engineering level from the initial design, to customer training after completion of the contract, both within the U.K. and overseas.

Applications are invited from engineers with a knowledge of T.V. studio engineering gained from experience in this type of work or from experience in the operation side of television.

Employment benefits include excellent salary, generous holidays, free life and health insurance, pension scheme, subsided meals and relocation expenses.

Please apply for further details and application forms to Jean Smith at the address given below.

**Name**

**Age**

**Address**

**Telephone Work/Home (if convenient)**

**Years of experience**

- 0-1 2-3 4-6 Over 6

**Present salary**

- £3,500- £4,500- £5,500- £6,500- £7,500- $

**Qualifications**

- None C & G HNC Degree

**Present job**

**Return this coupon to John Proctor, Marconi Instruments Limited, FREPOST, St. Albans, Herts, AL4 0BR. Tel. St. Albans 952922.**

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**MARINE ELECTRONICS ENGINEER**

Applications are invited from graduates or experienced engineers to undertake design, manufacture and test of sonar and radar equipment, and to provide technical support for customers.

There is a range of exciting opportunities for engineers at this stage of their career.

The successful candidate will have a sound technical background in electronics and be able to meet demanding standards in a fast-paced environment.

Salary is based on experience and qualifications.

Please apply for an application form to the Recruitment Officer, Mikronics, St. Albans, Herts, AL4 0BR.

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**ROYAL OBSERVATORY, EDINBURGH**

**PROFESSIONAL AND TECHNOLOGY OFFICER**

There is a vacancy in the Technology Unit at the Royal Observatory, Edinburgh, for an electronics engineer to work on the development of prototype astronomical instruments such as photometers, polarimeters, measuring machines and guidance and acquisition systems.

The Observatory provides technological support to several major national astronomical facilities in the UK and overseas.

Initially the successful candidate will work with Officers at PTO III, III and IV levels designing, developing and commissioning acquisition and guidance systems and other instruments for use on the 3.8-metre infrared telescope situated in Hawaii.

The Observatory incorporates a variety of detectors including cooled SiB TV cameras and microprocessor controlled digital image storage and display. Special techniques are being developed to present complex information in a simplified form to assist astronomers working in a difficult environment.

The successful candidate may be required to work aboard short term dispatched duty or on postings of up to three years. It is a pre-requisite of working in Hawaii that a special high-altitude medical examination be taken and passed.

Experience in one or more of the following fields would be an advantage: Detectors, Detector Arrays, CCDs and associated amplifiers, low level TV Systems. Integration and digital image storage techniques; application of microprocessor hardware and software.

Salary will be in the range £8,000-£10,200 per annum. There is a non-contributory superannuation scheme.

Application forms from The Personnel Officer, Royal Observatory, Blackford Hill, Edinburgh EH9 3HJ. Application forms should be returned by 1 September, 1980.
TELECOMMUNICATIONS

In London and at Harson Park, Milton Keynes, four are in the establishment, modification, maintenance and operation of key, VHF, UHF and microwave networks, associated test equipment, recorders, teleprinter and teleprinter equipment, radio and television transmitters, including satellite and microwave links (some using analogue and digital techniques), voice frequency telegraphy and other specialist plant in the department.

Candidates must have studied an apprenticeship or have had equivalent training. They should normally have 3 years relevant experience, and hold ONC in Engineering (with pass in Electrical Engineering) A or Applied Physics or SCOTTIE III, or similar qualification in a relevant subject. Ex-Service personnel who have had suitable training and at least 3 years equivalent experience (as Staff Sergeant or equivalent) will also be considered.

Salary: £6310 to £7170. London £780 more. Starting salary may be advanced by the department according to age / experience and names of 2 referees, to be returned by 12th September

Candidates are invited to submit details of their qualifications and experience to:

APPOINTMENTS

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London: 01-637 0591, or telephone 01-637 0626. Administration, King's Lynn.

Junior Development Engineers - Electronics

John Player and Sons, a leading manufacturer of tobacco products, offers the opportunity to young electronics engineers to gain valuable practical experience in industrial electronics.

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The successful candidate will undergo a period of training on specific machines during the evaluation period, be involved in the development of new features as, well as addressing evaluation tests and undertaking training of others in the maintenance of these machines on the production floor. We are looking for men or women who are qualified to ONC or equivalent, and who have 2 years experience in one or more of the following areas:

- Electronic control and logic circuits
- Microprocessors
- A knowledge of the tobacco industry is not essential.

We offer a starting salary around £6,500 per annum together with other benefits associated with a large progressive company including relocation assistance where applicable. Further information can be obtained by phoning Nottingham (STD 0602) 780111 or writing to:

Junior Development Engineers - Electronics

John Player and Sons

Nottingham NG7 5PY

King's College Hospital

Applications are invited for the post of

CHIEF, TELECOMMUNICATIONS

Department of Medical Physics

King's College Hospital: The Department provides a comprehensive service in Medical Physics (Teaching and some services to hospitals in the South East Thames Region), including the development of new stereotactic and computerized tools for assessing needs and making recommendations for purchase of equipment.

The successful candidate will be required to have completed a course of advanced studies in medical physics or equivalent degree in relevant engineering discipline, with eight years' professional experience. Should have an initial appointment of 4 years' duration to King's College Hospital, Desert Hill, London, SE5 9RS and telephone 01-274 8227, or telephone 2404 0926 at weekends.

Closing date: Sept 12, 1980.

ACOUSTIC ENGINEER/NATION

Acoustical Laboratory at King's College London. Responsibilities include developing technical equipment for the investigation of hearing. Practical experience with some knowledge of intermediate higher mathematics and use of computer equipment essential.

Salary: £7000 to £8000.

Applications: Please complete two copies of United Nations Personal History Form (P.11), and send details, curriculums vitae and Professional Recruitment Service, United Nations, New York, N.Y. 10017, USA. Mention the date of birth and nationality, and quote the Vacancy Announcement number:

VA. 79-25-S-357 NY.
LECTURING WITH A DIFFERENCE

The difference is the MARCONI COLLEGE in Zurich not an academic nor an established institution but an appealing blend of both. The College is presently located in Chelmsford and the members of staff are responsible for training the engineers of the Marconi Electronics Group and customers.

DIGITAL SYSTEMS

Appointments are invited for research and development on systems and equipment over a wide range of applications including the expanding field of automatic systems. Applicants should either have a degree or equivalent qualification in electronics with knowledge of digital techniques, or several years relevant experience. Teaching experience is desirable but not essential.

TELECOMMUNICATIONS

Appointments are invited for the research and training and maintenance of a wide range of telecommunications systems and equipment. The range includes HF, VHF and Microwave Systems incorporating the latest microprocessor devices.

Applications should have a sufficient combination from a degree or equivalent qualification, teaching experience in similar areas and 4 years relevant experience. Practical experience of professional radio communications systems is desirable.

JUNIOR DEVELOPMENT ENGINEERS - ELECTRONICS

John Playen and Sons, a leading manufacturer of tobacco products, offer the opportunity for young electronics engineers to gain practical experience in industrial electronics.

Vacancies exist for work in the following areas and applicants should demonstrate an interest in one or more of the following areas:

a) electronic control and logic circuits
b) microprocessors

c) a knowledge of the tobacco industry is not essential

We offer starting salaries around £6,500 per annum together with other benefits associated with a large prosperous company, including relocation assistance where applicable.

Electronic Development Engineers can be obtained by phoning Nottingham (STD 0602) 781111 or writing to:

John Playen and Sons
Nottingham NG7 6PY

KING'S COLLEGE HOSPITAL

Applications are invited for the post of

DEPARTMENTAL TELECOMMUNICATIONS ENGINEER

in the Department of Medical Physics, King's College Hospital. The Department provides a comprehensive service to the hospital, to Teaching and some services to hospitals in the South East Thames Region.

A Medical Physics Technician Grade I is required to take daily technical duties under the supervision of the Department, which employs approximately fifteen technicians.

The successful candidate will be required to have completed a course in basic scientific knowledge of present day digital and analogue techniques and equipment.

Salary: £17920-22070 inclusive

For further information, please contact the Department of Medical Physics on 2250. Application form and job description available on request (with reference to advert) from the Director of Medical Physics, King's College Hospital, Denmark Hill, London, SE5 9RS or telephone 01-274 6227 ext. 2401 quoting reference number 15403. Closing date 1st April 1980.

FIELD SERVICE ENGINEERS - ELECTRONICS

Applications are invited for the post of FIELD SERVICE ENGINEERS [Grade P-4] with the following qualifications and experience:

- A minimum of two years' experience in the maintenance and repair of electronic equipment
- A knowledge of the tobacco industry is not essential

Applications should be returned by 12th September 1980 to the Personnel Director, Almon Road, Basingsate, Harlow, Essex CM1 1LP. Telephone number 8256 B851 (generating office) 144.

GEC-Marconi Electronics Ltd.
Do you want to work in electronics as a Technician?

At the Government Communications Headquarters in Cheltenham, we carry out research and development in radio communications and their security, including related computer applications. Practically every type of system is under review, including long-range radio, satellite, microwave and telephony.

Your job as a Radio Technician will concern you in developing, constructing, installing, commissioning, testing and maintaining equipment. Such work will take you to the forefront of technology on a broad front and widen your area of expertise -- positive career opportunities for on-time and on-cost work paying good rates. Starting pay may be adjusted to £5,045 depending on relevant experience.

Applicants possessing the necessary formal qualifications (e.g. in Telecommunications Technician Certificate) but with insufficient practical experience for Radio Technician posts may be suitable for our Trainee Radio Technician posts. Pay scales for these posts are £3,825 per annum at age 19 to £4,640 at age 24. Successful completion of our practical training course will lead to grading to Radio Technician.

A non-contributory pension scheme provides cash and pension benefits based on salary and length of service. Annual leave is 4 weeks (for RT) plus 10 days public and private holidays.

Full details from our Recruitment Officer, Robbie Robinson, on Cheltenham (0342) 21491, Ext. 2269, or write to him at GCHO, Oakley, Priors Road, Cheltenham, Glos. GL52 5AJ. If you seem suitable we will invite you to interview in Cheltenham--at our expense.

---

**Electronic Technician**

Requirements:
- Applicants must be able to work on own initiative and have full working knowledge of basic electronic theory and practice.
- They must be familiar with digital and analog equipment and with discrete devices.
- Aids to successful applicants include the following:
  - Experience in the repair and maintenance of communication and electronic equipment.
  - Some knowledge of telecommunication and radio.
- Training will be comprehensive:
  - Special courses, both in-house and with manufacturers,
  - Modern logic and software techniques,
  - Positive career opportunities for on-time and on-cost work paying good rates.
- Starting pay may be adjusted to £5,045 depending on relevant experience.

**Salary and Benefits**
- Salary will be within a scale of £3,825 to £4,640 per annum.
- In addition to salary, employees may be eligible for a non-contributory pension scheme.
- The salary scale is adjusted to £5,045 at age 19 to £6,350 at age 24.
- Successful completion of a practical training course will lead to grading to Radio Technician.
- A non-contributory pension scheme provides cash and pension benefits based on salary and length of service.

**Application Process**
- Full details from our Recruitment Officer, Robbie Robinson, on Cheltenham (0342) 21491, Ext. 2269, or write to him at GCHO, Oakley, Priors Road, Cheltenham, Glos. GL52 5AJ. If you seem suitable we will invite you to interview in Cheltenham--at our expense.
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Your job as a Radio Technician will concern you in developing, constructing, installing, commissioning, testing and maintaining our equipment. Such work will take you to the frontiers of technology on a broad front and widen your area of expertise — positive career assets whatever the future brings. In the rapidly expanding field of digital communications, valuable experience in modern logic and software techniques will be gained.

Training is comprehensive; special courses, both in house and with manufacturers, will develop particular aspects of your knowledge and you will be encouraged to take advantage of appropriate day release facilities.

You should hold or expect to obtain a TEC Certificate in Telecommunications Engineering or the City and Guilds Telecommunications Technician Certificate Part 1 (Intermediate), or its equivalent, and have a sound knowledge of the principles of telecommunications and radio, together with experience of maintenance and the use of test equipment. If you are an ex-service in M. Forces, your Service trade may allow us to dispense with the need for formal qualifications.

Pay scales for Radio Technicians start at £6,640 per annum, rising to £6,525, and promotion will put you on the road to posts carrying substantially more, there are also opportunities for overtime and on-call work paying good rates. Starting pay may be adjusted to £5,045 depending on relevant experience.

Applicants possessing the necessary formal qualifications (e.g., TEC or C & G Telecommunications Technician Certificate) but with insufficient practical experience for Radio Technician posts may be suitable for our Trainee Radio Technician posts. Pay scales for these posts are £3,826 per annum at grade 19 to £6,640 at grade 24. Successful completion of our practical training course will lead to appointment as Radio Technician.

A non-contributory pension scheme provides cash and pension benefits based on salary and length of service. Annual leave is 4 weeks (for RT) plus 10 days' public and private holidays.

Full details from our Recruitment Officer, Robby Robinson, on Cheltenham (0242) 21491 Ext. 2206, or write to him at a GCHO, Oakley, Priors Road, Cheltenham, Glos. GL52 5AJ. If you seem suitable we will invite you to interview in Cheltenham — at our expense.

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The first two days of the conference are dedicated to design engineers seeking answers to problems encountered in designing and implementing microsystems through discussion and sharing experiences with other experts in the field. The third day is devoted to personal computers and small business systems and their use in industry, commerce, and education.

Microsystems '81 is sponsored by the publications Microprocessors & Microsystems, Computer Weekly Systems International and Practical Computing.

SCOPE

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- design aids
- distributed processing
- education and training
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- signal processing
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Symposia of papers for consideration should be sent by 12 September, 1980 to: Robert Parry, Microsystems '81, PO Box 63, Westbury House, Bury Street, Guildford, Surrey GU2 5BH.

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HERE IT IS! THE BRAND NEW 8022A HAND-HELD DMM

Consider the following features:

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- Functions: AC and DC, Ohms, mV, mΩ, and VT.

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WIRELESS WORLD, SEPTEMBER 1980
The Viewdata Exhibition
For Professional & Business People

WILL TAKE PLACE
29th-31st OCTOBER 1980
WEST CENTRE HOTEL, LILLIE ROAD, LONDON
10 am to 6 pm
(Closing 5 pm on the last day)

The response to the second exhibition for professional and business people has been overwhelming, justifying the decision to take the whole hall at the West Centre Hotel.

An additional feature to this year’s show will be a Workshop/Forum, where sponsoring company’s will hold an open discussion on the latest related topics. Entry to this will be free.

This year’s event is designed as it’s title suggests, to interest not only those professionally involved with Viewdata & teletext, but also those businessmen whose companies are able to use Viewdata or are already doing so.

The event has over 40 exhibitors including: Sony, GEC, Information Services, The Post Office, Langton Information Services, CAP CPP, Granada TV Rental, Fintel, Eastel, Cherry Electrical, Centronics, Link House Communication, Ansafone, STC, ITT, Bishopsgate Terminals, Oracle (London Weekend TV), and Barco Video Terminals (C.W. Cameron Ltd), showing a wide variety of exhibits such as:

- Editing equipment basic and advanced, monitors and user terminals, private viewdata systems and equipment, peripherals including printers, magnetic media recorders, light pens, graphic design aids and keyboards, accessories such as camera attachments, anti-glare sprays, screen hoods and masks, telephone timers, microcomputers for telesoftware and other "umbrella" activities and facilities, software services for advanced editing, publications, semiconductor devices and many more.

ENTRANCE TO THE EXHIBITION IS FREE BY REGISTRATION

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Multicore Wick for solder-removal and desoldering

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Easily adjustable for most sizes of flex and cable. Fitted with extra strong spring for automatic opening. Easy grip handles and handle-locking device.

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Savbit Dispenser

For radio, TV and similar work. Reduces copper erosion.

Emergency Solder

Self fluxing, tin/lead solder tape that melts with a match. For electrical and non-electrical applications. Size ES36 £1.38 inc. VAT

Econopak

A reel of 1.2mm ‘Ersin’ Multicore solder for general electrical use. Size 13A £4.14 inc. VAT

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Tacky mixture of solder powder and correct percentage of flux for difficult to reach areas.

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Make editing simple with the Bib splicer, tape cutter and splicing tape, with 3.3mm adaptor.

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Send S.A.E. for free copy of colour catalogue detailing complete range.

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Record Valet

Soft bristles on leading edge remove dust and humd velvet pad collects particles. This advanced cleaner is engineered in a fine shiny black finish and is supplied with dust cover and a 22ml. bottle of anti-static cleaner.

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Everything necessary for cleaning heads, capstan and pinch wheel on all types of recorders. Cleaning and polishing pads, cleaning liquid and brush inspection mirror included.

Groov-Kleen Automatic Record Cleaner

For single-play turntables. Removes harmful dust to protect records and stylus. Finished chrome, bright anodised aluminium and shiny black.

Record Winder

The Bib Cassette Fast Winder enables you to wind tape in one cassette whilst you are listening to another cassette. If you have a battery recorder, always use the Fast Winder to save the high battery consumption when fast winding. It winds a C10 cassette in 60 seconds — faster than most recorders.

All prices shown are recommended retail, inc. VAT.

Solder Cream

A fast non-corrosive, rosin flux for general electrical use. Size AB10 £1.38 inc. VAT.

Guard XL-2

preservative.

Anti-static Record preservative. When applied to the surface gets it together. Safe pump locking device.

Cassette Fast Hand Tape Winder

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Groov-Kleen Automatic Record Cleaner

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For radio, TV and similar work. Reduces copper erosion.

Emergency Solder

Self fluxing, tin/lead solder tape that melts with a match. For electrical and non-electrical applications. Size ES36 £1.38 inc. VAT

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