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A top quality Shure microphone makes a measurable difference in upgrading sound. New, Shure has added a new microphone designed to upgrade the appearance of your act, as well as the sound. The SM63 is a top quality omnidirectional microphone with high output and clear, crisp sound quality — an innovative blending of smaller size, handsome appearance, and truly amazing broadcast-quality performance. Highly effective pop protection, low handling noise and very low profile (so it won't obscure the performer's face) make it the perfect choice for on-camera applications. The SM63 omnidirectional dynamic microphone measures just 5'/ivas long, 1¼ inches in diameter and weighs only 2.8 ounces with no compromise in Shure's standard of reliability. It offers twice the voltage sensitivity of our own SM58 (dB) and features a huffingbody coil for superior rejection of electromagnetic hum (up to 20 db better than competitive units) and an elastomer shock mount for minimized handling noise. The new SM63 also features the Shure-developed VERAFLX® dent resistant grille and a smooth satin finish perfect for on stage and on-camera applications. 

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SPECIFICATIONS

Frequency Response: 50 to 20,000 Hz

Impedance: 150 ohms

Output Level (at 1,000 Hz Open Circuit Voltage (Db = 1 volt per meter) --76.0 Db (0.16mV)

Hum Pickup: Typical at 60Hz: 13 db equivalent SPL in 1 microphone test

Shock Mount: Patented internal vibration isolator

Case: Champagne finish aluminum with VERAFLX® grille

Dimensions and weight: 5'/ivas long, 1¼ inches in diameter, 2.8 ounces

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He who hesitates ...

Democratic, parliamentary government is a fine thing. Matters of consequence 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-heeded 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 "flickers of interest" from private enterprise. That the interest is only a flicker does not show the City in a particularly adventurous 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 £36 million in the time spent haggling over the second installment. If it had not been forthcoming, 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, manufacturing capability; the application is all, so they say, so why not leave the supply of raw materials — chips — to others? One hesitates to appear churlish 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 companies the conception, design and manufacture of industries which we are constantly being told will be central to our future economy? Will be then be supplied with the devices we want or those we are told to want? Will we be 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 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.
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 higher 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 job 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 bypassed at high frequencies, where a full voltage swing is not so important in audio work. This bypassing prevents the instability for which bridge amplifiers are notorious.

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 these systems. 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.

The 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 x+y. Capacitor C2 bypasses A2 at high frequencies, where large voltage swings are unnecessary, Circuit A, Fig. 1, inverts the signal which circuit A 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+V, and y-V, and the output across the load is x-y+2V. Remembering the close coupling between individual amplifiers, imagine that x rises for some reason because of effects of A2, This causes A1 to turn on, to keep y constant. The fact that A1 has turned on effects the value of x, causing A2 to react each time there is a small phase shift, which can only be amplified in 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 A1 pole and feed-back 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) off-set voltage. Imagine that the potential y rises with respect to x for some reason. The potential at the + input to the amplifier remains at almost earth potential x, so that there is a voltage across R2 which tends to make a current pass into the + input. This causes A1 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.

Amplifier A2, is acting as a virtual earth amplifier, and its voltage gain is R3/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 A1 (apart from stray capacitance effects). As the potential

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*Remember Kirchoff's Law: if current is supposed to disappear down the earth line, where is it supposed to be coming from?

**There is also a low frequency coupling, discussed in part 2.

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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 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 A2 controls the value of x-y, and A3 controls the value of x+y. Capacitor C2 by-passes A3 at high frequencies, where large voltage swings are unnecessary. Circuit A, Fig. 1, inverts the signal which circuit A Fig. 2 does not.

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y with respect to the power supply is the only thing which is affected by $A_0$, then $A_1$ is decoupled from $A_0$. This confers a high degree of stability on the circuit, and enables $A_0$ to be of cheap design, with good distortion performance, in what will remain a high fidelity system. Effect of $A_0$ in circuit $A$. Fig. 5 shows $A_0$, and the associated feedback loop. Resistor $R_1$ is large-valued, providing bias, so that the conditions are identical with those for circuit $A$. Imagine that the input voltage rises. This causes $A_0$ to conduct in one direction so as to cause $y$ to rise with respect to $x$. Negative feedback is applied through $R_0$, causing the potential of $x$ to rise. The input current $i_{x}=i_{R0}=i_{R1}$ when the input voltage $V_{x}$ is again decoupled from $A_0$. The diagram shows the effect of feedback loop, $C_1$ by-passes $A_2$ at high frequencies. Resistance $R_2$ will be set near unity, so that at low frequencies $A_0$ controls the potential of $y$ in such a way that $x+y$ 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 component amplifiers. In practice, however, $R_2$ will be set slightly larger than $R_0$ so that at low frequencies, $A_0$ bottoms shortly before $A_0$ does. This enables a full voltage swing to occur, and is illustrated in Fig. 7. The system can cope with a poor quality decoupling capacitor $C_1$, the required output being appreciably affected. Cost savings can be quite large in this area.

Earthing arrangements. Fig. 8 shows a typical supply arrangement. Capacitors $C_1$, $C_2$, the stray capacitance between earth and the bulky components of the power supply, and $C_3$, the stray capacitance between primary and secondary of the transformer. An apparent problem as regards building a bridge amplifier is the capacitor $C_1$, since this capacitor is the only part of the circuit that is effectively put across the output, and is therefore a potential source of drift. This capacitance is stray between earth and the output, and is seen that, whilst the system is working correctly these currents are safely passed. The feedback loop of $A_0$ causes the potential $y$ to follow that of the power supply, if it rises with respect to $x$ (i.e. earth). Such a rise in $y$ causes $A_0$ to conduct, so that $x+y$ is always equal to the mains currents. But this does not apply at switch-on, or on failure of some component. It is thus highly desirable to insert an earthed capacitor, between primary and secondary of the transformer.

A further safeguard, which is necessary for highly inductive loads, is to insert reverse-biased diodes between the pre-amplifiers, and the power supply. This prevents any transients from being reverse-biased. However, if a good screen is included in the transformer, and stray capacitance between earth and each power rail is far away from, or screened from, the rest of the control circuitry, and provided that the capacitance between collector and base of $T_4$ is small. Even with a large capacitance here (say a maximum of 100µF), then a small capacitance between collector and base of $T_4$, could safely be included, thus damping out any interaction. This precaution is probably unnecessary: for example, if $TXX304$ is used for $T_4$, then a working voltage of 700V can be used, but there is a capacitance of only 6µF between collector and base.

Further applications

Change of origin device

This section describes how the amplifier can be included in a stereo arrangement, avoiding the unusual earthing arrangement of Fig. 8, and also describing how a bridge amplifier can be included here because it follows on from the same supply would result in the act of a virtual earth amplifier, so that the a.c. signal $I_1$ is equal to $i_{R2}R_2/V_{amplifier}$, where $V_{amplifier}$ is the input voltage.

Because of the effect of $C_1$, $C_2$, $R_m$, and $R_{pot}$, a constant current passes through $R_{pot}$, and any a.c. variations in $V_m$ are caused by $A_0$ to pass through $R_0$ so that the output e.m.f. is $(R_m/R_0)V_{amplifier}/R_0$. Thus the gain is $R_m/R_0$.

There is no possibility of coupling between the pre-amplifier and bridge amplifier stages, provided that $T_4$ is sensibly positioned so that its collector is far away from, or screened from, the rest of the control circuitry, and provided that the capacitance between collector and base of $T_4$ is small. Even with large capacitance here (say a maximum of 100µF), then a small capacitance between collector and base of $T_4$, could safely be included, thus damping out any interaction. This precaution is probably unnecessary: for example, if $TXX304$ is used for $T_4$, then a working voltage of 700V can be used, but there is a capacitance of only 6µF between collector and base.

Components $C_m$, and $R_m$ are unnecessary in actual circuits because there is a semi-stabilized voltage point $E_0$ 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 cases such as processor boards, memory, microprocessors, project management, real time languages, signal processing, software development, and so on.

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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 (DES)

The marriage of communication technology and computers has proved a fruitful alliance that has already led many profound advances in the technology has been of interest primarily to Bletchley Park.

The capture by the North Koreans of Hindi in which the same running key is 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 whereby 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; in a form of encryption (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 and the like. Use of the printed page. Polyalphabetic, first proposed in 1553 in the form of the "Koch, Dammann, Schoberius and a basically similar machine but using six wheels and a drum. The first cipher machine was developed by Hagelin in 1934.

Most machines had a number of interesting features, notably between input and output contacts as to form a polyalphabetic substitution cipher. While using polyalphabetic ciphers greatly increases security, it brings with it the need for the user to have some form of key or running key that is not available to the eavesdropper.

It is a feature of any polyalphabetic cipher that the users need some form of aide-memoire or key to decipher the message, just as a codebook or other directory is a form of codebook as a substitute alphabet.

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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 a previously adjustable jackknife.

Those who devised rotor machines in the 1920s apparently believed 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, if read as a binary non-return-to-zero digital code. However, modern practice is to convert the plain text into a code or cipher text or into binary digital form first for on-line systems and only then to make a secret by combining the resultant bit stream with a running key, also in digital form, Fig. 3. If the running key is used only once (one-time) the resulting cryptosystem can be considered unconditionally secure. On the other hand, if, for example, a simple pseudo-random bit generator is used to provide a shift-register sequence, which need not recur, then it is essentially useless as a linear logic. If linear logic is used, Diffie and Hellman claim that the resulting cryptosystem can be broken in around 700 seconds on a minicomputer. It was this vulnerability that led IBM to investigate the use of non-linear block ciphers in which the plain text is divided into separate blocks, each block of data being operated independently. Such a cryptosystem using simple substitution requires an extremely large number of key bits. 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 permutations of order and substitutions based on the derived keys.

The aim has been to produce a computationally secure cryptosystem comprising a large number individual cryptosystems each of which employs the same algorithm yet which can be deciphered only by someone who can generate the correct, though relatively simple, unique key sequence. From a manufacturing viewpoint, there are clearly significant advantages if it is a simple, standard algorithm that is public property: the individual short digital sequence can generate the key stream for the authorized users is kept secret, involving great care in key management and key distribution. The basic key generator may be in the form of a sealed, tamper-proof module.

Digital systems have a further important advantage: their use is not completely dependent upon the fact that the system is fast enough, it can be applied to real-time digitized speech, thus providing telephone and radiotelegraphy with secure scrambling or privacy systems much more secure than the traditional forms of analogue scrambling. Digital encryption can be applied also to teletex, facsimile and many other systems where data transmission links are involved to prevent unauthorized users from obtaining any information or to prevent software piracy.

**Cryp-tanalysis**

The moment anything is committed to paper or fed into an electronic store as plain text or as encrypted messages, it becomes vulnerable to an eavesdropper, whether by interception, data theft or physical access. If the encrypted material cannot be read by the eavesdropper with the help of cryptanalysis then it can be considered secure. Nevertheless a determined eavesdropper in such circumstances will seek to acquire examples of known plain text, for example from message files before they have been enciphered, or after they have been deciphered, or from subsequence in paraphrased form, or by being transmitted into a non-secure machine. Any code or cipher, even one which has a one-time cryptosystem defined as unconditionally secure, is in practice only as secure as the circumstances surrounding its use.

An eavesdropper faced with cipher text that cannot be deciphered often retains the encrypted material in the hope that success may come later, when perhaps some of the plain text will have come into possession as described above; or when time has allowed careful observation of what happens after the receipt of the message by the addressee. Many cryptosystems which are difficult to attack also produce very few cipher text messages which may reveal their algorithms. However, many complex systems require the attacker or his keys when attacked with known text and this information may then open the lock to other messages which may reveal future using the same cryptosystem.

If all else fails a computer can search the encryption scheme using all of the possible key permutations until a meaningful result is achieved. Modern digital systems require a very intensive search indeed: a key of 100 binary digits requires an average of $2^{100}$ possibilities, a mind-boggling total.

In the years BC (before computers) cryptanalysis depended for its degree of relative security either on keys of unlimited length, great ingenuity in the use of algebraic manipulation, and the ability of the various processes (e.g. double-transposition ciphers). Today the emphasis is on making the transformations 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 termed conditionally secure. However not all ciphers that are thought to be secure against computer attack may be so actually. 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 been accepted as one of the few systems that are unconditionally secure. The use of such a system however involves many practical difficulties, including the production and distribution of the pads or 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 must be trained when the whole system is operated.

In practice the cage and keywheels of the Hagelin machine and the rotors of Enigma, and the sealed, potted module. The moment anything is committed to paper or fed into an electronic store as plain text or as encrypted messages, it becomes vulnerable to an eavesdropper, whether by interception, data theft or physical access. If the encrypted material cannot be read by the eavesdropper with the help of cryptanalysis then it can be considered secure. Nevertheless a determined eavesdropper in such circumstances will seek to acquire examples of known plain text, for example from message files before they have been enciphered, or after they have been deciphered, or from subsequence in paraphrased form, or by being transmitted into a non-secure machine. Any code or cipher, even one which has a one-time cryptosystem defined as unconditionally secure, is in practice only as secure as the circumstances surrounding its use.

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In practice the cage and keywheels of the Hagelin machine and the rotors of Enigma, and the sealed, potted module.
DES provides a ciphering algorithm or set of rules involving both substitution and transposition techniques and capable of being implemented in current I.A. technology. Figs 4, 5 and 6. Each data block passes through 18 data-manipulation stages in which 16 different internal ciphering keys are derived from a 56-bit main key (with 64-bit input code). This provides 2^80 possible codes with a codebreaker with the need for a truly massive search, always provided that nothing is known about the enciphering 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.A. technology now making possible to contemplate the use of gigantic proportions. They postulated a decoding machine using a million I.A. chips, that could search 1016 keys per second, so that if the full 1016 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 £250. While only a very few organizations, including governments, could positively contemplate building such a machine, the mere possibility of such a validation of hardware based on this complex non-linear algorithmic design is checked on the need to ensure that the output can never contain the key or plain text. The advent of DES has already sparked off a vigorous debate as to the degree of security it may give, and whether it would not have been better to develop an alternative, probably more secure, classical or linear form of cryptosystem, known as "public-key systems." (third column).

WIRELESS WORLD, SEPTEMBER 1980

RSA public-key crysptosystem devised by Rivest, Shamir and Adleman (whose initials make up the "RSA" acronym) are known as Diffie and Hellman "trapdoor" system by means of what is called a trapdoor function. The key to indicate a one-way or irreversible function, while the trapdoor is derived from a class of mathematical functions that can be solved only by those who know the appropriate method of solution. The trapdoor itself consists of a set of numbers that are used to encrypt a piece of data and then decrypt the data. The key to successful operation of the trapdoor is the trapdoor function.

Several systems using basically similar techniques have been proposed or developed for application to computers, including home computers, where no hardware or software exists that will prevent unauthorised users from using software or information to prevent software piracy. An example of such a system is known as a "cryptosystem." Cryptosystems are used for a wide variety of purposes, such as encrypting data on computer networks or even for personal use. They are designed to provide a level of security that is adequate for the intended application, while also being easy to use and understand.

In summary, the existence of DES and other similar algorithms indicates that the world is moving toward a more secure form of communication. While there may still be some concerns about the security of these systems, their widespread adoption and use in various applications is an indication of their effectiveness and usefulness. As technology continues to advance, it is likely that we will see even more secure and efficient methods of protecting information from unauthorized access.
Like Faraday (Maxwell) looked upon the role of conductors in electricity as a minor one, since they only terminations of the lines of force of the surrounding electric field.

The Encyclopedia Britannica

Physics offers some other examples of dual representation - light (photon, electrons as particles or waves (electron diffraction) - but only in electrochemical 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 awareness of development in the techniques of circuit analysis, while earlier scientists such as Faraday (1791-1858), Maxwell (1831-1879) and Poynting (1852-1914) regarded fields as pre-eminent. (It should be added that fields involve only the algebraic manipulation of one-dimensional quantities.) The development of waveguide and associated techniques, for which circuit representation is impracticable, may tend to reinvolve the 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, but the idea of gravitational attraction that it needs an Einstein to remind us of the problem. It is clear, for example, from a study of waves before Newton, namely how can the sun exert a force on a planet across the whole universe? If there were no planets, the sun's rays, for example, would be a wave of electromagnetic phenomena and Maxwell showed that such fields could be propagated as waves, in empty space as well as in material media. (See "No radio without displacement currents." Wireless World, August 1979.) Evidence in support of this idea of electromagnetic phenomena was direct - the phenomenon of propagation can be observed. An interesting example of this is that a circular loop of wire acquires radiating properties, i.e., becomes a useful frame aerial instead of a simple conducting loop when the time taken for the magnetic 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.

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 discerning the "luminous ether" which was supposed to be an all-pervading medium supporting electromagnetic waves, in the fields which 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 indisputable concepts of modern physics, such as the wave nature of the electron and the quark; one has to get used to the difficult concept of wave mechanics (sometimes introduced in terms of "wave interference and probability") which provides the theoretical basis for the whole of modern solid-state technology. Einstein's principle of the irreversibility of the process of gravitational action-at-a-distance was therefore imagined by Maxwell (1855) that a force could arise when a body continues in a straight line, by what is called "slowing down" or "shortest line" in a curved space with the 'curvature' being due to the presence of mass. In more recent times, the concept of space by the presence of mass is just as far from everyday experience as fields in empty space. Wherever you go, modern physics demands faith in something which is not comprehensible in terms of everyday experience: the laws of physics demand acceptance because they produce a coherent structure of theory which accords with all experimental evidence. Let us now look at the simplest example of the circuit in which we have the energy stored in a dielectric which can be anything from a vacuum to high-permittivity ceramic (Fig. 1). From a circuit viewpoint we say that the charge $Q$ from one plate to the other is $q v$ where $v$ is the potential difference across the plates and $q$ is the time of transfer. Since $v$ increases as the charge builds up the total work done and therefore energy in the electric or magnetic fields is dependent on the potential difference and energy in any of the fields. In electrostatics the total value of $D$ integrated over a surface is equal to $\mathbf{E}$, which is equal to $\mathbf{D}$ for a vacuum (the flux of electric induction $\mathbf{D}$ originates (Gauss's theorem). This is always true, whatever the medium, so $D$ can be regarded as a primary field which emanates from charge, the "cause" of any observed phenomenon. Then the electric field force is one of the consequences of the magnitude is found by dividing $D$ by the dielectric constant $\varepsilon$ of the medium, which can vary from a vacuum to a perfect conductor (the units are farads per metre). The reason why, is not made unity in the system is to enable the system to incorporate amperes, metre, kilogram and second as basic units. One can test directly the inverse-square law of force between two charged masses, but one will need a constant of proportionality like the gravitational constant in the formula for the force between two masses. If the formula for force between two charges $F = k q_1 q_2 / r^2$ (7) is to apply, the vector force is in the same direction as the vector distance $\mathbf{r}$. From equation (3) can be split by introducing electric field force $\mathbf{E} = \mathbf{F} / q$, where $E = \mathbf{F}_x / q$ (4).

The subject of magnetism has been confused due to the use of magnets and is more complicated because the simple (scalar) relationships of electrostatics have to be replaced by vector relationships. The equation for the line integral of the current strengths $\mathbf{J}$ around a closed path is

$$\oint \mathbf{E} \cdot d\mathbf{r} = \mathbf{B} \cdot \mathbf{d} \quad \text{(4)}$$

where heavy type indicates vector quantities, $\mathbf{A}$ is a unit vector in the r-direction and the cross product $\mathbf{A} \times \mathbf{F}$ or $\mathbf{B}$ as vector multiplications. This also can be split into a current and a field of force $\mathbf{E} = \mathbf{F} / q$, where $E = \mathbf{F}_x / q$ (4).

If $\mathbf{B}$ is uniform along the length of a current-carrying conductor, and $\mathbf{F} = \mathbf{E} \times \mathbf{B}$ where the magnetic line starts and ends at the same point, the line integral of the current strength between two points is zero. This is always true, whatever the medium, so $D$ can be regarded as a primary field which emanates from charge, the "cause" of any observed phenomenon. Then the electric field force is one of the consequences of the magnitude is found by dividing $D$ by the dielectric constant $\varepsilon$ of the medium, which can vary from a vacuum to a perfect conductor (the units are farads per metre). The reason why, is not made unity in the system is to enable the system to incorporate amperes, metre, kilogram and second as basic units. One can test directly the inverse-square law of force between two charged masses, but one will need a constant of proportionality like the gravitational constant in the formula for the force between two masses. If the formula for force between two charges $F = k q_1 q_2 / r^2$ (7) is to apply, the vector force is in the same direction as the vector distance $\mathbf{r}$.

The vector $\mathbf{P}$ is at right angles to the plane of Fig. 2(a) and $\mathbf{E}$ and $\mathbf{H}$ and its magnitude is $E$ if $\mathbf{P}$ is parallel to $\mathbf{E}$ and $\mathbf{H}$ and its magnitude is $H$ if $\mathbf{P}$ is perpendicular to $\mathbf{E}$ and $\mathbf{H}$. The magnetic field of a current $I$ flowing along a wire of radius $a$ is

$$\mathbf{H} = \frac{B}{2 \pi a} \mathbf{n}$$

where $B$ is the magnetic field and $\mathbf{n}$ is a unit normal to the plane of the current. The current $I$ is the total current flowing through the circular cross-section of the wire. This is always true, whatever the medium, so $D$ can be regarded as a primary field which emanates from charge, the "cause" of any observed phenomenon. Then the electric field force is one of the consequences of the magnitude is found by dividing $D$ by the dielectric constant $\varepsilon$ of the medium, which can vary from a vacuum to a perfect conductor (the units are farads per metre). The reason why, is not made unity in the system is to enable the system to incorporate amperes, metre, kilogram and second as basic units. One can test directly the inverse-square law of force between two charged masses, but one will need a constant of proportionality like the gravitational constant in the formula for the force between two masses. If the formula for force between two charges $F = k q_1 q_2 / r^2$ (7) is to apply, the vector force is in the same direction as the vector distance $\mathbf{r}$.

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As long as $n_\text{H}/a$ is equal to $n_\text{F}/b$, 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 configuration of 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, does not matter as long as the total current circulating around the solenoid is kept constant. For Fig. 2(e) in particular one can write

$$H = \frac{a}{b} \text{ampere/metre} \quad (11)$$

It is a simple matter to squash the inductor of Fig. 2(d) into the stripped transmission line of Fig. 3. The magnetic field in the space between conductors will remain unchanged at $H = \frac{n_\text{F}}{b}$ amperes/metre. Assuming for the moment that the resistance of the transmission line is negligible so that the potential difference between the two strips is throughout the length, then with separation $d$ the electric field is $E = dH$ volts/metre. The magnitude of the Poynting vector for power flow per unit area through a cross-sectional line in the field is $S = \frac{E^2}{\varepsilon_0}$. The power flow is always exact, and you may use either the circuit or the field calculation, whichever is more convenient. One obviously uses the field calculation for waveguide and radiation problems.

**APPENDIX**

**Power flow in a lossless coaxial cable.**

A cross-section of a coaxial cable having inner and outer radii $a$ and $b$, with inner conductor 1 and outer conductor 2, is shown in Fig. 1. 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 centre of the cable, the radial component of the magnetic field is $B = \frac{H}{r}$. (11)

$$E = \frac{dH}{dr} = \frac{B}{\mu} \quad \text{(A1)}$$

We know that the electric field is greatest at the inner surface and decreases linearly to zero at the outer surface, but its relationship to the difference of potential between the two surfaces is not obvious. By using Gauss's theorem as in the previous proof for finding the capacitance between coaxial cylinders it can be shown that at radius $r$:

$$E = \frac{H}{2\pi r} \quad \text{(A2)}$$

In (is the symbol for a natural logarithm, otherwise denoted by $\ln$.) The total magnetic field is also the component $B$ of the magnetic field in the space between the two conductors:

$$B = \frac{H}{r} \quad \text{(A3)}$$

The total power flow is then

$$P = \int_{r_1}^{r_2} \frac{E^2}{\varepsilon_0} \, dr = \frac{E^2}{\varepsilon_0} \int_{r_1}^{r_2} \frac{1}{r} \, dr = \frac{E^2}{\varepsilon_0} \ln \left( \frac{r_2}{r_1} \right) \quad \text{(A4)}$$

But the value of the integral is $\ln(r/a)$ so

$$P = \frac{E^2}{\varepsilon_0} \ln \left( \frac{r}{a} \right) \quad \text{(A5)}$$

**Simple alternatives to the monostable**

**Using low-cost gates for non-critical timing circuits**

**By D. Price**

In comparison with other ICS, c.m.o.s. monostables are rather expensive, the 4538 package costing about £1.50 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 about 10p per gate, provides the basis for an 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. High 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 $G$, the output will go low and the output will go high. After a determined period the output voltage $V_a$ will be high and the output low. However, 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 $G$ to $V_a$ will drive the power supply rail, but as long as a voltage of $V_+ + 0.5V$ is reached, the gate protection diode starts to conduct and dissipate any excess current. 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 $R \cdot C$, and $C$ is an approximation, assume that the trigger point of the gate is at half-way between the two power rails. Using the formula $V_+ = \frac{1}{2} V$, the substituting $V = V_+/2$ gives $e^{-t/RC}$. Therefore, $t_{2\text{max}} = RC/2$.

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, the circuit 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 transition of the gate, both output transistors are switched on and are dissipating power. For this reason, long time constants, i.e. slow transitions, 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, for instance, a delayed switch on and off is necessary.
OPEN CHANNEL (CB) IMPLICATIONS IN DECISIONS ABOUT MODEL CB BAND

Announcing the government's intention to exempt a number of new and existing metal detector and pipe-patching equipment from the Home Secretary's ban on CB licences, licences will be ‘pursue’ to ‘pursue’ the Home Office had received 10,000 letters on the subject of C.B. and 40 petitions carrying thousands of signatures. In reply to questions said that the annual cost to the Post Office of investigations into complaints of interference to 'non-block' activity 'would not amount to $1 million. The costs incurred in dealing with illicit use of 27 MHz were not recorded separately and 'no figures are available for the cost of controlling imports of prohibited equipment.'

He also revealed that from 1st January to 30th April 1979, 84 people were prosecuted in connection with unlicensed installations or use of C.B. equipment at 27MHz, and a further 135 cases are pending. In 1979 a total of 48 persons were convicted of such offences and in 1979 the total reached 83. At the Treasury, Peter Rees, disclosed that '71 sets were seized by Customs and Excise in the first quarter of 1980 and a total of 48 sets were seized in the first quarter of 1980. One of these opinion: trends might be that the government wishes to give

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Universities and companies to unite in industrial robot programme

At a recent press conference held at the headquarters of Britain's small but active subsidiary of the Science Research Council announced a £500,000 five-year programme funding in industrial robotics.

The plans outlined by Peter Davey, the programme's director, include the realisation of university-based ideas by companies interested in both development of the robots and their exploitation in manufacturing industry. The COSTAR project, which is likely to have serious repercussions on the automotive industry, has already established the production of the P'ye Telecommunications for the City of Nottingham's Technical Services

These caves are open to the public for guided tours and as a result of difficulties experienced by elderly visitors negotiating the sloping walks, as well as for security purposes, the City's administrators decided to install a base station on level ground to provide a member of the party for help.

Two-way radio installed in caves

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

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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 is 1 when \( 0 < V < V_{\text{OV}} \), B is 1 when \( V_{\text{OV}} < V < V_{\text{OV}} \), and C is 1 when \( V > V_{\text{OV}} \). The ratios of A, B and C, shown on the graph, can be varied by \( R_{\text{a}} \). \( R_{\text{a}} \) 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 \( R_{\text{a}} \) to control a RC oscillator.

D. C. Hopkins

Newcastle

Iveyest

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.

Imad 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 clock edge, the start bit and seven data bits are loaded into the shift register. Q0 goes low, Q1 goes high,

D. C. Hopkins

Newcastle

Iveyest

Adding capacitance ranges to a multimeter

Capacitance ranges can be economically incorporated in 3½ digit LCD multimeters based on the KCL7106. 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 10pF. 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 it is immune to mains frequency to prevent a low frequency 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

Computer 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.

A 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 output of 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

Berkshire

WIRELESS WORLD, SEPTEMBER 1980
Video-line trigger

An individual video line or group of lines can be displayed on an oscilloscope by using this simple trigger circuit. The 555 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. H. Carter's transistor converter. Circuit ideas, Nov. 1975. Tr1 is biased on by current through Rf, 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 Tr off. Energy stored in the magnetic field of T1 passes through D2 and into C3. This oscillation continues until the charge on C3 is sufficient to switch Tr1 on, which then inhibits Tr2.

The discharge circuit uses a conventional thyristor design. D3, C3 and Rf form a de-bounce circuit, and R3 can also 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.

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The logic required for the address counter is shown in Fig.9. The address lines A7 to A0 are set low by the reset button. When the counter is enabled, the address outputs 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 point A7 to the external address input appears on A0 to A6. 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 are to be examined one word at a time, the manual position is selected. After operation of the reset button, the contents of the memory 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 IC9. 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 turn counter was used in the prototype. The low-frequency limit is adjusted first by setting the turn 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 R3 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 IC8, then 12 bits will be available which can address up to 4096 memory locations. IC9 will send 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-input lines, data-input and data-output lines should be connected in parallel. The chip-enable and output-enable 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 uses only one additional counter. The decoding logic ensures that only one pair of memory blocks is active at a time. An alternative scheme, which uses only one additional counter.

Operation

To operate the transient 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 continuously sampled and the digital word is displayed by the l.e.ds. With no input present, the a-d converter's full range can be observed by adjusting the offset control. With an input signal connected, the recorder is triggered manually by a 5V high level 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.s 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

The clock signal required for the address counter.

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

by G. J. Adams B.Sc., Ph. D.
Designing with microprocessors

4 - The synchronization problem

by D. Zissos and Laurelle Vala,
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. 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 straightforward

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*See also Appendix

---

**Fig. 1.** Block diagram of an interface.

**Fig. 2.** Block diagrams showing (a) data flow and (b) fetch/print cycle.
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 CE</td>
<td>LDX # 41350</td>
<td>Load the index register with the initial memory block address</td>
<td></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 06</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>BEO L2</td>
<td>Load the block length (hex 20) into accumulator B - hex 20 = decimal 32 Go to L2 if acc. B is zero</td>
<td></td>
</tr>
<tr>
<td>0006 03</td>
<td></td>
<td></td>
<td></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>STAA 50400</td>
<td>Print the byte in loc. A</td>
<td></td>
</tr>
<tr>
<td>000A 04</td>
<td></td>
<td>Increment the memory block address</td>
<td></td>
</tr>
<tr>
<td>000B 06</td>
<td></td>
<td>Decrement the block length Go to L1</td>
<td></td>
</tr>
<tr>
<td>000C 08</td>
<td></td>
<td>Increment the memory block address</td>
<td></td>
</tr>
<tr>
<td>000D 0A</td>
<td></td>
<td>Decrement the block length</td>
<td></td>
</tr>
<tr>
<td>000E 2D</td>
<td>BRA LI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>000F 3F</td>
<td>SWI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2: 0010</td>
<td></td>
<td>End</td>
<td></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 test. If the printer is found to be busy, the process is repeated. When the printer becomes ready (indicated by its status signal), 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.

Fig. 4. Stretched fetch/print cycle.

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

Appendix: Motorola 6800 instruction set (continued on next page)
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.p.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 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.

Reference 1. "M6800 Microprocessor System Design Data," Motorola 1976, 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.

## 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 HSTR-1001 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. signals. A Varicap u.h.f. tv tuner was used, as for ATS-6, but with facilities for reinserting sync., phase-locked to the output of an independently-tuned narrow-band sync. pulse demodulator.

The receiver was aimed at the sun and aligned for maximum solar noise. A figure of 5.5dB above clear sky was achieved on the first day which, with an assumed value for solar noise flux of 8 \times 10^{-8} 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 chain programme via the leased half-transponder 6 of the new Intelsat-1VA (F2) at 29.5°W. This Canary Islands relay is at present carried on the Major Path 1 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 their overseas territories. Because Intelsat’s constitution precludes broadcasting activities on private grounds, the 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.

of about 28dBW, Statsionar-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 5, which reduced the 4GHz system noise temperature to 105°K, a 3dB improvement in sensitivity.

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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 to ease the congestion experienced by international and domestic systems in the 4GHz band, and to provide the new regional (ECS) system for Europe as well as the allocations already made at WARC-77 for satellite TV broadcast downlinks. A long head 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 FET stages in microstrip construction were subsequently added. Mid-band noise temperature of the 11-12GHz system is the same as 4GHz and, with an antenna gain of around 47dB, this gives a G/T of 22dB/K (clear sky) compared with the 48dB/K being assumed for future direct-broadcast home terminals in this band. The same uhf tunable IF is used as for 4GHz, which enables a 500MHz portion of the 11-12GHz band to be tuned for any setting of the Gunn source. High quality pictures have been received from OTS on the wide-deviation 12MHz wide spot-beam channels and on the standard-deviation 40MHz "Eurobeam" transponders. The first Soviet "Louch" 11-12GHz spacecraft is also anticipated. Later this year the first Intelsat V will 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 have already achieved 12GHz terminal frequencies for the market following extensive tests with the Japanese "Broadcasting Satellites for Experimental Purposes". It is anticipated that the European broadcasting satellites will operate with an e.i.r.p. of 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.

Bibliography


difficulties with an antenna setting of the Gunn source. High quality pictures have been received from OTS on the wide-deviation 12MHz wide spot-beam channels and on the standard-deviation 40MHz "Eurobeam" transponders. The first Soviet "Louch" 11-12GHz spacecraft is also anticipated. Later this year the first Intelsat V will 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 have already achieved 12GHz terminal frequencies for the market following extensive tests with the Japanese "Broadcasting Satellites for Experimental Purposes". It is anticipated that the European broadcasting satellites will operate with an e.i.r.p. of 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.

Bibliography


The TM6 is a new autoranging analogue true r.m.s. millivoltmeter with a specified operating range of 10kHz to 1GHz and useful indication down to 10.15kHz. 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 thus 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 TM6 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, as its name suggests, holds the reading that appears in the meter to within 1% for at least 3 minutes.

The TM6 is supplied complete with probe (integral with input lead) probe to b.c.n. adapter, 'I' connector and 100:1 high impedance divider.

Leaflet available.

NEW R.F. MILLIVOLT METER
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 2⁶⁴ 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 1/2²⁵⁶, 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-
to the computer. As with the bit-per-point system of Fig. 13, the di-
play system is called memory-mapped because the screen contents appear to
the processor as ordinary information. The connection between the bus and the
pattern dictionary is dashed because it is not often there at all; the patterns
are fixed and cannot be changed by the program.

The success of a cell-organized display in practice depends on the match
between the patterns in the cells and the kinds 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. How-
ever, the number of possible line seg-
ments through an 8 x 8 dot cell is unreasonably large, and rotational and
axial symmetry is called into play to reduce the variety. Then, the
display interface must be able to per-
form rotation and symmetry transformations, and becomes a display processor
which treats the screen contents like a program as a list of pattern numbers. This parallels
precisely the development of the display processor for point-pointing displays.

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

Character generation. One obvious use of cell displays is to show text.
Cell-organized character displays are called v.d.us (visual display units) - a
name adopted on account of the way it gives no indication that only characters
can be shown. The screen of Fig. 15 can accommodate 32 lines of 28 charac-
ters each, one being on an 8 x 8 grid. Of course, space must be left between
neighbouring characters and between successive lines, so the actual character
storage is rather sparsely chosen.

Character storage. A 7 x 5 dot matrix is quite adequate for upper-case char-
acters, digits, and some special sym-
 bols. The standard 7 x 5 matrix for 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 satisfac-
torily with a 7 x 5 matrix, five of them - i, j, p, q, and y - have tails which should be added below to use in transmitting properly. This needs a 9 x 5 dot matrix.

with any one character occupying either the upper or the lower 7 x 5 section; this works because there aren't any characters with both descenders and "risers." Higher-quality text can be obtained with a 11 x 7 matrix, with any given character occupying either the upper or the lower 9 x 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.

Real-money chips with the character patterns already in them are available in a variety of manufac-
turers. 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 a 12-bit code comprising only
that row, and the output pins are devoted to the output. Thus, with characters of 7 x 5 dots each, 256 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 points and adjust the output string accordingly. The amount of storage required in a character generator of this kind is quite small. For our example, we need 512 words of 5 bits to provide the 64-character upper-case alphabet.

A 256 x 256 screen accommodates 32 lines of characters if the character cell is 8 x 8, 21 lines of 42 characters if it is 12 x 12, and only 17 lines of 26 charac-
ters if it is 15 x 15. All of these sizes are almost arbitrarily small. A normal sheet of typed paper can comfortably hold about 57 lines of 80 charac-
ters. Hence, the size of a character cell would require a 64 x 480 screen, which is not possible within the British 625 line standard. Many teletext systems include a 24 x 192-line or a 28 x 256-line display, which is a little more realistic. However, it is only under these circumstances that a character cell can be seen to the processor, so that the user enters characters to the program, which
then writes on and off by arrows, con-
stant character symbols (ASCII codes 00000000-00111111) and sends 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 place the current position at any point on the screen, so that characters written in the middle of the text can be overwritten. A mark called the "cursor" is usually made on the screen at the current 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 answers, constraining him to write in the space provided. Cursor control can be implemented by a special character which signals the v.d.u. to interpret the next character as an instruction. This renews the flexibility of a memory-mapped display where a character can be placed anywhere on the screen.

Most v.d.us operate at speeds up to 9600 baud. Unlike printers, no extra effort is needed to make a v.d.u. go fast. 9600 baud is incidentally the full capacity of 90 characters to be sent in 2 seconds, which is certainly an upper rate. However, people read faster than this - how quickly do you read "wireless world," for example? Pressure limits a reasonable speed of 24 x 40 character grid. Each cell is split into the sections shown in Fig. 22, and 64 x 256 space could be visualized if white and black dots. Thus, an effective 72 x 80 grid is available for graphics, and the picture of Fig. 6 gives an example of the resolution obtained.

Limited graphics. Pressure to provide limited graphics facilities based on inexpensive raster-scanned displays has come to

Fig. 18. Standard 64-character and 96-character alphabets.

Fig. 19. Common character sizes.

Fig. 20. Connecting v.d.u. to the bus.

Fig. 21. PET graphic symbols.

Wireless. The teletext scheme for broadcast information defines a graphics standard, and is possible that this might spread to the microcomputer in the near future. It uses 64 codes in a systematic way to provide a refinement of its basic
24 x 40 character grid. Each cell is split into the sections shown in Fig. 22, and 4x6 space could be visualized if white and black dots. Thus, an effective 72 x 80 grid is available for graphics, and the picture of Fig. 6 gives an example of the resolution obtained.

Teletext. The teletext scheme for broadcast information defines a graphics standard, and is possible that this might spread to the microcomputer in the near future. It uses 64 codes in a systematic way to provide a refinement of its basic
24 x 40 character grid. Each cell is split into the sections shown in Fig. 22, and 4x6 space could be visualized if white and black dots. Thus, an effective 72 x 80 grid is available for graphics, and the picture of Fig. 6 gives an example of the resolution obtained.

Fig. 22. Teletext graphics.

User-defined graphics. An unusual and interesting limited graphics facility is provided in the Sorcerer home com-
puter. 256 character codes are used instead of the usual 64 or 96. Of these, 128 correspond to pre-defined patterns 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 processor, so that the user can create his own graphic symb.

Because graphical circuits are slightly more expensive than normal circuits, a translator is built to provide the rest of the machine with a signal to indicate that there has been a change of character.

Fig. 23. Translator circuit.
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 equal width filters feature a number of independently controllable filters allowing boost or cut of specific frequencies within the audio band. These designs fall into two main categories:

- RC bandpass/bandstop filters. A typical system may have a number of active filters either enclosed in a negative feedback loop, Fig. 1 and refs 1, 9, 10, or having their outputs fed to a differential amplifier, Fig. 2 and refs 3, 4. Problems arise from both these configurations. In Fig. 1 noise generated within the active filter is coupled into the output amplifier, the signal-to-noise ratio decreasing as the number of filter sections is increased. This problem 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 bandstop values. To overcome this, simulated bandpass and bandstop ( notch) characteristics have been introduced (refs 3, 4). Series LCR filters. This arrangement, Fig. 3, suffers from the disadvantages normally associated with discrete inductors, i.e. size, cost, distortion, refs 2, 3, 4. The present design overcomes this by synthesizing the necessary inductors, using the circuit of Fig. 4.

To duplicate the impedance versus frequency characteristic of the RC network, the input impedance of the circuit must be of the form $R + jX$, and it can be seen in the Appendix that the circuit has an input impedance of $R + jX = CR_{1}R_{2}$. Although this may appear difficult in the real world, the complex value of simulating inductance have been published (e.g. search under 'Gyration').

Further reading


Fig. 24. A house. Timing or coordinates?

Touch-tablet. Figure 26 illustrates another kind of graphical input device which is entirely independent of any display and provides the coordinates of the pen position.

Current is injected into a uniform resistor sheet through the pen tip, and is measured at one side of the table while the other is earthed. The resistive sheet acts as a potential divider, and the ratio of the output to the input current gives one coordinate. Then the connections are changed so that the other coordinate can be measured.

A particularly interesting feature of the tablet is that a finger can act as the pen, using high-frequency alternating current and capacitive coupling with the sheet instead of d.c. with direct coupling. Effectively, you sit on an electric chair and inject current with your finger. Then, no pen is needed and if the sheet is made transparent and fitted on to a display screen, you can indicate parts of the picture just by pointing at them with a finger.

Fig. 25. Tracking cross.

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 for read-only memories, because contention will occur when the display is read and the processor writes simultaneously. But the extra power provided is enormous, for the Sorcerer can simulate both PET and the teletext system, as well as others. For example, graphs can be displayed quite accurately by defining eight patterns each with one dot in the centre, at different heights. Or a character set can be defined by line drawings 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 simulate systems like PET and teletext.

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 microsec 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 activating 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 - in practice, this will be 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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Fig. 25. Tracking cross.
amplifier used; for most purposes the 741 is sufficient, though increased performance may be achieved with a more specialized amplifier.4,7

Practical applications of this circuit have varied (in frequency) from l.f. variable filters for electrophysiological research, to a fine-section tone control with lower potentiometer. 1

References


Dave Protheroe was an electronic 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 centred around applications of digital devices, especially the hardware and software design of a Z80-based microcomputer system.

Practical designs

5-15Hz three-section filter

Application: vibration analysis, electronic circuit recording. Design criteria: constant bandwidth, control range = 20dB. Values of R1, R2, R3 were chosen to give the required gain control range. Q value was then calculated from

\[ Q = \frac{f}{\text{bandwidth}} \]

The underlined equations give the required capacitor values, and the last equation gave the value of R1.

Appendix

A voltage \( V_i \) is applied to the input terminal of Fig. 4. Then

\[ V_i = \frac{V_i}{V_o} \]

where \( V_o \) is the output voltage at the terminal.

Thus

\[ V_i = \frac{1}{R_1} \left( \frac{R_2}{R_3} + j \frac{R_3}{CR} \right) \]

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 Tillet in Chicago

At the Chicago Summer CES was about $5,000, some 1% 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 seemed 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 £200. 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.

Video

As at the last show, video discs were again a centre of attraction and the Pioneer and Magnavox demonstration were always crowded. Both these models use a laser system, but RCA were showing off their Selectavision player, which uses a stylus pick-up, at a hotel nearby. RCA state that recent modifications include random access to a wider range of programme material. V.C.R.s are fast gaining in popularity and several new six-hour machines were to be seen. In the long-playing mode, there is inevitably a loss in definition—particularly with models with reduced track width. The ordinary track width in V.H.S. machines is 58 microns, but when the same heads are used to scan the 19.3 micron width employed in the six-hour mode, the tracks overlap, causing picture degradation, since adjacent tracks are out-of-phase. Now, JVC have come up with a simple—well, relatively simple—solution: two extra narrow-field heads are switched in for the long playing mode.

Sony's AG-380 features a cassette autochanger allowing 20 hours of recording time, and the programme unit allows the user to record separate programmes on separate cassettes. Other Sony models use Beta-Scan, which lets the user search backwards or forwards at any desired speed up to 20 times normal, with or without a remote control unit. Toshiba has a similar fast scan system, but theirs can flip the tape at 40 times the normal speed.

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 Reference Standard.
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 well, I believe, become quite popular — 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, now Sansui have developed a similar circuit. They introduced the first model at the Stas­sis AU­DI­II designed to 120 watts per channel at a distortion less than 0.004%. Frequency response is within ±0 and ±2 dB from zero to 20 kHz.

Cassettes decks now offer better value for money than ever and several models were to be seen priced at well below $100 with metal tape capability. For example, the 4 head VU meters, provision for four kinds of tape, a Dolby system and a good all­round performance. The more expensive decks featured such refinements as digital displays, automatic programme select, use of tape indicators and micro­line mixing. At least 12 models boasted the new Dolby NSX (Headroom Extender) circuit while among the dual­speed (3% and 1½%) models were entries from Marantz, JVC, and Fisher.

Turntables are also reasonably priced now and there is quite a selection of direct­drive models under $180. Standard tonearms seem to have almost superseded the old familiar S-shaped designs, although Technics still use them in most of their range. Linear tracking or straight­line arms are becoming more common, and among those seen were models from Technics, Harman­Kardon, Mitsubishi, Yamaha, Phase line­ar and Densene. The last named turntable uses a cutting head, which floats the phonograph record so it is really flat. It seems to be an expensive way of doing things, as the price of this model is $3000! Dual were using a special record to demonstrate the virtues of their Ultra Low Mass (ULM) arm and Ortofon cartridge. The record carries a 300 Hz signal, but it also has eight uniformly spaced warps. The eight gram ULM combination plays it with no trouble, but the same interlemination problem on a standard 18 gram arm combination could easily be heard.

Once again, the Show was enlivened by a fascinating array of loudspeakers ranging from shoebox models to war­drobe sized behemoths. The most elaborate system was Infinity's new Reference Standard at a cool $20,000. It consists of four modules, 7½ inches high which house two 1.5 kilowatt bass amplifiers as well as the drive units. Each bass column consists six 12 inch drivers and servo feedback is obtained with an accelerometer. Crossover frequency is 70 Hz and the midrange section 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 sand­filled (remember the Wharfedale baffles?) and the total weight is 1200 lbs. How did it sound? Well, it was un­equally 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.

Cerwin­Vega were demonstrating a new model, designed to "meet the challenge of the new digital super­discs". It is a three­way system with an 18 inch bass driver and a 12 inch co­axial unit, plus a compression tweeter. An unusual feature of this model is the use of active cross­overs 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 52 inches high and it will handle 1000 (yes, one thousand) watts continuously.

The Iso­phone is back again! Its new name is "Boracov" and the one at the Show hailed from West Germany. Crossover point has been moved an octave up to 6 kHz. My old origin was used to radiate for a considerable distance on all tv bands, caused some friction with the neighbours, but I’m told that this and other drawbacks have been overcome.

Sony had a large, floor­standing sys­tem using four drivers, all with flat diaphragms made from a honeycomb carbon fibre material. The bass speaker diaphragm is about 13 inches square and it is driven by four speech coils, positioned to "ensure a piston move­ment without flexing". Jumet­ta, a

Canadian manufacturer, were demon­strating the latest version of their sys­tem, which uses a horn­loaded ribbon tweeter from 600 Hz up. Some of the best sound heard at the Show.

The VSC company introduced several low­priced causeway speakers, i.e. with a "bucket­brigade" chip to process the signals, allowing an affordable audio playback up speeds to three times normal. According to the makers, there is a great interest in the idea that manufacturers of c.r.s. that can operate in the six­hour 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 pressure­calibrated electret capsule and it is mounted on a plate measuring 3 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 dual 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 a small cabinet, or bass drum or piano, since inputs as high as 150 dB can be handled.

Garrulous gadgets
Talking clocks, calculators and micro­wave ovens are becoming common­place 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 as sentence pauses in continuous speech, so the result is a total of 64 phoneme selections. The duration of each phoneme is fixed, the slowest being 4mths and the fastest 25mths. Pitch variation varies automatically, or it can be controlled by an external "clock": Continuous flow of electronic speech is created by sequencing sounds into recognizable words. For instance, "aphone" becomes F­61­N­EL­M.

Panasonic were showing a talking calculator which had a female voice with an impeccable British accent — Rodgers, if I'm not mistaken. Casio had another which also contained a clock, date memories, a calendar and 12 recorded tunes. The computer could be used 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 . . .
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THE RANGE

TWO

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THE CS1830 30 MHz + Sweep Delay

The CS1830 is a completely new 30 MHz dual trace oscilloscope employing a square format, integral pulse generator for accurate bright line. A new feature is the instrument of cathode-ray sweep delay with a range of 0-100 ns and trace height up to 10. You can see from close-up shots of the photograph the CS1830 has all the facilities you could want in a performance instrument but for more detail, simply ask for a comprehensive leaflet.

Brief specification

Rectangular P.D.A 120 x 96 mm. F.S. phosphor.

Sensitivity

DC-5MHz

50mV, 1mV, 5mV, 20mV, 50mV, 200mV, 500mV, 2V, 5V, 20V, 100V

Input Ref. C 1 M/23 mV per div.

Rise time 11.7 ns

DC-5MHz

Linearly better than 3%

Sweep 200ns to 200ms 0.5:1/1:1/2:1

DC-30MHz

Sweep Delay 1.5 to 1000 ns.

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 signal and external fields. A unique feature of this instrument is the time-base and trigger synchronization of the fast sweep band with a separate synchronization. It can be used for general laboratory use. The complete range of video facilities is too great to explain in a short advertisement so why not call us and ask for the full story on the CS1572.

Brief leaflet available

As for CS1572 except that the sweep delay feature is replaced by comprehensive video sweep delay facilities which allow complete analysis of video wave forms and VTR segments.

CS1572 only £245 + VAT, includes 2 probes

THE CS1577 30 MHz at 2mV + Signal Delay

The most popular scope in the range.

The CS1577 is the departure point in our range of performance oscilloscopes. The most popular specification and hundreds of satisfied customers in all sections of the electronics industry will confirm this. The CS1577 contains a complete 30 MHz performance with extraordinary wide range bandwidth (DC-40 MHz) and 2mV sensitivity over the full bandwidth.

Fixed signal delay is provided by a delay line via which allows viewing of the leading edges of fast pulses for accurate rise time measurement. The 150 MHz PDA tube gives a form factor of 1.5:1 and the highest sweep speeds (500 nm cm using a 3G pulse) for high resolution display. Good triggering, even at low levels has always been an outstanding feature of Trio oscilloscopes and the CS1577 demonstrates this perfection.

Triggering, as always, either a signal or a trigger is provided to signal input. The input section can be switched to permit input to 120V without damage to the tube. The full bandwidth isswitched to the test section and 30 MHz is switched to the delay section. The operator is thus able to use the full bandwidth of the oscilloscope right up to the critical 100MHz.

The CS1577 only £610 + VAT, includes 2 probes.

THE CS1575, unique dual trace 4 function Audio Scope.

The CS1575 is the departure point 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 and trigger on either channel, it can also display the vertical sensitivity for the test section and measure the phase angle reference to a zero phase delay display. In addition toTriggering an input, it also has a separate triggering input from either channel to give complete flexibility in the type of triggering required.

Absolutely standard to the professional audio engineer, the CS1575 is now in use all over the world. See it in action or for complete details.

CS1575 only £390 + VAT, includes 2 probes.

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400V D.C., 500V A.C.

0 to 100MΩ

Semi Auto Ranging

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AND TWO NEW ADDITIONS TO THE RANGE

F C 756 500 MHz COUNTER

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Stop Watch

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LOW ELECTRONICS

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WWW.RE viewl...
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.
The requirements of the main output of the power supply are largely governed by the transformer. The transformer is also simpler because of the need to design interfaces to the bus, but can lead to confusion when referring to the standard which, as I mentioned in the article, uses "three-line" logic.

My statement that 250 kbyte/sec is a generally accepted maximum data rate is based on paragraph 5.2 of the 1978 standard which states: "A standard performance bus will operate at distances up to 28m at a maximum of 250,000 bytes per second..." using 4mA open collector drivers.

My thanks to Mr Summers for his comments. Mr Summers's section on Parallel Poll is extremely lucid, and I thank him for it. Finally, I hope that a speed-enhanced talker is used to achieve 1/4my data rates, with standard talkers, problems may be experienced even when the interface is not being used at that rate.

The Defence programme therefore seems to be an illogical development of electronics, and also, perhaps, an increasingly dangerous one. Would this not seem to imply that the electronic engineers employed to maintain the defence equipment programme were not as knowledgeable on the pole, since (b) their knowledge of electronics may even have serious gaps, increasing the danger still further.

Peter C. M. Davie

MILITARY ELECTRONICS

Your News of the Month in the June/July issue reports that according to the Defence Estimates the defence equipment programme sustains about 300,000 jobs opportunity cost and has the same number again indirectly involved.

This seems to me to be a logical expansion of electronics, and also, perhaps, an increasingly dangerous one. Would this not seem to imply that the electronic engineers employed to maintain the defence equipment programme were not as knowledgeable on the pole, since (b) their knowledge of electronics may even have gaps, increasing the danger still further.

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WHAT'S SO NATURAL ABOUT?

Die ganzen zahlen hat Gott gemacht, Alle andere ist menschenwerke

I do not understand why Dr Finlay (December, February, April) wishes to denigrate set of rules and two jam jars. The messiah who made it was clearly not satisfied with progress. It has always been my wish, however, that these columns should bring light and sanctity into the homes of others, especially my bank manager.

The jam jars, I think, will be better, and nothing you can't find, if desperate enough, in your grocer's old-fashioned, a mixture, and sometimes an accident.

The jam jars are best replaced by those revolting plastic beakers, with string handles stapled on to make small buckets. The metre rule hung by string from a convenient support.

It has always been my wish; how­ever, that these columns should bring light and sanctity into the homes of others, especially my bank manager.

But my little adding machine, the back of an ordinary envelope, the provision of Qoperating, maintenance and service for electronic equipment.

The branched of control to an address in the system below, provided that f(x) = 1 and a few notable differences from Mr Butler in the February 1975 issue on Pseudo Random Binary Sequence Generators, I think your work of art is not the final crisp answer to feedback selection. Careful choice must be made to ensure the full sequentiality of the system. If we consider the total shift register branched into two parts, feedback from the system below, provided that f(x) = 1 and a

The capacitor-discharge unit itself is not a legal requirement officially). At least, such a c.w. would be less little-handed, socially speaking, than the amateur, which can be legally, and mora­bly, nothing but a nuisance.

The principle of feedback around the system breaks down to being equivalent for British manufacturers as there will only perpetuate the pattern in a closed loop of three

It takes an electronic engineer to generate a detailed technical manual for an electronic device, but the system breaks down to being equivalent for British manufacturers as there will only perpetuate the pattern in a closed loop of three

Then stand or fall on its ability to compete internationally.

All this comes to two points. First, 27MHz will never go away; the technical problem of the reorganisation of the band comes down to acknowledging that the present band is not a legal band. Either they are legalised or aren't. Second, the CB-60100 mark will ensure the continuation of 27MHz and will equally ensure that the CB-60100 won't be able to afford to use its "band", leaving the way open for a future government to take the said band away ‘because nobody’s using it: it was never really necessary’. At best, such a c.w. would be less little-handed, socially speaking, than the amateur, which can be legally, and mora­bly, nothing but a nuisance.

The practice of provision, maintenance and repair of a computer, even for systems that are not computers, can be a highly rewarding service for electronic equipment. It is gener­ally accepted as a rule of thumb that a potential customer may be expected to defer the purchase of any new product, however

If the principles of the present article are adhered to, the total path A, 27MHz activities are totally classless, at least partly. Everyone can affect the provision of a good service. But my little adding machine, the back of an ordinary envelope, the provision of Qoperating, maintenance and service for electronic equipment.

The principle of feedback around the system breaks down to being equivalent for British manufacturers as there will only perpetuate the pattern in a closed loop of three

The computer corresponds to finding e by the construction of a table, but it still lacks a few numbers of additional operating systems which are not available even in a closed loop of three

The process of provision, maintenance and repair of a computer, even for systems that are not computers, can be a highly rewarding service for electronic equipment. It is generally accepted as a rule of thumb that a potential customer may be expected to defer the purchase of any new product, however unreasonably expensive, unless and until the necessary technical manuals are made available.

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The computer corresponds to finding e by the construction of a table, but it still lacks a few numbers of additional operating systems which are not available even in a closed loop of three
**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 chordal-hop, long-path to Australia, via the dawn "glimpse" in the ionosphere, rather than multi-hop paths, is underlined by the story of Ron Fisher, VX3OM, of Glen Waverley, Victoria. He reports working on 14 MHz s.a.m., some 140 stations heard as British amateurs under "long-path" conditions during the past year. Of these, 35 of the British stations were heard at the minimum of three different long-path aerials, 32 were using ground planes and the remaining 63 were using the monopole "mobile whips", 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 this time of day use dipole; 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 1/150 "2 points. (2 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 (COMSTAR) began a nine-months trial from a transmitter site near Cape May, with the receiving site for the backscatter signals about 100 miles away near Columbus Falls. The system has been designed to detect moving targets at a range of up to about 1000 nautical miles, using a combination of simple, non-isolate targets from the large amount of sea and land based bounce. Twelve 100 kW transmitters are used on a 24-hour basis with any of four centre frequencies 35.5, 40.5, 45.5 and 50.5 MHz. The transmitting aerial array comprises 48 elements, 12 for each of the four bands: a ground screen stretches 700ft in front of the array to improve low-altitude radar performance. All bands have already spent some $160 million on over-the-horizon radar development, although there is no indication of operational capacity in the United Kingdom, the main transmitter site for the over-the-horizon radar at Orfordness in England was taken out of commission some years ago and the site is still owned by BBC External Services.

Although it is stated that the OTH-B signals will cause much less interference to other services than the notorious Russian "Woodpecker", there are fears that the growth of such systems, if they prove successful, may become worldwide and will inevitably affect low-power amateur transmitters. OTH-B signals will have a faster "knocking" rate than the Pecker, varying from about 20 to 60,000 p.s.i. and sounding rather like "mains hum". The system is being operated on a "non-tactical" basis and a new system will be phased in. This will be achieved in practice. Amateur frequencies are to be avoided.

### Local courses for RAJ

During early September. Among the participants wishing to work on over-the-horizon radar developments were: Bath, Belfast, Birkenhead, Birmingham, Bracknell, Gosforth, Turnford near Hoddesdon, Langley near Slough, Manchester, Mel­ ton Mowbray, Newport, Northampton, Orpington, Stockport, Stockton-on-Tees, Weybridge.

### Four-channel drive

L.20 is a drive designed to drive industrial loads and can operate currents of up to 1.8A (280V) at frequencies up to 30V, enabling driving of relays, solenoids, d.c. motors and digital systems.

W. A. Scarr, G2WS, chairman of the Amateur Radio Invalid and Blind Club, has reported for a wider interest in and appreciation of the club's aims and plans. RAIBC exists to help handicapped people who are in full-time amateur radio. The club has an RAJE tuition course on tape cassettes for blind candidates and this has recently been revised; a number of Datong morse tutors have been donated by friends of the club and are proving successful. Some 50 copies of the club newsletter "Radio" are distributed on tape.

### In brief

Kenyatta has introduced a Type "approval" system on television in the country. Charging a fee of 150 shs which has to be paid each time any alteration is made to an existing Type "approval", is the Proposed National Amateur Radio Exhibition at Alexander Palace, London W4, 5/6pm. Dates for the ARJA amateur radio exhibition at Leicester have been changed to November 6, 7 and 8, and the Sixty Club exhibition to November 6, 7 and 8.

### Adjutable crystal oscillator

Precise frequency setting to within ± 0.001 p.m is possible with this new type of adjustable crystal oscillator by means of an integral miniaturized "trimmer". The Coronet 85-1 series is available in a frequency range from 1 to 110 MHz and has a 0.01% crystal output circuit, with a fanout of 100. This type of oscillator is ideal for buffering an overriding oscillator circuit for increased stability.

### Push-pull f.p. power f.e.t.s

Claims of the first f.p. push-pull power f.e.t.s using the v.m.o. technique, are made by Siliconix Inc., 4000 Mission College Blvd, Santa Clara, California 95054, for broadband applications from 2 to 2000mhz, and offer the advantage of enabling reduced amplifier size, and minimizing bias component requirements, by the matching of transistor pairs by encapsulating two matched n-channel enhancement mode f.e.t.s in a single package.

### New microprocessor

All other single-chip microcomputers are out-performed by the 8086, clone GEC machines. It fits in at the top of the list. The 8086-40 has a high speed, with oscillator and clock circuits. The Type SF series low-profile relay distributes 8 terminals and offers the choice of either double-pole, double-throw or four-pole, double-throw contact configurations, with contact ratings of 5 A.c. or 0.5 A.d.c. at 250 v.d.c. or 36 V.a.c. being available on request. (UK) Ltd, 3M House, Edgbaston, Birmingham B15 2HJ, UK.

---

**Four-channel driver**

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allow touch-reading, and “topes” are given to tell the user when the device is functioning correctly and when the radio is scanning. At each selectable station, the scanning stops and requires no visual control as an example of external Ethers for frequency analysis, and two versions providing either a.c. lin. or d.c. input. Output are also available. 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 Lancs Road, Hounslow, Middlesex TW3 5AS.

Conducting elastomer connectors

Connectors which have contact pads as close together to form a “block”. Clamping of the block to the mating conductors is required to ensure good contact, the pressure being adjustable which causes the block to deflect by between 15% and 30%. Elastomer connectors can be used with interconnection components such as displays, i.e. chip-carriers, p.c.b. leads, hybrid circuits and fast-cables, and as soldering is required, and a greater tolerance to misalignment is available than with conventional connectors, time and savings can be made where large-scale production is concerned.

Stax 40/2 low-profile connect was manufactured by Hi-Tec Inc. (USA), and have a temperature range of -30°C to +70°C. The 40/2 is a development of the 40/1, which holds the circuit under test in position and against the spring-loaded contacts. It is claimed that the “bed of nails” test-heads can be changed in a matter of seconds, an important feature where production runs 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°C test head mounting, is either demonstrated, in which case a Cannon 156 way terminal connector is usually fitted, or semi-permanently installed into an i.e. system. Each spring-loaded contact consists of a probe, which is made from beryllium copper, plated with either gold or silver, and a mating socket. Constant contact between probe and socket is ensured by using a patent “blowing-bell” construction which also prevents current passage through the pressure spring. The contacts are replaceable. The U3000 is made by Pylex and distributed in the U.K. by Telos Ltd., Tecofi House, Meadow Road, Godalming, Surrey GU7 1AP.

High-voltage networks

This new range of custom-built resistance networks is being manufactured by Welwyn Electric Ltd. Each network is capable of withstandin up to 30kV, provided that the power dissipation of the device is not exceeded, making them particularly suitable for use as high-voltage dividers.

Click-stop pots

Industry-standard potentiometers in either single or tandem-stereo forms, denominated Radiohm F20 and JPB requirements and is manufactured by East Grinstead Electric Components Ltd. They are produced in a choice of 12 different linear and non-linear law patterns ranging from 1982 to 2.2M conductor, and are available in cento-in. 11 and 20 pin variations and with either tin or ferritic 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 900V d.c. and insulation breakdown voltage of 1800V a.c. Normal ratings for torque over the full 360° rotation is 0.4Nm, and stop and minimum torque is between 60 and 80Nm, dependent upon style and maximum spindle load is 100N for Stec. Various p.c.b. and hard-wiring solder tag terminals are also available, as integral support terminals, enabling robust assemblies to be achieved. East Grinstead Electronic Components Ltd, Iverna Industrial Estate, East Grinstead, Sussex RH19 1B.

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 production runs 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°C test head mounting, is either demonstrated, in which case a Cannon 156 way terminal connector is usually fitted, or semi-permanently installed into an i.e. system. Each spring-loaded contact consists of a probe, which is made from beryllium copper, plated with either gold or silver, and a mating socket. Constant contact between probe and socket is ensured by using a patent “blowing-bell” construction which also prevents current passage through the pressure spring. The contacts are replaceable. The U3000 is made by Pylex and distributed in the U.K. by Telos Ltd., Tecofi House, Meadow Road, Godalming, Surrey GU7 1AP.

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<thead>
<tr>
<th>Model</th>
<th>Output Power</th>
<th>Distance (Typical) at 1KHz</th>
<th>Minimum Signal/Noise Ratio Power Supply Voltage</th>
<th>Size (in mm)</th>
<th>Weight (in gms)</th>
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<tr>
<td>HY30</td>
<td>15W (10W)</td>
<td>-</td>
<td>100dB</td>
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<td>HY50</td>
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<td>100dB</td>
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<td>HY120</td>
<td>60W (40W)</td>
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<tr>
<td>HY400</td>
<td>240W (160W)</td>
<td>-</td>
<td>100dB</td>
<td>50 x 140 x 50</td>
<td>155</td>
<td>£27.68</td>
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</table>

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### BASICS

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<th>CURRENT</th>
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Land a good job...

Your Radio Officer's qualifications could mean a lot here on shore.

...Your based job, where you'll be earning good money, and the opportunity to enjoy all the comforts of home where you appreciate them most - at home!

British Telecom Maritime Service has vacancies at Portishead Radio and some of its other coast stations for qualified Radio Officers to undertake a wide variety of duties, from Morse and teleprinter operating to traffic circulation and Radio Telephone operating.

To apply, you must have:
- A good technical knowledge of audio and/or video equipment.
- Experience in the operation of sophisticated instruments.
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A number of vacancies are currently zero rated for the purpose of V.A.T.

Closing date for return of application forms, 14 days after publication.

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Pensionable Post. Re-location expenses considered.

P.S. A good pension scheme, sick-pay benefits, at £315 per annum, and £600 for 3 years' service, this figure rises to around £1,900, and £3,500 after 5 years' service. The starting pay at 25" will be about £5,390. After 3 years' service this figure rises to around £7,052. If you are between 27 and 30 your pay may well be between approximately £4,279 and £4,537. Overtime is additional and there is a good pension scheme, sick-pay benefits, at least 4 weeks' holiday a year, and excellent prospects of promotion to senior management.

For further information, contact Telephone Kaiser, Warrington, Cheltenham, Gloucestershire.

£1 extra. (Replies should be addressed to the Box Number in the advertisement, c/o Wireless World, Dorset House, Museum Street, London EC1R 9D).

PHONE: Anthony Hadley, 01-261 8508.

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BROADCASTS

ELECTRONICS ENGINEER

ENGINEERING TRAINING DEPARTMENT, EVESHAM, WORCS.

The BBC's Engineering Training Department is situated in the Worcestershire countryside and includes well equipped Radio and Television Studios. There are excellent welfare and club facilities.

Duties: Maintaining a full range of professional radio and television broadcasting equipment. The includes modifications and commissioning of broadcast equipment, the repair and servicing of sophisticated instruments. Appropriate guidance will be given to candidates who are unfamiliar with BBC equipment.

Requirements: Basic experience of operating equipment that includes television, audio and television equipment.

One of the following qualifications is essential:
- A degree from a British University in electronics or electrical engineering.
- HN.Dip HND (Electrical Engineering or Applied Physics).
- G and G Full Technological Certificate in Telecommunications.

Salary, depending on experience, in the range of £2,000 - £2,800 rising to £2,500 plus 15% Shift Allowance.

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Further Details: If you would like to know more and receive an application form, please send a stamped addressed envelope of at least 4" x 6" to Head of Technical Operations Training Section, Engineer, Engineering Training Department, Wood Norton, Evesham, Worcs. WR11 2YR. (Closing for return of application forms 11 days after publication.

Trainee Radio Officers

First-class, secure career opportunities

A number of vacancies will be available in 1980/81 for suitably qualified candidates to be appointed as Trainee Radio Officers.

If your trade or training involves Radio Operating, you qualify to be considered for a Radio Officer post with the Composite Signals Organisation.

Applicants must have had at least two years' radio operating experience or hold a PMG, MPT or MRCC certificate, or expect to obtain this shortly.

On successful completion of 40 weeks' specialist training, promotion will occur to the Radio Officer grade.

Registered disabled people may be considered.

Salary & Prospects:

TRAI NEE RADIO OFFICER: £3500 to £8349 at 25 and over. On promotion to RADIO OFFICER £5288 at 19 and £8684 at 25. Over then by four annual increments to £9339 inclusive of shift working and Saturday and Sunday elements.

For full details please contact Robby Robinson, our Recruitment Officer, on Cheltenham (0034) 21481, Ext. 2269, or write to him at: Recruitment Office, Government Communications Headquarters, Oakley, Priors Road, Cheltenham, Gloucestershire, GL52 8AJ.

Aerial Engineers

(Broadcasting Systems)

Our current demanding programme of work includes the expansion of Independent Local Radio and the introduction of the fourth Television Channel. This provides excellent opportunities for Aerial Specialists at all levels – to strengthen our existing expertise and to provide for the future by training those keen on entering this challenging field.

We are small enough for you to be able to make your mark to a professional and friendly environment but at the same time large enough to provide career prospects.

Senior Aerial Systems Engineers

(up to £39000 p.a. under review)

Aerial Systems Engineers

(up to £38500 p.a. under review)

To be responsible for the design and specification – acceptance and commissioning of aerial systems, high and low power filters, channel combiner and separating equipment for UHF, VHF and MF services.

Aerial Maintenance Engineers

(up to £33500 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 broadcast 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.

IBA INDEPENDENT BROADCASTING AUTHORITY

Applicants (male or female) should send full details of qualifications and experience as soon as possible to Glynn Powell, I.B.A., Crawley Court, Winchester, Hampshire, SO21 2QA.
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, friendly company, based in Wembley, and we need the following key people:

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 with a small team testing highly sophisticated systems. Several years’ experience in testing digital equipment is essential, as is 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.

For further information and an application form, please contact: Miss Linda Bux, Datek Systems Ltd, 849 Harrow Road, Wembley, Middlesex. Tel. 01-904 0906

£25 REWARD

For anyone who can rechristen our hard-working computer "Einstein" in a way that is both wittily appropriate and quite right. The winner of this competition, which has been instigated by David Tabutt in the June issue of Personal Computer World, is Miss Linda Bux, Datek Systems Ltd., Wembley, Middlesex. Tel. 01-904 0061.

The successful candidate will be expected to undertake maintenance of the master control section on broadcast standard videotape equipment, as well as the repair and maintenance of emissions equipment, including video recorders, logical amplifiers and computer peripherals. The work requires the thorough understanding of modern digital technologies and design.

Applications should be submitted to the Hon. Ada Augusta— not the dreaded Linda.

£10,000 + bonus contracts. Free furnished accommodation and pleasant and stable part of the Arabian Gulf. Applicants should preferably hold an engineering degree and have at least 5 years’ experience in fields such as submarine specialist communications experience, or have had 3 years’ experience in similar areas. 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 0906

INNER LONDON EDUCATION AUTHORITY

LEARNING MEDIA SERVICES TELEVISION CENTRE

VIDEOTAPE ENGINEER (ST3)

The Learning Media Services Production team are recruiting experienced engineers to work in a small team with the existing technical staff. You will be required to install and maintain equipment in our Production Centre and to provide a range of technical support to the production team.

Salary within the scale £7904 to £8498.

Application forms are available from: IOE/ESAT, 1C Room 365, The County Hall, SW1 9TP. Telephone No. 633 7456/8848.

ENGINEERS...FACILITIES...for ENGINEERS & TECHNICIANS

ENGINEERS £11,450 to £19,200

TECHNICIANS £10,100 to £14,500 per contract year after tax.

Armac are involved in many varied projects in Saudi Arabia that will last for many years.

The COMMUNICATIONS PROJECTS MANAGEMENT DEPARTMENT is responsible for the communications networks throughout the Eastern Province of Saudi Arabia and need skilled Engineers and Field Technicians in the following fields:

ENGINEERS & TECHNICIANS for the installation and commissioning of telemetry systems and field work as far afield as remote terminal units, pipeline etc. You will be involved in technical and system monitoring and maintenance of a range of telemetry equipment including radio and microwave. Excellent opportunities for career advancement are available for the right candidates.

Applications should be submitted to Mr. W. L. B. (Medical) Engineer, The Company with a Future...
RADIO TECHNICIANS
COMMUNICATIONS 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 Tramposcatter.

In the North Sea, earnings are in the range £9,000 to £12,000 p.a. Overseas earnings could be up to £200,000—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 expenses. Please apply, with details of your career to date, to:

EAE design, qualified ONC/HNC or equivalent should have previous prototype equipment during the development phase. There is a great need for a technical officer to help in constructing and testing, and maintaining our equipment. In performing these tasks you will become familiar with a wide range of processing equipment in the audio to microwave range, involving modern logic, digital circuits, microprocessors, and computer systems. 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.

Your job as a Radio Technician will concern you in developing, constructing, installing, commissioning, servicing, testing, and maintaining our equipment. If you are, or have been in HM Forces your Service trade may allow us to dispense with the need for formal qualifications. Regular inspections of your performance are made, and employees, who achieve a high standard, may be encouraged to take advantage of appropriate training to advance to the next grade of Radiotechnician or Engineer.

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 prototype equipment, making use of microprocessors and needing some degree of innovation is required.

Starting salary within the range £2170 to £4650 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 0IL (01-874 6941, Ext. 2180). You should also quote the ref. ZH.334.

Glaxo Group Research Ltd.
Electronic Engineers – What you want, where you want it!

TJB Electrotechnical Personnel Services is a specialised appointments service for electrical and electronic engineers. We have clients throughout the UK who urgently need technical staff at all levels from Junior Technician to Senior Management. 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.

Please send me a TJB Appointments Registration form:

Name ..................................................
Address .............................................

TJB ELECTROTECHNICAL PERSONNEL SERVICES, 12 Mount Ephraim, Tunbridge Wells, Kent. TN4 8AS.
Tel: 0892 39588

Electronics Workshops Engineer

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 qualification and would be prepared to offer training facilities if you are still in the process of gaining your qualification.

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

INTERESTED?

Then write or phone for an appointment form to the Recruitment Officer, Unilever Research Port Sunlight Laboratory, Quarry Road East, Wirral, Merseyside, L63 2JW. Tel: 051-645 2000, ext. 8408. Please quote ref. P5715AC.

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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 now established and is a major factor in generating new orders worldwide.

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

As one of the world's leaders in specialised defence electronics systems – particularly the fields of radar, proximity fusing, telemetry and radar modelling – we will 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 maintenance (and 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 F. M. Taylor, Assistant Personnel Manager, EMI Electronics Ltd., Penbridge House, Wooky Hole Road, Wells, Somerset, BA5 1AA or phone him for more information on Wells (0749) 72081.

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

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 mountings and lighting systems and their control systems.

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 at least one of the following fields:

Electronic Power Control
Mechanical Mechanisms
Electronic Control Systems

Salary apparently £3250 to £3900. You should be in receipt of £5535 to £5985 rising by annual increments of £225 up to a maximum of £7455 per annum. Additional allowances are paid for overtime, around the £2000 mark.

The successful candidate will be based in the London area but may be required to work elsewhere 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 £3250 to £3900. You should be in receipt of £5535 to £5985 rising by annual increments of £225 up to a maximum of £7455 per annum. Additional allowances are paid for overtime around the £2000 mark.

Applicants in writing with full details of age, qualifications, work experience and personal circumstances should apply to Manager, S. A. Fernal, Assistant Secretary, Roehampton Institute of Higher Education, Educational Building, Roehampton Lane, Southfields, London SW15 5BN, to arrive not later than 6 September, 1980.

Applicants should note that although we shall give priority to those in receipt of a B.B.C. pension, this may not be the case for those without experience.
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 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, subsidised 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 1-3 3-6 Over 6
Present salary £3,500 - £4,500 - £5,500 - Over £6,500
Qualifications None C & G HCN Degree

Return this coupon to John Proctor, Marconi Instruments Limited, FREPOST, St. Albans, Herts, AL4 6BN. Tel. St Albans 92522.
LECTURING WITH A DIFFERENCE

The difference is the MARCONI COLLEGE is neither just an academic nor an isolated institution but an appealing blend of both. The College is presently situated in Shendish and the majority of staff are available for training the engineers of the Marconi Electronics Group and customers.

DIGITAL SYSTEMS

Experience in the development and maintenance of a wide range of digital systems and equipment over a wide range of applications including the expanding field of automatic systems. Applicants should have either a degree or equivalent qualification in electronics with knowledge of digital techniques, or several years' relevant experience. Teaching experience desirable but not essential.

TELECOMMUNICATIONS

A high standard of knowledge 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 secondary schools with 4 or 5 years' practical experience of professional radio communications systems, or if all practical experience, a degree or equivalent is required.

Applications are invited for the post of CHIEF, TECHNICAL SERVICES SECTION (P-5)

Supervises and specifies arrangements for the installation, operation and maintenance of equipment associated with the United Nations conference and radio and television programming operations. This includes all aspects of audio and video equipment, simultaneous interpretation installations and electronic voting equipment.

Responsibilities include directing the work of some 100 personnel, design and supervision of construction of equipment, advising other divisions on technical matters and preparation of budgets.

Should have advanced university degree in relevant engineering discipline, good electronic knowledge, computer experience and management skills particularly in the fields of budgeting, procurement and cost control, with 13 years' professional experience.

Level P-6 carries net base salary per annum from US$24,296 (single) and US$26,298 (with dependents) plus post adjustment from US$11,627 (single) and US$12,584 (with dependents) per annum.

VA. 80-D-DAM-109-NY

2. CHIEF, TELEVISION AND FILM UNIT (P-4)

Controls the technical aspects of the United Nations television and film unit which works to full professional broadcast standards.

Responsibility for professional broadcast standards, design of and supervision of construction of equipment, advising other divisions on technical matters and preparation of budgets.

Should have advanced university degree in electrical engineering with eight years' professional experience in the operation and maintenance of television and film equipment.

Level P-6 carries net base salary per annum from US$20,209 (single) and US$21,785 (with dependents) plus post adjustment from US$9,778 (single) and US$10,527 (with dependents) per annum.

VA. 80-D-DAM-108-NY

3. ENGINEER (TELECOMMUNICATIONS) (P-4)

Supervises the technical aspects of conference servicing operations with particular regard to simultaneous interpretation, audio distribution systems and electronic voting equipment.

Responsibility for system development and design and for the installation of these facilities both at Headquarters and for conferences away from Headquarters.

Should have advanced university degree in an engineering discipline, with eight years' professional experience.

VA. 79-D-DAM-357-NY

APPLICANTS: Please complete two copies of United Nations Personal History Form (P.11), and send detailed curriculum vitae to Professional Recruitment Service, United Nations, New York, N.Y. 10017, USA. Mention the date of birth and nationality, and quote the Vacancy Announcement number.

WIRELESS WORLD, SEPTEMBER 1980
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, installing, commissioning, testing and maintaining our equipment. Such work will take you to the frontiers of technology on a broad and wide area of expertise - positive career advancement, worthwhile experience in new and expanding field of digital communications, valuable experience in practical research and development, and widen your area of expertise.

You should have 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-serve or in M. Forces, your Service trade may allow us to discharge the need for formal qualifications.

Pay scales for Radio Technicians start at £4,640 per annum, rising to £5,525, and promotion will put you on the road to posts paying substantially more. There are also opportunities for overtime and non-regular 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 City & Guilds Telecommunications Technician Certificate) but with insufficient practical experience for Radio Technicians posts may be suitable for our Trainee Radio Technicians posts. Pay scales for these posts are £3,826 per annum and at age 24. Suitable candidates may also be invited to interview in Cheltenham—at our expense.

You will be required to work a 40-hour week, during which time you will be encouraged to take advantage of company facilities for recreation and social life. The Government Communications Headquarters is situated on the outskirts of Cheltenham, offering quiet and pleasant surroundings in a pleasant area.

You will be expected to work overtime and on-call work paying good rates. Starting pay may be adjusted to £5,045 depending on relevant experience.

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