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Front cover caption shows a Leica camera incorporating Ferranti u.l.a. (see page 52) on a background formed by tracks on an integrated circuit. Photograph by Paul Brierley.

IN OUR NEXT ISSUE

Can we distinguish ‘amplifier sound’? This article first discusses the subjective aspects of listening tests then describes objective laboratory experiments to verify listeners’ reports.

Microprocessor interfacing. First of a series on methods for connecting microprocessors/microcomputers to other equipment. Part one on a ‘universal’ interface for 6502-based microcomputers.

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*Reader inquiry number 220*

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**WIRELESS World September 1981**

**View from the footprint**

In giving his approval for an early start to satellite broadcasting in the UK, the Home Secretary has opened a hive of questions which are now buzzing in all directions demanding attention: who will provide the satellites, the earth stations, the equipment, the programmes, the finance; who will administer the service, what kind of programmes will it offer, how will the public respond ... and so on. Many of these questions are in fact being attended to with apparent urgency, and already at least two companies have been formed specifically to provide and operate satellite systems.

One source of pressure behind this urgency is the British aerospace and electronics companies. They, understandably, are keen to exploit the new technology which this type of broadcasting will make necessary throughout the world. An early start for a British service would give them a good domestic base from which to launch themselves into the world market. The existing broadcasters, BBC and commercial, are also keen to go ahead.

Although the commercial programme contractors are now preoccupied with financial problems in their terrestrial broadcasting and transmitters, they have the prospect of supporting the fourth tv channel to face, they are of course completely alive to the possibility of satellites as a new medium for advertising.

But in all those projections anyone has really stopped to consider the man in the footprint, the prospective customer for these new transmitters.

So far, it seems, the public has not been consulted in any effective way on what it thinks about the whole scheme. The Home Office has certainly published a report through HMSO (News, July issue), but after spending a year or two more preparing it they allowed only two months after publication (on May 19) for anyone to comment on it. Such a time limit is plainly ridiculous. It is no more than a token gesture towards public consultation. Another instance of the contempt with which governments treat electorates once they have used them to get into power (cf. last month's editorial). Of course, those who are directly interested - the specialized organizations, firms, pressure groups, well-informed individuals and so on - will have responded smartly enough. It will have been another "carve-up" among the elites, while the majority remains almost unaware of what is going on.

A project of this magnitude - essentially national because the transmissions provide immediate coverage of the whole country - justifies public consultation on a large scale. At least a year should have been allowed. Several months would be needed to ensure that people were properly informed about the proposed service and the remaining months to give them time to think, discuss and make considered replies. It would require all this time because the options available are not straightforward. For one thing, they depend on engineering options that are not simple to explain. For example, because, as mentioned above, a satellite transmitter provides national coverage without any difficulty, it is a more efficient way of broadcasting a national service than terrestrial transmitters, which could be received for local and regional services. Then there is the question of how the available bandwidth might be distributed between sound and television transmissions, with the possibility of including such newer developments as high-definition television, multichannel sound and text information retrieval.

The fact that satellite broadcasting is now possible gives us a fresh viewpoint for looking at our broadcasting as a whole. It would be folly to throw away this opportunity, because of indecent haste to explain what some people see merely as a new commercial gimmick. After all, the idea of satellite broadcasting has been established long enough (since Arthur C. Clarke's article in Wireless World of October 1945). Let us give the chance it deserves for its potentialities to be used to the greatest advantage.
Acceleration feedback loudspeaker

Feedback from speaker cone reduces distortion and improves frequency response

by D. De Groot and J. Vandewege, Laboratorium voor Elektromagnetisme en Acustica, Gent, Belgium.

An economical and easily built acceleration-feedback loudspeaker is described. It consists of a two-way, passive-crossover speaker system housed in a compact 44 litre box, and a preamplifier to process the woofer cone-movement feedback signal. Any good power amplifier with a maximum output power lower than 120W r.m.s. can drive this system; no critical adjustments are required. Acceleration feedback is shown to improve considerably the system response below 200Hz. In this region, distortion is reduced by a factor 2 to 5, and the power handling capability of the box is increased by 50 percent. In spite of the simplicity of the design, a 20Hz to 20kHz frequency response, flat to within ±3dB, was easily obtained.

A pair of 20cm diameter Philips AD8067/WMFB4 woofers was chosen for our purpose. These speakers have a built-in piezoelectric transducer, and can handle 40W r.m.s. each. Electrically connected in series, and acoustically coupled, they displace the same volume of air as a single 25cm woofer. However, they are mechanically stronger, and cone break-up occurs at much higher frequency (1250Hz for the AD8067/WMFB4 instead of 200 to 400Hz for a 25cm woofer). The coupling between the woofers forces them to behave as a system, showing a single fundamental resonance. The 22mm chipboard box shown in Fig. 1 has an effective volume of 44 litres. Its inside dimensions approach the 1:6:1.25:1 ratio required for a good distribution of the box resonance frequencies. The oblique partition successfully eliminates the lowest low-frequency resonance of the box at around 300Hz without deteriorating the acoustical coupling between both woofers. Figure 2 shows the woofer frequency response measured in an anechoic room at 1m on axis, after filling the box completely with polyether foam, which produced a 60Hz woofer resonance with a 0.7 quality factor. Each woofer cone carries a small printed-circuit board (Fig. 3) on which a piezoelectric acceleration transducer and f.e.t. amplifier are mounted. As Reference 3 shows, cone acceleration is proportional to the low-frequency, far-field acoustic pressure generated.

The transducer output was recorded while driving the f.e.t. by a grounded-base p-n-p BC549 to form a cascade stage. Figs 4 and 5 show the results: the 30 to 120Hz speaker response is very well reproduced. Further measurements showed the transducer output below 30Hz to be decreasing, probably because of the finite f.e.t. input impedance. Above 120Hz, the transducer output falls because cone movements are increasingly damped by the surrounding air. Above 1kHz, cone break up and transducer resonances dominate. In the region of interest, the difference between speaker response and transducer signal can easily be modelled as a first-order, 300Hz highpass filter.

Feedback system

A source of inspiration was the Philips MFB speaker system 22R4532. It has separated power amplifiers for low (40W) and medium to high frequencies (20W), which are incorporated in the box together with a number of filter stages. Woofer feedback is active (loop gain <1) in the 15 to 400Hz frequency range.

We succeeded in using a single good-quality power amplifier for the entire audio range, by carefully redesigning the feedback system as in Fig. 7. Any good power amplifier can be used, provided its passband reaches as low as 5Hz (for loop stability's sake), and its power output doesn't exceed 120W r.m.s. Loop gain has to be adjusted, once and for all, to 32dB at 100Hz, a 20 per cent fault being hardly noticeable.

A crucial point in our configuration is the 44Hz low-pass filter in the feedback signal path. It eliminates distortion components of the piezo transducer in the medium range, where transducer distortion...
A feedforward compensation of the servo-loop transfer characteristic.

Power stage or the speakers.
times and possible destruction of causing severe distortion, long settling times and possible destruction of the system even for higher drive levels. This feedback level for those very low frequencies, however, produces an increasing frequency power-handling capabilities. As the servo loop is operated as low as 12Hz, a high-pass rumble filter may be needed when reproducing discs: the filter time constants, however, produce an increasing feedback level for those very low frequencies. Subsonic cone movements are strongly damped, obliging the voice coil to stay in the linear region of the magnet system even for higher drive levels. This raises the processable power level, for typical audio programme material, from 80 to about 120W r.m.s. Figure 11 shows woofer distortion when a 25W sinusoidal signal is applied to the box: closing the feedback loop dramatically decreases low frequency distortion.

9. A relay shorts the power amplifier input for ten seconds after switch on, to avoid switching transients.

As Fig. 10 shows, the power-amplifier input signal, generated by a constant servo-system input level, is a complement of the woofer frequency response, as determined by the servo loop. Because audio programme material seldom contains strong very low frequencies, this bass boost does not require excessive power levels. However, the box must be carefully sealed and filled with polyester foam in order not to reduce the woofer's low-frequency power-handling capabilities. As the servo loop is operative as low as 12Hz, a high-pass rumble filter may be needed when reproducing discs: the filter time constants, however, produce an increasing feedback level for those very low frequencies. Subsonic cone movements are strongly damped, obliging the voice coil to stay in the linear region of the magnet system even for higher drive levels. This raises the processable power level, for typical audio programme material, from 80 to about 120W r.m.s. Figure 11 shows woofer distortion when a 25W sinusoidal signal is applied to the box: closing the feedback loop dramatically decreases low frequency distortion.

Fig. 7. Block diagram of the acceleration feedback system.

Fig. 8. Filter and feedback stages.

Fig. 9. Relay driver circuit and voltage stabilizer.

Fig. 10. Power-amplifier drive signal with constant servo-system input voltage.

Fig. 11. Total harmonic distortion of the speaker system with and without feedback, for 25W sinusoidal drive.

Fig. 12. Passive crossover network.
Crossover

With constructional simplicity in mind, we searched for a good amplitude and transient waveform response. Ordinary constant-impedance filters showed excessive ringing (squarewave response), and only combinations of first-order and low-Q second-order filters proved to be acceptable acoustically.

Different three-way combinations were built, in which a Motorola piano tweeter, or a 2.5cm Philips dome tweeter, ADL TTS, was used with a 4kHz second crossover frequency. Main problems were tweeter resonances in the 1 to 4kHz region, causing poor squarewave response. Moreover, thermal modulation of the tweeter sensitivity was observed at higher drive levels: due to the short thermal time constants (around two seconds for a 2.5cm dome tweeter), voice coil resistance can change appreciably with the rhythm of strong transients.

A much better result was obtained with a 5cm Philips soft dome midrange, type AD02110 SQ8, in a two-way configuration with 900 Hz crossover frequency. This speakers has a 20 seconds thermal time constant. Its high-frequency response is equalised electronically from 8 to 20kHz in filter stage e of Fig. 7, and from 4 to 8 kHz (approximately first-order pole at 4kHz) in the crossover network of Fig. 12. The coils are wound on Siemens ferrite drum cores, thus avoiding excessive wire length and resistance. The high-pass section contains no electrolytic capacitors, as these were inaccurate and often inductive at higher frequencies, and parallel combinations of foil capacitors (Siemens MKM series) were used, each capacitor being able to handle 400mA of current. Low inductance resistors are also preferred.

Finally, Fig. 13 shows the anechoic room amplitude response of the system. Although these curves can stand comparison with much more complicated (and expensive) setups, the most impressive result cannot be written down: a very sharp-cut transient response even at high levels, and a completely uncoloured reproduction of the human voice.

Editorial note

The drive units are obtainable from Philips Spares Division, 604 Purley Way, Waddon, Croydon CR04DR, at £42.22, £22.70 and £17.25 for the woofer, 2in dome and tweeter respectively. Siemens MKM capacitors are stocked by A. Marshell (London) Ltd, Kingsgate House, Kingsgate Place, London NW6 4TA.

References

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Consumer video records

There is still no agreement on a single standard for video disc systems.

Lack of agreement on a single standard for consumer video discs has been no barrier to the completion of many other agreements, but none so obviously in the consumer's interests as a single standard. Almost every interested company has an agreement to produce more than one kind of video disc system.

The first of the video disc systems to be demonstrated was the laser optical disc originating with Philips a decade and 47million ago, and put on the market in the USA 2½ years back. Then came RCA's grooved capacitance disc, the product of 15 years research and development costing between $50 and $200million, put on sale six months after. Another is Matsushita in the form of JVC looking to repeat its VHS video cassette recorder success with a groovcapacitance disc, to go on sale next month in Japan, and in 1982 for the USA. Sony are also in.
many of the agreements being reached are exclusive. What seems to be happening is that the vast majority of agreements are non-exclusive - RCA named only two items as exclusive. Nevertheless, in a situation as competitive as this one must expect features to be sought on an exclusive basis and used for promotional purposes. Negotiating rights to overseas material is an area where video disc companies are very active. RCA have formed joint companies in various countries; those announced are with Beta/Taurus in Germany, Precision Tapes in the UK, Gaumont in France, as well as a joint company with Columbia Pictures to trade in overseas rights.

In proclaiming its 26,000 sales RCA could be said to be grossly inflated compared with an estimated 30,000 sales for the optical system over two years.

Optical system protagonists argue that optical player sales had been held back as a result of difficulties in supplying discs. Philips contest the estimated figure, quoting sales of 40,000 at the end of 1980. But a CED player does not directly compete with a laser player; limitations of mono sound, no freeze-frame facility, limited stereo and record life go with this unshakably mass-market machine. And price differential is substantial: $720 for the optical player and $499 for CED.

The optical disc system, now called LaserDisc and sold by both Magnavox and Pioneer, is set for UK launch later this year with a promotions budget of $2.5m and selling "marginally cheaper" than a VCR ($499). Details are largely as previously reported (see Berlin show reports, especially 1973 and 1975), the major extension in recent years being adoption of constant linear velocity to extend playing time. This is achieved by cranking more than two fields per revolution as the track radius increases and motor speed decreases proportionately. The constant angular velocity mode, with its facility for reversing, speeding up, slowing down and freezing motion by track jumping, gives only half the speed and variable track length to allow track jumping.

While Sony appears to differ from Pioneer, is set for early next year, preparing "optically cheaper" CED. And though Pioneer, is set for early next year, Pioneer, is set for early next year, Sony and Akai, General, Hitachi, Mitsubishi, Matsushita have declared their support for the system. RCA are to make what have formed joint companies in various countries; those announced are with Beta/Taurus in Germany, Precision Tapes in the UK, Gaumont in France, as well as a joint company with Columbia Pictures to trade in overseas rights.

In proclaiming its 26,000 sales RCA could be said to be grossly inflated compared with an estimated 30,000 sales for the optical system over two years.

Optical system protagonists argue that optical player sales had been held back as a result of difficulties in supplying discs. Philips contest the estimated figure, quoting sales of 40,000 at the end of 1980. But a CED player does not directly compete with a laser player; limitations of mono sound, no freeze-frame facility, limited stereo and record life go with this unshakably mass-market machine. And price differential is substantial: $720 for the optical player and $499 for CED.

The optical disc system, now called LaserDisc and sold by both Magnavox and Pioneer, is set for UK launch later this year with a promotions budget of $2.5m and selling "marginally cheaper" than a VCR ($499). Details are largely as previously reported (see Berlin show reports, especially 1973 and 1975), the major extension in recent years being adoption of constant linear velocity to extend playing time. This is achieved by cranking more than two fields per revolution as the track radius increases and motor speed decreases proportionately. The constant angular velocity mode, with its facility for reversing, speeding up, slowing down and freezing motion by track jumping, gives only half the speed and variable track length to allow track jumping.

First model of RCA video record player features rapid access at 150 normal speed with muting, visual search at 16x normal speed by groove jumping and is priced at $409. 150 programmes, aimed at "average family", sold at $15 to $28 each. CBS as well as RCA are expected to sell records in the UK, but a PAL version of the player has yet to be demonstrated.

Optical video discs carry education programmes could be used for interactive teaching programmes tailored to individual needs by linking record player to microcomputer (both enhanced with presented cartridges and separate test display). But teaching and training programmes in which the features of slow motion, frame-frame and reverse play are ideally suited but are not available initially.

Available for sale in the U.S. early next year, Sharps' VHD-formal video record player includes "video search, enabling speeded up viewing by either 12 or 50x normal speed, frame-stop, frame-by-frame advance in either forward or reverse, variable speed control from 1/8 to five times normal speed in either forward or reverse and pause, and is now available in the U.S. players may turn out to be clearer than the $350 currently being quoted.

In any case, the specification for the player features rapid access at 150 normal speed with muting, visual search at 16x normal speed by groove jumping and is priced at $409. 150 programmes, aimed at "average family", sold at $15 to $28 each. CBS as well as RCA are expected to sell records in the UK, but a PAL version of the player has yet to be demonstrated.

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Microcomputer tester
A simple but versatile fault-finding aid
by Tony Cassera

More and more service and repair departments are finding themselves dealing with the repair of microcomputer-oriented equipment. Larger departments can usually afford to use multimeter-based testers and analyzers to aid fault finding but the majority, mainly for cost reasons, have to rely on manufacturers' test routines, logic probes and the 'plug-a-new-one-in-and-see' method used since the advent of the thermionic diode. The author presents here a low-cost design, for both amateurs and professionals, for testing 8080-based microcomputer circuits and, rather than concentrating on constructional details, he has described the unit so that it can be adapted for testing any microprocessor based system.

Over the past few years, this test unit has been used successfully for fault-finding in 8080-based microcomputer peripheral circuit boards and feature of its design will be of interest to others faced with the problems of repairing similar boards. As anyone who has ever tried to measure voltages at I.C. pins using standard probes will understand, connection of the test unit to the circuit under test is difficult and the chances of damaging the unit through misconnections are great. With this in mind, the test unit was designed as cheaply and as simply as possible so it can easily be repaired or replaced. The tester can be used to:
- read data from memory
- write data into memory
- check I/O operation
- single step through a program

- run a program and stop it at preset breakpoints

When used in conjunction with an oscilloscope, circuit diagrams and program listings, the unit can be used to diagnose most faults.

Microcomputers have strong similarities in general architecture but differ in details of which the reader can make use. Apart from the timing resistor of the microprocessor but the data bus is held in its high-impedance state by the BUSEN signal. After resetting the microprocessor runs and advances the program counter.

Single cycle stepping is used as opposed to instruction stepping. The address switches are also connected to the microprocessor but the data bus is used. Using a sensible choice of breakpoints, it is possible to reconstruct the path of the program under execution. When a breakpoint is set on the address switches, the c.p.u. mode switch set to run and the breakpoint switch to enable the program counter to stop.

Functional description
C.p.u. mode. A three position switch with settings marked disable, jump and run is connected to the c.p.u. and BUSEN signals of the system, see Fig.1. In the disable mode a HOLD signal is applied to the microprocessor and to the enable signals.

The output buffers of the 8228, when this signal is high, the output buffers are in their high-impedance state.

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If the processor is mounted in a socket a 'test jig' can be made from a socket. This test jig has the necessary test leads soldered to its pins and is most useful for back fashion in the processor socket. The microprocessor then plugs into the test jig. Provided the test jig is made to suit the processor the signals HOLD and RDYN (or similar signals) to the processor. On the board for which the tester is made there are three OR gates in these wires which hold the external pull-up resistor and collector outputs in the tester supplied with these gates with satisfactory signals. If these signals are made available on the board to be tested, an alternative is to wire OR the functions so suitable open collector output on the tester. To stop clamping of the test signals when a switch is opened the leg of the i.c. must be bont towards so that it does not fit into the socket. If sockets are not used, either all of the i.c. or the associated track on the p.c.b. can be cut and rejoined after the fault has been found. The site address line and eight data line connections do not create a problem as they are connected via tri-state buffers.

Modifications
A simple pulse is difficult to see on an oscilloscope so I added a 1kHz oscillator to the 4511 test circuit as an alternative to the push button. A small r.s.m. was considered to which you would connect a crystal or transistor to control the oscillator at 1ppm. An extra circuit for directing the program to the starting address of the memory would be required. Data transformers are used so the oscillator pulses is tedious so a hexadecimal keypad is used to load data into the output at this point I felt that the concept was too complex and decided that if such features were needed an entirely new design would be required.

Literature received
Applications manual on analogue-to-digital and d-to-a converters is published by Texas Instruments. It contains design specification, error sources, and additional information. "A STUDY OF SMALL SCALE SAMPLE AND-HOLD AMPLIFIER CIRCUITS AND APPLICATIONS" is available from Power Products Limited, 362A Spring Road, Southampton, S014 2LD. (See also the preceding paragraph.) Select. In the system for which the tester was made the i/o ports were each selected by a D-SELECT circuit. The D-SELECT circuit was generated by a decoded address bus by a DEVICE SELECT signal. This signal was generated by a decoded address bus of the processor using an extra pin.

Write. Provided that the data bus switch is in the invariable position the bit pattern on the data switch is written into r.a.m. at the address set on the address switches. The write signal is 1 is preceded in the same way as the read signal described in the preceding paragraph, and so is also a one.

In the system for which the tester was made the switch was made · by a flip-flop to debounce the switch contacts which i.e. sockets are used, the switch contact. The output of the flip-flop goes directly to the board coil. The output of the flip-flop is latched when the switch is turned off.

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VOLTAGE CONTROLLED FILTER

The following comments on the article by A. A.
Thomas in your June issue (pp. 79-81) may be

Filters of the form shown in Fig. 2, and their
newer counterparts, are known as Sallen-Ke
Key filters.

It is quite all right to use the factor
$
\frac{1}{Q} = \kappa_0 Q
$
and factor $\frac{Q}{\kappa_0}$ in the damping factor as usually defined, but both that
factor. Difficulties arise with the latter in a

The addition of a relatively large integ
al expression could have been avoided by

phase shift (high-pass) = -180

phase shift (low-pass) = +180

Please name and address

MICROCHIPS AND MEGADEATHS

Not one of the five centennial letters in your
May issue, I would have thought, pointed out
that the 1979 Nunn-Lugar Amendment (Public
Law 96-35) creates a blueprint for the control of
nuclear assistance and the state of arms
spending in the 1980's. As the years
pass, the claims of the LB&L (Lawrence
Brooks & Levitan) group for
tightening and isolation of the
arms control system become ever
more pressing. The recent
Western European meetings
about nuclear arms and the
Western European statements
calling for arms reduction and
control are direct
consequences of the Nunn-Lugar Amendment.

The author replies:
Christopher Darrell
Linden

REFERENCES

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 foursquare window; and the text ends with 'I am a German, too."

D. Brooks
Blackburn, Lancs

JAMES CLARK MAXWELL

(May 1831 and May 1879) attributes the change from the classical physics of Clerk Maxwell's experiments – Michelson and Morley's measurement of the velocity of light with experiments with cathode-ray tubes and Planck's measurement of the frequency distribution of black body radiation. However, while Planck developed quantum theory to explain the frequency distribution of black body radiation it soon proved to have other applications. One of the first applications of the dependence of the photon-energy on the frequency of the radiation, it explained Balmer's formula for the lines of the hydrogen distribution of black body radiation. Hence, we have developed, the fact that the central construct of his model could be refined by the observations of a certain line of sight, that the energy of the electric current model is beyond controversy.

Maxwell's equations now became the basis of a number of other phenomena such as X-rays, radio waves, and television. The equations are:

\[\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} \]
\[\nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t} \]
\[\nabla \cdot \mathbf{D} = \rho \]
\[\nabla \cdot \mathbf{B} = 0 \]

\[E = \text{the electric field (in volts per meter)}\]
\[B = \text{the magnetic field (in tesla)}\]
\[\mu_0 = \text{the magnetic permeability of free space (in henries per meter)}\]
\[\mu = \text{the magnetic permeability of the medium}\]
\[\epsilon_0 = \text{the electric permittivity of free space (in farads per meter)}\]
\[\epsilon = \text{the electric permittivity of the medium}\]
\[\rho = \text{the electric charge density (in coulombs per cubic meter)}\]
\[\mathbf{J} = \text{the current density (in amperes per meter squared)}\]

Digital electronics are playing an increasingly important role throughout industry. Here we take a look at some of the applications that are now being advanced by several companies at their Engineering Research Station, Killingworth, near Newcastle upon Tyne. Mr Catt, who was digging so many holes in the roads, is not surprising that many of the projects will help them to locate the best place to dig, by locating the pipes or cables. Radio communication within a limited bandwidth and a novel way to measure the contents of gas holder are two other experiments which will lead to improved efficiency in the operation of the pipeline system operated by British Gas last year—and each cost about £250. Not surprisingly, British Gas moved 40 million tons of earth last year. There will always be a need to dig holes in the road, to replace old pipes or repair damaged cables. Any improvement in accuracy in detecting the position of a pipe would save the industry millions of pounds a year. For example, the area of range by displaying 'L' for low field and 'H' for high field. The device was linked to a conventional instrument. If the receiver batteries are exhausted the circuitry monitors that condition and displays 'F' for flat. Useful of the transmitter can receive corruptions spaced pipes to a much closer proximity. The instrument is now undergoing field trials and has been shown to possess a performance necessary to operate successfully in the congested streets of Britain's towns and cities.

High frequency ground

Ground probing radars, similar to conventional radars in that they use very high frequency electromagnetic energy are radiated downward and reflected back from distant objects are then collected, usually, but not always, by the same antenna. Many other systems, intended for the purpose of detecting distress, environment or terrain, are used for use for other purpose. Additionally, there should be a good deal of work on the side of the distress channel, with the same restrictions. To use the dominant of the following facilities, conventional radars are set up in the pipeline system. Following the failure of a number of conventional organisations to respond to the gas industry's needs, the Engineering Research Station (ERS) of British Gas started to develop two parallel and complementary types of location equipment: Although both use electromagnetic field techniques the compact equipment employs a low frequency induction or magnetic field to achieve detection of metallic pipe, whereas the pipe is a sophisticated equipment for non-metallic pipe the reduced field in the lower microwave frequency region.

ERS has developed an experimental instrument, intended for the systems used for GAS COrporation Pipe And Cable Tracer, which uses magnetic field detection. GASCOFACT is a considerable advance on currently available commercial equipment. The instrument has two parts, a transmitter to induce eddy currents in the ground and a receiver to detect the induced current that will flow in buried pipes or cables. The receiver uses an array of sensors to accurately locate the position of the pipe or cable. The circuits of an automated receiver which gives a digital readout of pipe or cable position. All the functions of the receiver, tuning, etc. make the operation of conventional instruments awkward have been eliminated by automatic control circuits. The receiver l.c.d. display provides an 'X' indication when the receiver is right over the pipe and an 'O' indication when the pipe is away. The receiver monitors correct operation by a calibration of range by displaying 'L' for low field and 'H' for high field. The field was too weak for the transmitter. If the receiver batteries are exhausted the circuitry monitors that condition and displays 'F' for flat. The first polyethylene gas main in the UK was laid in 1968. Usage has grown to the point where 80 per cent of the 4,200km of gas mains laid each year for new supplies or as replacements to the existing system, and 90 per cent of the 65,000 services, are in this category; that is, replacements for polythene pipes such as this requires new instruments and one problem is the accurate location of the new polythene.
Passive microwave imaging. Similar to the above technique but the instrument does not transmit any energy but detects the natural emissions from objects within the beamwidth of the antenna.

Short pulse radar. Pulses of energy lasting 10^-9 seconds are transmitted using special antennae. Most conventional radars use this technique but with pulses lasting 10^-7 seconds.

Frequency modulated continuous wave (F.m.c.w.) radar. Conventional radar techniques as being the approaches most likely to offer solutions. Progress in the other techniques will be monitored as part of the development programme.

Possible methods

Within the broad description of ground probing radars, there are several possible methods of implementing a system:

- Microwave imaging. This is a continuous wave or unmodulated radar where an image similar to an optical image is mathematically constructed for systematic measurements taken in a plane horizontal to the ground.

- Acoustic leak location

It is important that the position of any gas leak is determined within one metre to avoid unnecessary digging. This position is normally deduced from concentration of gas in the soil above the suspect pipe; the leaks generally lying beneath the points of highest concentration. Samples of the gas and air mixture are obtained by probing through the road surface into the soil below. This technique is usually successful, but sometimes confusing results are obtained.

Two methods of detecting leaks with sound waves

1. The 'X' displayed by the Gascopact locator indicates the position of the pipe. 'O' would be near the pipe, 'L' that the signal is too low, 'H' that the signal is too high, and 'P' that the internal power supply is low — flat battery. A microswitch in the handle switches the instrument on automatically when it is lifted.

2. An experiment to locate pipes using microwave radar. The portable anechoic chamber surrounding the test site would not be necessary in practice.

3. Placing geophones to pick up the sound emanating from a gas leak, and the vast amount of electronics used to locate the leak. This is at an experimental stage and it is thought that the equipment would be more compact when a practical system had evolved.

4. A service fitter returns to his van to find a print-out waiting for him with details of his next job. He can acknowledge the call or print-out waiting for him with details of his next job. He can acknowledge the call or

5. The Gray scale reflective strips on the side of this gas holder can be used to measure, very accurately, the contents of the holder.
Digital mobile radio communication

British Gas is an extensive user of mobile radio systems, which is not surprising when the efficient management of gas works is considered. The gas holder is in effect made of pipes, and the signals can be transmitted to it via the radio to be detected at the mobile terminals. The system is then able to pinpoint the location of the gas holder when it is activated, and the surface above the pipe is surveyed progressively. This type of system is being used to detect low level leak signals and reduce the number of leaks.

Against this background other significant developments are beginning to appear in the mobile radio system. In the application of computers (for job scheduling) to communications of the 48-character block. This is possible to leave a picture of the type of gas holder to be installed in a particular area and save it to a file. When a new area is to be assessed, the file can be loaded into the computer and a new job assigned. This is especially useful when several areas are to be assessed in a short time. Even at modest data rates of 1180Hz., this pay-off has been recognised for the transmit direction and de-interleaves the data stream before reproducing it. If the error correction code is shortened, the output signal to the radio to be transmitted to the mobile terminal. The system will, however, always acknowledge by a short data block that the message has been received correctly or with uncorrectable error. This will be requested. This acknowledge will be requested by up to six blocks to be transmitted to build up a longer printed message.

System functions

The mobile installation is able to receive both long and short messages which allows the mobile to be used in a wide variety of applications. Mobiles will receive all data messages, but only decode messages containing their own call sign code. Call signs consist of one letter and two digits.

- Receive a short message containing select data call and light the indication lamp when the signal is received.
- Allow normal speech operation, but the press-to-talk function is inhibited while the mobile is transmitting or receiving data.
- Transmit acknowledgement to all data messages, but only long data blocks. The system will, however, allow up to six blocks to be transmitted to build up a longer printed message.
- Transmit up to six status conditions which can be used for the transmit direction and de-interleaves the data stream before reproducing it. If the error correction code is shortened, the output signal to the radio to be transmitted to the mobile terminal. The system will, however, always acknowledge by a short data block that the message has been received correctly or with uncorrectable error. This will be requested. This acknowledge will be requested by up to six blocks to be transmitted to build up a longer printed message.

The software at the control end allows the following operations to be performed via a single line data communications system:
- Selectively call any mobile.
- Display the queue of waiting mobiles.
- Send one of the three standard messages held in the store.
- Send user messages entered via the keyboard.
- Highlight the emergency status on the screen when received from a mobile.

The future

A multi-station base system for operational use is at present being studied which will be based on the principles of the simple single station system described above. This would deal with the power supply and supply to be transmitted to the mobile terminal. The system will, however, allow up to six blocks to be transmitted to build up a longer printed message.

Distinguishing ‘amplifier sound’

Some audio enthusiasts claim to be able to distinguish the ‘sound’ of an amplifier from other equipment, even the reproducing chain. This first article describes the subjective aspects of the equipment and describes objective laboratory tests to verify whether this claim is justified.

Multi channel digital recorder

Using an ordinary stereo cassette recorder and some digital electronics to construct a 12-channel instrumentation type recorder with zero wow and flutter. Number of channels can be improved by changing bandwidth from 70Hz to 420Hz. S/N ratio of playback-analog signal is 60dB.
Advertisements for Sinclair's ZX81 personal computer mention its British custom-designed "master chip" but do not go into the details that this is a Ferranti device designed from an uncommitted logic array (u.l.a., an array of transistorized logic cells that can be configured into a variety of circuit designs by applying a mask to the cell metallization layer to form the required system). This is a good example of the use of u.l.a. custom design to reduce the number of ICs required — and hence the cost of manufacture — to a consumer product. So is the Leica camera on our front cover this month, which includes the Ferranti u.l.a. chip as the main processing unit of its light measurement and exposure control system for automatic shutter control. There has, in fact, been a wide variety of applications for this firm's FELA process, in both commercial and professional products, ranging from a Black & Decker drill speed control system to British Telecom electronic telephone exchanges.

The majority of u.l.a. custom designed ICs are made by bipolar processes. Ferranti in particular have developed the Bell Telephone Laboratories collector diffusions isolation (c.d.i.) bipolar process for this purpose.* This so far, throughout the 1970s, has allowed the manufacture of u.l.a. chips containing from 100 to 2000 logic gates. But recent demand for greater circuit complexity and higher performance, as we move further into the era of l.s.i. and v.l.s.i., has caused the industry to seek more advanced types of u.l.a. for custom-designed circuits. The aim is to produce devices which can handle 10,000 gates on a chip, propagation delays characteristic of emitter-coupled logic, e.g., down to less than 1 ns, and gate power dissipation levels comparable with c.m.o.s.

This has been done, claims the company, with a new bipolar process which is similar to c.d.i. in being simple and therefore requiring a small number of masks — a desideratum for economic yields in manufacture — but which in fact uses six masks instead of the five required for c.d.i. A cross-section of a bipolar p-n transistor made in the new process is shown on the right, alongside a corresponding transistor in c.d.i. It will be seen immediately that it is smaller. In fact the minimum "feature size" is now 3 μm and with a smaller emitter structure the improvement in packing density of devices on a chip is claimed to be about 2:1. The extra, sixth, mask is used to remove the non-selected p+ diffusion away from the isolation diffusion in c.d.i. (see footnote). This reduces the capacitance at the critical collector/base junction and results in an improved speed-power performance, higher voltage capability and the availability of a p-channel junction (i.e., by further masking of the p-region under the transistor emitter. Capacitance is also reduced as a result of the smaller emitter structure mentioned above. The new uncommitted logic arrays for custom design arising out of this new process offer chip complexities varying from 500 to 10,000 logic gates and gate delays varying from 5 ns down to 0.5 ns. One group, in the l.s.i. bracket, includes five arrays of 500, 900, 1,200, 1,600 and 2,000 gate complexities. Each array has three gate delay/gate power categories, 2.5 ns, 300 μW, 7.5 μs, 60 μW, and 15 μs, 300 μW. These arrays are available for design work now. A second group, of v.l.s.i. devices, comprises two arrays of 4,000 and 10,000 gate complexities. In each case the gate delay is 2.5 ns and the gate power 300 μW. Engineering samples of these will be available by the end of 1981 and customers' designs will be accepted during 1982. Finally, a third group, described as "sub-nanosecond" u.l.a.s, provides 1,000, 2,000 and 4,000 gate arrays with gate delays of 0.5 ns, and 1 ns respectively. These will be available during 1982.

New gate circuit

Apart from the manufacturing process itself, the new u.l.a. devices also incorporate an innovation in the circuit design of the basic logic gate. The gate circuit has similarities to c.d.i. but is said to consume less power. It consists of a non-saturation current-sourced logic gate with emitter follower buffered outputs (see diagram). Minimum propagation delay can be as low as 0.5 ns and, because of the emitter-follower buffer, the delay is independent of fan-out. Ferranti think this feature is unique in v.l.s.i. arrays, most manufacturers apparently prefer a simple gate circuit because of packing density limitation.


Comparing the structure of a transistor fabricated in the new bipolar process (right) with the structure in the c.d.i. process.

The firm of Ferranti, which makes the above devices, owes its existence to the 19th century pioneering work of its founder, Sebastian de Ferranti, in building alternators for the public electricity supply. So, like many others, it was a reality in itself and could be considered as something belonging to a material body. Now it was replaced by a sublateral concept, namely a field of force, something that was a reality in itself and could be considered as isolation from material bodies. But although it was left to Maxwell to predict formally that electromagnetic fields are propagated through space, and that light is electromagnetic in nature, some historians of science point out that Faraday might well have had an inkling of these concepts as early as the 1830s. Here is part of a sealed note, signed by Faraday on 12th March 1832, which had been deposited in a strong box at the Royal Society, London, and was not opened until 1898 (photographs of the note appear in "Magneto and electricity" by G. R. M. Garratt, Wireless World, 5 May, 1938):

"Certain of the results of the investigations which are embodied in the two papers entitled Experimental Researches in Electricity, lately read to the Royal Society, and the views arising therefrom, in connection with other views and experiments, lead me to believe that magnetic action is progressive, and requires time: i.e., that when a magnet acts upon a distant piece of iron, the attracting cause, (which I call the momentary magnetism), proceeds gradually from the magnetic body, and requires time for its transmission which will probably be found to be very short.

"I think also, that I reason for supposing that electric induction (of tension) is also performed in a similar progressive way.

"I am inclined to conceive the diffusion of magnetic forces from a magnetic pole to the vibrations upon the surface of disturbed water, or of those in the phenomena of sound, i.e., I am inclined to think the vibratory theory will apply to these phenomena, as it does to sound and most probably to light.

"By analogy I think it may possibly apply to the phenomenon of induction of electricity of tension also."
Op-amp oscillator

During the design of an op-amp Wien-bridge oscillator, two Zener diodes were used to limit the amplitude. However, the distortion produced by this circuit was high due to a slight difference between the Zener diode voltages. An arrangement using a single Zener diode in a bridge rectifier was still above 0.1%. The final circuit uses a transistor bridge which reduces the t.h.d. to 0.04% at 1kHz.

G. C. Gale
Guildford
Surrey

Synchronous motor oscillator

A small two-phase synchronous motor can be driven in either direction over a 10:1 speed range with this oscillator. The design is a two-integrator loop which forms a loss-free resonant circuit whose resonant frequency is 1/RC. Capacitor C provides excess phase for starting the frequency is

\[ \frac{1}{2\pi RC} \]

The drive voltage to R is controlled by varying R or, as shown, the drive voltage to R.

The distortion caused by non-linearities in the bridge rectifier was still above 0.1%. The final circuit uses a transistor bridge which reduces the t.h.d. to 0.04% at 1kHz.

G. C. Gale
Guildford
Surrey

Theatre fire effect

For theatre use the circuit shown provides an alternative to the flickering-fire effect published in Jan. 1981. Although this method lacks the sophistication of the original, it is simple and cheap.

A Goulcejn-tube starter is wired in series with the lamp, and the rate of flicker can be adjusted slightly by using different lamps from 25 to 100W. The fire effect can be improved if several lamp and starter circuits are used. Theatre dimmers can be added to switch the fire on and off together with other stage lighting.

N. C. Moon
London

Variable expansion unit

Wideband expansion can successfully be achieved using current biased diodes as voltage controlled resistors. This design produces less than 0.5% t.h.d., below 1mV I.F. modulation, and d.c. surging below 2.5mV.

The control section, Tr 1 to Tr 3, consists of two voltage regulators back-to-back which provide smooth and noiseless control of expansion. One control section can drive up to 12 expanders over a 14dB range. If a greater range is required, the 10kΩ resistor can be reduced. If is provided to restore the original volume level and can be omitted. The 22μF tantalum capacitors should be matched as closely as possible. Because silicon diodes require 0.4V to conduct, the resistor network around D 1 and D 2 provides a bias voltage so that active rectifiers are not required at low levels. If a higher supply voltage is used, the resistors should be adjusted to provide 0.8V across points X and Y. To keep distortion below 1%, the voltage applied to r.c.c. diodes D 1 and D 2 does not exceed 7mV. Also, the 10kΩ resistors in series further reduces distortion.

It is not advisable to use a supply voltage below 9V because the 741s do not operate satisfactorily.

R. G. Young
Newhaven
Sussex

600 ohm floating source

Fig. 1 shows a unity-gain 300 ohm driver which uses voltage and current feedback to provide a high maximum output level from low supply rails. Driving two of these circuits in antiphase produces a 600 ohm balanced-line output as shown in Fig. 2. However, connecting an unbalanced load to this circuit causes a level drop of 3.5dB because one amplifier drives into 600 ohms and the other is shorted. Fig. 3 shows a current source driven from the current-feedback resistor of A 1. This provides an infinite common-mode output impedance, i.e. a floating load. By splitting the feedback to A 1 equally between the two output terminals as shown in Fig. 4, the output amplitude remains constant irrespective of whether the centre or either end of the load is connected to ground.

D. Austin
Birmingham

www.americanradiohistory.com
Generating square-waves with phase-jumps

The transient response of a p.i.l. can be tested by alternately advancing and retarding by 180° the phase of a square-wave generator. With the values shown, output frequency is about 2kHz and the phase-jumps occur at intervals of about 2s, but these figures can easily be altered to suit other applications. The output frequency is limited to below 1MHz by the ripple-carra propagation delay of the divider chain. However, if a synchronous divider is used, the frequency range can be significantly increased. If the output is applied to an auxiliary divider, the magnitude of the phase-jumps will be reduced in the same ratio as the frequency.

Three exclusive-OR gates form a conventional oscillator which drives the divider chain at about 4kHz. The fourth gate produces a 2kHz square-wave which is reversed every 4096 cycles. A spike produced at each reversal is eliminated by the output 4013 which triggers on opposite oscillator transitions to the divider. At alternate reversals, a second 4013 is triggered which resets the first, so the output

Random-number generator

A simple random-number generator, such as the electronic dice circuit shown, can be constructed by using switch bounce to produce clock pulses. If the switch is biased LED off normally on, so pressing the switch turns E off and enables the display. Each depression and release of the switch produces a random number of pulses.

J. Cameron Bradford

4013 completes one cycle during one oscillator cycle, which represents a phase-advance of 180°. At intervening reversals, the second 4013 is not triggered and the output 4013 remains in the reset state for two consecutive oscillator cycles. Therefore, three oscillator cycles are required to complete the sequence and this represents a retardation of 180°. The output waveform contains the same number of transitions as the first-stage output of the divider chain, and the positive-going transitions are directly timed by the oscillator.

E. L. Jones

Bucknell Shropshire

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Frequency synthesizer for c.b.

A circuit for the proposed UK bands

by P. E. Chadwick, Plessey Semiconductors Ltd.

So called 'single-chip' synthesizers now in existence require a considerable number of extra circuits as they are designed for use in mixer-type synthesizer applications. This article outlines a simple single-loop type synthesizer designed with the Home Office's proposed regulations for UK citizens' bands in mind (as far as transceiver specifications and frequency allocations are concerned).

At the hub of the design are two i.c.s from Plessey: the SP8793, 40/41 dual-modular divider and the NJ8812, a n.m.o.s. synthesizer controller.

The proposed frequency allocation for citizens' band (c.b.) radio in the UK is 27,00125 to 27,99125MHz. This band is divided into 10kHz channels numbered from 1 to 40. A simple low-cost frequency synthesizer capable of meeting the proposed UK (c.b. specifications in terms of adjacent channel noise, spurious side-bands, etc. can be made using the NJ8812 and SP8793 i.c.s from Plessey. Frequency modulation of the synthesizer is simple but the audio response is shaped to limit adjacent channel power.

All synthesizer controllers, the NJ8812, controls the divider. This device comprises two programmable dividers, one in the signal path and one for the reference-frequency input to the phase detector. These dividers feed a digital phase detector, the outputs of which are used to drive the frequency of the v.c.o. higher or lower as required.

An address consisting of 3/2 words, each 4-bits long, is used to program the controller. These words are multiplexed into the device under control of an internal data selector and result in two outputs called DS1 and DS2 which form part of the program for a r.m.o. or p.r.o.m.

The controller address may be provided, in a number of ways from a simple circuit with two 74133 multiplexers to a microprocessor system. A 2716 p.r.o.m. is used here. The reference divider in the controller can be set to one of sixteen division ratios using pins 8 and 9 (FA and FB). In this case, FA and FB are wired to 5V and ground respectively.

Circuit description

The circuit, Fig. 1, is a simple single-loop synthesizer with two-modulus prescaling. A low-power consumption 40/41 dual-modular divider, the SP8793, does the prescaling. This high-sensitivity i.c. has a t.r.l. compatible control input and divider output, and an internal voltage regulator so that it can be used with a wide range of supply voltages.

One gate of a CD4011, biased to operate in its linear region, is used for the 4.8MHz reference oscillator. A further gate of the same i.c. buffers the oscillator signal. The VU (up) and VD (down) outputs of the NJ8812 are combined in a charge pump circuit. The VD output is inverted by a c.m.o.s. gate and fed through a diode into the loop filter so that when the VD output decreases the control line voltage increases. At the same time the VU output pulls the control voltage lower.

The loop filter, consisting of C1, C2 and R3, integrates the pulses from the phase detector. Further filtering is provided by a low-pass filter with a 5dB point at 45kHz, C3 and C4. The reference frequency fed into the phase detector is 10.000444kHz. Because the loop locks so that the output frequency of the synthesizer is an integral multiple of the reference frequency, exact 10kHz steps can only be produced on channels that are an exact multiple of 10kHz. For example, with a reference frequency of 10kHz and second divider ratio of 2780, the output frequency is changed to produce an output of 2780125kHz. Thus, channel 80 corresponds to 2760 times the reference frequency and channel 40, 2799 times. This ensures that small errors of +8.54Hz at channel 40 and -8.99Hz at channel 1, do not cause the transmitter frequency to be outside the allocated channel.

The reference frequency input to the NJ8812 is set by means of a crystal adjusted to 4600.215kHz. The specification requires that the transmitter frequency be controlled to within ±1kHz at all times. This means that an accuracy of ±50 p.p.m. is needed. Through not using exactly 10kHz as the reference frequency, an error of 0.33 p.p.m. is introduced. This error can thus be ignored. Because the required temperature is 50°C, the temperature coefficient of the reference frequency crystal should not exceed 0.75 p.p.m./°C. This stability allows for some degradation of the other oscillator components.

Voltage controlled oscillator

The v.c.o. is the heart of any frequency synthesizer. It has to be carefully designed to ensure that phase noise is minimized, that the frequency control voltage characteristics are monotonic and that the frequency range is no more than that required for the coverage so that noise modulation is minimized.

In this synthesizer the v.c.o. uses a junction f.e.t. in a Colpits circuit. A f.e.t. was used because it does not produce l.f. noise and thus minimizes noise modulation.
of the signal. Tuning is done by a variable-
capacitance diode and modulation is applied
to the control line on transmit. For
receiving, a second variable-capacitance
diode is switched in parallel with the in-
ductor. A parallel trimming capacitor
allows the receive frequency range to be
adjusted.

An emitter follower provides the neces-
sary isolation between the v.c.o. and
the external circuitry. In the prototype a
2N5757 was used for the follower but
many other similar devices may be used.
The output from this stage is at a low level
and amplification is required in transmit
mode. In the receive mode the output is
adequate for most receiver mixers. The
v.c.o. is buffered to minimize the chance
of spurious modulation caused by the di-
lider.

Programming
A 31/2 word 3-x 4-bit address programs the
divisor in the NJ8812 and hence deter-
rmines the output frequency from the
controller/divider phase-locked loop con-
figuration. The controller/divider combi-
nation used here is capable of dividing by
integer values between 1600 and 11839.
When the range input (pin 1) of the con-
troller is at logic 0 the divisor range is
from 6720 to 16959. Divisors between
1600 and 6720 are covered when the range
input is at logic 1.

The 14 bits that make up the address
can be found using a calculator as follows.
First find the program number N using the
formula,
\[ N = \frac{1000}{C} \cdot R \]
where \( f \) is the v.c.o. frequency in MHz, \( C \) is
the channel spacing in kHz and \( R \) is the
divider range number. When the controller
range input is at logic 1, \( R = 1600 \) and
when at logic 0, \( R = 6720 \).

The program number \( N \) may be
converted to its decimal equivalent on a
calculator using the following procedure:
- enter the number \( N \)
- divide by 640
- write down the number before the deci-
nal point
- subtract the number before the decimal
point
- multiply by 16
- write down the number before the decimal
point
- subtract the number before the decimal
point
- multiply by 40
- write down the nearest whole number
to the one displayed.

For example, you will have an answer in
the form 8, 31, 30. This result can now be
converted to binary noting that the third
decimal number gives the last six bits of
binary as follows: 1001, 0111, or, in binary
words, 1001, 1011, 1110.

The least significant word is first en-
tered into the data read 1 time slot via
the inputs \( D_3 \) and \( D_4 \) and the most
significant last (data read 4 time slot). The
second least significant word contains only
two bits entered via the inputs \( D_5 \) and \( D_6 \).
Data presented to the inputs \( D_7 \) and \( D_8 \)
during the second time slot is ignored by
the controller.

Conversion to a 14-bit binary number is
performed as follows:
- Divide \( N \) by 640
- Write down number before
decimal place (word ‘D’)
- Subtract this number
- Multiply by 16
- Write down number before
decimal place (word ‘C’)
- Subtract this number
- Multiply by 40
- Write down nearest whole
number (word ‘A’ + ‘B’)

The decimal numbers obtained for words
‘C’ and ‘D’ may be directly converted to 4-bit binary words, while the
decimal number for words ‘A’ and ‘B’ will
convert to a 6-bit binary word. The least
significant four bits of this word give word
‘A’ while the two most significant bits give
the least significant bits of word ‘B’ (the
two most significant bits of word ‘B’ hav-
ing ‘don’t care’ states). These are pre-
sent in the data inputs as follows:

<table>
<thead>
<tr>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>X</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

As mentioned above the NJ8812 is pro-
grammed for each channel by 31/2 words
of 4 bits each. As a result 1120 bits are
required to program a 40-channel synthe-
sizer (i.e. 40 transmit and 40 receive).

Because of the architecture of r.o.m.s
and p.r.o.ms these channels can only be
satisfactorily accommodated by a 512 x 4-
bit memory. Such memories are available
but they are expensive. This circuit uses
the common 2716 p.r.o.m., which may be
replaced by a 2138 r.o.m. if required.

Manufacturers of equipment covering
European channels conforming to the
FCC specification and/or the 94 MHz UK
allocation can use the spare capacity of
the r.o.m./p.r.o.m. to include the extra
programming information. Selection of
either UK or FCC channels can then be
made by providing a link on the p.c.b. for
the A10 input. For 94 MHz, A10 is either
grounded or tied to +5 V depending on the
system (as will be described later) and A11
is tied to +5 V.

Where a 455 kHz second f.c. is used in
the receiver, a separate crystal is required
to convert the nominal 10.7 MHz first f.c.
to 455 kHz. This crystal varies between
10245.4815 kHz for UK channels and
10246.968 kHz for FCC channels, and is
best realised using a 10246.25 kHz crystal
in a circuit which allows adjustment to
either frequency.

The r.o.m./p.r.o.m. used to program
the NJ8812 is addressed from the channel
selection mechanism of the equipment.
Because the channels are numbered 1 to 40
rather than 0 to 39, additional circuitry is
required to modify the display using an
8-bit input NOR gate. The b.c.d. program
input to the r.o.m./p.r.o.m. is arranged so
that addresses 1 to 39 program channels 1
to 39, and address 0 programs and displays
channel 40.

The NJ8812 has a "lock-detector" output
which, when integrated in an RC network,
provides a logic level 0 which can be used
for inhibition. This flag can also be used to
blank the i.e.d. display.

Setting up
Referring to the circuit diagram of Fig. 1,
start by selecting channel 20 and connect
point p.t.t., i.e. the point at the bottom
right of Fig. 1, to +V. Adjust the core of L4
so that the voltage at tp4 is 4 V. Next,
connect p.t.t. to +12V, i.e. in receive
mode, and adjust C1 until tp is at 4 V.

The specification requires that when the
transmitter is modulated at 12500 Hz with
a modulation level 20dB greater than that
required to produce 1500 Hz deviation, the
power in an 8.5 kHz bandwidth centred
at 10 kHz away from the carrier frequency
should be less than 100 mW. This corre-
sponds to a power of -95dBc in a 1 kHz
bandwidth for carrier separations of
5.25 kHz or greater.

The Home Office's publications describing
performance specifications for c.b. radio
equipment are MPT340 for 27MHz and
MPT221 for 94 MHz. They are available
from Her Majesty's Stationery Office.
Plessey Semiconductors Ltd's address is
Kembrey Park, Swindon, Wilts SN2 6BA.

Double-sided glass fibre p.c.b.s will be
available for £5 exclusive of v.a.t. and UK
postage from M. Sagin, 22 Keynes Rd, London NW2.
Electronics on the road - 2

Automatic control, instruments and display

by J. R. Watkinson, B.Sc., M.Sc.

The first part of this article, in the August issue, was concerned with ignition electronics and automatic gearboxes. Part 2 is on the use of electronics in controls for suspension and throttle operation.

Electronic drive for vehicles is described and there is mention of recent work on instruments and computers.

One of the more important uses of electronics is in braking, particularly in heavy vehicles and in poor road conditions, where jack-knifing can happen.

Antilock braking. Under heavy braking (Fig. 8), weight transfer unloads the rear wheels of a vehicle. It's to such an extent that the reaction from the road may not be enough to turn them against the resistance of the brakes. This results in a rear-wheel sliding. The decision can be made by the propellor shaft. If the velocity changes predicted imminently, the brake line to the affected wheel is isolated from the remainder. Having fitted the speed transducer, it is latched from the roadspeed at the moment the wheel is back where it was, which eliminates the slow-roll-over phenomenon.

Fig. 8. At constant speed, weight is distributed evenly, while during braking, weight is transferred to front wheels. Reduction of weight at rear axle could cause rear wheels to lock.

The principle of active suspension could not be used to lock up if the vehicle is too heavy, and therefore the vehicle can't act. Then the actuator of the brake line is to retract the piston, reducing pressure in brake line.

Active suspension. When a vehicle corners, the force accelerating it toward the centre of the turn acts at ground level, but the centre of mass of a practical vehicle is some distance above. Weight transfer causes the vehicle to lean outwards on its springs, which usually results in an instability with the steering and changes in the camber angles of the tyres. Energy is stored in the springs, which must be dissipated by the dampers as the vehicle leaves the corner. The vibration of inertia of the vehicle about the roll axis and the roll stiffness governs the resonant frequency of the system. If the dampers are ineffective, the vehicle will slide. The decision can be made by the propellor shaft. If the velocity changes in a purely mechanical fashion, electronic control has to be considerably restricted, since otherwise the suspension would appear unfinished or ill-judged.

Fig. 9. If rate of change of wheel speed, v, exceeds reference, wheel lockup, diaphragm is actuated. The e.m.f. is just less than the applied potential. The current in or out of a machine can be predicted by Ohm's Law, stated as the e.m.f. divided by the resistance equals the current in or out of the machine.

The current in or out of a machine will try to run at a constant and steady speed. As shown in Fig. 13, roadspeed can be monitored by a pulse generator on the propellor shaft, which can be electrically or vacuum operated. For safety reasons the system disengages if the brake pedal is pressed, and a switch is fitted to the clutch pedal to prevent the system blowing up the engine if the clutch is depressed. On most systems the driver can override the speed control to go faster just by pressing the throttle, the preset speed being resumed when the throttle is released. The desired speed is latched from the roadspeed at the moment that the system is engaged.

Fig. 13. Cruise control. Pulse rate represents road speed. Current speed is latched and subsequent speeds compared. Error operates throttle.

Having fitted the speed transducer, it is a simple matter to drive a long-scale, moving-coil speedometer dial, eliminating the usual drive cable. The odometer then counts pulses from the transducer. Fig. 14 shows such a device which is considerably more linear than the usual eddy current type speedometer.

Electric motor control. The technology of electric vehicles is well developed, mainly in the fields of rail traction, fork trucks and mills. The most sophisticated of electric power to road vehicles awaits the development of lightweight batteries or fuel cells since, with current designs, only the centre of mass rises, the vehicle can actually be made to move into a corner. The bandwidth of the system has to be carefully restricted, since otherwise the suspension would appear unfinished or ill-judged.

Active suspension systems can be implemented in a purely mechanical fashion, but as the complexity rises, electronic control has to be considered. A subset of active suspension is self-leveling suspension, which is designed to compensate only for load variation. In these systems the rams on each end of the axle are plumbed in parallel, and the bandwidth of the system is very small. Citroen have offered cars with full self levelling and load-sensitive brake proportions for many years, although no electronics were employed as the system was launched in the 1950s.

Cruise control. This application takes the form of a delay, which compares actual roadspeed with a preset reference, and operates the throttle to maintain constant speed. As shown in Fig. 13, roadspeed can be monitored by a pulse generator on the propellor shaft, which is the antilock brake system. The servo error drives an actuator on the throttle spindle, which can be electrically or vacuum operated. For safety reasons the system disengages if the brake pedal is pressed.

The current in or out of a machine can be predicted by Ohm's Law, stated as the e.m.f. divided by the resistance equals the current in or out of the machine.

The current in or out of a machine will try to run at a constant and steady speed. As shown in Fig. 13, roadspeed can be monitored by a pulse generator on the propellor shaft, which can be electrically or vacuum operated. For safety reasons the system disengages if the brake pedal is pressed, and a switch is fitted to the clutch pedal to prevent the system blowing up the engine if the clutch is depressed. On most systems the driver can override the speed control to go faster just by pressing the throttle, the preset speed being resumed when the throttle is released. The desired speed is latched from the roadspeed at the moment that the system is engaged.

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creased, such that the c.m.f. now exceeds the applied voltage, and the motor acts as a generator, taking energy from the vehicle's movement and putting it back into the supply. In the interests of efficiency the field current is controlled by a switching regulator.

Dynamic braking is already in use in trains and railways, where true regeneration takes place. It also finds application in very heavy vehicles, such as those used in open-cast mining and civil engineering. Because of the enormous power of such vehicles, conventional clutches and brakes would burn up. To overcome this problem, the transmission from the diesel or gas turbine is by way of a generator driving electric motors. Cooling is achieved by field current as previously described. As it is not possible to recover the electrical energy by using an engine, the electrical energy developed during braking is dumped into huge resistor banks. With all dynamic braking systems it is not possible to brake to a complete halt, and therefore conventional brakes must be provided to finally stop, and for parking. On light vehicles with a single motor, these brakes would also be necessary in the case of a motor failure, but heavy vehicles use multiple motors with duplicated systems so repair is not so critical.

In the absence of the clutch, electronic devices can be used to control the power output. Because of its efficiency, the electrically driven motor has considerable advantages in cold areas, where the lower engine oil viscosities would affect performance.

In this respect, electronic devices and water temperature control systems have already been in use in various forms for many years. The automotive industry has always had to cope with the problems of cars running into the preceding vehicle, and a radar system can respond to echoes of twice the transmitted frequency. This can be used to calculate various quantities.

Collision avoidance. Many problems beset the introduction of collision-avoidance systems for road vehicles. Possibly the most likely system yet has been researched in the U.S.A. The most common collision in conditions of poor visibility is that of running into the preceding vehicle, and a radar system can be postulated to help prevent this. The main problem with on-vehicle radar is discrimination between the preceding vehicle and those joining the other way, not to mention roadside objects. One possibility is that the field plate of all vehicles should incorporate a passive frequency doubler network, so that the receiving vehicle would only respond to echoes of twice the transmitted frequency. In the U.S.A., one boy licence plates are automatically inactive at tax disc expiry, and as a result it would be possible to equip every car with the wonder in about a year. The radar-equipped vehicle could then compute distance and closing speed to determine warning signals, and ultimately the brakes if a transponder was being approached in the path of the vehicle. The system would probably be necessary in order to prevent false alarms from parked vehicles at the side of the road, particularly on bends.

Influence on automotive electronics

Efficiency is one of the primary considerations in the design and selection of automotive electronic devices and systems.

Social forces. At the moment, most cars are sold to fleet owners who will keep them for a year. The exception to this is the c.m.f., which last much longer without requiring replacement. One of the major features of electronic devices is that moving parts are largely eliminated and that long-term performance is therefore good. In the peculiar logic of the motor industry longevity is not a virtue, and as a result no electronic device will be selected on this ground alone except by quality makers. The electronic device must actually be cheaper than the mechanism it replaces before the economists who really design mass-produced vehicles will consider it. The exception to this is if the device can be put on the open market by the image makers of the advertising department. An example which happily fitted both categories was the alternator, which was actually cheaper to make than the dynamo, and whose advantages could be explained in nursery language by the Admen. The unfortunate regulator could not be expected to capture anyone's imagination, so for a long time mechanical regulators degraded alternators until electronic regulators had been introduced.

Environment. The underbonnet area of a motor car is pretty hostile to electronic equipment, so good design and engineering is necessary in order that the device survives. If, however, the device does survive, it should do so for a long time.

One problem is the temperature range encountered. Vehicles are frequently parked in temperatures which are far removed from the freezing engine, the voltage can drop to as little as 6 volts, but with the engine running it can go up to about 14½ volts. Superimposed upon these interferences is feedback from the ignition and from various electric motors and switching regulators. Filtering, decoupling and screening can all be used to combat the interference problem and to ensure careful circuit design has to be used to ensure operation at extremes of supply voltage.

Legislation. The form of modern vehicles is heavily controlled by legislation which, in turn, is usually dictated by regulations concerning noise and emission requirements. In due course, the motor industry will probably be forced to employ more electronic devices to meet higher standards demanded by law. Certainly, has not been for emission and the tetrachloroethylene industry is heavily controlled by legislation which, in the U.S.A., electronic ignition would not have become so widely used.

Maintenance. Before designing any device, the responsible designer must first establish the level of competence of those who are expected to maintain it. There is little point in designing a complex device for production if it is too difficult to repair. The motor trade already works extensively on an assembly principle, whereby a unit is replaced whole rather than repaired, and in this component level. The exchanged specialist centres are then either repaired by dealers or returned, depending on the economics of the individual assembly concerned.

Because of the mechanical parts, the fault is usually easy to locate to an assembly, but this is not necessarily the case with electronic systems. Before designing a complex electronic system for a vehicle, it will have to be assured that the system will incorporate sufficient diagnostic ability to call out its own faulty parts. The latest generation of automotive computers incorporate many of the features which can be fixed by relatively unskilled technicians, and it is expected that this technology will filter down to consumer equipment. Ultimately, of course, someone has to know how these devices actually work, in order to repair the small percentage of faults which the internal diagnostics fail to identify. When judging by studies of customer dissatisfaction with the motor trade, it would be as well to appreciate that it is in this support area that there is a need for a more effective structure.

The amateur. The home constructor has a great advantage over the mass producer in that he is not obliged to make a profit. Looked at in a cold light, no home-made electronic equipment results in a financial saving, but the potential for learning and self-expression far exceeds that of purchasing ready-made goods. In the sphere of automotive electronics, there are certain constraints which are not normally applied.

To give some structure to this argument, your home-made fuel-injection system passes away in the middle of Dartmouth. In the event of a failure, the vehicle would be packed up, no one is even remotely interested, and one is left to an argument, your home-made fuel-injection system passes away in the middle of Dartmouth. In the event of a failure, the vehicle would be packed up, no one is even remotely interested, and one is left to your own devices. The motor trade already works extensively on an assembly principle, whereby a unit is replaced whole rather than repaired, and in this component level. The exchanged specialist centres are then either repaired by dealers or returned, depending on the economics of the individual assembly concerned.

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Satellite tracking by home computer - 2

Formulea and programs

by Neoklis Kyriazis, B.Sc.

The complete machine-code program is given in Table 1. Once the routine interface is completed it should be connected to the computer through the interface. All satellite tracking variables are processed in the machine-code program so, thanks to the CALL instruction of the MM57109, all interfac- e. system, refer to the interface and rotators program so, thanks to the CALL instruction of the program explanations, a few

The program uses this formulae to process satellite orbit parameters and converts resulting data for use with the computer. The complete program consists of two parts: a BURP MM57109 program which contains the numerical computations and a machine-code program for rotor/motor control through the interface. All satellite tracking variables are processed in the BURP program so, thanks to the CALL instruction of the MM57109, the machine-code program need not be changed when orbit parameters change. In the machine-code program some subroutines are used to carry out the main task of controlling the aerial rotators and others are used to check hardware. Both program explanations, a few

The following formulae, presented in a table, are used by the authors. The values in the table are those that give a unit elevation angle and Fq is the unit normal velocity of the earth which is 175. If the orbit inclination is less than 90° then the azimuth angle is negative. The first request

A=\cos^{-1}\left(\sin Fs\cos Fq+\cos Fs\cos Fq\sin Fq\right)

where Fs is the station longitude and Fq is the station latitude.

Table 1: This machine-code program uses data from the BURP program to control the aerial rotators through the interface.

| 1650 02 16 60 E5 | C5 EF E6 21 | 63 35 EF 3C | 06 CD 02 |
| 1653 03 00 33 71 | 3F FF 21 | 83 35 EF 3D | 05 ED EF |
| 1656 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1659 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1662 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1665 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1668 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1671 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1674 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1677 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1680 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1683 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1686 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |
| 1689 07 67 2D | 05 ED FF | 3F FF 6D | 05 ED EF |

where G is the azimuth angle and finally,

E=\arccos\left(\sin A-R\left(\frac{Fq}{\sin A}\right)\right)

where E is the elevation angle, R is each of the first request for 435.1 MHz. Both aerials are mounted on the same shaft supported in the middle by the elevation rotator which is mounted on the azimuth rotator.

This aerial system is used by the author for tracking Occar satellites. The aerial to the left is for 145.85 MHz and the one to the right for 435.1 MHz.

1.6EO 5C

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where Fs is the station longitude and Fq is the station latitude. The values in the table are those that give a unit elevation angle and Fq is the unit normal velocity of the earth which is 175. If the orbit inclination is less than 90° then the azimuth angle is negative. The first request

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Operating the system

After the aerial-control interface has been tested using the procedure described earlier the system is ready for final setting up. When the routine at 1600 is run the rotators will be at 180° azimuth and 0° elevation so the satellites can be positioned on the rotation centres but remember to leave slack in the cables to allow rotation to the limit stops.

To use a satellite the data entry station at line 200 can be started by closing switch S1 (see the circuit diagram in part 1 of this article). Type RUND into the computer and then supply the data requested by the program. When real time is equal to the time requested in line 4 of the program the timer of the interface circuit will be started by closing switch S2 of the rotor-control interface. The program will run 10 seconds later after a pulse from the timer on the interface received.

Tracking will commence when the elevation angle is greater than −5° and S2 is closed the interface is open. If S1 is closed tracking will stop and if the azimuth rotator is running the program and rotator will no longer be synchronized. Problems with synchronization will also be encountered if the program is reset while either rotator is running. The routine at 1600 can be used to solve synchronization problems.

Where the satellite is to pass north of the earth station azimuth and elevation angles are adjusted in line 36 ofavoid action of the azimuth and elevation limit stop. In line 42 the azimuth and elevation angles are finally converted to the nearest integer representing them in steps of 10° and the tracking routine at 1636 is called. After aerial rotation the sequence is repeated from line 14.
environments (for example, patient monitoring in hospitals), where high sensitivity and fast responses are essential.

Basic d.m.a. configuration

A simplified form of a basic d.m.a. configuration, using either the block transfer or the cycle steal mode, is shown in Figure 3. The interface consists of two components, the d.m.a. controller and the peripheral interface, the basic functions of which are as follows. The programmer sends to the d.m.a. controller (by means of i/o instructions) three items of information specifying (i) the starting address, (ii) the size of the block, and (iii) the direction of transfer, followed by a 'go' command. On receipt of the 'go' command, the d.m.a. controller activates the peripheral interface by pulling enable signal E in Figure 3 high (E=1). In its activated state, the interface monitors the status signals of the peripheral and requests the microprocessor to have them set up, data transfers in d.m.a. systems take place autonomously, that is with no programmer intervention.

References


Electronic Pocket Book, by Andrew Patz. 350pp., paperback.

Newnes Technical Books, £5.60. This is a basic attempt to cover, in 340 pages of largely non-mathematical text, the whole gamut of electronics. It starts with the atom and touches on circuitry, components and systems from transistor amplifiers to computers in industrial and domestic use.

The book is the fourth edition of a well-known title, completely rewritten since the last one in 1976. It is by no means a detailed textbook, but is rather an introductory view of the many topics covered; the writing is simple, direct and to no knowledge is assumed. Coverage of individual subjects is necessarily limited and fairly superficial, but the book will serve as a convenient lead-in for the newcomer, who can then follow up his particular interest in more exhaustive texts: a list of equivalents, and a list of acronyms and abbreviations appears at the end of the book, the latter also being given in subsidiary positions in the main body of the text.

Aries is a member of international committees working on units and terminology: the authority of the entries can therefore be relied on with a high degree of confidence.

Guide to Acoustic Practice, prepared by K. A. Rose. 95pp., paperback.

BBC, £10 (stereo plus £2.31). Engineers and architects at the BBC have accumulated a great deal of experience over many years in the design of studios and control rooms, which has been distilled and prepared for publication in the form of a guide. Until recently, the guide has been in constant use inside the BBC, but demand from overseas has forced the Corporation to make it more generally available.

Insulation to reduce external noise and acoustic treatment for internally generated sounds are both covered thoroughly, a further section dealing with the effects of studio furniture and fittings on sound characteristics. There are two sections on noise borne by service ducts and galvanized pipes, lifts, electrical equipment and generators. Nearly half the book is devoted to drawings and tables relating to the text.

This is a remarkably concise and practical work and is highly relevant to other structures such as conference halls and music rooms where the sound quality is important. As is pointed out at the beginning, it is no use glazing a few acoustic tiles on the wall and expecting the noise to disappear.

Oscilloscopes, by Ian Hickman. 12pp., paperback.

Newnes Technical Books, £3.45. This is addressed to school physics students and technicians, as well as to those with an interest in electronics as a hobby. It is a simple book, with no pretensions to depth, and provides an easily read guide to modern oscilloscopes and their use, which should help students approaching these instruments for the first time.

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Oscilloscopes, by Ian Hickman. 12pp., paperback.

Newnes Technical Books, £3.45. This is addressed to school physics students and technicians, as well as to those with an interest in electronics as a hobby. It is a simple book, with no pretensions to depth, and provides an easily read guide to modern oscilloscopes and their use, which should help students approaching these instruments for the first time.

Electronic Pocket Book, by Andrew Patz. 350pp., paperback.

Newnes Technical Books, £5.60.

This is a basic attempt to cover, in 340 pages of largely non-mathematical text, the whole gamut of electronics. It starts with the atom and touches on circuitry, components and systems from transistor amplifiers to computers in industrial and domestic use.

The book is the fourth edition of a well-known title, completely rewritten since the last one in 1976. It is by no means a detailed textbook, but is rather an introductory view of the many topics covered; the writing is simple, direct and to no knowledge is assumed. Coverage of individual subjects is necessarily limited and fairly superficial, but the book will serve as a convenient lead-in for the newcomer, who can then follow up his particular interest in more exhaustive texts: a list of equivalents, and a list of acronyms and abbreviations appears at the end of the book, the latter also being given in subsidiary positions in the main body of the text.

Aries is a member of international committees working on units and terminology: the authority of the entries can therefore be relied on with a high degree of confidence.

Guide to Acoustic Practice, prepared by K. A. Rose. 95pp., paperback.

BBC, £10 (stereo plus £2.31). Engineers and architects at the BBC have accumulated a great deal of experience over many years in the design of studios and control rooms, which has been distilled and prepared for publication in the form of a guide. Until recently, the guide has been in constant use inside the BBC, but demand from overseas has forced the Corporation to make it more generally available.

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CES, Chicago

Setup up from the largest American consumer electronics show

by George Tillet

This year the Summer Consumer Electronics Show in Chicago was larger than ever with a record breaking attendance of well over 60,000. Almost 900 exhibitors were spread over 550,000 square feet of space and 300 demonstration rooms at adjacent hotels: As with recent shows, main interest centred on video, emphasized by the impressive space age array of giant satellite dishes outside the main entrance.

Video disc players were naturally attracting a lot of attention — in fact, you could hardly miss them, stacked as they were to make an eye-catching video wall. Although the new RCA Selectavision model has only one audio channel and lacks many of the features provided by its competitors, it has been popular, mainly because of its lower price. In terms of both performance, it is comparable with the VHD and laser models in spite of its styling-over- design. Critics described it as "a giant step backwards" but this has not deterred companies like Sansui and Toshiba who have also opted for this system, now called CED. The VHD system developed by JVC also uses a strip but it glides over the record surface, not in a groove. New models were shown by Sansui, Quasar and Sharp, the last-named deciding to go with VHD "because of the super stereo sound". Sansui were also showing a CED model and at this point were undecided which to make.

Laser players are made by Pioneer and Maganvox and the former has signed agreements with Columbia Pictures, Cointent Garden Productions and many Hollywood program sources. Further agreements are being made between the various film makers so the same movies will eventually be available in all three formats: CED, VHD and Laservision. So the situation is a little better than the quadraphonic fiasco when the competing manufacturers didn't even agree on the spelling of the name!

Turning to video cassette recorders, well, we have had to live with Beta and VHS recorders for some time but it seems that we'll have to cop with another standard or standards for portable models. Technicolor introduced a miniature cam- recorder last year which used 5/16-inch tape in cassettes not much larger than those made for audio and weighing only two ounces. But now Japanese photographc equipment makers, faced with a disappearing home movie market, have turned their eyes to video so to speak. Fuji and Canon have already introduced "Camcorders" and other manufacturers will release models soon. Sony retaliated with the Betapak described as the "world's lightest VCR" at just over 9lb. A great many Beta and VHS portable and domestic models were introduced at the Show, including entries from Kenwood (Triov) and Sansui;

Pressure zone microphone claims flat amplitude response at all angles of incidence by virtue of tiny phase-canceling gap.

Prices have come down to meet the video disc competition but the tape itself is expensive. One reason is the high cost of real-time duplication but the situation could change. Mitsubishi were showing a high-speed video tape duplicator which uses a process called "video anhydrous transfer printing" to copy a four-hour tape in four minutes. It's expensive but the quantities involved are high enough to justify the outlay for many cassette suppliers. There are rumours of a video disc system with recording capability but I can find no hard evidence. On the other hand, it is true that a company in New England has plans for a playback-only video cassette machine to cost about half the present models.

A great number of new cassette decks were to be seen: most of the top models boasting automatic bias, equalization and sensitivity circuits. Several provide Dolby C noise reduction while Marantz, Teco, Yamaha and Technics have plumped for dbx in some of their models. Competition between dbx and Dolby has increased recently with the Dolby Labs emphasizing the greater dynamic range plus noise reduction over the whole band. Dolby's answer was the HX circuit and Dolby C, plus the reminder that compatibility is most important as there are some 100 million Dolby decks out there!

The new CBS CX (compatible expansion) records were being demonstrated by Sound Concepts, MXR, Powerline and Audioristics, all of whom make the decoders. At the moment, only four records are actually on the market but CBS say that all their records will soon be in this format. Furthermore, their goal is to make it the industry standard for recording. Warner are believed to be going along with the idea but at the time of writing, nothing has been heard from RCA or any other record company. In some respects the CX process is like the dbx system: it uses the same 1:2 expansion ratio in playback but it does not function over the whole dynamic range. No pre-emphasis is used in the encoder and CBS claim that these records will be "audibly acceptable" when played without a decoder. Amplitude response will be uncharged and noise level will be worse. The decoder parts are relatively inexpensive so eventually, if the idea catches on, we will see this facility built-in to many record players, receivers and amplifiers.

Another noise reduction unit was being demonstrated by National Semiconductor. This is nice. So and it is in the form of a single i.e. with two channels. It works on the same principle as the Burwen-KLH but RCA Records have since agreed to adopt the process — Ed.
EMP and thermionic valves

The electromagnetic pulse (EMP) produced by a nuclear explosion high above the Earth could wreck telecommunications across a continent, according to Anthony Tucker, writing in the Guardian of 2 July.

With the exception of several US Department of Defence reports issued in 1977, the Bell Laboratories EMP Engineering and Design Principles (1975) and a recent three-part series in Science on the subject (May to June 1981), An­

EMP was in peak signals of 250 kHz on the receiver's read-out. Among other countries experimenting with programme labelling, data may include such information as music titles, sports scores and future programmes for displays on the receiver's read-out. In other countries experiments on programme labelling are Sweden and France, who have systems with the BBC's, and talk under way in conjunction with the EBU to agree a common European system. More details next month.

Thermionic valve equipment, while not nearly as impressive as EMP, offers a greater margin of safety, although designers will have to balance the safety factor against the higher effi­

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Communications satellites are therefore highly vulnerable to EMP but it seems unlikely that Russian design strategy will involve the use of a thermionic valve equation of i.e., which would probably require the sending of bodies of the EMP to the North Pole.

The last (observed) effect of EMP was in 1958 when a nuclear explosion 250 miles above Hawaii disturbed the street lights 400 miles away.

Looking at one combined tv, radio and audio cassette player, this is actually a video cassette recorder and 20cm colour tv.

The built-in ESL matching amplifier is claimed to handle peaks up to 1200 watts.

In brief...

Yamaha's top receivers are provided with a "spatial expander control" which is claimed to widen the stereo image. It appears to work by delaying a portion of the signals from one channel and feeding them to the other. The Carver company were demonstrating a new f.m. tuner which, it is claimed, virtually eliminates multipath distortion. The detector circuit is called the "asymmetrical charge-controlled f.m. detector" but no other details were available. However, I can test if it really works!

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Once again the BBC has announced that it is to concentrate its efforts on improving the quality of its transmissions on the v.h.f. bands. This will bring about differences in interference from European stations on the medium and long wave bands, particularly in Britain. Negotiators will have decided upon a plan well in advance of the conference. In the full 88 to 108 MHz band the conference will decide whether or not full UK coverage on v.h.f. for Radio 4 and possibly a service network for educational broadcasting including schools and the Open Uni­

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Levy on blank tapes

Six of the main promoters of blank tape have banded together to form the Tape Manufacturers' Group, a transatlantic alliance of BASF, AM, Maxell, Memorex, Sony and TDK and has been brought together specifically to counter any levy on blank tapes reported to be recommended in the forthcoming Green Paper on copyright law, to be published soon (at time of writing).

Mr Bill Fulton, from Sony UK, acting as chairman for the Group, said that the levy plan proposed by the record industry was impractical and unworkable. "The problem of home taping is not being grossly overstated. A levy would penalize, to an unfair degree, all tape users, whether they tape when they should or not," he said. "Consumer groups as well as organisations representing the professional interests of journalists, educators, businessmen, tape retailers and disc jockeys agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessmen, tape retailers and disc jockeys appear to agree with us, and a broadly based lobby of politicians, businessman...
Phase locked detector
for double-sidband, diminished-carrier reception

Avoiding transient delays by locking to the transmitted carrier

By d. A. Tong, B.Sc., Ph.D. Datong Electronics

Previous methods of regenerating the carrier in a double-sidband, diminished-carrier receiver have suffered from delays, causing missed syllables at the start of transmission. In this design, a narrow-band, phase-locked loop is used to track the phase of the level carrier even in the absence of reception.

In the past few years it has been recognized that amplitude-modulation transmissions in which the carrier is either suppressed or diminished in amplitude have potentially significant advantages for equipment such as amateur transmitters, where one of the biggest limitations to range is the limited capacity of the battery power supply. Rave has pointed out that double-sidband, suppressed-carrier (d.s.b.s., d.s.b.d.c.) transmissions can be generated very efficiently in terms of the utilization of primary power with the scheme shown in Fig. 1. More recently, Perrotic 4 has described a transmitter using these principles to generate double-sidband, dimin­ished-carrier (d.s.b.d.c.) transmission.

Provided that the carrier is reasonably suppressed relative to the average sidebands, no matter which has to be paid for the above advantage is the increased complexity of the receiver. For good intelligibility in the transmission of speech it is necessary to reinstate the carrier not only with the correct frequency, as in a.s.b.c., but also with the correct phase relative to the sideband components. Because of its symmetry, even a d.s.b.d.c. signal contains contributions to both sidebands; the exact phase of the carrier is then less important, but it is necessary to reproduce it with reasonable accuracy (i.e., principally either the “reciprocating detector”5, the “IF method”6, or the phase-lock loop method7) so as not to lose the signal from the problem that they require a finite time to do the job. The job of regenerating the carrier is therefore split into several stages, depending partly on the exact technique used, partly on the incoming signal level, and partly on the initial degree of missing of the carrier. In the reciprocating detector, this delay in regenerating the carrier is apparently quite short, but long enough to give the detector a useful discrimination against impulsive interference.

With d.s.b.d.c., the low-level carrier in can be used to define the regenerated carrier: any transient delays only operate on transmission and are not a problem. In addition, the power consumption of the two systems can be compared by the requirements for the d.s.b.d.c. The power consumption of the demodulator is used in the voltage-controlled 180° phase filter. The price which has to be paid is the increased complexity of the receiver. For good intelligibility in the transmission of speech it is necessary to reinstate the carrier not only with the correct frequency, as in a.s.b.c., but also with the correct phase relative to the sideband components. Because of its symmetry, even a d.s.b.d.c. signal contains contributions to both sidebands; the exact phase of the carrier is then less important, but it is necessary to reproduce it with reasonable accuracy (i.e., principally either the “reciprocating detector”5, the “IF method”6, or the phase-lock loop method7) so as not to lose the signal from the problem that they require a finite time to do the job of regenerating the carrier. In the reciprocating detector, this delay in regenerating the carrier is apparently quite short, but long enough to give the detector a useful discrimination against impulsive interference.

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When the loop is locked it forces the two r.f. inputs to M1 into a 90° phase difference, and the d.c. output components of M2 is zero. A shift in relative phase of the two signals would give a d.c. output from M2 whose sign and amplitude would depend on the sense and magnitude of the shift. Because the mixer is enclosed in a negative-feedback loop, however, any tendency to phase shift is automatically corrected by a shift in the instantaneous frequency of the carrier-insertion oscillator.

The local oscillator fed to M1 is phase-shifted by 90° relative to that applied to M2. When the system is locked, therefore, M1 gives an output which is proportional to the amplitude of the incoming signal and which contains the demodulated audio signal, if any. The d.c. component is fed to A2 and A3 for the use as a g.c.c. source and to provide the "signal present" indication.

It is worth pointing out at this stage that a coherent detection system such as this has a number of advantages, even for ordinary a.m., over an envelope detector.

1. The signal-to-noise ratio at the audio output is the same as that at the r.f. input.
2. In combination, an envelope detector has a threshold below which the output signal-to-noise ratio is worse than that at the input.

An envelope detector gives a rectified output for noise-modulated r.f. voltages at any frequency. Thus, broadband noise (that is, noise with a bandwidth greater than that of the desired signal) at the input adds in the output of an envelope detector to the noise which is present within the information bandwidth. In contrast, in a coherent detector broadband noise is here-reduced to appropriately higher frequencies (i.e., higher than the highest component of the wanted signal) and can easily be filtered out with a low-pass audio filter. This advantage has long been utilized in s.s.b. receivers using so-called "product detectors".

Adjoint-channel interference is not demodulated properly but gives an output which is frequency-shifted like off-tone s.s.b. It is therefore more easily differentiated by the listener from the wanted signal.

By adding a low-pass filter prior to the "signal-present" comparator, an arbitrarily small (say 10Hz) r.f. bandwidth can be achieved. Thus even very low carrier levels can be reliably filtered from the noise, and excellent squeal suppression is achieved. Further, a squelch indication will only occur if the receiver is phase-locked. Any non-coherent input signal will not activate the comparator and false squeal openings are rare.

The output voltage from A2 is related to the frequency of the incoming carrier. Therefore if the loop bandwidth is great enough, frequency modulation will also be demodulated and appear at the output of A4.

Circuit operation

The block diagram of a circuit to meet the above criteria is shown in Fig. 2. It is basically a phase-lock loop with a bandwidth narrow enough to allow it to lock onto signals which are buried in the receiver's noise. The loop comprises a balanced mixer M0, operational amplifier A0, and the voltage-controlled carrier-insertion oscillator. By choosing appropriate parameters for the loop filter (A0 and associated components) an almost arbitrarily narrow bandwidth can be obtained, but at the expense of an increased lock-up time. The phase-lock loop behaves, in effect as a narrow-band r.f. filter which tracks the frequency of an incoming signal.

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Further, a squelch indication is required to charge the capacitors. A difference between also removes most of the sources of d.c. drift and makes the squelch circuit aholm independent of temperature and supply voltage. Each of the mixers is based on a pair of c.m.o.s. analogue switches controlled by square-wave switching waveforms at the frequency of the incoming carrier and to the circuit such that even when, for example, I0C0 is closed, I0C6 is open and vice versa. When open, the path through a gate behaves like a bidirectional resistor of about 300 ohms, whereas when closed its resistance is of the order of 10 ohms. When fed with good square waves, such a balanced mixer behaves verily well indeed as a phase-sensitive detector and has the advantages that it can, if necessary, be bidirectional and that its quiescent output voltage is the same as its input voltage. Thus, no temperature-dependent offset voltages are introduced to upset the differential symmetry.

Switching waveforms for the four gates (two in each mixer) are derived from IC1c, which is a dual J-K flip-flop connected as a digital phase-shifter. It requires an input clock frequency which is four times that of the output waveforms, and this is provided by a multivibrator based on IC0 as described by Linsley Hood. An alternative oscillator based on an LC tuned circuit is shown in Fig. 3. It is the function of IC0 to a fairly narrow range. Peaks of noise cannot then swing the v.c.o. frequency, receiver overload on, for example, random noise inputs, some incoherent a.g.c., derived from a diode rectifier fed from the last i.f. amplifier, may also be required.

When the a.g.c. loop is operating, the volume of audio recovered from a d.s.b.c. input depends on the degree of carrier suppression, since IC4 acts to maintain a constant rectified carrier level at the output of IC5. Conventional a.m. would therefore ensure from this detector at a very low level unless IC5 was reconfigured to match the increased carrier level.

For minimum lock-up time on a signal which is close to the working threshold, it is essential that the carrier-insertion oscillator is close to the correct frequency (say within 100Hz). It is the function of D1 and D2 to limit the voltage swing at the R10 end of IC4 to a fairly narrow range; peaks of noise cannot then swing the v.c.o. frequency.

When the a.g.c. loop is operating, the volume of audio recovered from a d.s.b.c. input depends on the degree of carrier suppression, since IC4 acts to maintain a constant rectified carrier level at the output of IC5. Conventional a.m. would therefore ensure from this detector at a very low level unless IC5 was reconfigured to match the increased carrier level.

Fig. 2. Block diagram of detector for double-sideband, diminished for undiminished i.f. carrier transmissions. System uses a phase-locked loop to generate a strong local "carrier", identical to the frequency of the incoming carrier and is locked; thereby ensuring that the a.g.c. output voltage goes high and the two gates are closed, thereby preventing the squelch circuit from operating.

Fig. 3. Circuit of d.a.b.d.c. detector, operating at input frequencies of 565 kHz, suitable for adding to final i.f. amplifier of Plessey SLE101, SLE102, SLE6000. R15 is essential for controlling Plessey SLE610, 611 or 612 i.f. amplifier i.c. R1.f. input level required is about 200 mV peak to peak and supply voltage can vary from 6 to 15 volts (max). For the squelch amplifier (as needed for d.a.b.d.c. but not a.m. or f.m.) supply voltage to IC4 should be stabilised.

Fig. 4. Simple alternative oscillator circuit.
Simple 100W inverter
Automatic mains back-up from 12V d.c. with battery charge mode

by A. K. H. Miller

This inverter was designed to provide back-up power for a desk-top computer during a period of frequent power cuts. While the normal mains voltage is available, the inverter circuit 'ticks over' and the 12V standby battery is not charged. If the mains supplies fail, the square-wave inverter starts up automatically providing up to 100W at 220V a.c. until the mains is restored. A simple overload protection circuit is incorporated.

Since the inverter provides a maximum supply of about 100 watts, it is suitable for driving most small domestic loads such as television sets, hi-fi apparatus and central heating pumps. Although it can provide a 12V load taken over from the normal mains supply, it may not be capable of providing the current peak required when the set is switched on.

Circuit operation
The complete circuit is shown in Fig. 1. When there is a likelihood of a power cut, a car battery and the mains supplies are connected to the inputs of the inverter and the load to its output. Under these circumstances, the mains input and output are connected together and the transformer keeps the battery charged through D1, D2, and the current limiting resistor, R4. When the mains supply fails, relay RLA disconnects the live input from the high-voltage winding of the mains isolating transformer and connects its low-voltage windings to the collectors of the Darlington pair output stages, Tr7 to Tr8. These two pairs are driven in antiphase by 50Hz square waves produced in the drive circuit which operates from a 5 volt supply provided by a voltage regulator, IC4.

Considering the circuit in more detail, IC4 is a 555 timer connected as an astable multivibrator running at 200Hz. Variable resistor R16 is used to set the frequency. A diode, D1, is connected across the supply lead to isolate the output stage from mains line. Two of these stages are driven together to produce square waves from the emitter followers Tr1 and Tr2. The output of one stage is 90° out of phase with the other. The square waves are then converted to square waves with their frequency divided by 4 by the voltage divider formed by the bases of the output transistors and the clock input of a bistable multivibrator. The output of the IC is a square wave, the frequency of which is determined by the large and small resistor values R17 and R16.

The frequency is provided by a voltage regulator, IC3, which is close to the positive supply and provides a square wave frequency. In the absence of an input signal, the square wave is fed to the inputs of the inverter which is in operation. On mains input, the relay contacts switch and the battery charger is energised.

Overload protection
The usual way of detecting an overload electronically is to place a low-value resistor in high-current lines and use the voltage drop across it to switch a transistor. In this design, the 0.7V required to switch an overload detection transistor would have resulted in a power loss in the detection resistor of some seven or eight watts, which would have significantly reduced the efficiency of the inverter.

Fig. 1. Complete diagram of the inverter and battery charger circuits. Two antiphase buffered square waves from the clock input are converted to square waves by IC3, which is close to the positive supply and provides a square wave frequency. In the absence of an input signal, the square wave is fed to the input of the inverter which is in operation. On mains input, the relay contacts switch and the battery charger is energised.

This current is therefore switched alternately through the two halves of the low-voltage winding of the transformer.

Current is therefore switched alternately through the two halves of the low-voltage winding of the transformer.

The transformer used in the prototype was a 100VA transformer with a secondary rating of 100VA, but a 200VA transformer was used in later versions because of its lower losses.

Transistors Tr1 to Tr8 must be mounted on a heat sink with a thermal resistance of about 10°C. For the input signal, a 50Hz square wave is produced by two 50Hz square waves in antiphase at the input frequency. These waves are buffered and used to drive two Darlington stages connected to the output transformer. The relay coil is shown in its non-active state as the inverter is in operation. On mains input, the relay contacts switch and the battery charger is energised.

When construction is completed connect the battery, but no load or mains supply, and check current consumption of the circuit. Depending on the state of the battery, the current should be between 1A and 1.5A, unless the inverter is operating. To adjust R16 such that its slider is at the 'ready' end of the track and connect a load such as a 100W lamp to the output. Adjust R16 until the overload protection circuit just fails to operate. This makes sure that the overload circuit operates when the output is shorted, exercising extreme caution as the output voltage is potentially lethal. Next, remove the short, connect the mains supply and check that the relay operates correctly and that the battery is charged being at not more than 4A. Finally, with the mains supply disconnected, adjust R16 to set the 50Hz frequency. In the absence of a frequency meter the easiest way to set the frequency is to use the inverter to drive a record player with a stroboscope type speed checking system. If the turntable speed remains the same when the mains input is switched on and then off the frequency is correct. The lamp used to illuminate the stroboscope disc must, of course, be driven correctly and at the correct operating frequency.

This inverter often used a modulated carrier whose peak-to-peak amplitude is only one tenth of that of the unmodulated random noise, which is itself at a level of about 500 mV peak-to-peak. A positive indication is obtained from the squelch circuit when such a weak signal is present within 50 mV of power being applied to the circuit. For larger input signals the lock-up time is much reduced and this will always be the case when ordinary a.m. is being received. Moreover, for a.m. and f.m. reception, a much wider band width can be used and there is then no need for gates IC5A, IC5B, IC5C and IC5D can then be reduced to say, 1mA. Similarly, D2 and D3 can be removed and a much wider acquisition range obtained. If f.m. is received, the output is taken from pin 6 of IC5. In all cases the squelch output comes from IC5 and is independent of temperature and supply voltage from 2.5V to 5.5V.
Digital/anologue multimeter

In an effort to combine the ease of reading of an analogue meter with the accuracy of a digital display, Bach-Simpson have used a 1½ digit digital with integral bar-graph type indication in their latest multimeters. The Model 676 has a push-holding facility, mobility for convenience, an accuracy check, and direct indication down to 50mV. Percentage modulations and signal-tracing measurements can be made. Basic measurement error (direct voltage) is ±0.1%. Ranges covered by the 676 include 200mV to 1000V; ±0.1% to ±750V; ±0.05% to ±1000V; ±0.01% to ±2000V. 20mA to 2A — d.c. and a.c. and 20A in the same range. This model is operational and portable. Bach-Simpson Ltd, Weadecote, Crangwell PL72 6HD.

WWW305

Supply decoupling d.i.p. sockets

Available to combine a dual-in-line socket and integral power supply decoupling capacitor (the only discrete component required with logic I.C.s) can increase p.c.b. component packing density by 12% and cut the cost of decoupling by eliminating mother board component applications, claims the manufacturer.

WWW315

Dummy load

This film resistor technique has been used by KDI Pye Ltd to produce a miniature coaxial dummy load, with low distortion ratings of 20W continuous, 200W peak at a maximum heat-stink temperature of 100°C. The PCL-2000-45, 85V, 0.1A may be altered. This i.e. operates directly from the character generator in visual display units have

WWW308

Fibre-optic evaluation kit

Palfrey, a leading manufacturer of Fibre Optic Evaluation Modules comprising a p.c.b. line of modules and a d.t.t. compatible transceiver, five meter and a fibre-optic cable and a fibre-optic oscilloscope, is available from Fairchild. This kit, when connected to a single 5V supply, can be operated at data rates from 0 to 100Mbit/s. The brochure contains such topics as fibre-optic theory, fibre connector technology, and coupling losses and, of course, the module's technical specifications. Each module costs £31.72 excluding v.a.t. Fairchild Components and Instrument (UK) Ltd, 230 High St, Potters Bar, Herts EN6 1BB. WWW310

Pressure transducers

Five transducers covering pressure ranges from 100 to 100000 psi make up the Vernichat Model 9000 series available through Computer Controls Ltd. These pressure transducers weigh under 8oz, have a three-terminal potentiometer type output so that a voltage can be obtained directly.

WWW309

Power transistors

Experiments in Monozorca's high-power transistor range have been made to accommodate what they call a "large upcoming high-power control market". Five new series of transistors, the MJ10000, MJ10010 and MJ10020 with leFtron ratings of 50, 100 and 200W, and MJ10030 with ratings of 450, 450 and 250V respectively. These transistors are designed to operate at frequencies from 300 to 1000Hz. The MJ10010 series are rated at 60A and can be obtained with reverse voltage ratings from 150V to 1000V. Three common-carbide dual

WWW304

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WWW304
Why not some jam today?

The Bill to give birth to the Act that will cut the umbilical cord joining British Telecom to the rest of the Post Office is labouring its way through the normal Parliamentary processes.

But, even though, as far as I can make out, it does not yet have an official identity, this lively youngster has already made its presence felt in more ways than one. Before we’d even had time to get used to the name or make sense of the new logo — part of which appears to be written in Hebrew — BT, under the approving eye of its proud parent, Peter Benton, got itself involved in what history may call The Great Yellow Paint Controversy. And if you know of a better way of arriving with a bang I’d like to hear about.

BT’s chairman, Sir George Jefferson, whom we can dub its putative grandfather, has played no mean role in putting his organization on the map of the public mind. In a number of weighty statements, supported by snowstorms of releases from the Press Offices, he has chronicled BT’s past achievements, told us about what is under way now and lifted the lid off some of the goodies we can expect in the future.

And he has reminded us, as a rider, that if BT should be congratulating itself while doing things. But later, when the scoffers laughed at Remington when he sat down and served truffles out of season, would BT’s chairman, Sir George Jefferson, whom we can dub its putative grandfather, have been satisfied with the performance of Prestel?

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A better break for Prestel

Meanwhile, back at the Post Office, the failure, in spite of intensive promotion, of Prestel to take off at the rate hoped for must be causing a fair bit of brow-furrowing.

Come to think of it, it furrows my brow as well. I would have thought that a facility for selecting, at the touch of a button, a five-star restaurant, not more than a mile off the M1, which features a full symphony orchestra for dancing on Saturday nights and serves truffles out of season, would have been snapped up like a pelican gulping down a sardine. One cannot help thinking that there is something wrong with a world whose inhabitants are reluctant to fork out a few hundred pounds for the pleasure of spending an evening playing ballistics, being psychospooked or taking part in a spelling bee. But there I go, mocking again . . .

Perhaps the trouble lies in the average Briton’s inbuilt resistance to change. They laughed at Caxton’s printing press when he gave his Jenny her first spin. Cartesian’s printing press was a case for ridicule and it’s only a matter of time. This notable achievement deserves a much more positive recognition, than it is currently getting — especially from the business world which it is uniquely capable of serving.

New thinking on the news

Still on the subject of information technology, I see that’s good news from the teletext front. One major set manufac­turer reports that, following the Spring trade show, their sales of teletext receivers are up by 250 per cent on last year. A spokesman expressed the company’s pleasure — which don’t seem to me to be all that startling a revelation — at this trend and added that the multiples have come to realize just how wide the scope of the teletext market is.

When I was at school the law of econo­mics held that an increase in the sales of a product should, all things being equal, be followed, as night follows day, by a cut in its price. Nowadays the trend is to up the price and then point out how much bigger the increase would have been if there had been no jump in sales. Nonetheless, if other setmakers have a similarly joyful tale to tell, the great British public will be looking for some movement in the price sector.

There is another angle to this. If teletext is now well and truly on the way to wider public acceptance, the broadcasters have a wonderful opportunity, if not a duty, to improve the service they give to viewers. This particularly applies to the updating of local news.

Recently, being of an investigative, scientific turn of mind, I conducted a selective experiment. In our home, being the only male, I tend to rise early in order to read the morning newspaper. However, when I was at school the law of econo­mics held that an increase in the sales of a product should, all things being equal, be followed, as night follows day, by a cut in its price. Nowadays the trend is to up the price and then point out how much bigger the increase would have been if there had been no jump in sales. Nonetheless, if other setmakers have a similarly joyful tale to tell, the great British public will be looking for some movement in the price sector.

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Recently, being of an investigative, scientific turn of mind, I conducted a selective experiment. In our home, being the only male, I tend to rise early in order to read the morning newspaper. However, it was a kind of defence mechanism, an instinct that if I didn’t hear the news before it was packed into the baggage compartment I would be left in the dark. But later, when the scoffers became convinced of the enormous advantages these innovations offered, they were welcomed with open arms.

The need for information has until now been met in two traditional ways: by talking to informed experts on the subject concerned, or by consulting standard reference works or other authoritative published data. What’s the difference, then, between that technique and Prestel? Not all that much. One’s ‘talks’ to the computer and it ‘answers’ by displaying the information you’re after. Of course, even with its memory of hundreds of thousands of pages, Prestel’s range of information is still relatively limited, compared with that found in a conventional library. But extension is only a matter of time.

This notable British achievement deserves a much more positive recognition, than it is currently getting — especially from the business world which it is uniquely capable of serving.

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Output Voltage 0-200V
Output Power 10W
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Applicants must hold a minimum qualification of ONC in electronics or equivalent.

Salary is £223 rising to £675 per annum.

New entrants into the Health Service will commence on the beginning of the salary scale.

An application form and job description may be obtained from Mr J A Simpson, Area Engineer, New Cross Hospital, Telephone Wolverhampton 732265 Ext. 3735.

Closing date: 25th September 1981.

Technican (Mobile Radio)
to £8500

Western Home Counties

This subsidiary of a world-wide group markets a diverse range of electronics and electronic products throughout the UK.

They are looking for a Technician to install and service a range of mobile telephone products. The successful candidate will be responsible for the service support offered by the Sales Team and may include involvement in a product training and development programme.

Applications are invited from candidates qualified by experience, and preferential treatment will be given to those with qualifications in electronics or similar technical field.

Salary is £223 rising to £675 per annum.

New entrants into the Health Service will commence on the beginning of the salary scale.

The successfully appointed will receive a competitive benefits package including company car and telephone.

Applications should be made to: Gerrard Recruitment Service, 25 Chapel Rd, Moseley Rd., W14 4LF. Tel: 01-727 5481.

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Railway Telecommunications Projects Management
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The world-wide revival of interest in rail transport and mass-transit systems is providing the greatest ever challenge and opportunity for companies manufacturing railway signalling and control equipment.

To meet this challenge it is necessary to harness telecommunications techniques to established and proven railway control systems.

Our British client, an internationally respected leader in this field is therefore looking for an engineer conversant with the latest developments in telecommunications and thoroughly familiar with present and potential applications and sources of supply. Working as Project Manager within a multi-disciplinary team of engineers the person appointed will be responsible for the service support offered by the Sales Team and may include involvement in a product training and development programme.

Salary is £223 rising to £675 per annum.

New entrants into the Health Service will commence on the beginning of the salary scale.

The successfully appointed will receive a competitive benefits package including company car and telephone.

Applications should be made to: Gerrard Recruitment Service, 25 Chapel Rd, Moseley Rd., W14 4LF. Tel: 01-727 5481.

Gerrard Recruitment Service

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Inorganic Chemistry Laboratory

Shell Experimental Officer

Applications are invited for the above post established by Shell Research Limited, Oxford, for 5 years, with possibility of renewal to an established grade 1A post, to provide instrumentation services to the Inorganic Chemistry Laboratory. The position requires a thorough knowledge of repair and calibration of the leading Test equipment manufacturers, e.g. Tektronix, Hewlett Packard, Fluke and Marconi.

The successful applicant would join a team of technicians working in a friendly environment but must be capable of working with a minimum of supervision.

For further details please contact: Mike Jones Technicial Director ELECTRONIC BROKERS LIMITED 61/65 King's Cross Road London WC1X 9LN Telephone: 01-278 3461, Ext 35

Electronic Brokers

Service/Calibration Technician

Electronic Brokers Ltd are Europe's leading suppliers of refurbished Test and Computer equipment. Due to internal promotion we have a position available in our service department for an experienced Technician. The position requires a thorough knowledge of repair and calibration of the leading Test equipment manufacturers, e.g. Tektronix, Hewlett Packard, Fluke and Marconi.

The successful applicant would join a team of technicians working in a friendly environment but must be capable of working with a minimum of supervision.

For further details please contact: Mike Jones Technical Director ELECTRONIC BROKERS LIMITED 61/65 King's Cross Road London WC1X 9LN Telephone: 01-278 3461, Ext 35

Electronic Brokers
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Put your experience to the test.

That's the challenge we're throwing open to qualified, experienced men and women who want to use their skills in a stimulating environment on a wide variety of sophisticated equipment.

In the BBC's Equipment Department - based at Chiswick, West London - we manufacture prototypes and small batches of high technology equipment for use in broadcasting. The work is varied - it's not just production - and involves testing, diagnostic fault finding and calibration of digital, analogue and signal processing equipment.

Your qualifications could be T.E.C. Certificate or equivalent - but experience and enthusiasm are essential and your job may well have a lot in common with your hobby. Current salary scales range to £6695 per annum, and benefits also stand up well to close inspection - they're very attractive. If you hold a Higher T.E.C. Certificate with salaries ranging to £8982 p.a. are available.

Give us a ring or write if you want more information and an application form to: P.W. Green, BBC, Avenue House, Power Rd., London W4 5PG.

(Tel: 0-994 8541 Ext. 232.)

MICRO - R & D

A company has been formed by a well known successful U.K. Group to develop high technology electronic products and it has strong group financial and managerial support: hardware and software engineers are required with background, experience and qualifications in micro technology to speed the progress in development and production of micro computer systems and dedicated micro processors and communication devices. Joining this powerfully backed new company will provide good prospects and salaries will recognise the creative nature of the work and will be negotiable for senior engineers.

Apply (in confidence) to:

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C/O Wireless World, Quadrant House, The Quadrant, Sutton, Surrey SM3 4AS.

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Senior Television Engineer

£8625-£9463 p.a. inc.

An opportunity to join a specialist team supporting teaching using the Polytechnic's extensive film and television facilities.

Based at Cockfosters, North London, your responsibilities would include the design, installation and maintenance of all systems and the supervision and training of technical operations staff.

A wide range of experience in the maintenance and operation of television studio equipment, with particular emphasis on colour systems at professional broadcasting level, is essential, together with appropriate qualifications.

Write quoting ref. L320D for further details and an application form, posting first class.

MIDDLESEX POLYTECHNIC

Senior Engineers are required with appropriate qualifications in micro technology to work with a specialist team supporting teaching using the Polytechnic's extensive film and television facilities.

The Quadrant, Power Rd., London NW1 1HG

Telephone: 01-637 6551 Ext. 291

Senior Electrical Engineer

£12,000 to £14,000 pa.

A valuable opportunity has arisen for a full time senior electrical engineer to join a high tech company.

A number of vacancies exist in all branches of electronics and electronic engineering.

T.J.B ELECTROTECHNICAL PERSONNEL SERVICES is a specialised appointments service for electrical and electronic engineers. We have clients throughout the UK who urgently need technical staff at all levels from Junior Technician to Senior Management. Vacancies exist in all branches of electronics and allied disciplines - right through from design to marketing - at salary levels from around £4000 to £12000 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 6AS.

Tel: 0622 393968

WIRELESS WORLD SEPTEMBER 1981

BIRKBECK COLLEGE

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Part-time Evening Degree Courses in Physics October 1981

Birkbeck offers evening courses leading to B.A. and B.Sc. Honours degrees and degrees of the University of London. Courses are designed so that students may continue to earn their living during the day time. Interviews for courses in Physics (to commence in October 1981) will be held from June onwards:

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A comprehensive course in theoretical and experimental Physics covering all the major fields. Physics is also available with Mathematics or Chemistry for a Combined Sciences degree.

M.Sc. Nuclear and Particle Physics

A two-year course, two evenings a week, with provision for theoretical or experimental projects.

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Starting October, 1982, a new two-year course on the theory of the electronic properties of solids, with practical applications to semiconductor devices.

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Part-time and full-time research students may be accepted in the following fields:

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(b) Experimental: Atomic, High Energy, and Solid State Physics

Further information and application forms may be obtained from the Assistant Registrar, Birkbeck College, Malet Street, London WC1E 7HX (Tel: 01-637 9563, answering machine out of office hours), or from the Physics Department at the College (Tel: 01-680 6822, ext. 289).
Engineer - Transmitters

We have a vacancy for an Engineer (male or female) to work in the Transmitter Project Section of our Station Design and Construction Department.

You will be required to assist in the preparation of specifications for transmitter and associated equipment including the subsequent analysis and evaluation of tenders. You will also assist in the installation and commissioning at site and will also be involved in the evaluation of new equipment and systems. Some design work will be involved, therefore, ideally you should have a good knowledge of microprocessors and software based systems.

You should be qualified to degree level in Electrical/Electronic Engineering and have had formal engineering training in broadcasting technology or a related field. You should also have several years post training experience in industry or broadcasting, in engineering on transmitters and associated equipment. A current driving licence is essential as the post involves travel from base.

The commercial salary (depending upon qualifications and experience) will be on a range which rises to £14,000. Salaries are currently under review. Relocation expenses will be paid where applicable.

IBA
INDEPENDENT BROADCASTING AUTHORITY

Please write or telephone for an application form quoting reference number WW/2624 to: Christine Gosling, IBA, Crayville Court, Winchester, Hampshire, SO21 2QJ. Telephone 822270.

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1 MARKETING MANAGER with digital design background to support area of computer based A.T.E. in Europe, Africa and Far East - £14,000.

2 SUPPORT ENGINEER to provide Technical Support and development engineering. £8,000 to £10,000.

3 Q.A. ENGINEER work on Micro-Electronic, Commercial and Military equipment. £11,000 to £15,000.

4 ELECTRONIC TECHNICAL STATEMENTS (ET) B.E. or equivalent. £7,000 to £8,000.

5 SENIOR ENGINEERS to design / install equipment. £12,000 to £14,000.

6 PROMOTION ENGINEER with experience of microcontrolled systems. £14,000 to £16,000.

7 CHIEF ELECTRONIC ENGINEER with experience of microwave control systems. £16,000 to £18,000.

8 TELECOMMUNICATIONS ENGINEERS with U.S. Embassy experience in the REMA area. Must have strong technical background and five years experience. £14,000 to £16,000.

9 ELECTRONIC INSTRUMENTS INSTRUCTOR with Electronics and Physics knowledge in the electronics field. £9,000 to £10,000.

10 ELECTRONIC TECHNICIAN with experience in design. £6,000 to £8,000.

11 SENIOR TECHNICAL INSTRUCTORS. £9,000.

12 TELECOMMUNICATIONS ENGINEERS with U.S. Embassy experience in the REMA area. Must have strong technical background and five years experience. £14,000 to £16,000.

WANTED

Full time position as

TELECOMMUNICATIONS TECHNICIAN

with U.S. Embassy component in the REMA area. Must have strong technical background and five years experience in at least one of the following fields: land mobile radio, link planning, data communications, CCTV, line communications, PA/B and Frequency planning.

Starting salary (under review) £10,625.

TO HOME OFFICE

PROJECT LEADER. £11K +

Senior Engineer required, 28+, with 280 H/W/SW experience, Herts area.

DIGITAL DESIGN ENGINEERS. £8K +

Experienced Engineers with background in digital TV systems, Berks area.

SOFTWARE ENGINEERS. £8,5K +

Must have experience in 280 H/W/SW, Herts area.

WE HAVE LOTS MORE JOBS FOR EXPERIENCED ELECTRONICS/COMPUTERS ELECTRICITY ENGINEERS SALARIES TO £15K

Contact: Roy Bostock, Blue Arrow Executive Selection
50 Bedford Street, London WC1 01-2140 0833/8 (0207)"
Develop your potential in our future

Transmitter Training Engineer at Pye TVT, Cambridge

Pye TVT of Cambridge is a world leader in the design, manufacture and marketing of professional broadcasting equipment. This year we were awarded the Queen's Award for Exports. (They amounted to 90% of our turnover.)

Our involvement with transmission equipment has been growing rapidly and this position has been created to assist the Transmitter Training Manager in dealing with the substantial increase in customer and staff training commitments.

To qualify, you should be in your late twenties or thirties, have earned an HNC, C.I.E. or Engineering Degree, and spent at least two years with a broadcast organisation. An ability to speak French or Spanish would be a distinct advantage - if not, then you must be willing to learn. You must also be able to communicate information directly and accurately in a pleasant manner.

Your principle duties will include the preparation and running of training courses on company products, assisting with the collection of courses for customer training programmes and liaising with other training establishments working for the company.

As well as many opportunities for travel, we are offering a pleasant working environment, subsidised catering and leisure facilities and an excellent remuneration package.

Why not contact Lynn Osborne at Pye TVT Ltd, Coldham's Lane, Cambridge CB1 1TD, telephone (0223) 453165 for an application form and further details? She will be pleased to hear from you.

Pye TVT Limited
The Broadcast Company of Pride

Join us in the forefront of technology

HF-VHF-UHF

Microwave Optics & Acoustics
A challenging and full career in Government Service

Candidates, normally aged under 30, should have a good honours degree or equivalent in a relevant subject, but any candidates about to graduate may be considered.

Applications as Higher Scientific Officer (£6,075-£7,999) or Scientific Officer (£4,805-£5,640) according to qualifications and experience. Promotion prospects.

Please apply for an application form to the Recruitment Officer (Dept. WW/81), H.M. Government Communications Centre, Hamilton Park, Milton Keynes, MK17 8HJ.
MAINTENANCE ENGINEER

The Television Centre produces a range of educational programmes in the form of video cassettes, sound cassettes and 16mm film. The Sound section of the Television Centre is expanding and, as a result, the position of a Maintenance Engineer has been created.

The successful candidate will be responsible for the maintenance and repair of professional equipment, both standard and specialist, as well as the supervision of the maintenance staff.

Applicants must have relevant technical qualifications (a knowledge of digital techniques would be an advantage), and should have good experience in the field, though consideration would be given to any who demonstrate the necessary qualifications and the Authority will pay for attendance at specialist manufacturer’s courses where these are considered necessary.

SOUND ASSISTANT

This is a largely unstaffed role requiring the enthusiast, but with periods of studio duty (drumming, bono operation, tape and grn.). The work is largely film recording using the Nagra, but with periods of overtime often necessary, particularly where travel to locations is involved.

Although applicants should have a thorough knowledge of sound techniques, as well as being familiar with a film environment, consideration will be given to those who are willing to learn, but who have appropriate technical qualifications and experience elsewhere in the sound-recording field.

WANTED

Electronic Technician

Salary range E5607-E6420 and E500/

The Authority, in association with its various functions, operates a wide range of telecommunications, telemetry, communication and control systems.

A Technician is required to join a team responsible for maintaining and installing all aspects of the equipment throughout the County.

Applicants, who should be qualified to TEC Ordinary or Higher level (or equivalent), should have had several years’ experience in electrical or electronic servicing. A basic knowledge of computers and programming would be an advantage as would previous experience on VHF radio-telephone systems.

The person appointed will be based in the Division’s workshops at Bridgewater and will be required to hold a valid full driving licence.

Closing date: 3 September 1981.

Application forms and job description obtainable from Divisional Personnel Officer, PO Box 5, King Square, Bridgewater; Tel: 57333.
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Ameri-Can Sales, 1550 West Empire, Toronto, Ontario M6J 1W6.

PUBLICATION AND ADVERTISING OFFICE

Antex (Electronics) Limited, 515-549 West 18th Street, New York, N.Y. 10011.

Wireless World, September 1981

WIRELESS WORLD SEPTEMBER 1981

AMBISONIC SURROUND SOUND DECODER MODULE

with STEREO DECODE FACILITY

Based on our hi-fi Ambisonic decoder which has received much critical praise, we have produced a module so that enthusiasts can build the Ambisonic facility into their own hi-fi equipment. Great care has been taken to ensure that the sound quality is as good as possible particularly in respect of noise and distortion. In addition a special stereo decode facility is included which enables smooth results to be obtained between conventional stereo sources and Ambisonic sources which can be controlled by the user with the stereo width control.

The module is fully built using component parts, high grade attack and decay, and tested to meet N.R.D.C. specifications. It is suitable for use with each Terraria decoder with over 50 measurements. As with all our modules quality and high performance are guaranteed.

Please send us further information on Mini Modules Ambisonic Decoder/Weekly Programmable Timer.

Mini Modules

Minim Electronics Ltd, 256 East St, Plymouth, Devon, PL2 1NY. Telephone: (0752) 452967.

RECEIVER FACTILITIES

UHF/VHF Format Ambisonic decoder
Stereo decode with adjustable width control
Stereo bopass switch
5-position switched precision layout control PCB

100 x 10mm with 3 push switches

Layout with component assembly mounted in a metal casing with a control panel adjustable from 50 to 70 after installation

(Price is inclusive of N.R.D.C. licence fee, N & S included)

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