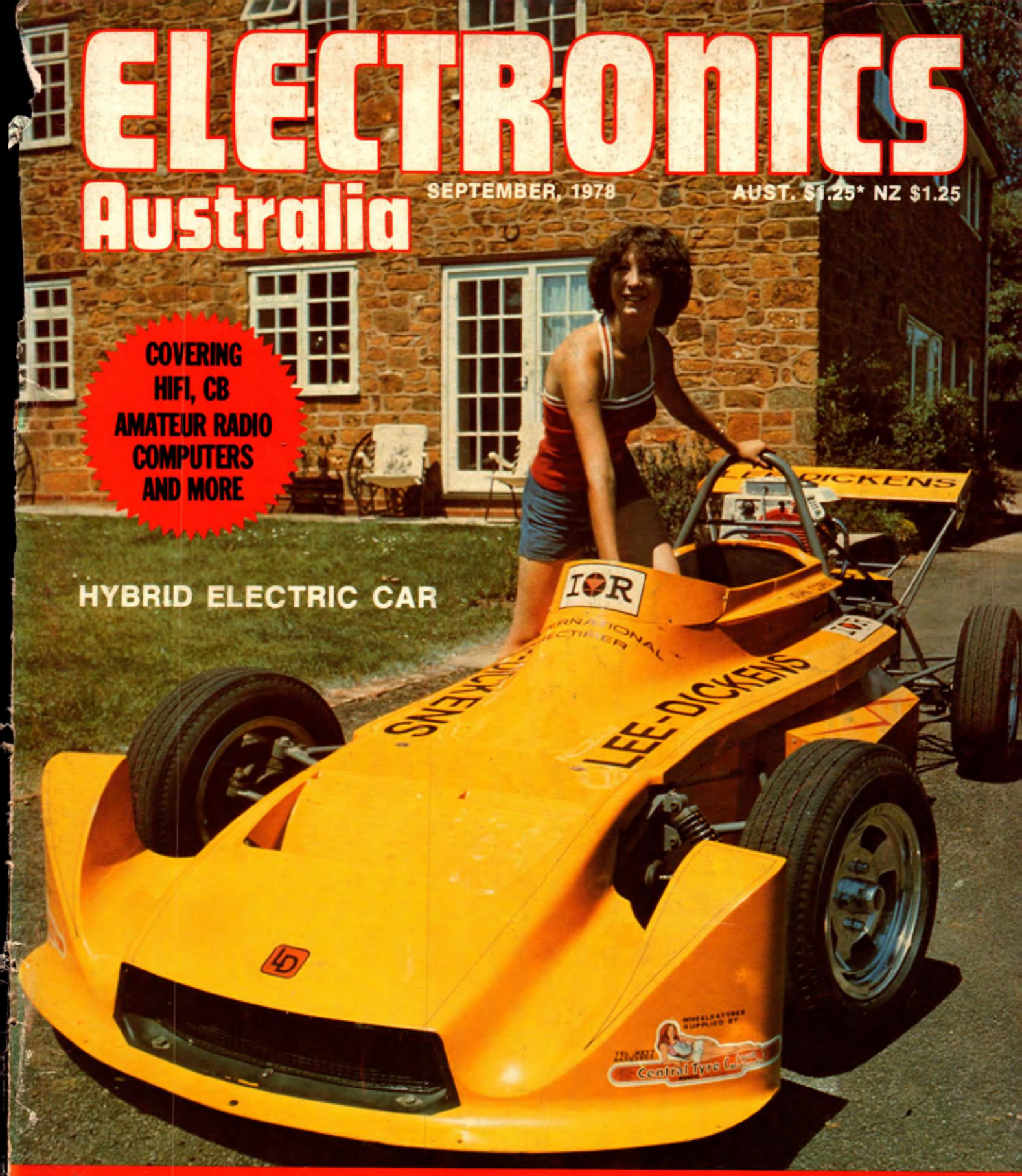
ELECTRONICS Australia

SEPTEMBER, 1978 AUST. $1.25* NZ $1.25

COVERING HIFI, CB AMATEUR RADIO COMPUTERS AND MORE



IS LOW COST SOLAR POWER ON THE WAY? ★ HOW TO TRACK AMATEUR RADIO SATELLITES ★ NEW MIXER FOR SOUND MOVIES & RECORDING ★ FET-INPUT VOLTMETER

THE LOGICAL CHOICE

SONYS NEW TC-K7II

REDUCING WOW & FLUTTER TO LESS THAN 0·045%

Introducing the King of Sony's new K series cassette decks. The outstanding TC-K7 II with Sony's most advanced electronic and mechanical engineering.

This is a deck that not only has specifications that are superior to many open reel decks but features easy to operate, gentle touch, logic controls in all tape transport modes. There is no need to push the stop bar when changing modes and should the wrong mode be selected accidentally, no damage can occur to your tapes or your deck. All modes including "record mute" can be activated from the optional remote control unit (RM 30).

How do Sony achieve that incredibly low wow and flutter figure (0.045% WRMS). Firstly by using a two motor system, each designed to do a specific job. One motor is for reel drive and Sony's New Tri-Duty Motor handles the capstan drive. The Tri-Duty Motor is a superb piece of engineering and with its servo system,speed variations caused by either line voltage fluctuations or tape load are virtually eliminated.

The TC-K7 II features a "Double" integrated, recording and play back level indication system. Dual, high quality VU meters are augmented by three instant reacting LED peak level indicators, set at "0" and at +4 and +8 dB, so that the oversaturation of recording circuits can be prevented.

Naturally the TC-K7 II has Dolby but it also has an MPX filter defeat (Filter off) mode, a record mute facility and a three position memory rewind and replay facility. The tape select system has three step bias and three step equalisation selectors, giving nine possible positions, for optimum performance from a wide variety of tapes.

At the heart of this deck there's Sony's Ferrite and Ferrite head, hard and highly polished, like black diamond, to give years of head life.

The combination of Sony engineering and research with logic controls and Sony's new Tri Duty Motor produces a cassette deck that must be the choice of discerning Hi-Fi enthusiasts: A sound logical choice.

CHECK THESE EXCEPTIONAL SPECIFICATIONS

Frequency Response	20 Hz — 18,000 Hz (FeCr)
	20 Hz — 17,000 Hz (CrO2)
S/N Ratio	60 dB (FeCr, Dolby off, peak)
Wow and Flutter	0.045% WRMS
Harmonic Distortion	1.3%

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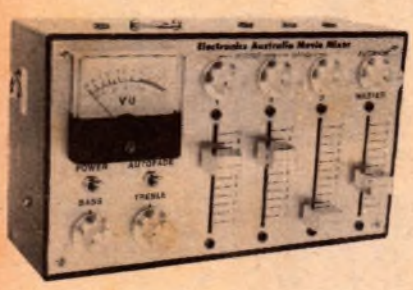
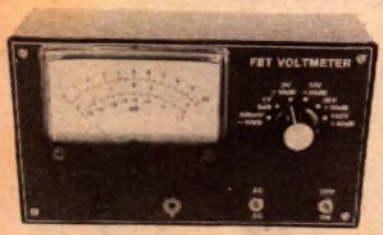
Australia's largest selling electronics & hi-fi magazine

On sale the first Monday of each month

VOL. 40 No. 6 SEPTEMBER, 1978



Our new 3-input audio mixer design features tone controls, a level meter, a headphone monitoring output, and auto-fading. Full construction details start on p42.



High input impedance and wide frequency response are the main features of this compact new meter which employs a single IC. Details on p74.

On the cover

This new British hybrid electric car has a system that recharges its own batteries. In the "boot" is a petrol generator, designed to replace a conventional engine, and adjacent to it are four 12V heavy duty car batteries. The batteries and a 1.86kW electric motor fitted over each of the rear wheels are charged and driven in parallel by the generator. The method could cut fuel consumption in half for a 2-litre sized car. (Photo courtesy British Information Service). See also Forum, p17.

FEATURES

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DEPARTMENTS

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Editorial Viewpoint

The channel 5A problem . . .

During recent weeks, there has been vigorous protest from the amateur fraternity over reported Government plans to make greater use of TV channel 5A. Amateurs fear that, since Channel 5A is immediately adjacent to their own 144-148MHz band, interference problems could lead to a restriction of amateur activity on that band.

While there is undoubtedly some ground for such fears, amateur protests have been weakened by a tendency to substitute emotive statements for hard, proven fact. For example, one correspondent rounded off his letter to us by suggesting that we needed only to ask any amateur in the Wollongong area to discover how serious the problem was.

This last observation surprised us because, despite all the 146MHz traffic between Sydney and the South Coast, we had never as much as heard mention of interference problems. And, when we started asking questions, it seemed that few South Coast amateurs had heard of them either! Even the local radio inspector had to rack his brains to remember any complaints from TV viewers involving 146MHz interference.

Faced with that kind of evidence, the authorities might be forgiven for concluding that the amateurs were "crying wolf". As someone remarked to me: if there is a real interference problem with channel 5A, the amateurs should surely be in a position to demonstrate and document it in the field.

In fact, it would appear that the greatest potential problem is not in the normal service area of a main regional 5A transmitter, because its direct signal can usually over-ride possible interference from amateur stations. It concerns, rather, possible penetration of amateur signal into translators tuned to the regional transmitter. This would affect, not just the isolated viewer, but every receiver tuned to the particular translator!

Assuming that greater use does have to be made of channel 5A to help clear the FM band, the critical thing is therefore to pressure the authorities to do what they have already done for many other translators: to feed them via UHF.

A further and logical step would be to instal, not just a UHF link, but a UHF service in parallel with the main 5A regional. Viewers could be encouraged to use the UHF signal to reduce dependance on 5A, and to hasten the day when it could be phased down and out.

Indeed, it should be possible, as funds permit, to parallel other troublesome VHF channels with a UHF service, so that our spectrum problems will gradually wind down rather than up!

— Neville Williams

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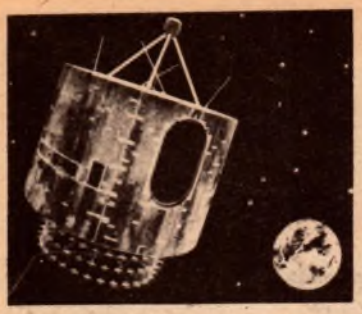


News Highlights

Tokamak for Sydney University

Imagine a flash, a bit longer than the flash from a camera, a deep pinkish red in colour, happening once a second for most of the day and night. This is what the new tokamak at the School of Physics, Sydney University, will be emitting when it is completed next year.

Incidentally, a tokamak is a doughnut-shaped plasma confinement device for research into the problems associated with nuclear fusion.

Nuclear fusion (the fusing together of atomic nuclei, as opposed to the splitting, or fission of nuclei) holds out the exciting prospect of providing a pollution-free and inexhaustible source of electrical power.

Large research projects costing hundreds of millions of dollars are in progress overseas, and many scientists are optimistic that fusion will become feasible within the first decades of the next century. Countries like Australia can assist with small, inexpensive projects which can supply vital data despite their small size and cost.

Sydney University's tokamak will be about 1½ metres in diameter and will stand about 2 metres high. It will be, in the words of Mr Hugh Kirbie, a "real crowd pleaser". The machine will be built with 24 diagnostic ports, at least 6 of which will be available to look inside at the glowing plasma.

The tokamak is a busy machine. Before each experiment it needs to spend from 7-15 hours discharging once a second. This cleans out impurities which gather on the walls inside the doughnut-shaped device. The impurities, consisting of oxygen and carbon, occur because of air leaks or oil impregnation.

The impurities could cause difficulties when the hydrogen gas inside is repeatedly heated up to 1 million degrees or so for short periods to experiment on plasma containment and diagnosis. In discharge cleaning, the hydrogen combines with the carbon and oxygen to produce methane which is pumped out of the system.

From left to right: Dr Rodney Cross, Dr Brian James, Mr Hugh Kirbie, and Associate Professor John Lehane with a model of the proposed tokamak.

First trials for wave energy rafts

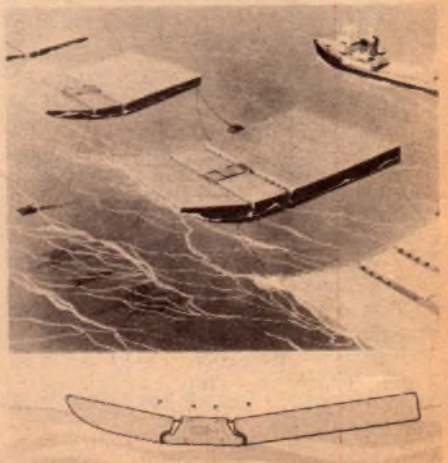
Shown in the accompanying photograph is an artist's impression of articulated wave energy rafts, designed by hovercraft inventor Sir Christopher Cockerell. Such a system could eventually convert power from the waves into electricity in sufficient quantities to feed into Britain's national grid. One is already undergoing trials off the coast of Britain.

The Cockerell Raft consists of a series of pontoons linked together and designed to take advantage of the alternating crest and trough of each wave, the relative movement of the adjacent pontoons producing a motion from which energy can be extracted. This is done either by a gearing system or via hydraulic rams (see lower diagram) which in turn drive electrical alternators.

Trials off the coast of England using one tenth scale models of the Raft were set up recently to verify results obtained in small scale tank testing of the device. The trials were held in wave conditions approximately one tenth the height of those found in the Western Isles of Scotland and the Western Approaches to the English Channel.

Experts calculate that a 965km stretch of wave energy machines set in those areas could, in principle, provide about one half of the UK's present electricity demand.

Britain is among world leaders in wave energy extraction research at a time when fossil fuels are becoming increasingly scarce.



IBA tunes to satellite TV

British engineers at the Independent Broadcasting Authority (IBA), Crawley Court, Winchester, are now receiving super-high-frequency (SHF) beacon transmissions from the new European Orbital Test Satellite.

The short-term objective of IBA space research is to prepare for Eurovision program exchange via satellite in the early '80s; and in the longer-term to prepare for possible direct broadcasting to homes from space satellites.

The Orbital Test Satellite (OTS) of the European Space Agency was successfully launched from Florida on May 11, 1978 and has now been manoeuvred into position at approximately 11° east.

The objectives of the current European space experiments are to gain experience of television working with satellites; to obtain detailed knowledge of the depolarisation and other effects of weather on SHF signals; to assess the performance of future satellite systems for television distribution and direct broadcasting to homes; and to assess the performance of different forms of modulation, including frequency and digital modulation systems.

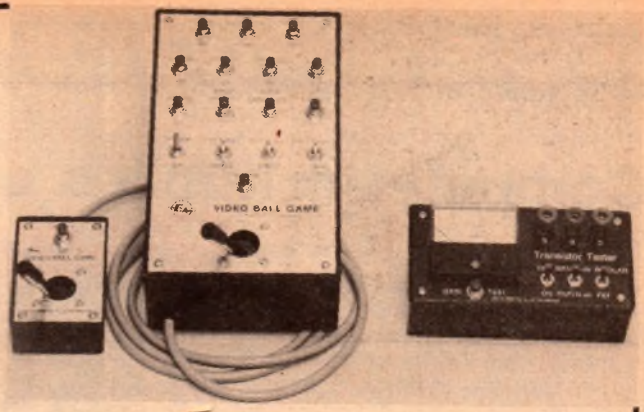
New Tandy stores

Tandy Electronics recently announced the opening of three new stores to bring its Australian tally to 117. The new store locations are: 525 Brighton Rd, Brighton, South Australia; Shop 85, Belconnen Mall, Benjamen Way, Belconnen, ACT; and Shop 26, Woodridge Plaza, Wembley Rd, Woodridge, Brisbane. 1978 is Tandy's fifth year of retailing in Australia.

Cordless soldering iron

Released around two years ago by Scope Laboratories (Melbourne), this 60W cordless soldering iron is powered by a pair of NiCd D cells and can reach operating temperature in 6-10 seconds. It can solder over 100 light electrical joints between recharges, and can be recharged between jobs and overnight with a car or workshop recharge accessory. For further information, contact Scope Laboratories, 3 Walton St, Airport West 3042.

Kits for EA Projects



Dick Smith Electronics has produced kits for two recent EA projects: the Video Ball Game and the Transistor Tester. Both were featured in the July 1978 issue of EA.

The kits contain all parts needed to build the projects, except batteries. In addition to electronic parts and hardware, they contain prepunched and anodised front panels which give the projects a "professionally-made" appearance.

The Video Ball Game Kit (catalog number K-3491) is priced at $49.50 and the Transistor Tester Kit (catalog number K-3052) $17.90. They are available at Dick Smith stores or by mail order (post and packing extra) from PO Box 747, Crows Nest, NSW 2065.

Neutron "gun" fights cancer growths

This £1 million cyclotron unit at the Western General Hospital in Edinburgh, Scotland bombards a cancerous tumour with a rapid stream of neutrons that can reach the 'target' without damaging surrounding healthy tissue.

It is the first unit to be based entirely on the new fast neutron therapy treatment of cancer in place of conventional radiotherapy methods. It is also the first unit in the world to be fitted with a steerable beam which can fire its concentrated high speed neutron stream at a patient's body from all angles. This is expected to increase considerably the success rate in treating cancerous tumours that have resisted conventional treatment.

Teletext tests in Sydney & Melbourne

A series of Teletext test transmissions has been carried out in Sydney and Melbourne under the supervision of the P & T Department. The tests, which took place on 29th June last, were conducted to determine the interference effects of Teletext transmissions on domestic television receivers under a wide range of conditions.

Tests were carried out to determine the effects of:

- varying the number of Teletext lines transmitted;
- varying the line positions of the Teletext signal; and
- varying the percentage level of the Teletext signal.

In addition, a number of other tests were carried out to assess the performance of a number of specially fitted Teletext decoders. The tests will help determine Australian standards for a possible Teletext service.

More than 1000 people took part in the survey, most generally associated with the local TV industry in one way or another. The tests originated in Sydney, and were put to air simultaneously by ABN-2, ATN-7, and TEN-10. Telecom bearer circuits were used to relay the signals to Melbourne for transmission by ABV-2, ATV-0, and HSV-7.

Signals were also relayed to ABAV-1 for transmission in the Albury-Wodonga area.

Developed by BBC and IBA engineers in Britain, Teletext is a technique whereby data is transmitted during the vertical blanking periods of a normal TV transmission. This information can be called up and displayed on the screen by the home TV viewer.

NEWS HIGHLIGHTS

Computer-controlled editing of TV programs

The editing of special visual effects into television programs by manual instructions and switching is a thing of the past at Video Tape Corporation, Sydney's largest television tape and film post-production complex. A computer is now doing the job.

The company's recently installed $500,000 computerised electronic editing complex is proving a very effective new technical aid, not only for producers of episodic-type programs but also for producers of television commercials, of which VTC processes a large share.

Previously, a producer editing videotape or film footage had to list all the cuts, colour variations, wipes, and fades he wanted in the job. He indicated the exact spot in the footage he wanted this done, and then left it to a control room technician to do this with split-second timing as he viewed the tape or film.

Now technical and editing instructions are prepared in the form of code numbers and fed into the memory of a CMX 340X computer editing system. This in turn is linked to a Control Dynamics Vision Switcher and a bank of four VPR-1 Ampex 1-inch videotape recorders.

The tape or film is run, and the computer does the rest. The visual effect or editing is exact and achieved more efficiently than human hands operating a bewildering array of control switches.

Picture shows the heart of Video Tape Corporation's new editing system. The vision switcher is situated at left, while the computer terminal is at right.

Roger Weatherstone, Manager of Video Tape Corporation, explained that the new complex cuts down the time involved in post-production, besides permitting a greater range of visual effects with either videotape or film. And, it will enable Video Tape Corporation to provide a faster turnaround of work to producers and production companies and free its technical staff for other urgent duties.

Dutch buy Viewdata know-how

The Netherlands has recently signed a contract to buy British Post Office know-how on the Viewdata system. Viewdata is a revolutionary communications system that enables people to call up information from computer data banks via the telephone network and have that information displayed on their TV sets.

The Netherlands is the second country to decide to acquire software for Viewdata, the first overseas sale going to West Germany in August last year. The contracts with Germany and the Netherlands are of the two-fold value: they will help ensure a common Viewdata standard; and will enable the development of one basic IC chip for international application.

New VCRs launched in Australia

With VCR sales in Europe and the USA booming, three new long-play VCR models have recently been released in Australia to compete with the previously released Philips N1700 unit. The new models, from Akai, Sony and Grundig, feature playing times of 3 hours, 3¼ hours, and 5 hours respectively. They were recently demonstrated to the technical press by Mr Derry Weis, owner of Consolidated Video Industries, 2 Guilfoyle Ave, Double Bay, 2028.

Prices of the three models vary in accordance with playing time and facilities. The Akai VS 9200EA unit is the cheapest of the three at around $1295. Main features are a 24 hour timer and a memory rewind facility. The Sony Betamax, at $1399, costs a little more than the Akai unit, but offers a 3-day timer and 15 minutes longer playing time.

The Grundig 4004 is the most advanced of the three units. It features 5 hours of playing time, a 10-day timer, remote control, and a facility to set the unit to record more than one program in advance. Retail price is around $1695.

Retailer Derry Weis demonstrates the Sony Betamax VCR. His company sells most of the major VCR brands.

All the models listed are capable of recording both VHF and UHF transmissions, and all have 24-hour LED digital time indicators and built-in tuners.

A WORLD OF ENERGY CONSERVATION

Think of how much energy is wasted in the production of millions of zinc or alkaline batteries. Once their energy supply has been used up, they are discarded.

The General Electric rechargeable battery system is the answer to power conservation. The G.E. battery is rechargeable and thus recyclable. Conservation of energy is the essence of this product. Don't throw away batteries. G.E.'s nickel cadmium rechargeable batteries can be recharged up to a thousand times. They last for years.

The features of the G.E. rechargeable battery are:-

- Constant voltage throughout the discharge period.
- Available in all standard sizes.
- Special heavy duty versions for industrial use.
- The heavy duty rechargeable batteries are designed to withstand high ambient temperatures and continuous discharge overload.

Be part of the energy conservation movement. Look into the General Electric Rechargeable Battery System.

For information on the G.E. nickel cadmium rechargeable battery system and list of stockists, fill in the coupon and return to Australian General Electric Battery Division, 86-90 Bay Street, Ultimo, N.S.W. 2007.

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GENERAL ELECTRIC

Tailoring room acoustics to suit the purpose . . .

The natural effects of electro-acoustics

By using modern electronic techniques, it is possible to tailor the acoustic response of concert halls or auditoria to suit the occasion. This article briefly outlines the electro-acoustic methods that have made multi-purpose halls a reality.

At one extreme, a multi-purpose hall must respond like a concert hall, warmly and sympathetically, to the infinite riches of a full symphony orchestra; and at the other it must permit every member of an audience to hear each syllable spoken by an actor as though he were only a few metres away.

Those are conflicting requirements. The sounds of orchestra, choir or organ must not be rudely hurried away: they must be permitted to linger a little while, just long enough for the diminishing glory of each sound to colour the succeeding sounds. That's what the composer had in mind when he wrote the music, because that's how he was (or is) accustomed to hearing music. But the sound of speech is not to be changed; it must be conveyed without converting it, because that's how our ears were made to hear it.

An engineer tests the acoustics of the new Oslo Concert Hall by using a pistol as the sound source.

We may express the varied requirements quite simply: any sound which is to be heard in the hall must sound natural. Unfortunately, there is no hall in the world which, in its natural state, will allow all kinds of sounds to be heard naturally. That is where the latest developments in electro-acoustics come in: they impart the desired naturalness to whatever kind of sound is being made, enhancing, overcoming, or not interfering with, the natural acoustics of the hall.

If a loud sharp noise is made in the hall — the engineer shown in the new Oslo Concert Hall is doing it professionally with a pistol — the direct sound of it will be followed by a gradually diminishing indirect sound, lasting up to two or more seconds. This phenomenon is known as reverberation, and the time for it to die away is known as the reverberation time. The professionals measure this time precisely with instruments, because it is the critical factor in designing an electro-acoustic system.

Reverberation is caused by the sound waves being reflected from walls, ceiling and floor. In the large volume of a cathedral, with hard surfaces which absorb very little of the sound striking them, a sound may take as much as five seconds to die away. In that time it will have travelled about 1700 metres. It is doubtful whether such a long reverberation time really suits any kind of music at all, though of course it creates an incredibly colourful tapestry of sound of cathedral choir and organ. The human speaking voice, however, is hopelessly and unintelligibly jumbled up in such an acoustic environment; in five seconds, there are ten or more spoken words!

In general, the reverberation time of an enclosed space increases with the volume, as the graph shows. However, the sound-absorbing properties of the walls, ceiling, floor, clothing of the audience, and other surfaces, have the effect of reducing the reverberation time because the sound dies away more quickly each time it strikes an absorbent surface. Thus a hall's reverberation time can be changed, within limits, by changing suitable surfaces. Note, however, that for the same reason a hall filled with spectators will have a shorter reverberation time than the same hall only partly filled, unless the seats are designed to have similar absorption characteristics to those of an audience.

Reverberation times which are typically suitable are: 1.5 to 2.5 seconds for orchestra, choral and organ music; about 1 second for cinema purposes; and about 0.5 to 1 second for jazz or chamber music (which, of course, is written for performance in what used to be called a chamber — typically a principal room in a large house). Speech requires the lowest practicable reverberation time — preferably not more than about 0.5 to 1 second.

How, then, can a multi-purpose hall meet these changeable requirements? The answer is to equip it with a sound-amplifying system to enable the acoustics to be adjusted to suit each application.

If it is a hall with a long reverberation time, suitable for orchestra or choir, it can be equipped for speech with a directional sound-reinforcement system or a stage amplification system, the loudspeakers of which beam the sound of the human voice only to the audience, thereby minimising reverberation. In the case of a large hall, loudspeakers placed farther away

from the sound source (eg. towards the back of the hall) are supplied with a signal which is delayed so that, for the audience in that part of the auditorium, all the sound arrives at the same time both directly from the person speaking and indirectly from the loudspeakers.

If, however, the hall has a short reverberation time, appropriate to speech, drama, etc., it can be given the characteristics of a long reverberation time, to suit orchestral, choral or similar music. This facility can be provided in various ways. For example, the sound of the orchestra or choir can be picked up by near-by microphones and fed into a reverberation device (there are several possible types), which has a number of outputs, each connected to loudspeakers. The overall effect is to produce a reasonably adequate indirect sound field.

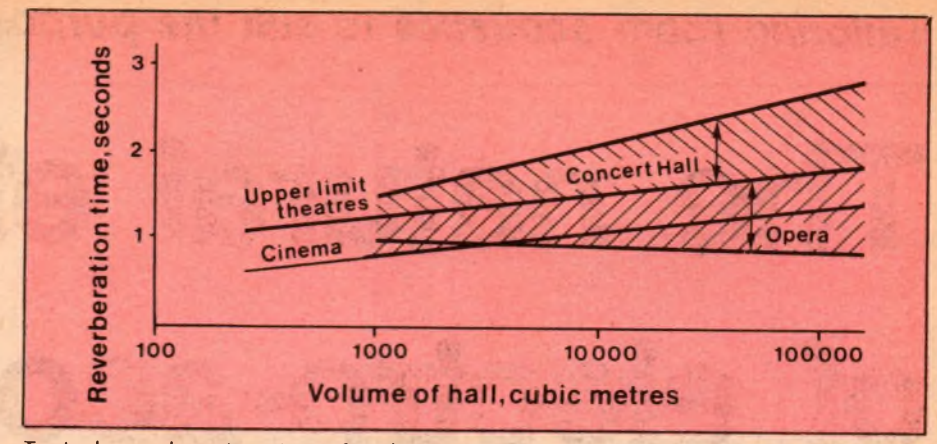
The newly-developed Multi-Channel Reverberation (MCR) system from Philips, however, provides a more advanced solution to this problem and has advantages over the earlier reverberation devices mentioned above. A large number of microphones, distributed throughout the hall (in the ceiling and walls), pick up the indirect sound field, and the signals from these microphones are fed to individual loudspeakers.

The effects of MCR are to enhance the sound-reflection characteristics of the hall. It enables direct control of reverberation time and reverberation level to give the desired sound necessary for the music being played. In addition, an important new feature is that the musicians can be supplied with the same diffuse sound as the audience, which is very helpful to them. It gives them a sense of "ambiance" — each musician no longer feels he is playing in isolation but experiences a certain inspiration from hearing the others.

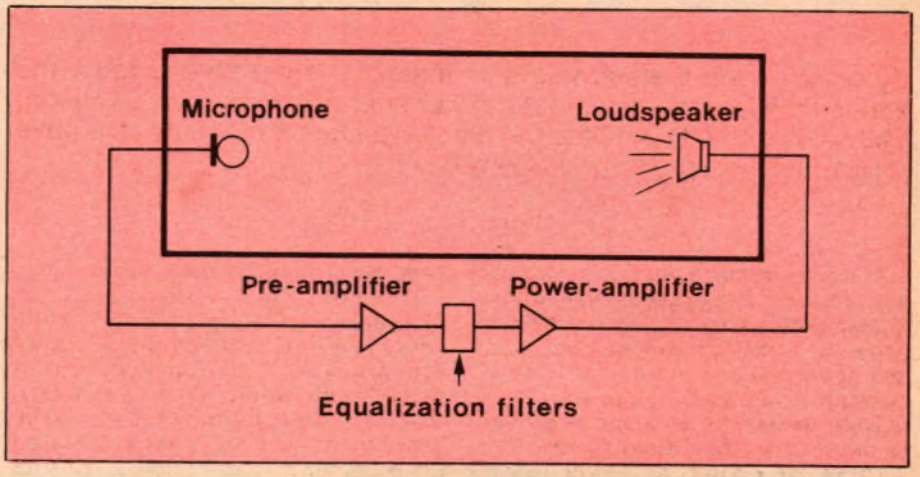
Without explaining all the possible ramifications of electro-acoustics in all kinds of halls —each hall is unique in its requirements — it is perhaps sufficient to point out that these systems are not restricted to multi-purpose halls. They can be applied to existing or new halls; they can convert a limited-purposes hall into a multi-purpose hall; they can improve the acoustics of a hall which was built with certain purposes in mind but which has fallen short of the ideal —it is hardly possible to cover all variations.

However the complexities and subtleties of sound — particularly the sound of music —are so important artistically, that we must consider another factor.

What has to be done to ensure that the loudspeakers reproduce the sound of, say, an orchestra faithfully, so that the balance between different instruments, over the full frequency range of the whole orchestra, is maintained exactly in conformity with the desired balance for which the conductor and the musicians have striven?



Typical reverberation times for theatres and concert halls.



The basic elements of one loop of a sound reinforcement system.

Unless steps are taken to ensure this maintenance of the original balance, the particular characteristics of the chosen microphones and loudspeakers, in association with the acoustic environment, have the effect of accentuating certain frequencies at the expense of others.

The method of correcting this effect is known as "equalization", ie ensuring that, as far as possible, the system provides equal amplification throughout the frequency range.

Equalization has to be done in two ways: first, equalizing the loudspeaker-plus-hall-acoustics system; second, equalizing the sound reinforcement system. The latter must be considered as a loop, and includes the acoustic path between the loudspeakers and microphones.

It should be noted that failure to equalize the amplification throughout the frequency range would not only distort the sound of the music; it would also increase the risk of "howl" or "acoustic feedback", and at the same time unnecessarily limit the capacity of the system to amplify the sound.

The accompanying diagram shows the basic elements of one loop of a sound reinforcement system in a hall. It will be noted that instead of there being simply one amplifier, there are two: the pre-amplifier raises the voltage of the signal from the microphone from its very low level, and the power amplifier both raises the voltage still further and delivers sufficient power to drive all the loudspeakers.

Equalization is achieved by interposing special filters between the two amplifiers. These filters reduce the peaks, ie. at the frequencies where amplification is too much; and lift the dips, ie. at the frequencies where amplification is too little. They give remarkable improvements in sound quality.

Thus the system as a whole maintains the correct balance, and it can be used to its maximum amplifying power without causing howl.

With the reverberation characteristics of the hall variable and under control, with the frequency characteristics of the music or other sound maintained, and with the sound level perfectly suited to the needs of every member of the audience, we have a hall which always sounds natural, whoever is using it.

Reprinted with acknowledgement to N.V. Philips' Gloeilampenfabrieken "Sound + Image" magazine.

Solar power: cutting the costs

With the price of conventional fossil fuels set to skyrocket, solar power looks like becoming an increasingly important energy source over the next few decades. The main hassle so far has to do with solar cell costs. Researchers at RCA Laboratories in Princeton, New Jersey, have come up with one possible answer to the problem.

Up to now, the cost of tapping electricity directly from the Sun has been very high indeed. At around $15 a watt, cost is the main reason large solar cell arrays are not delivering tens of kilowatts or megawatts to homes and buildings.

Technological limitations combined with a small, specialised market are the main reasons why solar cell prices have remained so high over the years. The major use of solar cells to date has been in spacecraft, where they must be used regardless of cost. However, they have also been used for low power applications in remote locations on Earth.

That situation may change in the near future, however. With the energy "crunch" firmly in view, there's a growing effort to reduce solar cell costs and bring solar power down to earth. The industry goal now is to cut the cost to around 50c a peak watt by 1986 and to 30c by 1990.

At those prices, solar cells would be able to produce electricity at a cost competitive with conventional sources of power.

A number of schemes are now under development to reduce solar cell costs. Such schemes include the development of techniques more suited to mass production, new crystal growing methods, and solar tracking and concentrator mechanisms to improve overall system efficiency.

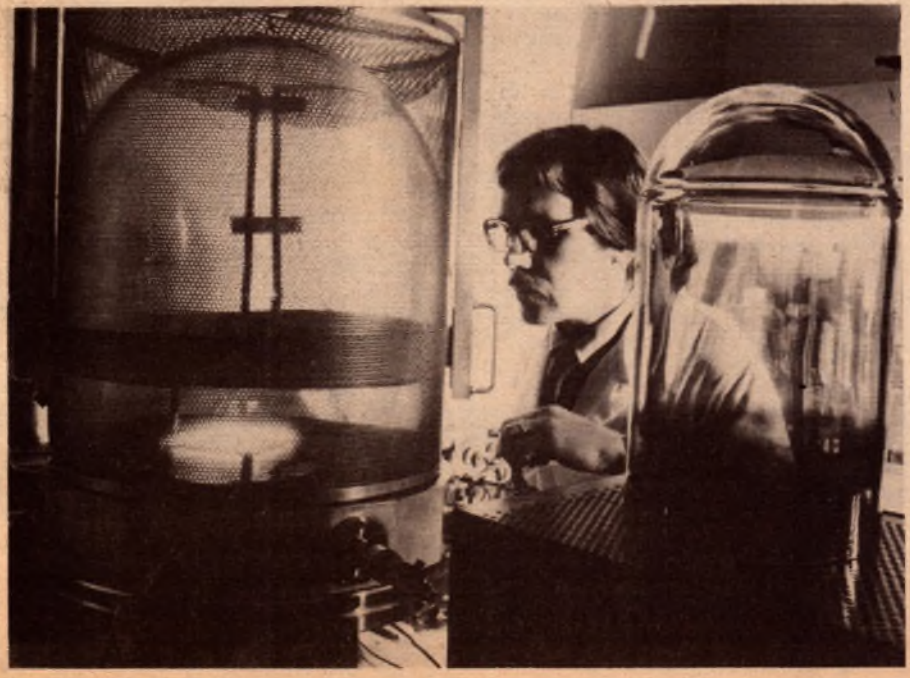
One promising technique, now under development at RCA Laboratories, involves making solar cells by depositing low-cost amorphous silicon on glass. Conventional solar cells, on the other hand, have to be made from a special high-purity silicon that is processed at high heat levels and then sliced into wafers (which results in loss of some of the material). The latter method is both time consuming and expensive.

RCA's new solar-cell technology is now covered by a US patent, granted towards the end of last year to Dr David Carlson. Dr Carlson is head of Photovoltaic Device Development in the RCA Energy Systems Research Laboratory (Princeton), and has been researching the properties of amorphous silicon since 1974.

Dr B. Williams, Director of the Laboratory, said that the amorphous silicon covered by Dr Carlson's patent is "the only amorphous material we know of that has been used successfully to make high performance, photovoltaic solar cells."

He added that although future amorphous silicon cells may involve different geometrical arrangements, the devices will basically be extensions of those patented by Dr Carlson rather than new ones. Because of this, RCA considers the patent one of the most important yet granted in the solar energy field.

Amorphous silicon solar cells are low cost because: the material (a sand derivative) is plentiful; the fabrication process involves a low temperature process (glow discharge); extremely thin layers of the material (about 1/20th the thickness of a human hair) can be placed on large area substrates of inexpensive glass or steel sheets; and initial



RCA scientist Dr David Carlson operates glow discharge equipment used in making solar cells from hydrogenated amorphous silicon. RCA believes that amorphous silicon solar cells may produce power at a cost competitive with conventional power sources by the mid-1980s.

tests indicate it is a long lasting, stable material.

Glow discharge systems are well known and have long been used in electronics for depositing thin layers of materials. Conventional fluorescent lights, in effect, employ glow discharges.

To make amorphous silicon, silane gas, consisting of silicon and hydrogen atoms, is processed in a low pressure glow discharge chamber. The hydrogenated amorphous silicon created by the process is spread thinly and evently over the desired substrate.

Amorphous silicon differs from the crystalline silicon used in many solar cells in that the arrangement of the atoms in amorphous silicon is not as orderly, or periodic, as the atoms in crystalline silicon. Therefore the material is easier to grow and may be deposited on a large variety of inexpensive substrates. Amorphous silicon also differs from crystalline silicon in that the amorphous silicon contains about 20 percent hydrogen.

Conventional solar cells are more efficient than amorphous cells but, as Dr Carlson is quick to point out, are considerably more expensive. And crystal silicon processing requires temperatures of more than 1100°C, compared with 300°C for the amorphous material. Furthermore, crystalline solar cells are roughly 250 times thicker than amorphous cells and, for the most part, are limited by fabrication problems to relatively small areas.

For example, many conventional cells are made of wafers only 7.5cm in diameter. Yet amorphous cells can be fabricated in 30cm square areas, according to Dr Carlson.

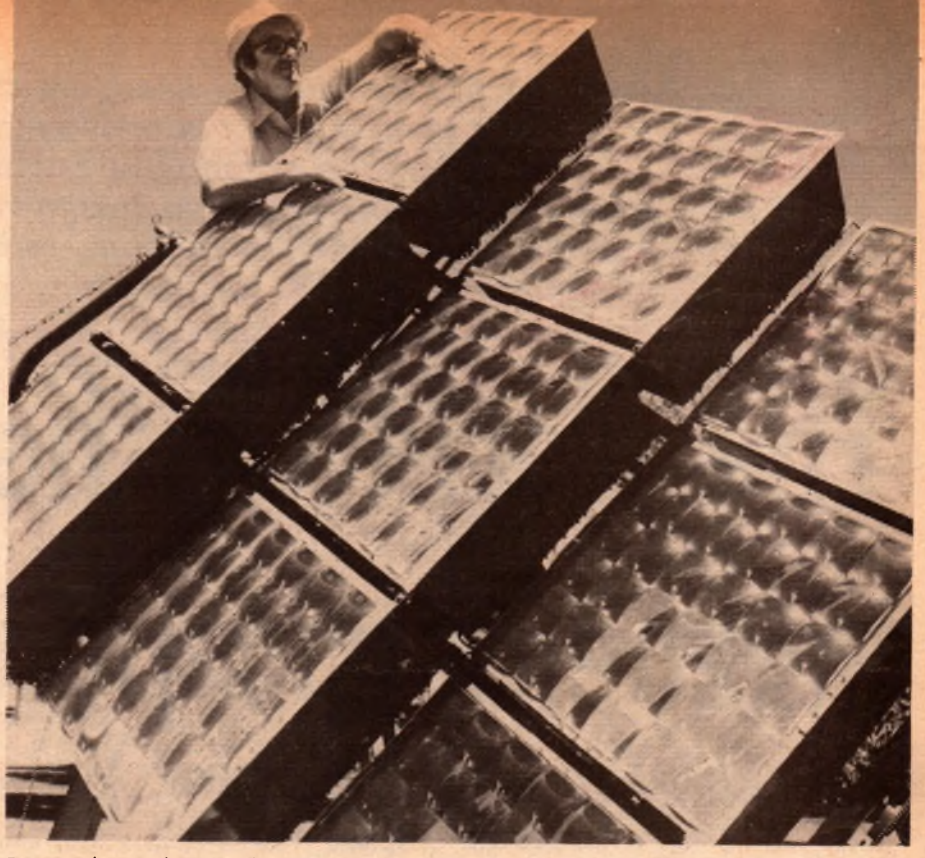
The projected cost of RCA's new cells is around $1 per watt once they are in full production.

Initially, RCA experts that the amorphous silicon cells could be used for electrification projects in developing nations lacking the extensive electric power distribution networks of America and Europe. Also, Dr Williams stated, many developing nations are in areas that receive a great deal of sunlight and their societies are built around small communities or villages with very modest electricity requirements. Solar cell power supplies seem particularly well suited to this environment.

Later on, as the technology is improved, amorphous solar cells could be employed in more developed nations, particularly in applications using large amounts of DC power.

The US Government has partially funded RCA's solar energy work since 1976, and at present the US Department of Energy is cost-sharing a greatly enlarged research program with RCA Laboratories. The goals of the on-going program are:

- to demonstrate high performance in large area cells;
- to improve the efficiency of amorphous cells, now at six percent, to 10 percent;
- to confirm initial tests showing that the material is very stable; and
- to achieve a better understanding of the mechanisms involved in amorphous silicon electronic devices.



Researcher John Hughes examines an array of plastic lenses used to focus the Sun's energy onto silicon solar cells. RCA's experimental 300W system continually tracks the Sun, and could significantly reduce solar energy costs.

RCA's Olga Gervasoni tests experimental solar cells by measuring the electricity they produce when they are placed in the beam of a simulated sun — in this case an arc lamp. Her work is part of the research program at RCA Laboratories in Princetown.

It will take several years of extensive research to achieve these goals, according to Dr Carlson. But success in this and other solar energy research programs is vital if we are to secure our energy future.

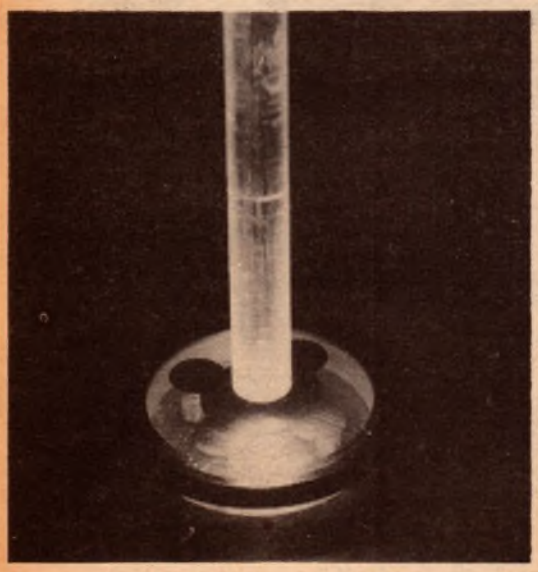
Perhaps it is only a matter of time before the rooftops of suburbia are studded with low-cost solar cell systems.

Piezoelectric transducers based on polymers are now being put to work in many diverse applications, ranging from stereo systems through to automobile crash studies. With these transducers, it is possible to design the measuring instrument to suit the measurement conditions, rather than to try to adapt the conditions to suit the instrument. . . by Madeleine Jacobs.

The world of the piezoelectric polymer

It has been a long hard day at the office and you're tired. You arrive home, kick off your shoes, settle down in your favourite easy chair, and turn on the stereo. Suddenly, it's as if you're sitting in a concert hall, listening to Berlioz' Symphonie Fantastique. The music can only be described as exquisite.

The realism of the sound is due to a specially processed polymer material in the stereo speakers that makes it possible to transform electrical energy into acoustical energy with nearly complete accuracy. The unique substance is an example of a class of materials known as piezoelectric (often pronounced pe-a-zo-electric) polymers. Their use is so new that the "Encyclopedia Britannica" fails to mention them in its section on piezoelectric devices.



Thermal pulse experiments can yield information about piezoelectricity in polymers. Here a light pipe is shown illuminating a polymer sample.

And yet, as a class, piezoelectric polymers are being used increasingly, not only in some stereo components but also in applications involving health, safety, national security, nondestructive evaluation, and even printing of currency.

"The most surprising thing about piezoelectric polymers is that they exist," declares Seymour Edelman, a physicist at the National Bureau of Standards and a leading pioneer in the field of piezoelectric polymer applications. "Polymers differ from conventional piezoelectric materials in so many of their properties that it seems strange that they should be comparable in their piezoelectric response.

"For example, conventional piezoelectric materials are typically crystalline or polycrystalline, hard, stiff, brittle, and dense," he continues. "They're difficult to machine into thin layers, they are not readily available in sheets of large area, and they are expensive. On the other hand, polymers are pliant, flexible, tough and light. They are available commercially in layers as thin as six micrometres in 1000 metre rolls over one metre wide. And they are relatively inexpensive."

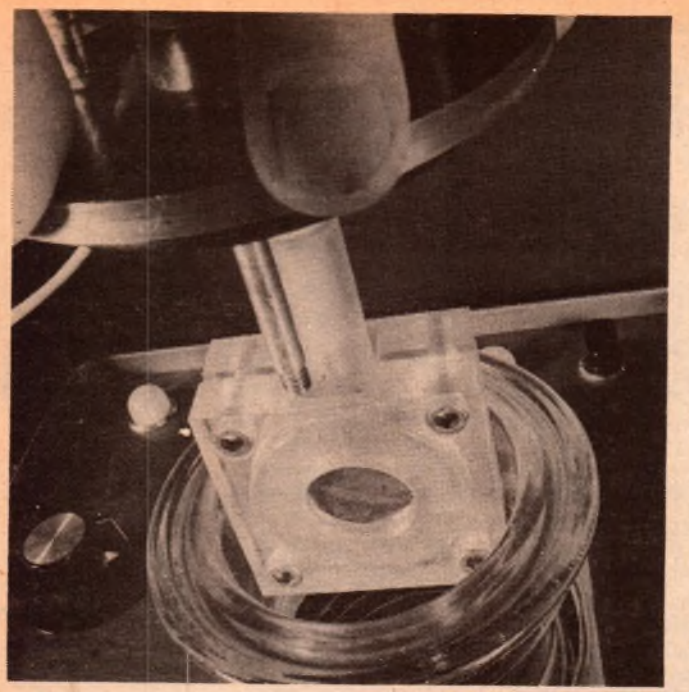
These properties make polymers uniquely suited for a variety of piezoelectric devices. While the Japanese have been studying the phenomenon in polymers longer than anyone else, NBS is at the vanguard of a handful of laboratories in the United States studying the theory, materials properties, and applications of this strange class of polymers.

Most piezoelectric devices today are based on certain crystals which, when deformed by pressure, generate an electric charge. The phenomenon is due to the electrically polar nature of the crystals. That is, they contain positively and negatively charged ions which separate when the crystals are subjected to stress.

This effect was discovered experimentally in 1880 by the Curie brothers, Pierre and Paul-Jacques. By placing a weight on a crystal, they observed a voltage on the surface of the material. The inverse effect was also found — that is, by applying a voltage to the material, a deformation of the crystal could be produced. The two effects go together in piezoelectric materials. (The latter is the basis for the use of piezoelectric devices in stereo components and other acoustically-based instruments).

Eventually, they found the effect in a number of crystals, including quartz, Rochelle salt, and tourmaline. Although Pierre Curie and his wife Marie later used the piezoelectric effect to study radio-activity, piezoelectricity in general remained a scientific curiosity until World War I, when it was used to produce acoustic waves in seawater to detect the presence of submarines.

Applications of the effect involved ceramics and other brittle crystalline materials. The first indication that still other substances might exhibit the effect came in 1892. A British scientist, Oliver Heaviside, postulated that certain waxes would form permanently polarized dielectrics when allowed to solidify from the molten state in the presence of an electric field. He viewed these as being the electrical analog of magnets. His theory was confirmed in



NBS scientists use a plasma or ionised gas, to generate poling fields large enough to induce piezoelectricity. Photo shows a polymer sample being lowered into a glass container where the plasma will be generated.

NBS physicist Seymour Edelman displays a variety of piezoelectric polymer transducers. The devices can be made in nearly any desired shape or size.

the 1920s, but not much else happened until the early 1940s when researchers in other countries began investigating piezoelectric effects in rubber and other materials.

NBS became involved in the research around 1968, recalls Edelman, who was then chief of the Vibration Section. "One of the major problems we had in calibrating instruments used to measure vibrations was getting rid of low frequency resonances. I had learned that rubber was piezoelectric from Dr Archibald T. McPherson, then associate director of NBS. It occurred to me that if the surface of the instrument were mounted on such a polymer and if we controlled it electrically, we could get rid of all the resonance frequencies that interfered with our measurements.

"We then looked at a number of polymers and tested them for piezoelectricity. At that time, there was only a limited amount of research reported in the literature on piezoelectricity in polymers."

This was the beginning of 10 years of application research, which has led to the development of many new and innovative devices. At NBS, the development of a device begins with inducing the property of piezoelectricity into a film of polyvinylidene fluoride, also known as PVDF. Polymers do not normally exhibit piezoelectric activity to any great extent — it must be induced.

NBS physicist Steve Roth begins with a film of PVDF, which looks much like a roll of ordinary plastic wrap. A layer of aluminium is evaporated on both sides of the film to form metallic electrodes. At this point, the material looks like a thin piece of plastic wrap coated with aluminium foil. Next, Roth places the film in an oven and raises the temperature to about 80°C. An electric field is concurrently applied, typically on the order of several hundred kilovolts per centimetre of polymer thickness.

While the voltage is maintained, the polymer is allowed to return to room temperature. This procedure is referred to as "poling".

The piezoelectric property of the material is stabilised in the polymer as it cools. PVDF as a piezoelectric material has a good response to changes in pressure over a wide range of frequencies, which makes it extremely useful for dynamic measurements. It also has many advantages over conventional ceramic materials.

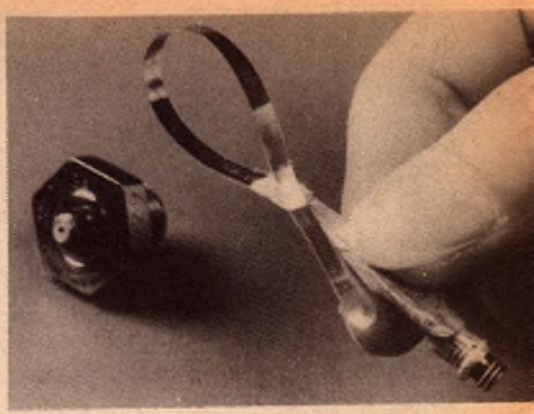
For example, a variety of transducers and devices can be made from the finished material in nearly any shape. Transducers using conventional piezoelectric materials usually have metal bases and housings and require threaded holes or specially ground flat surfaces of appreciable area for mounting. Polymer transducers, on the other hand, usually consist only of the active material and a metal lead. The finished film can be attached to the surface to be measured with rubber cement, cyanoacrylate, epoxy, or other cement. The transducer can be attached to curved, twisted, or pliant surfaces.

In addition, PVDF is not likely to be harmed by the usual conditions under which sensors are used, such as salt water, soaps, common organic solvents, nearby explosions, or other mechanical shocks.

Conventional transducers also tend to have many large amplitude resonances, both because of their internal spring-mass systems and because of the effect of the mass of the instrument on the mounting surface. Polymer transducer response is flat with frequency over wide ranges, typically into the megahertz range, their resonances are highly damped, and their mass is so small that they do not perturb the motions of the mounting surface.

Another important property is the piezoelectric modulus, g, which is the electric field per unit mechanical stress. This value governs the usefulness of a material as a detector and is about six times as large for PVDF as for a typical lead zirconate titanate ceramic.

Yet piezoelectric polymer devices are far from perfect for every use. For example, the value of the d modulus (strain per unit electric field), which measures the usefulness of the material as a generator of motion or as a sound source, is 20 times greater for ceramic devices than for polymer devices. (Use



The advantage of piezoelectric polymer transducers over conventional ceramic devices is illustrated in this photo. The polymer device is not only flexible, but weighs a mere 0.3 milligram (without the metal lead) compared to the ceramic device which weighs around 21 grams.

of piezoelectric polymers in stereo components is justified on the basis of their other properties and advantages.)

Another problem is temperature. Piezoelectric polymers are also pyroelectric; that is, they generate an electric charge with a change in temperature as well as with a change in pressure. There is no way to separate the two effects if the temperature and stress are changing together. Fortunately, many measurements are made at a constant or slowly changing temperature.

Many devices have been developed at NBS which take advantage of the remarkable versatility of piezoelectric polymers. The projects have been supported by other government agencies that have come to NBS for help with a variety of different measurement problems.

For the Frankford Arsenal and the Office of Army Research, for instance, NBS developed piezoelectric polymer devices as detonators for explosives. Edelman and a colleague demonstrated that these devices had sufficient electrical output in response to impact so that they could be used in place of ceramic elements in ordnance fuse systems. This application depends on the fact that in the process of poling, a polymer stores about one-and-a-half times as much energy per unit volume as is stored in ceramic devices under similar conditions.

Polymer sheet is also preferable to ceramics for this application because it can be connected to provide a desired electrical output impedance more readily and can be used to line a shell to provide detonation on any angle of incidence. For this research, the NBS scientists received an Army Commendation Award.

The thinness and flexibility of polymer gauges make them feel and act mechanically very much like skin. These properties were valuable when NBS was asked by the National Highway Traffic Safety Administration of the Department of Transportation to develop polymer stress gauges for automobile crash studies.

Two types of polymer gauges were developed. One was used for pressure changes during the impact of a collision between an anthropomorphic dummy and the instrument panel of a motor vehicle during a simulated crash. The other was used for measuring pressure changes in the brains of animal subjects during tests of controlled impact to the head.

The value of polymer devices in these two applications is obvious, Edelman explains. "Since the gauges behave very much like skin, they do not disturb the anthropomorphic behaviour of the dummy. Because they are flexible, they are not likely to be damaged in the crash or to damage parts of the vehicle on impact. The polymer gauge has a density close to that of brain matter, which makes it useful in the second application. If a conventional ceramic gauge were used, inertial effects would produce more signal than the pressure change."

The similarity to body tissues means that polymer gauges can be applied easily to the skin like an adhesive bandage to monitor heart sounds and pulse rates of patients during exercise. "Conventional instruments can be used for these applications, but their size and mass make the patient conscious of their presence and his behaviour is not entirely normal," Edelman notes. "He is much more likely to forget polymer gauges."

Piezoelectric polymers can also be used as strain gauges, Edelman says. "In this application, they have nearly the same sensitivity as semiconductor gauges but they can be used without the need for bias voltage or bridge balancing. They can be used where mechanical shock occurs and on curved surfaces."

One potentially important use of polymer strain gauges is to detect and measure strains accompanying stress waves in the soil. These gauges might be used to detect and follow tunnelling operations, to detect vehicle movements, to calculate the effect of

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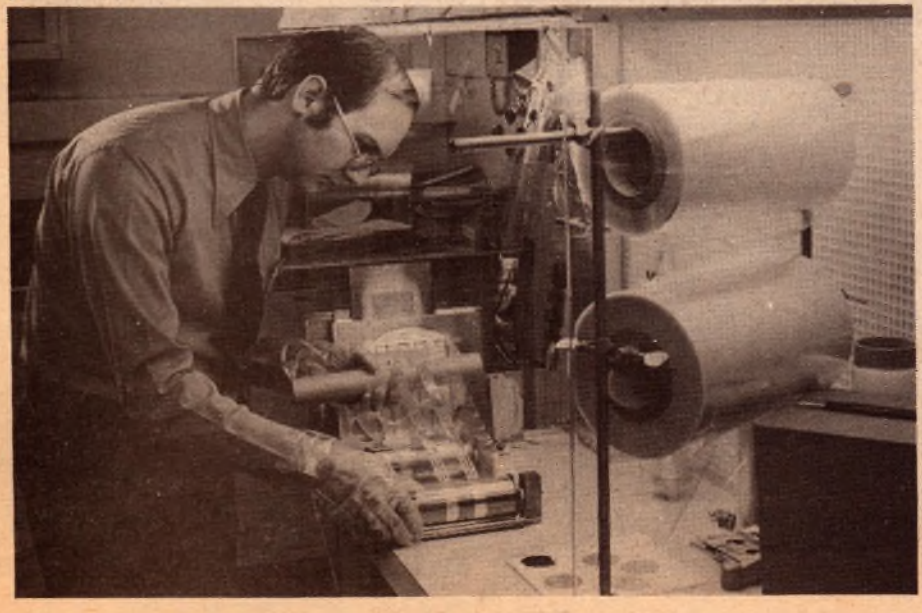

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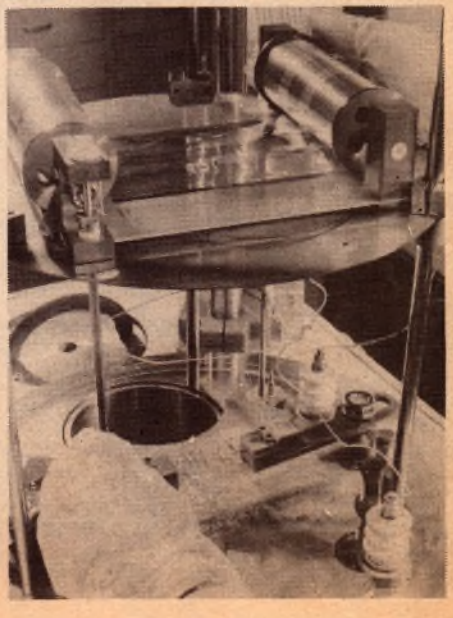

explosions on buried structures, or to detect disturbed ground and buried mines.

Similar gauges supplemented by acoustic emission (sound) sensors attached to bedrock can be used to detect and locate mining operations, progress of a tunnel, sudden movements in earth dams, and incipient avalanches in snow fields.

In another project, NBS built piezoelectric hydrophones for listening to sonar signals under water, an application that was funded by the US Navy. Similar units could be made up as arrays and used for finding fish or for underwater geophysical exploration.

Two recent projects are a further indication of the range of applications for piezoelectric polymers. NBS is working on gauges for the Department of Treasury to be used on the presses that print US currency. The Treasury Department needs a built-in gauge to monitor pressure on the presses that operate at very high speeds. Precise pressure is needed to maintain quality control. Piezoelectric polymer sensors, which can be cut to nearly any shape, could do this very well.

The list of potential applications runs to pages, but whatever the application, the key point, Edelman says, is that with piezoelectric polymers, "it is possible to design the measuring instrument to be suitable for the conditions under which the measurement is made, rather than try to adapt the conditions of the measurement to suit the needs of a conventional instrument designed to have general utility."

Much more needs to be done to understand the behaviour and theory of piezoelectric polymers. But without waiting for theory to catch up to applications, industry is already using the materials in an increasing number of ways. Of the many transducer manufacturers who have come to NBS to learn about this new technology, several have developed commercial applications. "Transferring our know-how to industry and other agency labs has been a primary goal of our work," says Martin Broadhurst, chief of the Bulk Properties Section in the Polymers Division at NBS.

Scientists involved in the research believe that someday piezoelectric devices made from polymers will be as commonplace as the plastic wraps found in nearly every household. Says Edelman of the outlook for piezoelectric polymers, "Some day, the applications of piezoelectric polymers will be limited only by the imagination of the user."

Explaining polymer piezoelectricity

Currently, there are two schools of thought to explain the phenomenon of piezoelectricity — the molecular dipole model and the trapped space charge model. These are highly complicated mathematical theories. Below are simplified explanations of the two theories.

Molecular dipole model

This model explains piezoelectric behaviour in two types of polymers — amorphous and semi-crystalline. Polymer molecules are made of polar sub-units called dipoles, which line up in an electric field like magnets in a magnetic field. Usually these dipoles are randomly oriented and cannot produce piezoelectricity.

If the dipoles can be oriented in one direction with an electric field and the orientation can be frozen (by cooling below the glass transition temperature in the case of amorphous polymers or by producing a polar crystal phase in the case of semi-crystalline polymers), then the polymers will be piezoelectric. That is, the surface charge on a poled film will depend on the net dipole moment divided by the film volume. The volume changes whenever the sample is stressed and induces charges on the film surface. The larger the dipoles and the more complete the alignment, the more active the film will be.

Trapped Charge Theory

This school of thought rejects the explanation that the aligning of dipoles is the basis for the piezoelectric responses of polymers. Instead, real charges in the material are trapped in certain polymer sites and it is these charges that respond to the electric field, according to this idea.

Reprinted from Dimensions, Journal of the National Bureau of Standards, Washington, DC.

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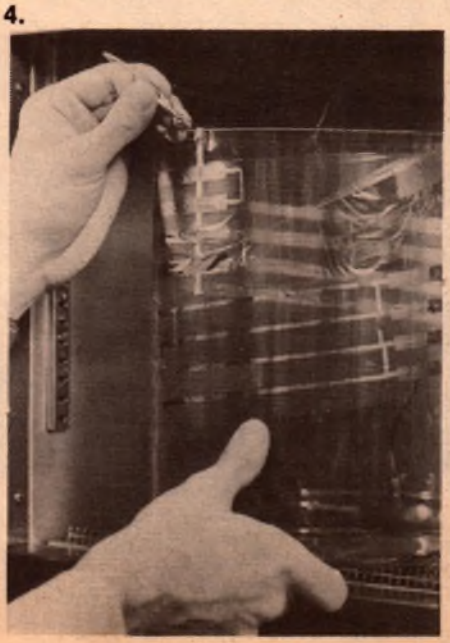

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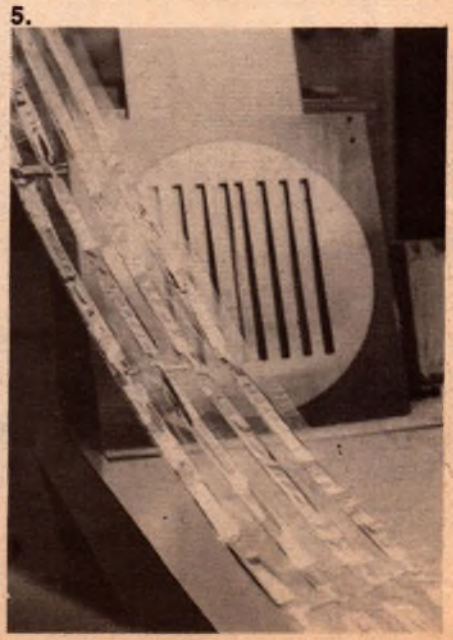


To make piezoelectric polymers, physicist Steve Roth positions a film of poly vinylidene fluoride in front of a mask to allow metal to be deposited (1). Film is placed in an evaporator to form metallic electrodes (2), then moved to an oven (3) where electrical leads are attached (4). The temperature is raised to 80°C and an electrical field is applied. Finished devices (5) will be used as pressure gauges on printing presses for the US Treasury Department.

Forum

Conducted by Neville Williams

Bits and pieces month, but first: the Boeing satellite power source

Every now and again, I find it necessary to have a "bits and pieces" month, when I clear the file of some of the oddments that tend to collect when the space is occupied by major items. First a denial by Boeing that they were guilty of a major error in the calculations to do with their proposed satellite/solar power station.

You may remember that we carried the original story in our December issue, last. It involved assembling and positioning an array of huge satellites in space in a geostationary orbit above the equator. Bathed in sunlight for 99% of the time, they would convert solar energy into microwave radio energy and beam it to antenna collector arrays on earth. Boeing envisage anything up to 45 such satellites in a long line across the sky, each one of them producing 10,000 megawatts of electricity.

Boeing see the scheme as mind-bending in its magnitude but certainly not "far-fetched". We already have the basic technology, they say, the essential problem being one of scale. And even the cost would not appear to be impossible, considered against the world need for energy, its rapidly rising costs and our dwindling resources.

E.A. readers appear to have taken the story at its face value, but not so R. W. Johnson of Ben Lomond, California. He saw reference to the proposal in an American publication and wrote a letter to "Electronics" magazine, which we reprinted in our July issue under the title "A Boo-Boo by Boeing?"

Mr Johnson made certain assumptions about the likely height of a geostationary satellite, the frequency at which the energy would be beamed to earth, the beam width, the size and gain of the antenna arrays at both ends and the atmospheric losses en-route. He ended up with a power level at the earth station of 631 watts: "about enough to power a toaster."

From the rest of the letter, it was clear that Mr Johnson regarded the whole idea as Boeing "pie in the sky" and felt that the money could be invested more productively in a chain of nuclear power plants, each delivering a "safe" 1100 megawatts.

We reproduced the letter as a matter of interest but made the comment that: "it seems unthinkable that Boeing engineers would not have been through a similar exercise". In particular, we suspected his reference to the square law, which assumes that the receiving antenna is intercepting part only of a diverging beam.

The letter has since been answered, again in "Electronics", by Ervin J. Nalos, on behalf of Boeing. He points out that the Boeing scheme is not a sudden or recent inspiration but has been kicked around for about 10 years by several NASA centres. It certainly has not been kicked out!

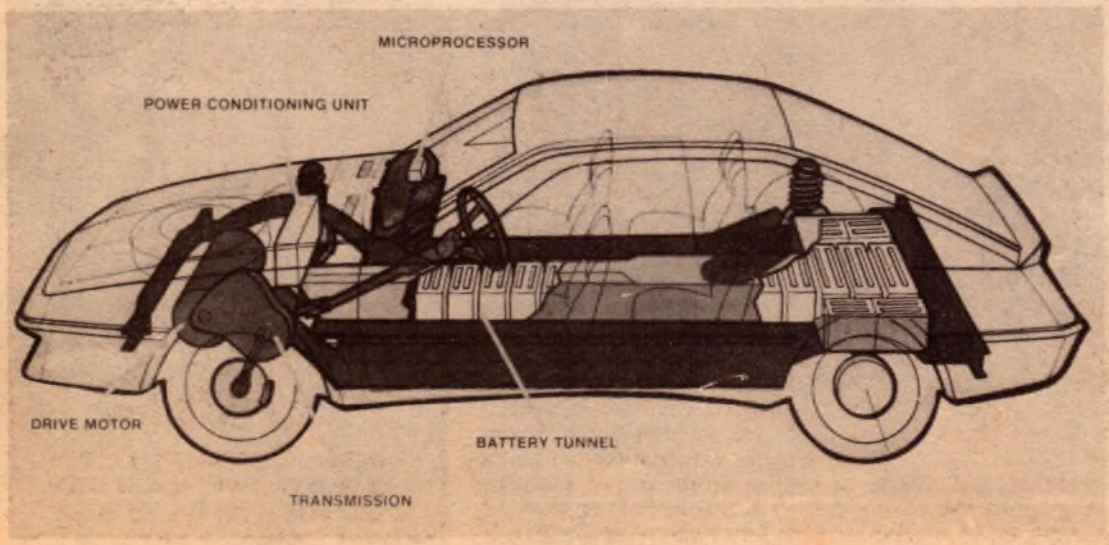
He specifies a likely frequency of around 2.45 gigahertz with a transmitting antenna array about 1km in diameter. It would comprise 7,220 sub-arrays, using retrodirective steering, to produce a beam width of 0.46 minute of arc. He goes on to say that research by NASA has established an error level of 0.0006-arc-minute, equivalent to a displacement of six metres on the ground. The system compensates automatically for ionospheric diffraction effects.

In short, the whole concept is far more sophisticated than anything envisaged by Mr Johnson.

With such a system, it is possible for the receiving antenna to approximate the area of the beam footprint, thereby virtually eliminating the devastating square law problem. The losses subside largely to those occasioned by the atmosphere, which could be tolerated at the nominated frequency.

With those problems resolved, the discussion seems to boil down to three main questions:

- How "safe" is the nuclear alternative favoured by people like Mr Johnson, not only in the handling and operation of nuclear fuels but in the possible heritage of non-disposable wastes and obsolete plants.
- How safe would satellite power stations be in time of war? One would think that the effort to



An artist's sketch of the electric car currently under development in the U.S. Design range is 145 miles at 35mph, or 75 miles of stop-and-go in city traffic with a full passenger load. Available cruise speed will be 55mph. The body shape stresses aerodynamics — the nub of the question is: would you buy it in preference to a . . .?

destroy them and the effort to protect them from destruction would make "The Dambusters" episode of World War II look like a scuffle on the carpet.

- For how long can we go on increasing our demands for energy, while disputing alternative means of obtaining it? In every year that so passes, we are burning up non-renewable resources that should more appropriately be reserved as a source of materials and chemicals for the future.

I couldn't help but think along these lines a few months ago, during a visit to the Shetland Islands, where I have a family connection. For as long as anyone can remember, the Shetlanders have relied on their abundant resources of peat to warm their crofthouses and to do their cooking. For all that time, the ritual of digging and stacking the peats has been an essential part of Shetland life.

But, today, most of the old stone crofthouses lie abandoned and empty, while island families live in concrete block homes, with lighting, cooking and heating provided by electricity from a central power station. The peat on the hills is largely forgotten amidst the technological scramble to win oil from the adjacent North Sea, so essential to sustain — modern technology!

Don't misunderstand me. I guess that if I (or we) lived there, I (or we) would gladly settle for a modern house, electric light, electric heating, colour television, hifi, &c — as we do right here in Australia. I mention it because it's such an eloquent microcosm of the impact and demands of modern technology.

We're all a part of it!

ELECTRIC CARS ...

While on this particular theme, the accompanying drawing of a planned new electric car appeared on my table a few days ago. The caption explained that it was being developed for the Near-Term Electric Vehicle Program of the US Department of Energy. The structure of the car would be built by the Chrysler Corporation, while General Electric would provide the separately excited direct current motor, electronic controls and regenerative braking system. Globe-Union would provide the high density lead-acid battery bank supplying the requisite 108 volts.

The 2-year $5.98 million project is scheduled to climax in about twelve months time with the production of two of the "sub-compact sized, four passenger" test vehicles.

The standard reaction to such an announcement is: "Ho-hum! Yet another electric car." This may be embellished by follow-up remarks like: "When will they develop one that really works?" Or, "If they can send a man to the moon, you'd think they could build a decent electric car." Or yet again: "Even if they did, the oil companies would kill it!"

While I don't dispute the possibility of some politicking over the years, the real enemies of the electric car are the potential customers: you and I. And I say this on very firmly established customer preferences.

Rarely is our choice of vehicle dictated by basic needs. We all tend to over-specify and over-buy.

We plainly prefer a car large enough to accommodate the passengers we think we might want to carry; a boot to accommodate the luggage for the tour that we might undertake; a range sufficient for that possible long, overnight journey; acceleration that we could use if roads were better; a top speed faster than we care to travel, anyway!

For the privilege, we're prepared to pay extra money — indeed a good deal of extra money!

Why then would we be likely to opt for a vehicle with limited speed, limited range, limited passenger and luggage space, and limited re-fuelling potential? At higher cost and with unproven reliability and resale value?

From the suppliers' viewpoint, what executive, in his right mind, would seek to launch such a vehicle on the market against established designs which would out-perform it in just about any direction?

While we — the public — may profess concern about conservation and the environment, I doubt that many will opt for an electric car until such times that we are enticed, or obliged, to do so. And that includes those of us who may have an initial bias towards electronics!

So much for basic energy and our attitudes to it. Let's get back to more familiar ground, to the subject of audio and hifi. First a brief but plaintive letter from a reader in Wahroonga, NSW, who faces a domestic problem:

DOMESTIC CRISIS?

Dear Sir,

How can I convince my wife that reception via FM is interference and static-free when, every time a car goes by, my "crystal clear stereo FM music" is punctuated by the machine-gun rattle of ignition noise?

What does one do about it?

J. R. (Wahroonga)

First off, J. R. is not unreasonable in expecting crystal-clear, noise-free sound from his stereo FM tuner. The textbooks abound with diagrams showing how the limiter stages slice away noise pulses, while sales brochures support the theme with unalloyed superlatives. However, it doesn't seem to work that way for J.R.

One possible explanation is that he may be on the wrong side of a hill and shielded from the FM signals. A modern FM tuner can typically receive

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and resolve a signal as low as 2uV in mono mode, and a somewhat larger figure in stereo mode. However, such signals would not be noise-free. For 50dB of quieting in stereo mode, a signal level of around 40uV may be required, while a still larger figure may be necessary to ensure complete rejection of external impulse noise.

A further consideration is the nature and position of the antenna which feeds the tuner. Ideally, it should be horizontally polarised (as for TV); it should have adequate pickup over the FM range (88-108MHz), be mounted high up out-of-doors and be orientated towards the transmitters. J. R. would have to be in an atrocious situation in Wahroonga for such an antenna not to pick up an adequate signal.

But does he have such an antenna, or is he relying on a stray piece of wire or an improvised "split" from the TV antenna? If, for any such reason, he is starving his tuner for signal, he may still pick up the stations in normal stereo — but with less than the normal ability to discriminate against impulse noise.

The other point which comes to mind is the behaviour of the FM tuner itself. There may be some fault in its design, or operation or adjustment, which is letting the noise pulses through, signal notwithstanding. Perhaps he should have it checked over by the suppliers with the specific problem in view, or else borrow another tuner for comparison.

A significant omission from the letter is any mention of a similar problem with TV sound. That, too, uses an FM system and, in the case of the ABC station at least, comes from the same tower. If the television sound is free from ignition interference, it would indicate that J. R. should have a closer look at his FM antenna, or his tuner, or both.

LINEAR PHASE?

Still on an audio/hifi theme, the accompanying letter from R. C. expresses his reservations about the current fad for linear phase loudspeakers. Without consciously trying to sit astride the fence, I'd say that he is, at the one time, both right and wrong.

He is right to the extent that virtually all available program material has been through processes which, to say the least, would modify the phase relationships between sound components of different frequency. It is arguable, of course, whether this in itself detracts from the listening pleasure, because a significant proportion of such material is still very impressive. If the quality has been damaged by phase mutation, it is difficult to say in what way.

But, impressive or not, R.C. is simply saying that if the vast majority of available program material has been processed without critical attention to phase, there is no point in attaching so much emphasis to it at the loudspeaker.

That argument is hard to shoot down. All other things being equal I, personally, would not advise anyone to discard (and lose money on) an existing high quality loudspeaker system, merely to replace it with a linear phase equivalent — unless the latter had advantages in other respects: better frequency response, lower distortion, freedom from intermodulation, &c.

To that extent I'm on side with R.C. But one can look at it in another way:

It is reasonable to attach some significance to the square wave tests described in the April issue and, on the strength of those tests, to opt for a deliberate rather than a random phase relationship between the driver cones. Such a choice could hardly be wrong but there's a chance that, in the longer term, it could turn out to be right.

On this basis the engineering decision to proceed with the phase linear concept has a certain logic.

Whether the difference will be apparent with currently available program material, or whether the engineering decision can live up to the weight of promotional ballyhoo, is quite another matter. But, fairly obviously, it would be too much to expect copywriters not to enlarge upon an idea which even they can understand!

I can only repeat the sentiments which I have expressed earlier on this subject: I am quite happy to accept the linear phase concept as a possible bonus in a loudspeaker system which has been carefully designed in all other respects. I would be biased against a system, built to a price, which traded driver quality for a fancy linear phase enclosure profile.

Dear Sir,

I cannot get excited about those phase linear loudspeakers. Until we have phase linear tape recorders and, just as important, phase linear tone controls then why — except for gimmickry — worry about phase linear loudspeakers?

I agree that, with pure tones, phase shifts can be heard. But music doesn't consist of single tones, or even of just first and second and other direct harmonics.

By the time Mr Dolby's "A", a couple of tape transfers, Mr Dolby's "B" and a cassette deck intervene, those beautiful square waves referred to in the tests (E.A. for April) would look pretty sick.

Perhaps, when everything else is digital, except the human ear of course, we can come back to phase linear!

R. C. (Ewey Bay, NSW)

Andrew Darbyshire: apprentice at station 3DB

Because of the difficult economic conditions that have prevailed over the last few years, many firms have ceased to employ apprentices. However, an apprentice can be an important and valuable staff member, particularly in radio and television broadcasting stations. One such success story is Andrew Darbyshire, a radio apprentice with radio station 3DB in Melbourne.

by GRAEME SCOTT*

Andrew started his apprenticeship at 3DB in mid-1976, beating competition from 276 other applicants for the job! He commenced the full-time technician course at RMIT and in 1977 converted to the one day per week apprenticeship course. In 1978 he chose, in conjunction with 3DB's management, to do the fifth elective stream offered to electronics/radio apprentices. This is the communications stream which concentrates on transmitters, aerials, receivers and test equipment.

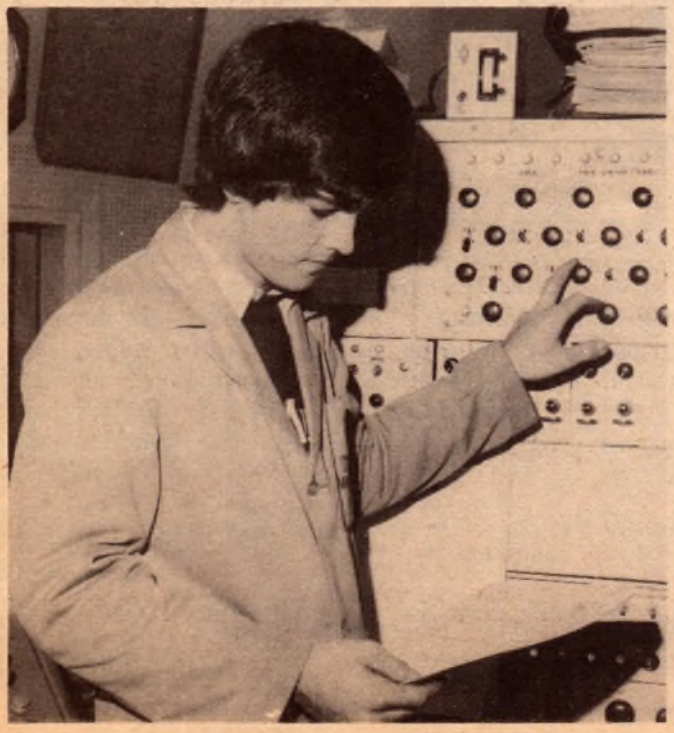
The work experience 3DB has offered Andrew includes studio control, transmitter tuning and repair, tape recorder and turntable maintenance, limiter adjustment, program-line equipment alignment, outside broadcasts, and construction and installation of studio equipment. He has also helped repair damage to the aerial system and transmitter caused by a number of lightning strikes, a job which involved Andrew climbing the tower to inspect and repair the loading coil.

Andrew believes the apprenticeship course is the best way to get his training as it offers a co-ordinated program of work experience and related schooling. He said that heavy emphasis has to be placed on digital techniques as they are being encountered in both studio equipment and transmitters nowadays. However, power valves are still used in transmitters and so must still be covered in the school course.

Andrew's supervisor, Murray Cauf, the station engineer at 3DB, is giving him every encouragement and assists with any difficult theory problems.

Andrew intends to continue his education past the mandatory apprenticeship schooling, and hopes in the future to become a station engineer.

*Training adviser and liaison officer, Industrial Training Commission, Victoria.



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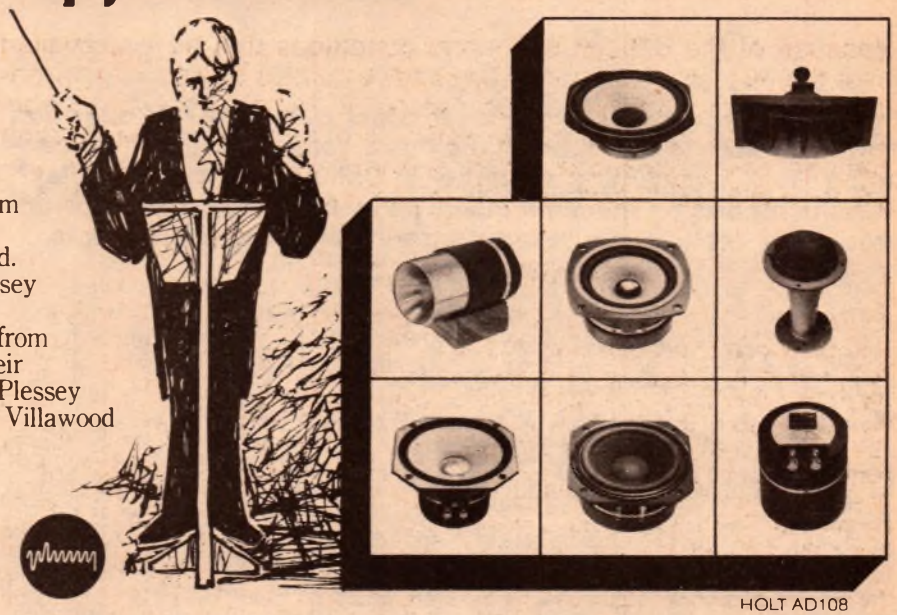

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A trip through 'Silicon Valley'

During his recent trip to the west coast of the USA, Editor Jim Rowe was able to visit most of the major semiconductor manufacturing firms — including a number in California's "silicon valley". Here he reports on the main things he learned concerning current production techniques, research trends and future prospects.

Although many of the big US semiconductor manufacturers have fabrication plants in a variety of states, as well as assembly facilities in other countries, most of them have plants in the "silicon valley" area of California. This is the traditional birthplace of silicon planar technology, and is still the nominal hub of the semiconductor revolution.

Actually the term "silicon valley" mainly came into use because of the number of semiconductor plants congregated within a relatively small area, in the Palo Alto — Mountain View — Sunnyvale — Santa Clara district about 60km south of San Francisco. It is true, though, that the area forms part of a large valley which encloses the southern end of San Francisco bay.

During my trip I was able to stay in the area for almost a week, based at a hotel in Palo Alto just a few kilometres down the historic El Camino Real highway from Stanford University. In the time available I was able to visit most of the larger semiconductor plants sited there.

Only two of the major semiconductor manufacturers do not have plants in the silicon valley area — Motorola and Texas Instruments. Luckily I was able to spend a day in Phoenix, Arizona, later in the trip, looking over a couple of the Motorola plants there. So, all in all, I was able to see quite a representative selection of current US semiconductor factories.

Before talking about specific companies, perhaps I should make a few general comments.

When I visited each firm I made a point of asking its executives to comment on the growing competition from Japan, and their attitude to it. This seemed particularly relevant in view of some of the statements made recently by US industry spokesmen.

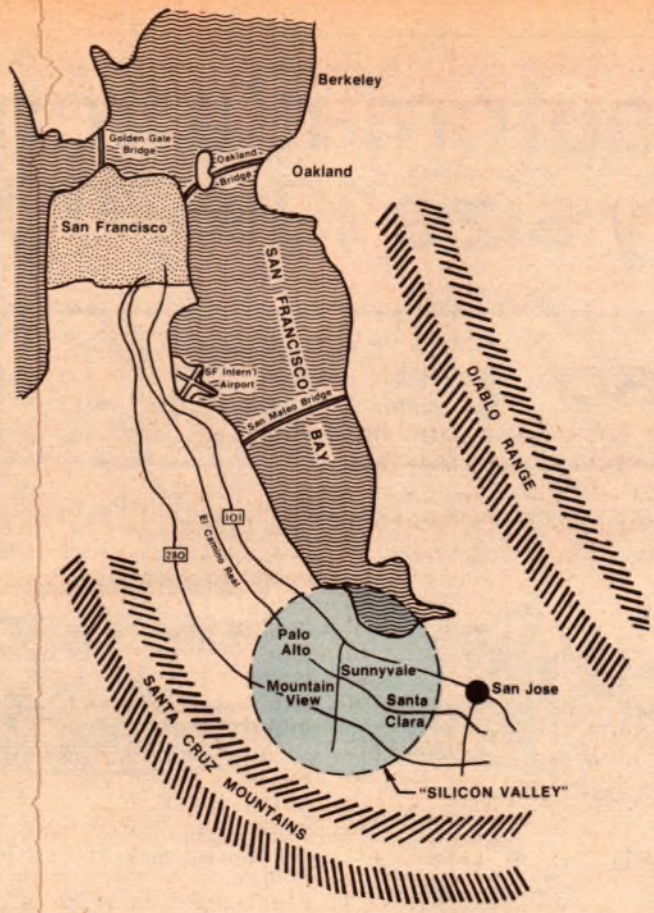
In almost every case the answer I got was that, although the problem has been somewhat exaggerated, the US industry is concerned because it sees itself disadvantaged in two main ways. One is the import tariff disparity between the two countries: imports into Japan attract 12% tariff, twice that into the USA.

This makes it significantly harder for the US industry to compete — not so much for the domestic Japanese market, but for the much larger export market. Japan is now a major supplier — if not the largest — of the world's electronic equipment, and US semiconductor makers believe they must have reasonable access to this market.

This problem could conceivably be solved by negotiation between the US and Japanese governments, with a view to equalising the tariffs, and the industry is currently urging their government to seek such an agreement. But

A fairly typical sight in "silicon valley". This shot shows the Signetics Corporation administration building in Sunnyvale.

Many IC wafer fabrication steps are now computer controlled. (Courtesy Signetics.)



just what could be done if such negotiations fail is hard to say — the US industry could hardly ask for the US tariff to be doubled, as this would conflict with their free enterprise and trade policy!

The other main problem, as the US industry sees it, is that the Japanese semiconductor industry is being coordinated by their government to minimise R & D duplication and to raise business efficiency by segregating market areas. This effectively makes the total Japanese semiconductor industry into a single monopolistic competitor, of formidable size.

Needless to say the US firms see this as leading to a "united they stand, divided we fall" situation. But the way to prevent this is not at all clear.

There's no way of preventing the Japanese from uniting, yet the idea of having the US Government coordinate their own industry conflicts strongly with the concept of free enterprise. And, of course, it must be conceded that the free enterprise system does generate a tremendous amount of technological and marketing initiative, despite the negative aspects of competition and duplication.

One interesting way in which this initiative makes itself apparent is in working conditions. What impressed me about all of the semiconductor manufacturing plants I visited was the working environment, which seems particularly pleasant.

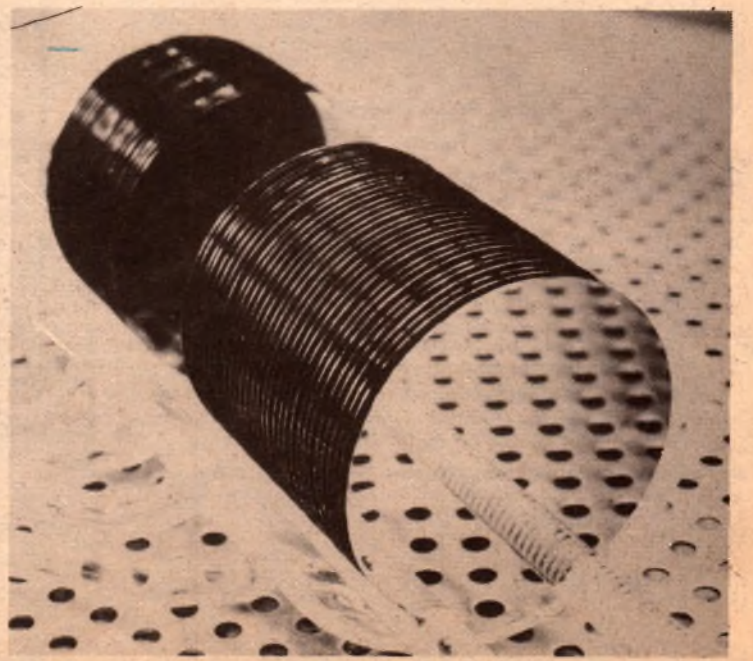
Each plant is generally set in spacious landscaped grounds, with many attractive trees and shrubs (incidentally many of the trees in California are eucalypts, originally imported from Australia). Many have well-appointed employee rest areas, and most have a bright canteen-restaurant offering excellent food at subsidised prices.

At one such canteen there is an outdoor eating area, with redwood tables and benches set on an attractive brick-paved patio beside a charming landscaped lily pond.

Virtually all of the plants provide a large car park for employees, and even these are usually dressed up with shrubs and gardens, to improve the overall outlook.

What makes all this particularly significant is that there are virtually no trade unions operating in these plants.

Now well established, ion implantation chambers are also largely computer controlled. (Courtesy Signetics.)



Many of the semiconductor makers are now processing 100m-diameter wafers, with 150mm wafers already envisaged. (Signetics.)

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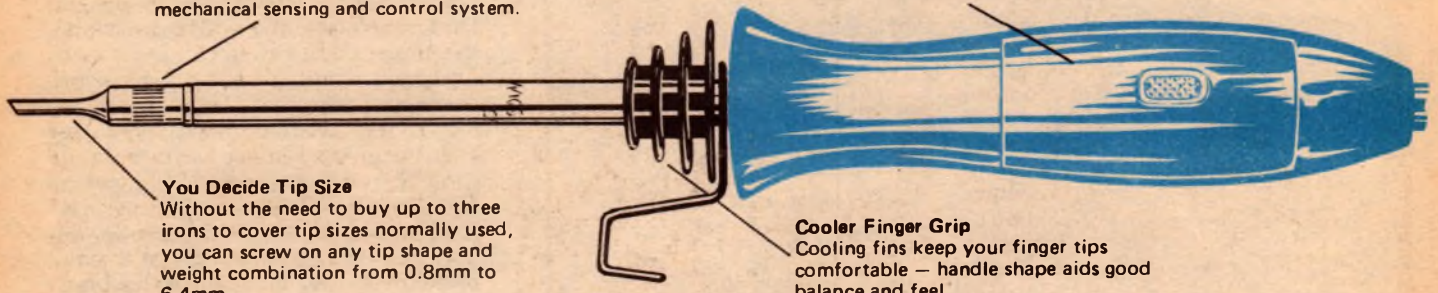

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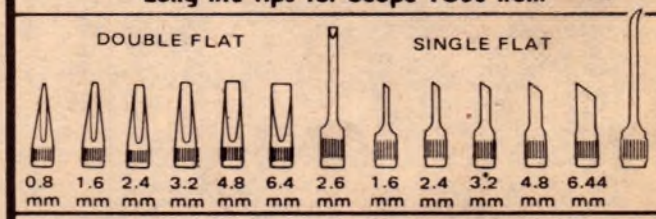

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All of the amenities have been provided by the firms in response to competitive pressures. As one plant worker replied when I commented on this, "Well, the company knows that if they don't provide good amenities, we are likely to quit and get a job down the road!"

On the technological side, as one would expect, the competitive pressures are pushing all of the companies ever onward into LSI (large-scale integration) and parallel technologies like magnetic bubbles.

Most of the companies seem to be getting into bubble technology, even though it requires rather different processing from conventional semiconductor devices. Perhaps more of them are committed to CCD (charge-coupled devices), although the consensus of opinion seems to be that standard N-channel MOS technology is still capable of considerable development.

Broadly speaking, most companies seem confident that product developments will continue to take place at the current rate. For example memory devices are expected to continue doubling in capacity every three years or so.

Needless to say, maintaining this rate of production development involves heavy investment in both R & D and fabrication plant. Most of the US semiconductor companies plough between 10% and 12% of their profits back into R & D, while I was told that production costs tend to increase by a factor of 10 times for each doubling of memory device capacity (for example).

In the area of fabrication, most companies are currently using 75mm diameter silicon wafers, although a number are in the process of changing to 100mm wafers. The next likely shift is to 150mm wafers, but this is probably about two years away.

Some firms are still using contact printing for wafer masking, but most seem to have either changed or are in the process of changing over to optical projection printing. Some have started to work with electron beam masking, but this still seems to be experimental as yet.

An exotic new technique only a few years ago, ion implantation is now a standard fabrication procedure. Although still a costly and impressive machine, ion implanters are now "just another piece of fabrication plant", found in many facilities along with diffusion furnaces, epitaxy reactors and metalisation chambers.

Incidentally as you might expect computers are now used not only for product testing and sorting, but to control many of the wafer fabrication processes as well. In fact most of the major fabrication steps are now fully automated, removing variables due to the human element.

Turning now to specific companies, the first firm I visited was the Intel Corporation, in Santa Clara. This is the company which was founded only 10 years ago by semiconductor pioneers Dr Gordon Moore and Dr Robert Noyce, the acknowledged inventor of the microprocessor. It specialises in high-technology LSI products like memory chips and microprocessors, and tends to lead the field with new developments.

At Intel I was shown around by Mr Ward Gebhardt, their director of international market development.

Among the interesting things I learned from talking with Ward Gebhardt

As with fabrication, testing of both wafers and final devices is now almost completely computerised. (Signetics.)

was the news that Intel are shortly releasing a 16-bit microprocessor, the 8086. It will have a more powerful instruction set than 8-bit processors, together with a significantly enhanced addressing capability.

Intel are also working on magnetic bubble memories. As was announced in the US technical press a couple of months ago, they have entered into an agreement with IBM, to exchange their own single-chip microcomputer technology for IBM's bubble memory know-how.

One of the areas where Intel has been leading the field is in EPROMs of course. They have recently announced a new family of single-5V-supply EPROMs which includes a 32k bit device, and have for some time been making a single-chip microcomputer featuring an EPROM on the same chip as the processor and RAM memory.

As EPROMs have the reputation of being tricky things to make, particularly when combined with other types of element on the same chip, I asked Ward Gebhardt if Intel had struck any problems. He smiled broadly and said "No more than we expected!" Fairly obviously they solved whatever problems they did encounter, and are now getting good yields.

The next firm I visited was Fairchild Semiconductor, with plants in both Santa Clara and Mountain View. Fairchild is basically the oldest of the semiconductor firms in silicon valley, having started there at the beginning of the silicon transistor era. They still hold the key patents on planar technology, used in virtually all modern transistors and integrated circuits.

Because Fairchild has been in the business so long, almost everyone working in the silicon valley area seems to have worked there at one time or another. Many engineers have gained their basic training there, and many of the other firms have been started by ex-Fairchild employees wanting to "go it alone". As a result the firm is often described jokingly as the "university of Fairchild".

Fairchild has a high degree of "vertical integration", being involved directly in just about every phase of product manufacture and application. On the manufacturing side they start right from scratch, growing their own silicon crystals and refining them before performing all of the normal fabrication processes.

And after the semiconductor devices are made, they also use them in a variety of proprietary product lines. These include digital watches, clocks and video games.

During my visit to Fairchild I met Mr Bill Wirth, international operations manager for their video products division. Bill Wirth gave me a very interesting demonstration of the Fairchild "Channel F" microprocessor-based video game, with its range of plug-in "Videocart" game cartridges.

The basic game itself contains 3 of the Fairchild F8 microprocessors, together with 4 ROM program storage chips. Each of the various plug-in games cartridges contains a PC board with additional F8 and PSU chips, giving a very flexible system. The two hand controls each have 8 directions of movement. All in all, a most impressive game indeed.

In fact, it is so far ahead of the familiar "ping-pong" type video games that Fairchild have been presented with quite a marketing challenge. As Bill Wirth explained, it hasn't been easy to convey the game's full potential to an electronically unsophisticated public.

A trip through "Silicon Valley"

Despite this they are now starting to sell really well, and you can see them in many US department stores.

The third company I was able to visit was National Semiconductor Corporation, with a number of plants in Santa Clara. Like Intel, National was formed in the 1960's by ex-Fairchild people, and is currently headed by former Fairchild executive Charles Sporck.

National is a broad-based company, however, and makes a wide range of semiconductor devices. It also has a high degree of vertical integration, making memory systems and industrial mini and micro computers as well as consumer products like digital watches and calculators.

I was shown around National by Mr Jack Query, their marketing coordinator for the far East region. Jack had organised a very interesting tour, and I was able to meet many of the National engineers and executives as well as see a variety of product fabrication lines and other faciliies.

I was able to see fabrication lines of both the "batch" and "continuous" type, and the comparisons were interesting. With the batch type of line less equipment is required, as the same equipment may be used for a number of different stages in the fabrication sequence. In contrast the continuous type of line requires more equipment, as the wafers pass through each station only once.

The continuous type of line has the potential for greater throughput, but requires a somewhat greater capital investment. It also tends to be more vulnerable to stoppages due to equipment breakdown.

Talking with National engineers I learned that they will shortly be coming out with a new single-board microcomputer system for industrial applications. Based on SC/MP, it will have 4k bytes of RAM, National's NIBL (extended Tiny Basic) interpreter in a single Maxi-ROM, parallel I/O and a programmer for 8k/16k PROMs, all on the single PCB.

Looking further into the crystal ball, I was told that they expect to release a 1k byte static RAM chip within about 12 months. Shortly after that we should see 32k bit EPROMs, with 64k EPROMs only about 3 years off at the most.

Incidentally one of the people I met at National was Ms Georgia Marszalek, director of their microprocessor user's group. We had a very friendly talk, and compared notes on the problems of publishing a technical magazine. Georgia told me that her "Compute" newsletter now has a circulation of about 12,000 worldwide, with about 500 coming to Australia.

The final semiconductor company I was able to visit in the silicon valley area was the Signetics Corporation, in Sunnyvale. As most readers will be aware, Signetics became part of the worldwide Philips organisation in 1975. Before that it was a subsidiary of Corning Glass.

Signetics started in 1961 as a supplier of a broad range of fairly standard devices. Later it came out with quite a few pioneering products of its own, including such things as phase-locked loop chips and the classic 555 timer IC.

My host at Signetics was senior sales engineer Mr Herb Jesse, who again had organised a very interesting day of plant tours and meetings with engineers and executives. I met the people behind the 2650 microprocessor, and saw a new 2650-based microprocessor tutor unit which they will be releasing shortly.

One of the things that the Signetics people were keen to stress was that although the 2650 microprocessor may have been a little late to enter the market, they are definitely committed to it and its fast-growing family of interfacing chips. They certainly don't see it as an "also-ran", in danger of being eclipsed by the older and more established microprocessors.

One of the new chips coming out shortly as part of the 2650 family is a 2k-byte ROM with an improved version of the Signetics "PIPBUG" debug/monitor, together with a new line assembler known as "PIPLA". This should be of great interest to both industrial and hobbyist users with 2650-based systems.

One of the many interesting things I saw at Signetics was a demonstration of a new video game chip set, currently under development. One of the games provided by the set was a fascinating "boxing" game, in which two humanoid figures appear on the colour TV screen. By manipulating the game's hand controls you can make them slug one another, knock one another out and so on.

The game is complete with sound effects, so that each figure makes the appropriate noises when hit. The game also monitors the expended "energy" used by the two figures, and this together with a random factor is used to determine whether a boxer recovers from a knockdown or stays down for the count. It sure is a far cry from the familiar "ping-pong" type of simple video game!

Outside one of the Motorola plants in Phoenix, Arizona. Note the large cactus on the right, with palm trees behind it.

About a week after leaving the silicon valley area, I was able to spend a day in Pheonix, Arizona, looking over some of the plants of Motorola Semiconductor. As most readers will be aware, this firm is a subsidiary of Motorola, Inc — one of the largest US electronics companies.

I was shown around the Pheonix plants by my old friend Jim Wiggins, who ran Motorola's Sydney office for some years. It was good to meet him again, and to hear how successfully he has settled in sunny Arizona.

Another familiar face at Motorola belonged to Mr Bob Hammond, marketing manager for solar operations, whom I met about a year ago when he visited Australia to

promote the new Motorola silicon solar panel. He was able to tell me that since then the solar panels have been selling extremely well — so well, in fact, that they can't make them fast enough!

Speaking of solar energy, Bob was able to tell me of two interesting new developments. One is that Motorola has developed a high efficiency concentrator-type solar cell, with integral mirror system and heatsinks. A prototype array of these cells is likely to be set up at Pheonix airport, as described in a featured story in last month's issue.

The other development is that Motorola has made considerable progress with ribbon fabrication technology, believed to hold the key to low cost solar electricity.

Whereas other firms have been working on die-pulling methods of making a continuous silicon ribbon, Motorola has developed a method of depositing a polycrystalline layer on a continuous band of special substrate material. The two are then separated, and the resulting thin silicon ribbon is zone melted by a high-power laser beam to recrystallise it into single crystal form.

In one of their development labs I saw 50mm-wide ribbons about 200mm long made in this way, with a 500 watt carbon dioxide laser being used for the zone melting. The results certainly look promising, although my impression is that it could well be 2 or 3 years before we see the resulting low-cost solar cells.

In another Motorola plant I saw liquid-crystal displays for watches being made. These involve quite a deal of skilled labour at present, possibly one reason why they are as yet more expensive than LEDs. The LCD displays are used in Motorola's watch modules, which are sold to many watch manufacturers.

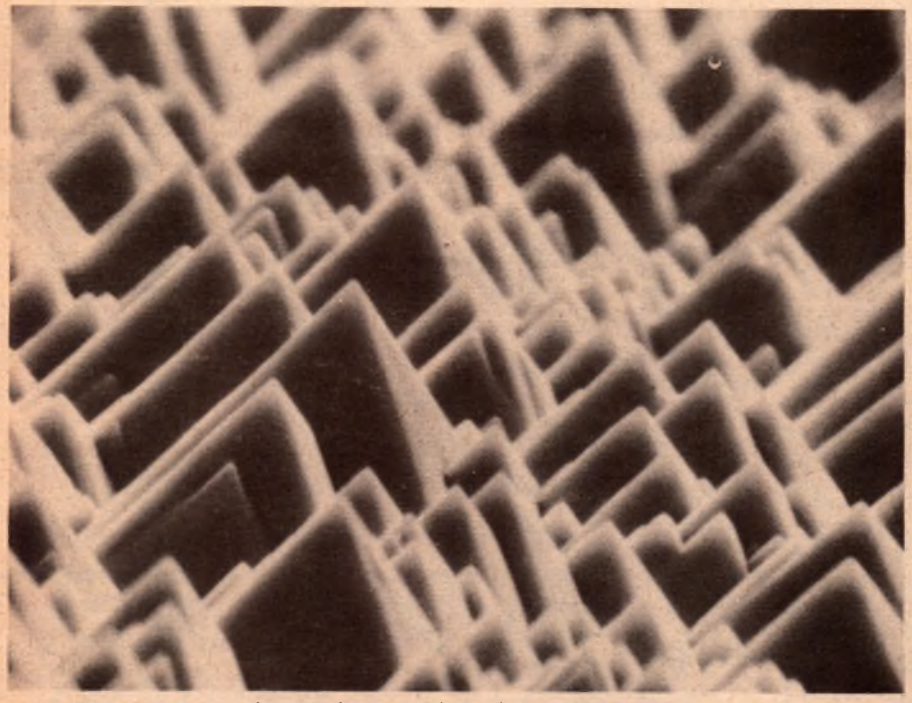
Needless to say, Motorola is very active in the microprocessor area.

Their 6800 is still going strongly, with a growing family of peripheral chips and additional processors. An interesting new addition to the family is the MC14500B, a single-bit processor designed specifically for decision-orientated controller applications.

The MC14500B is described as an "industrial control unit" or ICU. It has an instruction set with only 16 instructions, and is designed to be used by engineers without any previous knowledge of microprocessors. Motorola sees it as filling an important application area, doing control jobs which are really too simple for even 4-bit conventional microprocessors.

Well, I hope the foregoing has given you a good idea of the main things I learned on a quick tour of most of the major US semiconductor firms. Perhaps it has also given you some idea of the sort of developments we can expect from these firms in the next couple of years. Judging by what I saw, we should see some exciting new products.

Finally, a note of thanks. This sort of tour would not have been possible without the generous cooperation of many people in the firms concerned, and I am most grateful to all the people concerned. This includes not only those in the US facilities I visited, but also those in Australia who arranged the various visits.



A microscopic view of one of Motorola's silicon cell wafers. The texture-etched pyramids give an exceptional 99 per cent energy absorption rate.

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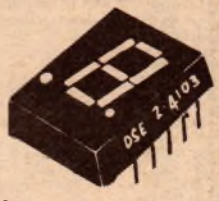

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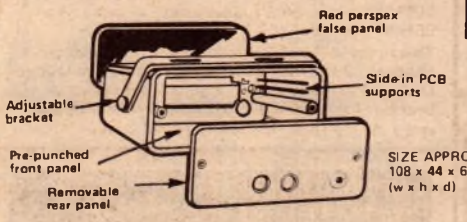

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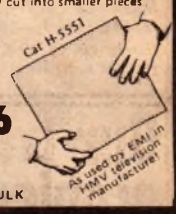

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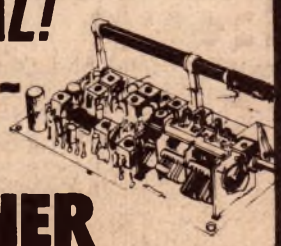

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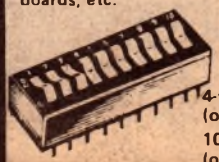
4 or 10 SPST rocker switches mounted in a DIL package – ideal for PCB mounting. Use for pre-programming, for changing circuit constants on boards, etc.



from $1.70

4-way: Cat S-1604 .. $1.85 (or $1.70 for 10 or more)
10-way: Cat S-1610 .. $2.95 (or $2.65 for 10 or more)

NEW!

DIGITAL WATCH KIT

It's cheap enough to be a toy for the kids (Christmas is close!) but it's far from a toy — it's a full function digital electronic watch kit. Kit? All you do is put a couple of modules in place and snap the back shut! But this electronic masterpiece (which sold for around $50 only 12 months or so ago) shows date, day & seconds as well as hours & minutes. Real value!

Cat. K-3455

$12.50 includes strap, batt.

SPARE BATTERIES
Pack of 2 ultra-high reliability silver oxide batteries.
Cat S-3295 .. .. .. $1.95

Build a 200 Meg DFM.

It's one of the handiest pieces of test gear to have in the workshop, the shack, the laboratory — a digital frequency meter.

40MHz: Cat K-3436
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200MHz Version: Add a 95H90 IC (Cat Z-5360) Now reduced to only $12.50 (save $4.00!)

Now you can build your own 200MHz DFM for just over $100. In fact, if you only need 40MHz, (and many people don't need more) the kit is less than $100. And if you want to increase it to 200MHz in the future, that's easy — just add a 95H90 pre-scaler IC.

This is the all-new Electronics Australia design (August/September issues) and features exclusive Dick Smith front panel. You'll find it hard to beat our kit — it comes with explicit instructions and a 'Sorry Dick it Doesn't Work' coupon.

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Our ads are often so successful that the stores run out of advertised lines within a few days. Or, in some cases, a last minute hitch may develop: a wharf strike may hold up goods, a parcel may go astray, a flu epidemic may hit our warehouse . . . What we're trying to say is that SOMETIMES the lines shown on these pages may not be available in the stores when you go in. Please don't blame the shop staff: they're as helpless as we are! So if you're about to drive across town or across the state to pick up a certain line, play it safe: PLEASE PHONE THE STORE FIRST — they'll be able to tell you if what you want is in stock!

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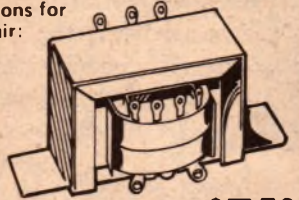

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M-2155 nominally 15V @ 1A with taps at 6.3V, 7.5V, 8.5V, 9.5V, 12.6V, 15V. Gives the following combinations: 1.0V, 1.2V, 2.0V, 2.2V, 2.4V, 3.1V, 3.2V, 3.5V, 4.1V, 5.1V, 5.5V, 6.3V, 7.5V, 8.5V, 8.7V, 9.5V, 12.6V and 15V, plus 2.0V CT, 12.6V CT, 15.0V CT. A TOTAL OF 21 COMBINATIONS! **$5.50**

M-6672 nominally 30V @ 1A with taps at 15V, 17.5V, 20V, 24V, 27.5V, 30V. Gives the following combinations: 2.5V, 3.5V, 4.0V, 5.0V, 6.0V, 6.5V, 7.5V, 9.0V, 10.0V, 12.5V, 15.0V, 17.5V, 20.0V, 24.0V, 27.5V, 30.0V, plus 5V CT, 30V CT. A TOTAL OF 18 COMBINATIONS! **$6.75**

M-6978 nominally 15V @ 2A with taps at 6.3V, 7.5V, 9V, 10.5V, 12.6V, 15V Gives the following combinations: 1.2V, 1.5V, 2.1V, 2.4V, 2.5V, 2.7V, 3.0V, 3.6V, 4.0V, 4.2V, 4.5V, 5.1V, 6.3V, 7.5V, 8.7V, 9.0V, 10.5V, 12.6V, 15V, plus 3V CT, 12.6V CT, 15V CT. A TOTAL OF 22 COMBINATIONS! **$16.00**

PARTS FOR NEW KITS

UNIVERSAL MOVIE MIXER (See September E.A.)
Complete kit, including instructions .. .. Cat K-3492 .. $49.50
SEPARATE PARTS:
PC Board (only) .. Cat H-8354 .. $2.95
50k A curve 45mm slider pot .. Cat R-1980 .. 85c
Knobs to suit slider pot .. Cat H-3774 .. 30c

FET INPUT AC-DC VOLTMETER (See September E.A.)
Not produced as a special kit — all parts available ex stock
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1mA MRA-65B Panel Meter .. Cat Q-2060 .. $14.50
Fabricate your own meter scale using the Scotchcal process:
8005 black Scotchcal photo sensitive aluminium .. Cat H-5694 .. $6.00
CA-3140 FET op amp .. Cat Z-5417 .. $2.50

DIGITAL DIAL (See September E.T.I.)
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PC Boards:
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ETI 591 A/B (suit special Dick Smith LT 303 7 segment displays .. .. Cat H-8617 .. $4.00
ETI 591C (suits yellow H/P 5082-7663 displays) .. Cat H-8618 .. $1.80
ICM 7217A up down counter IC .. Cat Z-5416 .. $16.00
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Same style as previous kit, but new circuitry means it is easier to build, set up and is more sensitive. Basic counter is 40MHz — by adding a single 95H90 IC the range is extended to 200MHz
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PC Boards (set of two top quality boards) .. Cat H-8346 .. $8.50
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74C926 IC (4 digit counter) .. Cat Z-5414 .. $12.00
3.579545MHz crystal (new low price!) .. Cat K-6031 .. $3.00
LT-303 7 segment display .. Cat Z-4103 .. $1.50
All other components are normal stock lines at all of our stores.

PHOTO TACHOMETER (See August E.A.)
Although we do not produce a full kit for this project, all parts are normal stock lines at all of our stores.
PCB (only) .. Cat H-8352 .. $1.80
FPT100 phototransistor .. Cat Z-1950 .. $2.00

UTILITY TIMER (See August E.A.)
Again, not produced as a special kit — all parts are normal stock lines.
PCB (only) .. Cat H-8345 .. $3.50
6V Buzzer .. Cat L-7009 .. $1.75
Zippy box case .. Cat H-2753 .. $1.95

NEW 10 GAME TV GAME KIT (See July E.A.)
Complete kit, including instructions .. Cat K-3491 .. $49.50
SEPARATE PARTS:
PCB (only) .. Cat H-8344 .. $3.95
Fully built RF modulator .. Cat K-6040 .. $3.00
Fully built audio modulator .. Cat K-6042 .. $4.50
AY-3-8600 IC .. Cat Z-6852 .. $15.00

TRANSISTOR TESTER (See July E.A.)
Complete kit, including instructions .. .. Cat K-3052 .. $17.90
SEPARATE PARTS:
PCB (only) .. Cat H-8350 .. $1.95
1mA panel meter .. Cat Q-2010 .. $7.90

UP/DOWN PRESETTABLE COUNTER (See E.T.I. July)
Not a full kit. Special parts
ICM 7212A IC counter .. Cat Z-5416 .. $16.00
Special PC boards to suit the Dick Smith Z 4103 7 segment displays:
PC boards A & B .. Cat H-8617 .. $4.95
7 segment displays .. Cat Z-4103 .. $1.50

STUNT MOTORCYCLE TV GAME (See E.T.I. June)
Full kit, including instructions .. .. Cat K-3474 .. $29.50
SEPARATE PARTS:
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Fully built RF modulator .. Cat K-6040 .. $3.00
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3.58MHz crystal (new low price) .. Cat K-6031 .. $3.00

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But we suggest you hear it for yourself. Take your favorite record or tape to your dbx dealer and ask for a demonstration. Once you hear the 3BX in action, you'll wonder how you ever listened to music without it.

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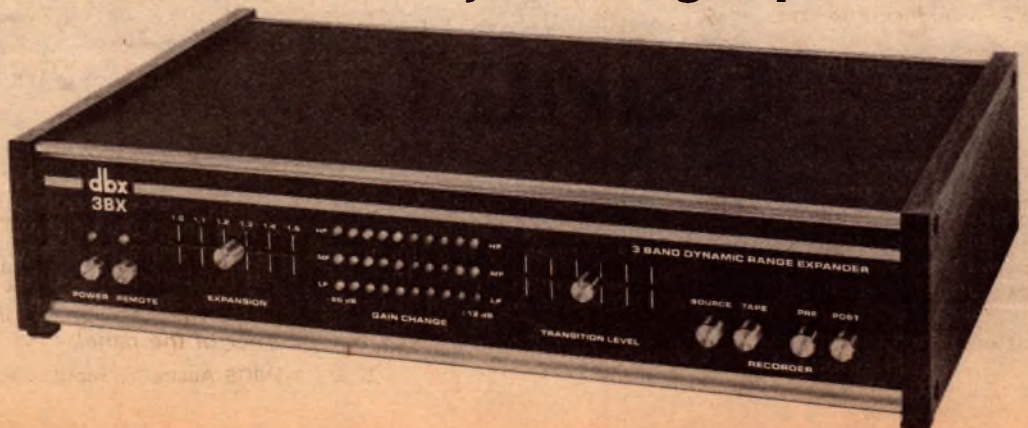


Hi Fi News

THE CHICAGO CES: FROM THE WAY AHEAD TO THE WAY OUT!

With electronic exhibitions much in the news of late, our U.S. correspondent George Tillett reports on the most recent Chicago Consumer Electronics Show. He draws attention to some of the items that you may well be aspiring to own during the next couple of years!

Forerunner of what may turn out to be a whole new generation of recording tape, this Scotch brand "Metafine" uses particles of metallic iron, as distinct from iron or other oxides. It offers improved performance but requires the use of much higher bias and erase currents.

The Chicago Consumer Electronics Show keeps on growing and, this year, there were no less than 821 exhibitors spread over some 500,000 feet at the huge McCormick Center and the adjoining McCormick Inn.

For the past two or three years, makers of audio equipment have been pressuring for a separate audio show where they would not have to compete with video games, TV, CB radios, calculators and other such products. So about 80 exhibitors were segregated at the Pick-Congress hotel under the designation "Esoteric High-Fidelity". Another 70 had demonstration rooms at the afore-mentioned McCormick Inn, so it would seem that the CES organizers had listened to the audio critics.

By a strange coincidence, the Institute of High Fidelity (IHF) put on an Audio Show ony three weeks before, at Atlanta in the Deep South. Several manufacturers patronised both events (about 200 were at Atlanta) but many found the two shows to be too close together so it is more than likely that next year's IHF affair will be held at a different time.

Space will not permit more than a brief description of a few of the new products seen at both shows. Indeed, many may have found their way to Australia by now, for inclusion in your own recent shows.

First a few words about TV: large-screen projection models are beginning to be more popular and there are now several models to choose from. GE introduced a rear-projection model using an acrylic fresnel lens with a 45 inch (measured diagonally) screen. A special two-gun 13-inch tube was developed and the system uses a three-element plastic lens and two mirrors. EHT supply is 32kV and among the features are remote control electronic tuning and two loudspeakers. Price is in the region of $2800.

Another model in the same price bracket is the new Sharp two-piece system which boasts a 72 inch screen. It uses three projection tubes and it has a built-in cross line pattern generator, an ultra-sonic remote control unit and electronic channel selector.

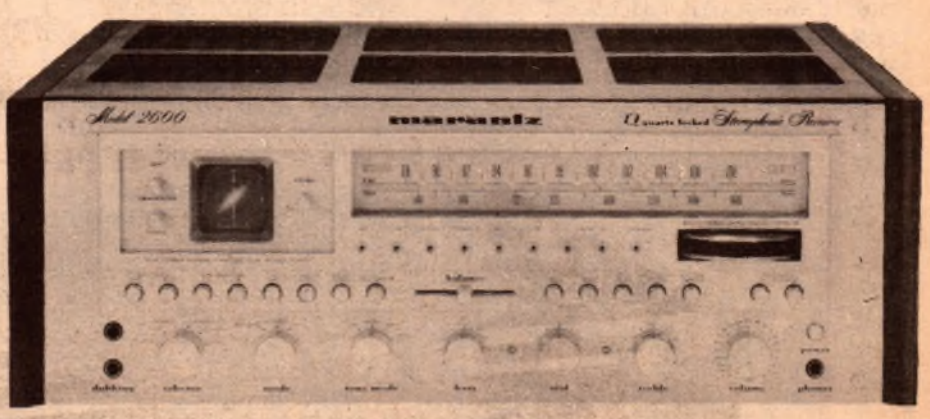
Two-piece models are made by Advent and Sony — the latter company now also marketing two single unit models.

The increased interest in large-screen TV has prompted a number of enterprising firms to market relatively inexpensive models using ordinary 19-inch sets with a lens and screen. Some have separate screens, while others use a rear projection system, but few offer a really bright picture.

The most interesting news in the tape world is the imminent introduction of metal, or metal film tapes which use iron particles instead of oxides. Efficiency can be as much as 10dB higher, with better signal to noise ratio, wider frequency response and less high frequency saturation.

Several manufacturers like BASF, Fuji and Scotch (3M) are concerned with the development of these new high-coercivity tapes and it is to be hoped that standards will soon be set.

Their main use initially will be in cassette decks but tape heads first have to be redesigned and bias current doubled. Equalization might have to be changed as well, although the 3M company has made metal tape which they call "Metafine" in a 70uS format. This was being demonstrated on a special Tandberg two-head cassette deck and a direct-disc record was being used as a comparison.



Most powerful receiver on display at the Chicago CES was this Marantz 2600, offering 400W per channel, from a direct coupled power amplifier. The FM tuner front end boasts dual-gate FETs with a 5-gang tuning, while the signal is displayed on a 3-inch oscilloscope, seen at the top left corner of the panel.

Introducing the new range of EMI Cassettes.

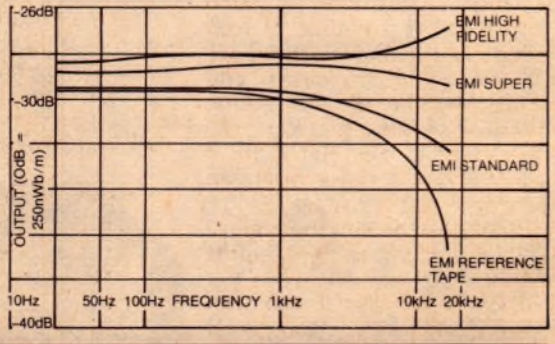
These new cassettes from EMI are designed to meet and exceed the exacting specifications in all performance areas, with special attention given to ensure smooth and trouble-free mechanical operation.

The new EMI Cassettes produce excellent results over the whole range of available equipment. All are available in 60, 90 and 120 minute playing time.

Whatever your equipment, whether they are recording speech or music, the EMI Cassette range will precisely match your needs.

1. Measured using the EMI recommended 2.5dB overbias at 6.3kHZ, derived from the reference batch C521V (the value of bias internationally used by the majority of domestic recorder manufacturers).
   Tape speed 4.76cm/s (1⅞ in/s)
   Track width 0.6 mm
   Record head gap length 2μm
   Replay head gap length 2μm
   Replay amplifier characteristics: 120μsec and 3180μsec
   (In accordance with IEC Publication 94 Edition 3, BS1568 Part 1 and DIN 45513)
2. The Frequency Response is obtained when the record amplifier characteristic has been adjusted to give a flat frequency response (25Hz – 15Hz) from the reference tape batch C521V of –30dB (Ref. 1*).
   **Ref 1. Relative to an RMS Flux of 250nWb/m Tape Width (25mMx/mm) at a frequency of 315Hz (in accordance with IEC Publication 94 Part 2)*

TYPICAL FREQUENCY RESPONSE OF EMI CASSETTES



Nakamichi were also demonstrating metal tapes and they were using a modified Model 1000 studio cassette machine; the results were being compared with a tape played on a Revox open-reel recorder.

In addition to showing the capabilities of the new tapes, the Nakamichi demonstration was concerned with noise reduction systems. A 3-position on the deck switched in a Dolby or Telcon (Telefunken) system which gives 20dB noise reduction against Dolby's 10dB. Who knows? This could start another trend!

Most of us have assumed that the Philips cassette license precluded the manufacture of decks with 3.75ips speeds. Either we were misinformed or the situation has changed because B.I.C.-Avenet introduced three decks with both 1.87 and 3.75ips speeds. The top model has a monitor head and the frequency response at the higher speed is claimed to be 22kHz, within +3dB. Playing time is, of course, cut in half but, if the idea becomes popular, perhaps tape manufacturers will take another look at the C.120 cassette.

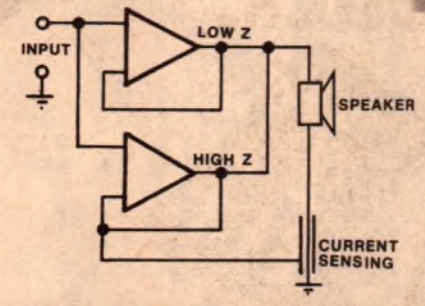
Several new tuners and receivers were to be seen-in all price ranges and a number of the more expensive models used frequency synthesis. Sherwood's Micro CPU 100 is one of the few tuners that can display the station's call letters in addition to the frequency read-out and it has automatic scanning with preset station selection as well.

The new Dynaco tuner has no fewer than six tuned stages in the "front end" and, as soon as the hand is released from the tuning knob, the read-out frequency display becomes a clock!

Nakamichi's new Model 730 receiver is a most sophisticated unit with some unusual features. For example, the "front end" uses a motor-driven 4-gang capacitor which is controlled by touch sensors and there is a choice of four preset stations. Mode and functions are also controlled by touch sensors and these include the motor-driven volume control. Because of the use of logic circuitry, the design is well suited for a remote control and a pulse operated system with infra-red is used.

Prize for the receiver with the highest power goes (at present) to the Marantz 2600 which can put out 400 watts per channel! Like its smaller(!) 270 watt brother, the 2500, this super-receiver uses a small fan with tunnel heat sinks which certainly keeps the weight down. Even so, you need a strong shelf and a well-lined pocket book as the price is well over $1500!

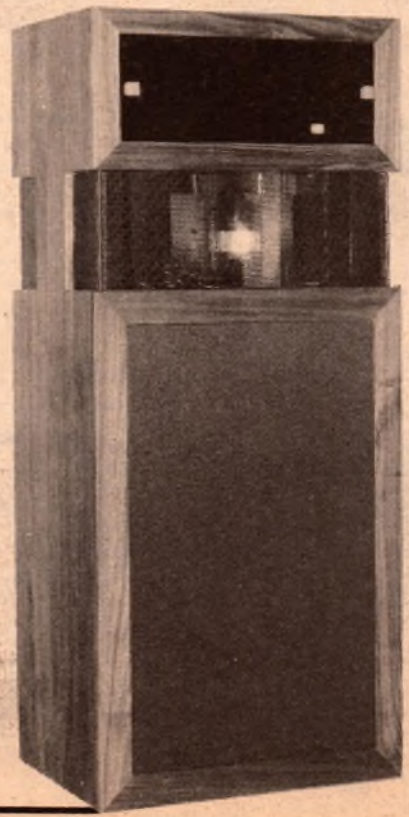
NEW CONCEPTS FROM THRESHOLD



Pictured above is a new high-power amplifier from "Threshold" (see text) which employs class A but uses bias tracking to conserve idling current. In another design (see diagram) they use a conventional high power low impedance amplifier to drive the speaker and a separate precision amplifier to sense and cancel any distortion.

Turning now to amplifiers, a California based company called Threshold were demonstrating an all-cascode Class A model which has a one-kilowatt power transformer. A unique biasing circuit tracks the bias under all conditions so that constant Class A operation is maintained. It is claimed that this innovation keeps the idling current down by 75 per cent.

But the most interesting amplifier here was a "feed-forward" model which used a separate amplifier to null the distortion. The amplifier was the Stasis 1 and Threshold say that "its near perfect operating parameters are achieved through the fact that the only work required of it (the error-nulling stasis amp) is to null out the small inaccuracies appearing in the output of a powerful active current source." This technique is not new, but this design is superior to others because the error nulling amplifier section is connected directly to the load. Power output is rated at 300 watts per channel at a distortion of less than 0.002 per cent.



Among the new preamps was the Crown DL-2 which is called a stereo Controller. It really consists of three units: a small head amplifier, a control unit and a power supply. The head amplifier is designed to mount as close to the phono cartridge as possible and it is fitted with RF suppressors. The control unit has eight dual switched inputs, digital touch-buttons for gain and balance, and high and low filters, with each having 4 selectable positions. There is a separate headphone amplifier, precision loudness compensation, two digital displays and much more. Siwtching is accomplished by reed relays and the level is adjusted by varying the actual gain. Provision is made for full remote control and computer connections are at the rear. Truly the Rolls-Royce of preamps!

Well, as you might expect, there were all kinds of loudspeakers to be seen and heard at both shows, ranging from tiny shoebox midgets to huge systems like the Infinity Quantum Reference Standard which stands 76 inches high by 48 wide. It uses a 15-inch twin-voice coil woofer with two vertical arrays of flat induction type midrange and treble units. Another seven treble units (called EMITS, or Electro-Magnetic Induction Transducers) are mounted at the rear and two separate stereo amplifiers are required for each

Modulated plasma tweeter

The Hill Plasmatronic loudspeaker system which uses a modulated plasma "corona" to generate and radiate frequencies above about 700Hz. There is no cone, no mass, no beaming but the leaflet warns: "To achieve uncompromising quality, it is necessary to bleed a small amount of helium into the plasma. About every 300 listening hours a helium supplier will need to come to your home and exchange the tanks".

pair. Price is about $6000.

ESS were demonstrating their Transar system — the one with the five diaphragm bass driver, and a French company, Acoustique 3A, were attracting a lot of attention with their coffee table Triphonic systems. The coffee table contains two 12-inch bass drivers, a control unit, amplifiers, crossover, a turntable and a tuner. Frequencies above 100Hz are red to a pair of satellite speakers which can be hung on the wall or placed on a bookshelf. Some tables have space for a telephone and all are fitted with an electret microphone for checking the overall frequency response.

Last year, Koss introduced three systems based on the work in Australia by Thiele and Small, two being conventional reflex types while the third uses a passive radiator with a removable brass weight so the response could have a "bump" at 60Hz if so desired. This year, the range was augmented by a bookshelf model using an 8-inch woofer with an 8-inch passive radiator. At 3kHz, signals are taken to a 1-inch dome which has a short horn.

Quite a number of "linear phase" systems were to be seen and the B&W company, one of the first to take up this concept, were giving a remarkably effective "live versus recorded" demonstration with the aid of a musician who played a saxophone and clarinet. Although I was sitting near the front of the room, I found it quite difficult to tell when the sound was coming from the loudspeakers — a tribute to the synchronization of the performer.

Bozak, Martin and Dynaco all introduced "linear phase" systems and people are becoming accustomed to the "staircase" appearance.

One of the best Japanese loudspeaker makers is Mitsubishi, whose studio monitors are used by the NHK broadcasting authorities. They were showing some new designs including a studio model that weighed over 300lbs! Cones or diaphragms are made of performated aluminium covered with a semi-viscous plastic to get rigidity with good damping. Mitsubishi call this material a "honeycomb" and it is used in midrange units as well as woofers.

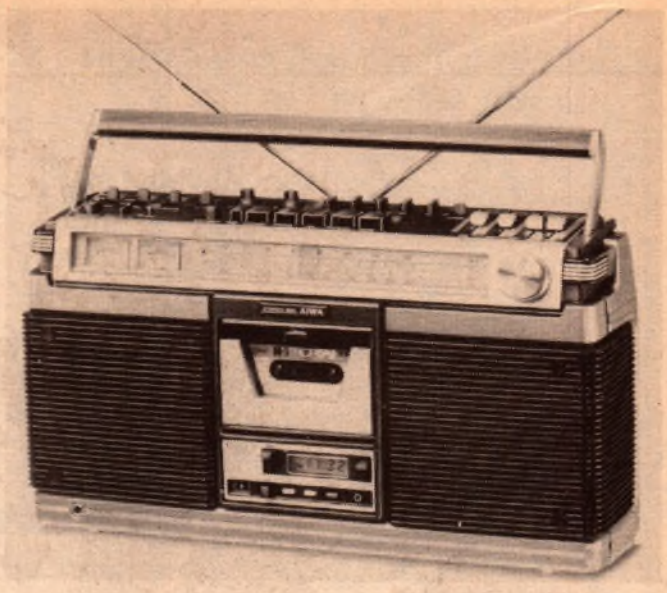
One of the most interesting loudspeakers was the Barcus-Berry glass plate tweeter. It consists of a sheet of glass measuring about five by seven inches mounted at the front of a small box. A driving unit — probably a piezoelectric device — is coupled to the rear and a 2kHz crossover is in the said box. Nothing exceptional about that but the curious thing is this: radiation is not directional but is almost omnidirectional! White noise disclosed a certain amount of ringing but I am sure this can be damped out.

An even more unusual system was called the Hill Plasmatronic which used a modulated plasma "corona" for frequencies above 700Hz. I quote from the leaflet, "the incandescent, lavender plasma of the Hill speaker system radiates sound in a spherical pattern with no phase problems". And there is no cone break-up to contend with, no mass, no voice coil and no "beaming". But this dream of perfection has a snag and I quote from the leaflet again, "To achieve uncompromising quality, it is necessary to bleed a small amount of helium into the plasma. About every 300 listening hours, a helium supplier will need to come to your home and exchange the tanks".

IN BRIEF

Sharp had a turntable which used a microprocessor for programming. A laser scanner counts the grooves and initiates the operation ... Revox introduced a straight-line tracking arm with turntable ... DBX were demonstrating the "Boom-Box" which synthesizes low frequency subharmonics from signals in the 80 to 150Hz range ... Empire introduced a new record cleaner called the Audio Groome. A thin plastic solution is applied to the record; when it is dry, the whole film is removed, taking the

A different approach to hifi by AIWA



While being more active than ever in the top end of the hifi market, AIWA are also catering for the buyer who is looking for equipment which combines good performance with greater portability and less bulk.

At the heart of the new equipment is a line of portable radio cassette recorders, such as the TPR-980 (illustrated) which is a versatile self-contained unit, yet capable of being interfaced with external hifi components.

As a self-contained unit, it can operate from internal batteries, car battery and AC power mains. It provides for AM, FM and short-wave coverage, while the stereo cassette recorder has specifications which bear comparison with domestic decks.

However, the TPR-980, like other units in the range, has provision for a stereo pair of microphones, headphones, extension bass reflex loudspeakers, and a magnetic phono preamplifier which allows it to be used with a quality direct-drive turntable, such as the AIWA AP-2200. When connected the latter, the cassette mechanism can be set up to start and stop in synchronism with the turntable.

For greater acoustic output, a compact, a compact power amplifier can be connected between the TPR-980 and the loudspeakers, while a prefabricated equipment rack is also available.

For further details: AIWA Australia Pty Ltd, 14 Gertrude St, Arncliffe 2205. Tel. (02) 597-2388.

New heavy duty cartridge

A new Goldring phono cartridge has been announced recently, expressly intended for use by radio station (and other) disc jockeys. Designated as type G800-DJ, it has a nude diamond stylus mounted in a steel shank, reinforced to withstand heavy handling and/or backtracking. It is ground to a spherical tip, 0.0006in dia, and operates with a playing weight of 1.5 to 3.5g. A bold arrowhead simplifies placement in a specific groove. For details: Soundring Distributors, Suite 1, 514 Miller St, Cammeray 2062. Tel. (02) 92-1990.

HIFI NEWS — Continued

dirt with it.

A hand-held breathalyzer was shown on one stand: it is fitted with 3 LEDS, green, amber and red. Nearby, a salesman was demonstrating battery testers in the form of a figure of W. C. Fields with a red nose! These two companies really ought to get together . . .

AUDAX LOUDSPEAKERS: Bill Webb Stereo of Melbourne have been appointed distributors in Australia of Audax audio products. Initially only the Audax drivers are being imported but future plans call for the marketing of speaker kits, microphones and headphones. Audax speakers are made in France and have become famous over the last couple of years through their use in many of the better quality English speaker systems. Spendor, Rogers, Tangent and Harbeth all employ Audax drivers, and they have also become popular in the UK with do-it-yourself enthusiasts.

Initially the distributors will concentrate on marketing the top quality HD range of drivers. In this range alone there are over 70 units, the largest being a 355mm 100 watt bass driver. At the other end of the scale there are eight different 25mm soft dome tweeters.

Even though speaker manufacturers will account for the bulk of Audax sales, Bill Webb will be happy to discuss the range with interested audio enthusiasts.

For further information on Audax Speakers contact Bill Webb Stereo, 32 Wilson Street, Oakleigh, Vic. Phone: (03) 579 5196.

ORTOFON MANUFACTURING A/S, best known for their moving coil phono cartridges, advise that their production has doubled during the first half of 1978. They are looking for further increases as the result of three new cartridge releases.

One of the three is a new moving coil model, MC-10, intended to meet the rising demand for a moving coil cartridge at a "quality magnetic" price. The MC-10 has an elliptical stylus with an effective tip mass of 0.5mg and a moderate order of compliance (15um/mN) which will allow

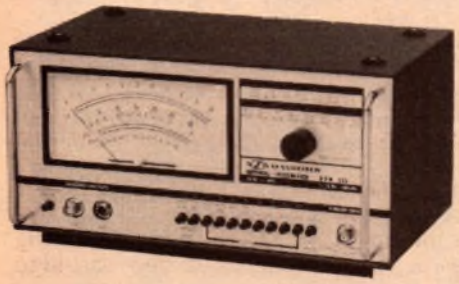
Toshiba's new Series 330 audio package may well provide a ready made answer for those confused by the variety of equipment being offered in the hifi shops. The system comprises a fully automatic belt-driven turntable, an AM/FM stereo tuner, a 40W per channel power amplifier, a control unit with dubbing facilities for an extra tape deck and microphone, and a front loading Dolby cassette deck. All these units are mounted in a vertical or horizontal rack, as preferred, and accompanied by a pair of 2-way reflex loudspeakers. For further information: Toshiba (Australia) Pty Ltd, 16 Mars Rd, Lane Cove 2066.

it to mate with most arms. Because of its low impedance and low output, the MC-10 would need to be used, either with a pre-preamplifier or with Ortofon's STM-72 step-up transformer.

The other two cartridges are more conventional magnetic designs using the VMS (variable magnetic shunt) principle. The FF15 X MkII is supplied with a spherical diamond and has a relatively low compliance (0.8um/mN), increased tip mass (0.8mg) and playing weight (5 grams), being intended for use in equipment with high mass tone arms. Nominal output is 1.3mV.

The FF15XE MkII would also appear to be designed for situations requiring a relatively rugged cartridge but it offers higher compliance and an elliptical stylus.

SENNHEISER have recently released their Universal Level Meter model UPM 550, for the measurement of AC voltages from 10Hz to 1MHz. It



provides for 15 overlapping ranges to 300V RMS, the lowest range (0 to 30 microvolts) being adequate to measure the tiny voltages produced by tape heads, microphones, etc.

The utility of the instrument is increased by an in-built CCIR "earcurve" filter, a 1000Hz filter, A-filter and noiseweighting to DIN 45 500. Provision is available to plug in other external filters, as required.

The meter is overload protected and the internal amplifier has "headroom" for peaks up to 10 times the full-scale RMS of the range selected. It can be switched for peak reading mode.

For further information: R. H. Cunningham Pty Ltd, 493-499 Victoria St, West Melbourne 3003, or in other capitals.

NATIONAL PANASONIC (AUSTRALIA) PTY LTD is the name of a new company that has been formed to take over the marketing in Australia of consumer products under the brands of National, Technics and Panasonic. Their postal address for inquiries, orders, accounts, etc, is PO Box 278, Kensington, NSW 2033.

Formation of the new company terminates the long-standing arrangement by which National and Technics products have been marketed in this country by the Haco/Hagemeyer group.

Hagemeyer (Australasia) B.V. have re-located their Sydney head office at Unit C, Centre Court Estate, 25-27 Paul St, North Ryde 2113. Telephone (02) 887 1555. New addresses also apply for Melbourne, Adelaide, Perth and Brisbane.

Intag Marketing Corporation Pty Ltd has acquired the entire stock of the Ferris audio division of Kemtron Ltd, as an initial step in a major Intag expansion programme. Mr John J. Manneken, chairman and managing director of Melbourne-based Intag, said the purchase included the Ferris business name and trademark, as well as its service department.

"We will market a range of high-quality new products under the Ferris name," Mr Manneken said. These will include pushbutton radios, exterior cassettes and speaker systems.

Founded in 1972, Intag is an importer and wholesaler of a wide range of audio electronic products. The company has an office in Sydney, and distributor representatives in Perth, Brisbane, Canberra, Adelaide and Tasmania. Intag is headquartered at 42 Grantham Street, West Brunswick 3055. Telephone: 387 3844.

3M AUSTRALIA PTY LTD has announced the appointment of Mr Rick Downes as Sales Manager, Recording Materials Group, in NSW; also the appointment of Mr Adrian Williams as Sales Manager Recording Materials Group in Victoria.

3M's Recording Materials Group incorporates the Company's Magnetic Audio-Video Division and its Data Recording products Division.

Both men have a broad expertise in these products and are anxious to assist clients.

Sansui G-5000 stereo receiver

The Sansui G-5000 stereo receiver is one of a new series recently released by Sansui Electric Co. Ltd of Japan. It has a rated power output of 45 watts per channel, comprehensive output protection and power amplifier response down to DC.

Compared with former Sansui models, the G-5000 and the other stereo receivers in the Sansui G-line have far less subdued styling. The unit has a lot more brightwork and more colour on the dial scale. The overall styling combines to make the unit seem larger than it really is.

Our black and white photos do not adequately convey this impression. The front panel is bright brushed aluminium, while the dial background is gold. The AM calibrations are blue and those for FM, white. Other colour accents are the beacon and power indicators and the green chamfered edge of the dial glass.

An unusual feature of the styling is the "random knurling" of the control knobs. While perhaps a little less elegant-looking, these are comfortable to grip and probably have less affinity for dirt than straight-knurled knobs.

Overall dimensions of the G-5000 are 464 x 181 x 408mm (W x H x D) including knobs, rubber feet and rear projections. Extra clearance is required at the rear to allow the hinged ferrite rod antenna to be oriented for best reception. Mass of the unit is 14kg.

The control line-up of the G-5000 is farily standard. Loudspeaker switching for two pairs of loudspeakers is provided with two push-buttons. Further along the control panel, another pair of buttons provides for defeat of the tone control settings and a sub-sonic filter which has its turnover (-3dB point) at 16Hz.

In the centre of the control panel another pair of buttons provide —20dB muting of the audio program and less usefully, a Loudness characteristic for the Volume control. Then on the right-hand side of the panel are four buttons for FM interstation muting, Mode selector (stereo or mono) and Tape Monitor (for two decks).

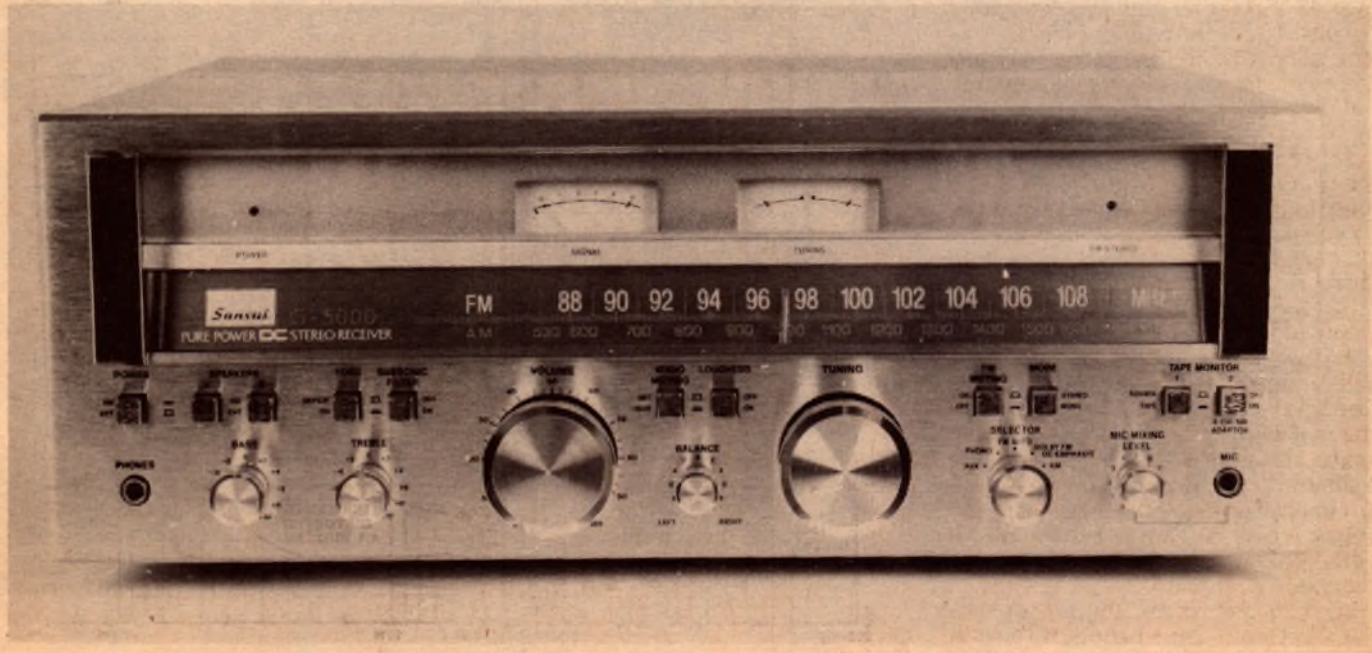
Both the Bass and Treble controls have detents which provide 2dB steps in boost or cut at 50Hz and 10kHz. That is useful, because it allows the user to easily apply a fixed amount of boost or cut. But we cannot see the point of the 40 detents on the volume control. It does not have logarithmic calibrations, nor does it have better matching between tracks than ordinary dual ganged potentiometers used in most other amplifiers and receivers.

On the extreme right-hand of the control panel is a small knob and 6.5m socket which allow connection and mixing of a microphone. It allows you to sing along with the selected program (perish the thought) but cannot be used for recording.

The rear panel of the G-5000 is quite crowded, not because it offers more than the usual number of facilities but because the output transistor heatsinks occupy a major portion of the area.

Over the last few years output transistors have tended to be hidden inside the chassis of receiver and amplifiers. This has been due to a number of factors, one of which is the need to avoid the possible shock hazard of output transistors running at high voltages. Sansui have taken a different approach to this problem in that the output transistors are mounted on a flat extrusion just inside the rear panel. Mounted over this is a large finned casting which makes thermal contact to the aforementioned extrusion via heatsink compound. Not only does this provide a well ventilated heatsink system, but it also gives good access to the output transistors should they have to be replaced.

Removing the synthetic veneered timber cover reveals a closely packed interior dominated by the large transformer and filter capacitors. At



one end of the chassis is a large PCB for the AM and FM tuners, while an equally large PCB in the centre of the chassis accommodates the complex power supply and output protection circuitry. Almost insignificant by comparison is the vertically mounted stereo power amplifier PCB.

The RIAA preamplifier is sandwiched between the tuner PCB and the bottom panel of the chassis. The rest of the circuitry is scattered along behind the front panel amongst seven small PCB's. Accessibility is not a strong point. Luckily, these behemoths are generally reliable beasts.

A three-core flex with moulded three-pin plug is fitted to the unit, so it conforms to local standards in this regard. However it has two-pin mains sockets for accessories. While some enthusiasts appreciate this feature, other manufacturers have removed them to conform to local standards.

One point we must congratulate Sansui on is the fact they have included a full circuit diagram along with the comprehensive owner's manual.

Like a number of other recently released amplifier and receivers, the Sansui G-5000 has power amplifiers with response down to DC. We have yet to be convinced of the merit of this idea and are of the opinion that it has little or no effect on the accuracy of reproduction. It does require a more complex amplifier and coarse and fine adjustments for offset voltage.

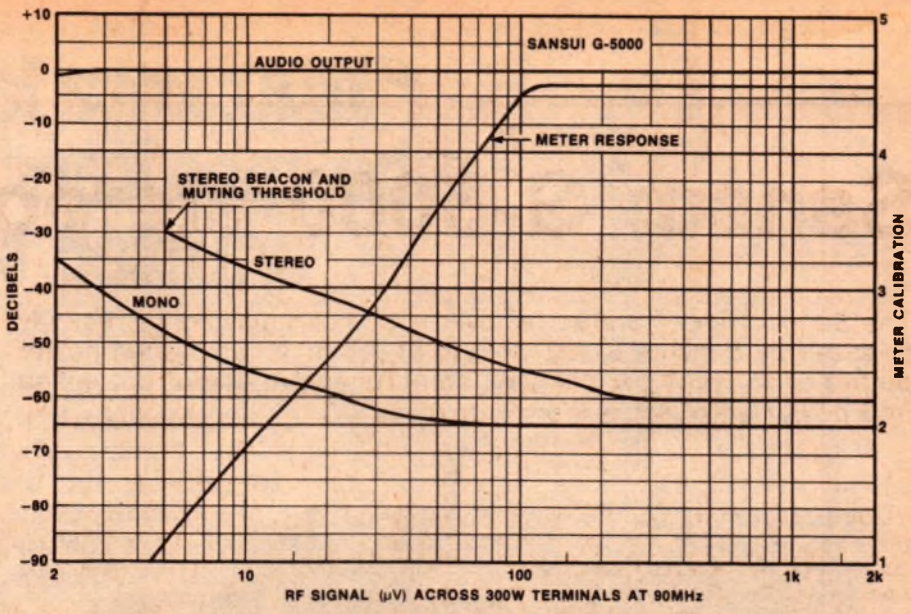
Very comprehensive protection circuitry is included in the G-5000. It monitors the output stages and uses a relay to disconnect the loudspeakers in the event of large dc offset voltage, short-circuits, excessive loading or over-drive. We could not faze it with any likely abuse.

In the G-5000 the AM tuner consists of one integrated circuit followed by a class-B detector. It is the simplest of superhets. By comparison the FM tuner uses 12 transistors and two integrated circuits. The front-end employs a dual-gate MOSFET and the IF stages are discrete transistors. The detector and multiplex decoder functions are provided by IC's.

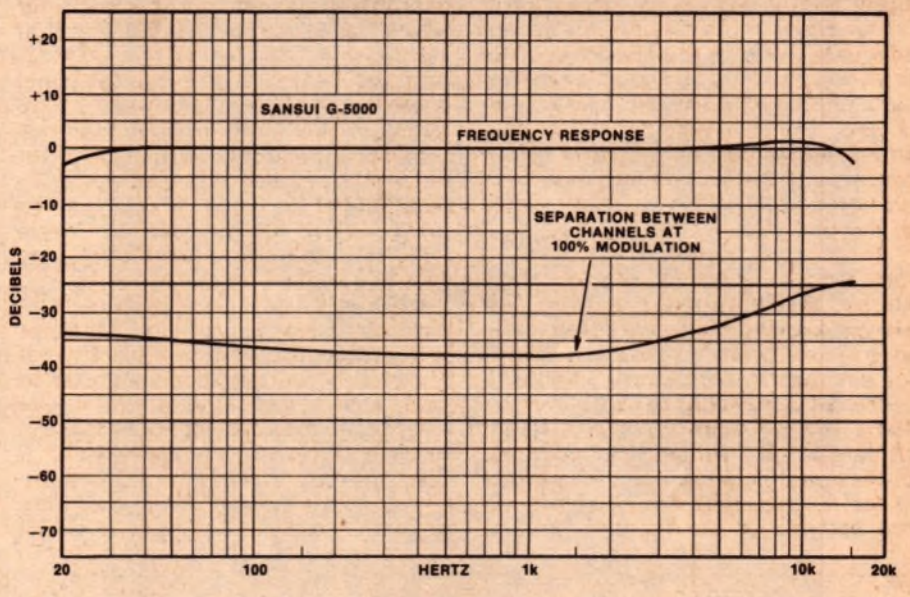
Performance testing reveals more of the character of the Sansui G-5000. The three graphs summarise the key points. Power output is rated at 45 watts per channel into 8-ohm loads, with both channels driven, for a rated distortion of 0.03 per cent or less over the bandwidth 20Hz to 20kHz.

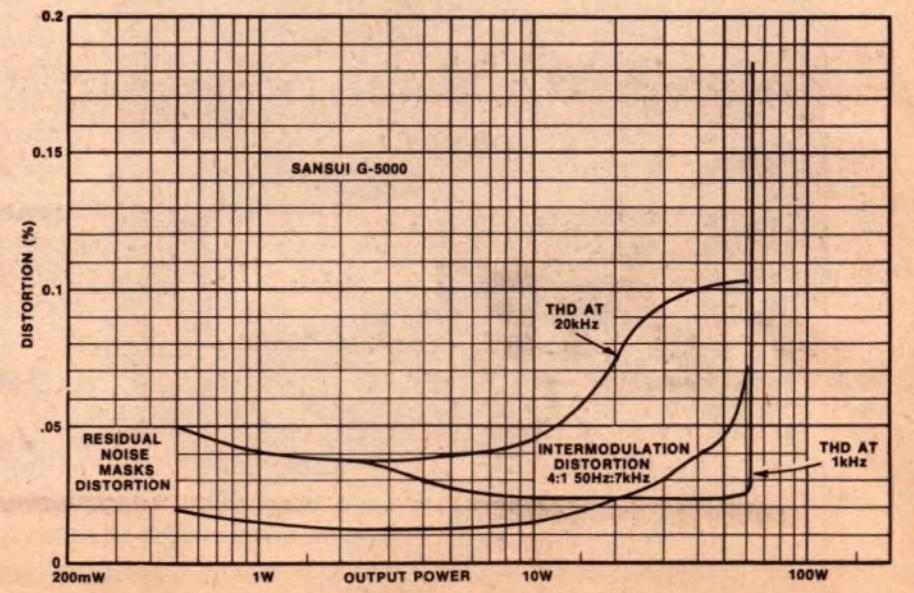
At the lower frequencies the G-5000 had no problem meeting the specification. We measured 54 watts per channel with both driven into 8-ohm loads, at onset of clipping. With one channel driven, the figure increased to just over 60 watts. With 4-ohm loads the power rises to 80 watts per channel with both driven or 96 watts into one channel.

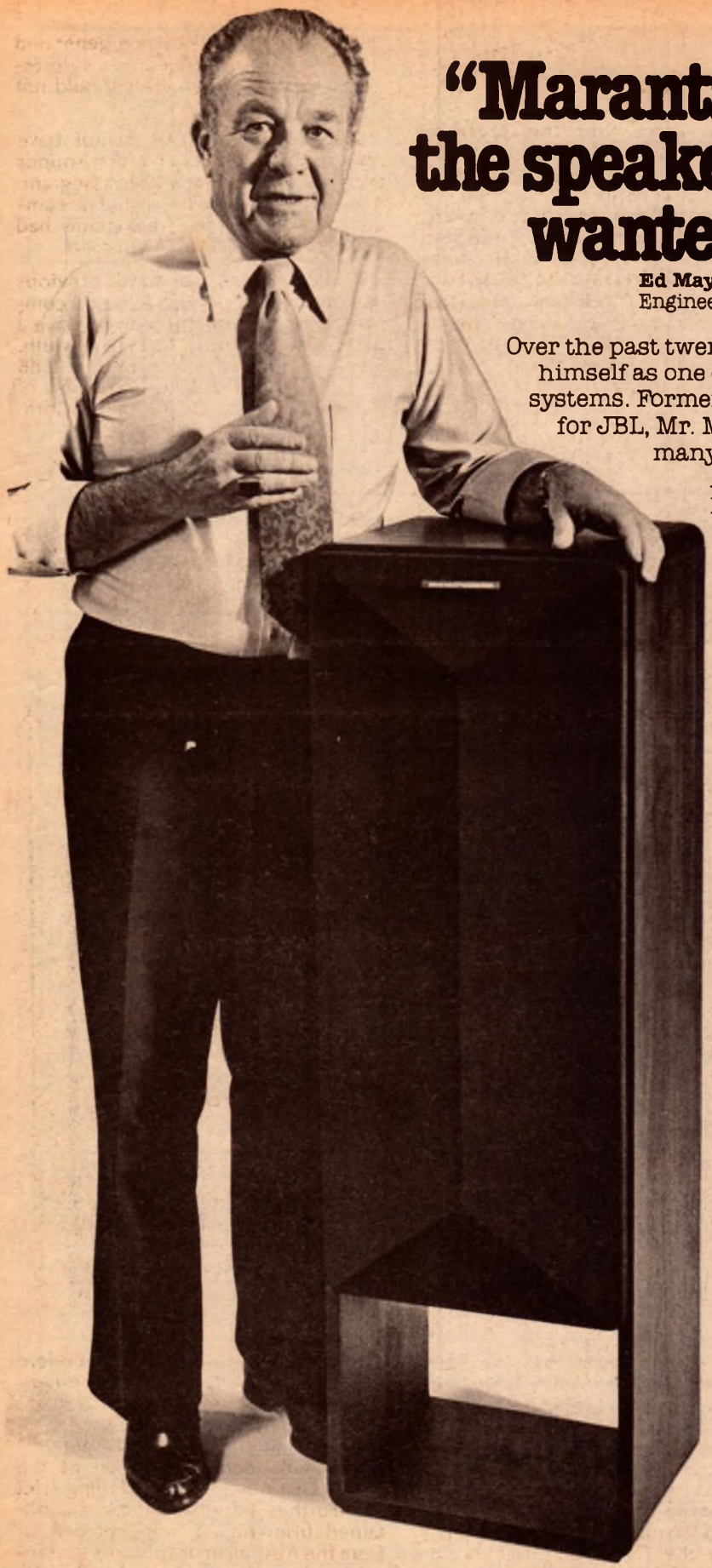
With 16-ohm loads, the power output is 33 watts per channel with both



This graph shows the Quieting characteristics and meter response of the Sansui G-5000.







"Marantz let me build the speakers I've always wanted to build."

Ed May, Vice President Speaker Engineering for Marantz

Over the past twenty years Ed May has firmly established himself as one of the industry's top experts on speaker systems. Formerly the manager of speaker engineering for JBL, Mr. May has personally been responsible for many of the advances in speaker technology. As the new director of Marantz Speaker Development we asked him to comment on the new Marantz Speaker line.

"Since joining Marantz I've never been turned down on anything I've wanted to do to improve quality. When it comes to quality, cost is no object."

"Our new Marantz speaker line is one of the top lines in the industry. The reproduction capability of our speakers can equal or out perform speakers that cost two to three times the price."

"We don't follow fads. We stay away from frivolous things that only increase the price tag without increasing performance."

"Our toughest critics are ourselves. Many of the things we measure and test for are seldom encountered in the field."

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driven or 36 watts with one channel.

At 20kHz the harmonic distortion was above the rated figure (0.03 per cent), but at powers of 40 watts and below it was 0.1 per cent or less, which is still very good. And the intermodulation distortion measured with 50Hz:7kHz signal in 4:1 ratio is on a par with the best stereo amplifiers.

Distortion is slightly higher for 4-ohm loads (or parallel-connected 8-ohm loadspeakers) and slightly lower for 16-ohm loads. Frequency response at one watt into 8 ohms yielded —1dB points a 10Hz and 40kHz when measured via the auxiliary inputs.

In the interest of providing a better basis for comparisons, we have changed our method of measuring signal-to-noise ratio and separation between channels. From now on (unless otherwise qualified) amplifiers and receivers will have their S/N ratio and separation between channels measured with respect to 10 watts into 8-ohm loads, with undriven inputs loaded with 4.7k and with volume control set for maximum sensitivity. Sensitivity for 10 watts into 8-ohm loads will be stated.

Using the above method, signal-to-noise ratio for the G-5000 is 74dB unweighted for the auxiliary and tape inputs. Separation between channels was 62dB at 10kHz, 72dB at 1kHz and below the residual noise at 100Hz (ie, below 74dB). Sensitivity for the 10W reference power was 70 millivolts RMS.

Phono sensitivity for 10 watts was 1mV at 1kHz. Signal-to-noise ratio with respect to 10 watts and 10mV input at 1kHz is 70dB unweighted with a typical cartridge (Shure M55E) connected. To obtain this latter figure the turntable must be 60cm, or more, away from the receiver, to avoid the substantial hum field of the power transformer.

Phono input overload is 250mV at 1kHz which is far more than adequate. RIAA equalisation is within +0.2dB from 30Hz to 15kHz.

With power amplifiers having an extended bass response, it is important to have some filter facility for removing unwanted rumble or warp effects when playing discs. Ideally, the way to do this would be to have a steep cut high pass filter (removes low frequencies) with switchable turnover frequencies at say, 20Hz and 60Hz.

While we therefore welcome the inclusion of a subsonic filter in the Sansui G-5000, it really does not have enough attenuation at warp frequencies (only —5dB at 10Hz) to have a worthwhile effect.

Stability testing with capacitances shunting the load tripped the overload protection when performed at high powers. This indicates the protection does a thorough job. No other effects were noted.

Turning now to the tuner section, it can be seen that the Quieting characteristics are similar to many other fine tuners. Stereo and mono frequency response, with the internal de-emphasis switch set to 50 microseconds, was identical — +1dB from 30Hz to 14kHz, —3dB at 15kHz. This is very good. Harmonic distortion measured at 100 per cent modulation (75kHz deviation) was 0.2 per cent at 100Hz, 0.14 per cent at 1kHz and 0.3 per cent at 6kHz in mono mode.

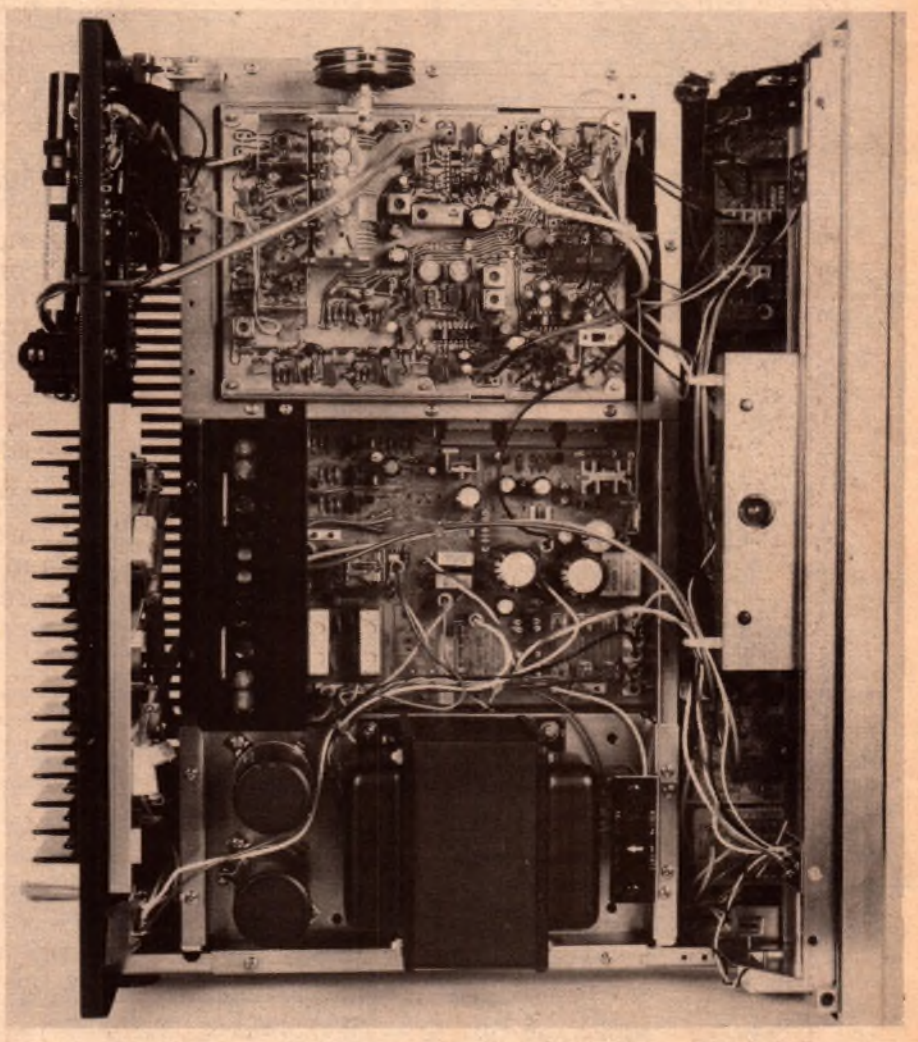
In stereo, the respective figures were 0.3 per cent, 0.2 per cent and 0.35 per cent. These figures are in close agreement with the specifications. The same can be said for the graph showing separation between channels.

A period of several weeks' use at home confirmed that the Sansui is a fine performer, with more than adequate power for most situations. It also has good control characteristics, particularly the FM tuning and muting. Several points of irritation did arise though.

The first was that when playing records the unit was unduly sensitive to mains-radiated interference generated by switch-off of refrigerators, fluorescent lights and so on. This should not be so.

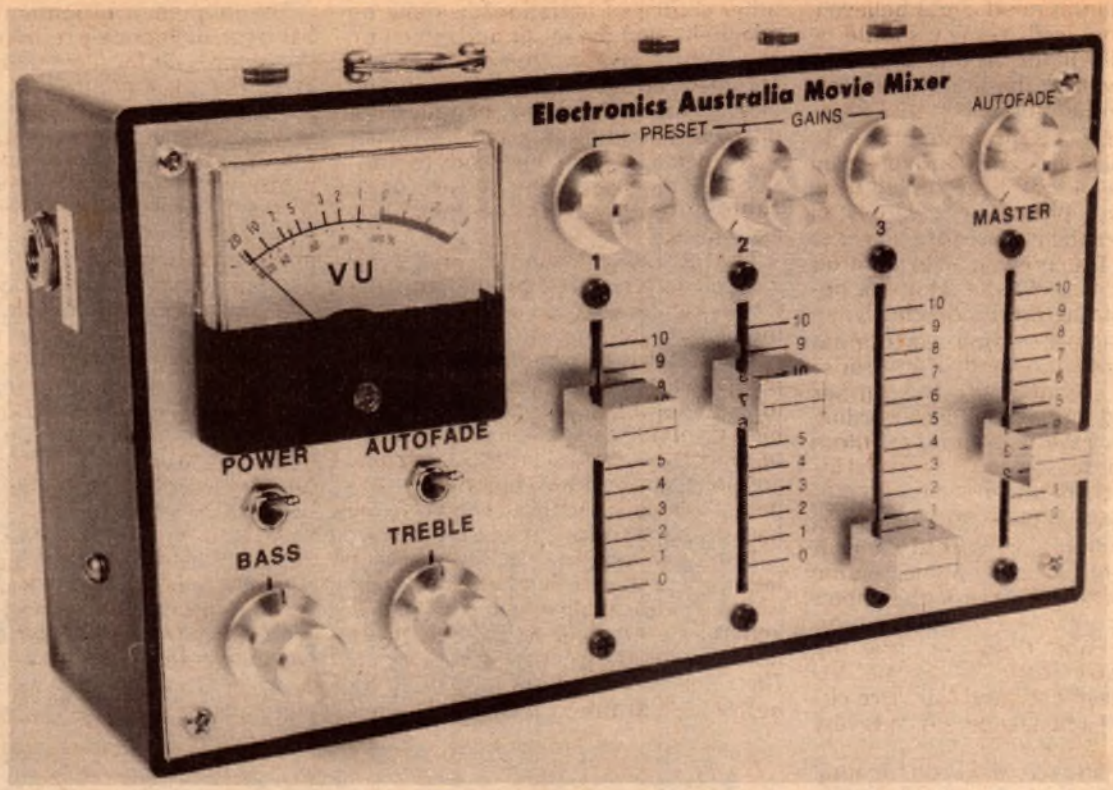
The second was that Sansui have produced an AM tuner which sounds every bit as mellow as a 1955 radiogram. Actually that might be an unfair comparison; quite a few radiograms had respectable wideband AM tuners.

While we do not have previous measurements on which to base a comparison, the Sansui did seem to have a particularly narrow AM bandwidth. Sansui claims that selectivity is —35dB at ±10kHz, so that gives some idea of the narrowness of the bandwidth.



While we recognise that most modern receivers have only vestigial AM tuners, we believe the time has come to indicate that it is not good enough in medium and high-priced equipment.

Recommended retail price of the Sansui G5000 is $599.00 including sales tax. Further information can be obtained from high fidelity retailers or from the Australian distributors for Sansui products, Vanfi (Australia) Pty Ltd, 162 Albert Road, South Melbourne, Victoria or 5 Northcliff Street, Milsons Point, NSW. (LDS).



A Mixer for Home Movies

Here is a very flexible three-input audio mixer design with features which should make it of particular interest to home movie and recording enthusiasts. Although very compact it offers bass and treble controls, a level meter, a headphone monitoring output and a handy auto-fading facility. And best of all, you should be able to build it for far less than commercial mixers offering fewer features!

by JAMIESON ROWE

There are now large numbers of home movie enthusiasts making their own sound movies. In fact, since Kodak introduced its Ektasound prestriped super—8mm sound camera film cartridges and direct sound cameras in late 1973, home sound movies have really boomed. You can now buy from a very wide range of sound cameras and projectors from a host of manufacturers, along with a variety of camera cartridges and an ever-increasing range of sound prints made from commercial movies and TV shows.

You can also buy animated-viewer editors with sound reader attachments, home striping units to add a magnetic stripe to your existing silent films, and small sound mixing units.

Why mixing units? Well, most of the currently available sound cameras are fairly limited in terms of input facilities. They generally have only a single microphone input and, because the cameras use automatic recording level circuitry, there isn't even a manual gain control. At most, there may be a two-position sensitivity switch, to allow the gain to be lowered for shooting in noisy locations.

So if you want to be a little adventurous and use more than one microphone when you're shooting a scene, you really have to use a separate mixer.

For example, few amateurs can rely on having someone to move the microphone during shooting, to ensure optimum sound pickup (i.e., the job of the professional's "boom operator"). But you can often achieve much the same result by using a number of fixed microphones, and fading from one to another to follow the action. To do this you obviously need a mixer.

It's much the same with projectors. Although most super-8 sound projectors can record as well as play, few are provided with more than quite rudimentary mixing facilities. If you want to assemble a track with say narration, music and the odd sound effect, you really need an external mixer in order to do the job properly. Some projectors allow you to assemble such a track by means of over-record superimposition or track-jumping using the so-called "balance stripe", but both of these techniques have severe limitations.

A small self-contained mixer can thus be very handy, whether you're working with a sound camera, a projector or both. Unfortunately, the mixers that are made for this purpose by the camera and projector manufacturers seem to be very basic, yet surprisingly expensive. For example one of the few mixers currently available here in Australia is made by a big Japanese firm. It sells for more than $90 in local camera stores yet offers no level meter, tone controls or other features.

In short, there's a need for a flexible mixer, offering the features most needed by super-8 sound enthusiasts, and at a reasonable price. The build-it-

yourself design presented here is intended to fill this need, and I believe it does so rather well. Yet you should be able to build it for around $60, considerably less than the simple commercial mixer noted above.

The mixer has three input channels, each of which has an adjustable gain preamplifier so that it can be fed from either a microphone or a variety of other sources such as a record player or tape deck. The preamp gain controls allow each channel to be set up for optimum recording level individually.

For the actual mixing each input channel is also provided with a slider potentiometer, and there is a further "master" slider to set overall recording level. Sliders have been used for these controls in order to allow easy visual indication of channel proportions.

To allow convenient visual monitoring of recording level a small meter is provided, with the appropriate volume unit (VU) scale. Although the meter movement concerned is a low cost imported type and does not have the ballistic characteristic of a true VU meter, we have designed the drive circuit to give it a behaviour which is very similar.

The mixer also has provision for aural monitoring, by means of headphones. For the best results the headphones should be of the medium impedance variety, but the circuit will give satisfactory results with readily available low impedance stereo headphones.

To allow tonal balancing and adjustment, both bass and treble tone controls are provided. These are low distortion active tone controls of the type used in modern hi-fi amplifiers, not simple passive controls. However, the control action has been modified to make them better suited for film recording use. The two turnover frequencies have been brought closer together, to give them greater control within the available recording bandwidth. At the same time the maximum boost and cut range of each has been reduced, partly to compensate for the closer turnover frequencies and partly to allow easier fine adjustment.

A further important feature of the mixer is an "autofade" facility, which may be switched either in or out. When switched in, it uses the signal on input channel 1 to control the mixing levels of any signals on channels 2 and 3, over-riding the sliders for these channels. Thus when a signal appears on channel 1, any signals on the other two channels are rapidly and automatically faded down to a predetermined level; then when the signal on channel 1 ends, the other channels are smoothly and automatically faded back up to their original levels, at a suitable rate.

This facility can be very handy indeed if you have to assemble a sound track in which music and/or sound effects are frequently punctuated by narration or dialogue. By having the microphone or other source of narration/dialogue on channel 1, and the music and effects on channels 2 and 3, the autofade will automatically fade down the music and effects each time the narration or dialogue has to be inserted.

This lets you use your hands to position the pickup on the record, or to control the tape deck, without any assistance.

The level to which the channel 2 and 3 signals are reduced by the autofade facility can be adjusted over a range, by means of a front-panel control.

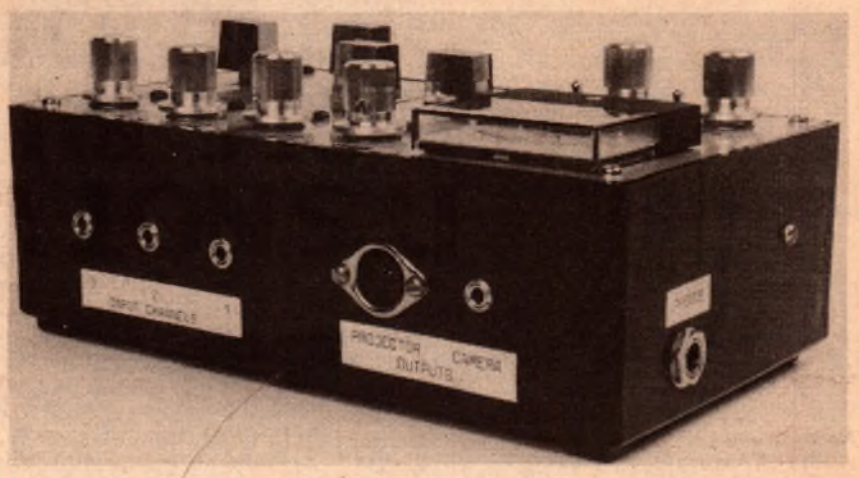
The mixer is provided with two outputs, one a low-level output suitable for microphone inputs and the other a high level output suitable for "pickup" or "auxiliary" inputs. As most cameras are only provided with microphone inputs, the low-level output will normally have to be used for camera recording.

The same output can be used for feeding a projector, but if the projector is fitted with a high level input it is generally preferable to use this input fed from the mixer's high level output. The signal to noise level is likely to be better, due to the lower gain required from the projector amplifier.

The frequency response of the mixer has been deliberately restricted, to give the best results for film recording work. With the tone controls in the "flat" position, for example, the bass response rolls off at about 75-80Hz (-3dB). This is in line with normal professional motion picture practice. It allows the use of higner average recording levels, without the risk of intermodulation from the high amplitude but relatively inaudible and unimportant signal components in the lower bass region. It also reduces the system sensitivity to hum pickup.

Similarly the treble response is deliberately arranged to roll off at about 8kHz (-3dB), again in the "controls flat" position. This is high enough to realise the full attainable recording bandwidth on super-8mm magnetic stripe but, by restricting the signal and noise bandwidth, it gives cleaner recordings by minimising noise modulation and intermodulation effects.

Incidentally the response of the mixer and the range of its tone controls can easily be extended to normal "hi-fi" standards, if desired. This means that



HERE IS THE SPECIFICATION:

A 3-input mono mixer, suitable for both home movie sound recording and wide-range recording. Compact and battery operated for full portability. All three input channels are medium impedance with adjustable gain, and may be used with either microphones (dynamic or electret capacitor), or high level sources such as record players or tape decks. Features active bass and treble tone controls, a VU-type level meter, a headphone monitoring jack and a switchable "autofade" facility whereby channel 1 signal can automatically fade channels 2 and 3 to an adjustable low level.

Nominal output level: 0.774V from the high level output, 5mV from the low level output.

Maximum input sensitivity, all channels: 0.7mV or better for nominal output.

Minimum input sensitivity, all channels: approx 100mV for nominal output, with slider at maximum.

Output noise, all sliders at zero: 87dB below nominal output.

Output noise, all preamps at full gain and all sliders at maximum; 60dB below nominal output.

Frequency response, controls flat: 80Hz — 8kHz (-3dB), when used for movie sound recording. Extends to 40Hz —30kHz (-3dB) when modified for wide-range recording.

Distortion: Less than 1% THD for nominal output at all gain settings and frequencies in the passband.

Tone control range: ±7dB at 200Hz, ±6dB at 5kHz (see curves) for movie work. May be extended for wide range.

Battery drain: Approx. 9mA at 18V (two 216-type batteries).

the mixer can easily be adapted for high quality tape recording work — although it may have only limited use in such applications because it is basically only a monophonic mixer. Details on how to extend the response are given later in this article.

As the current drain of the mixer is quite low (around 9mA), it has been designed to operate from batteries. This tends to avoid hum troubles, and also makes the unit compatible with battery-operated cameras.

As you can see from the circuit diagram, the mixer uses conventional discrete silicon transistors. This gives good noise performance and also makes the unit easy to build and low in cost. A total of fifteen transistors are used, all of them readily available low cost types.

The three input channel preamplifiers are all identical, using a well-tried two transistor circuit. The preset gain controls take the form of adjustable feedback resistors, which give improved distortion and signal to noise ratio when the gain is reduced to handle larger input signals.

Following the preamps are the channel slider pots. These are 50k in value, with a 45 mm slider travel (Soanar type VSU45-AH-50k). The pots used have a linear taper rather than "logarithmic", as the linear type are much more readily available. To give them the desirable logarithmic taper, they are shunted by 10k resistors between the slider and the top of the element. The same applies with the master slider.

The signals from the channels 2 and 3 pots are mixed together and fed to emitter follower Q10, while the signal from the channel 1 pot is fed separately to emitter follower Q7. This is done in order that the channel 1 signal may be used to control the other signals via the autofade circuitry, involving transistors Q8 and Q9.

The autofade works as follows: Q9 is a junction FET, connected between the base of emitter follower Q10 and an AC shunting circuit formed by the 10uF capacitor and the 47k "autofade level" pot. The FET is normally kept cut off, by the reverse bias applied to its gate from the 470k pot at the lower end of the Q10 bias divider. In this cutoff condition Q9 does not affect the signals at the base of Q10.

Channel 1 signals from the emitter of Q7 are fed to transistor Q8, which is connected as a buffer amplifier with a gain of about 10. The amplified signals are then fed to a voltage-doubling rectifier, which produces a proportional DC voltage. When the autofade switch is closed, this DC voltage is fed into Q9's gate circuit, cancelling its standing cutoff bias and driving it into conduction. This causes Q9 to shunt the channel 2/3 signals to ground via the 10uF capacitor and 47k pot, reducing their level accordingly.

If the 47k "autofade level" pot is set to minimum resistance, the channel 2/3 signals are reduced by about 40dB. If it is set to maximum resistance, the reduction is only about 6dB. By varying the control you can set the autofade level anywhere between these limits.

The attack time of the autofade circuit is quite short, lowering the channel 2/3 signals in level within a few milliseconds of an effective signal appearing on channel 1. The decay time is rather longer, taking about 600 milliseconds for the channel 2/3 signals to return to their original levels after the channel 1 signal ceases. This gives a smooth audible fade-up, and also prevents the autofade circuit from fading-up between individual words.

The outputs from emitter followers Q7 and Q10 are mixed together to form the final composite signal, which is then fed to the master level control slider. Across this control is a .0015uF shunt capacitor, used to limit the mixer's high frequency response as explained earlier.

Following the master level control the signals pass to an amplifier stage using transistors Q11 and Q12. This uses the same basic configuration as the input preamps, but the gain is fixed at about 20 times, compensating for mixing losses and bringing the signals up to their final level.

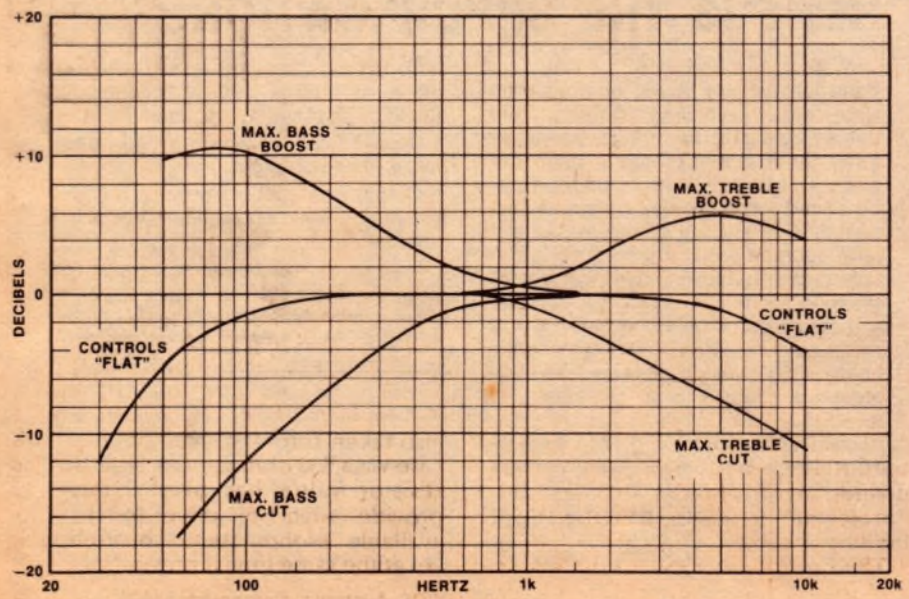
The signals then pass to the final sections of the circuit, comprising the tone controls, output stage and metering stage. The tone controls are of the Baxandall feedback type, connected around the output stage in the modified configuration described by P. M. Quilter in the April 1971 issue of Wireless World.

Here the capacitor shunting the bass pot has been reduced in value to give a higher turnover frequency, while the end resistors have been increased in value to limit the control range. Similarly the capacitors at each end of the treble pot have been increased in value to lower the turnover frequency, while the end resistors have again been increased to limit the control range.

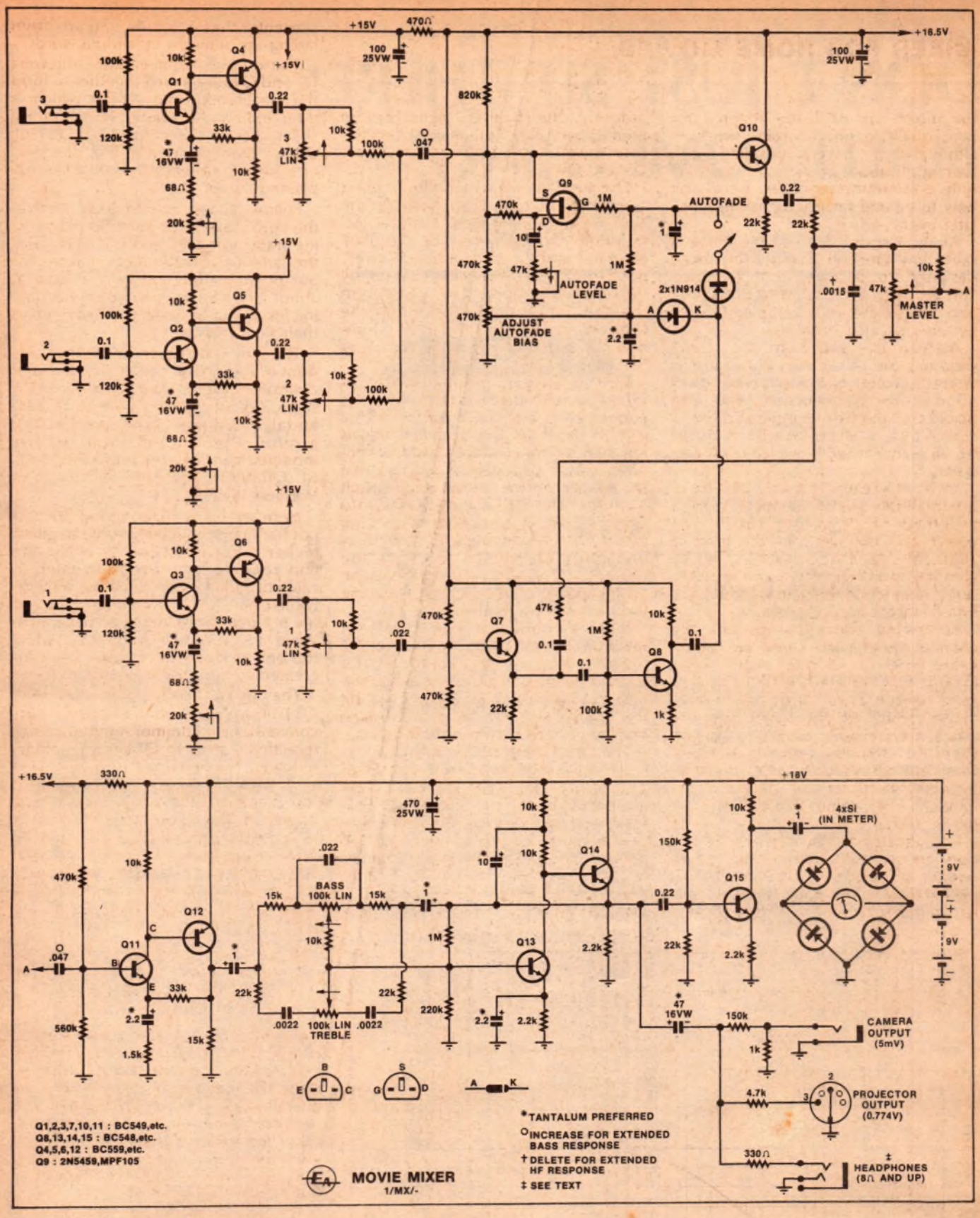
The output stage uses transistors Q13-14, with Q13 connected as a fairly conventional common-emitter stage directly coupled to Q14 as an emitter-follower. However the load of Q13 is split, with the output signal from Q14 fed back to the split via a 10uF capacitor. This "bootstraps" the lower load resistor, giving it an effective AC value many times its nominal value of 10k, and hence increasing the voltage gain of Q13 quite significantly.

DC base bias for Q13 is derived from the emitter of Q14, giving a high order of quiescent stabilisation. Also the AC feedback for the tone controls is taken from the emitter of Q14, giving an overall stage gain of unity when the tone controls are in the "flat" position. This high order of negative feedback gives the output stage very low distortion, even when loaded fairly heavily at the output.

The signal at the emitter of Q14 becomes the output signal of the mixer. It is fed to the level meter via buffer transistor Q15, which is connected as a common emitter stage with emitter degeneration to give it a relatively high output impedance. This provides substantially constant-current drive to the meter, making its behaviour ap-



The response curves at left can easily be changed for "hi-fi" recording. The full mixer circuit is shown opposite.



proximate that of a true VU meter. The meter rectifier diodes are internal to the meter case incidentally.

The signals for the two main mixer outputs are both taken from the emitter of Q14, via a 47uF coupling capacitor. The low level or "camera" output is derived via a 150:1 voltage divider, while that for the high level "projector" output is taken via a 4.7k limiting resistor.

The headphone monitoring output is also taken from the same point, in this case via a 330 ohm limiting resistor. The resistor value has been chosen to provide adequate drive for readily-available 8-ohm stereo headphones, yet at the same time it prevents the out-

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put stage from being unduly loaded when such low impedance 'phones are connected.

Due to the heavy negative feedback around the output stage, it can deliver more than 800mV RMS (2.2V P-P) with 8-ohm 'phones connected, with low distortion. This should be quite sufficient for most applications. However if you want the mixer to be able to deliver more output before distortion becomes evident, there is a simple remedy: use higher impedance 'phones, or an impedance matching transformer to increase the loading impedance. More about this later.

Before leaving the circuit, here are a few words on extending the frequency response of the mixer for the benefit of those who may want to use it for wide range recording rather than movie work.

To extend the bass response, simply increase the values of the input coupling capacitors for Q7, Q10 and Q11. These capacitors are identified on the circuit, and are easy to find. If you make Q7's input capacitor .047uF instead of .022uF, and the other two 0.1uF instead of .047uF, the overall bass response will extend down to about 40Hz (-3dB). This is with the tone controls in the "flat" position.

Extending the treble response is even simpler. All that is necessary is to remove the .0015uF capacitor shunting the top of the master gain slider. This extends the treble response of the mixer to about 30kHz (-3dB), again with the tone controls in the "flat" position.

To remove the overlap between the tone controls, making them a little more suitable for wide-range recording, the bass control shunting capacitor should be increased from .022uF to .047uF. Similarly the two capacitors associated with the treble control should be reduced from .0022uF to .0015uF. And if you want to give the controls the full normal range provided in a hi-fi amplifier, simply reduce all four end limiting resistors to 10k. These are the two 22k resistors associated with the treble control, and the two 15k resistors associated with the bass control.

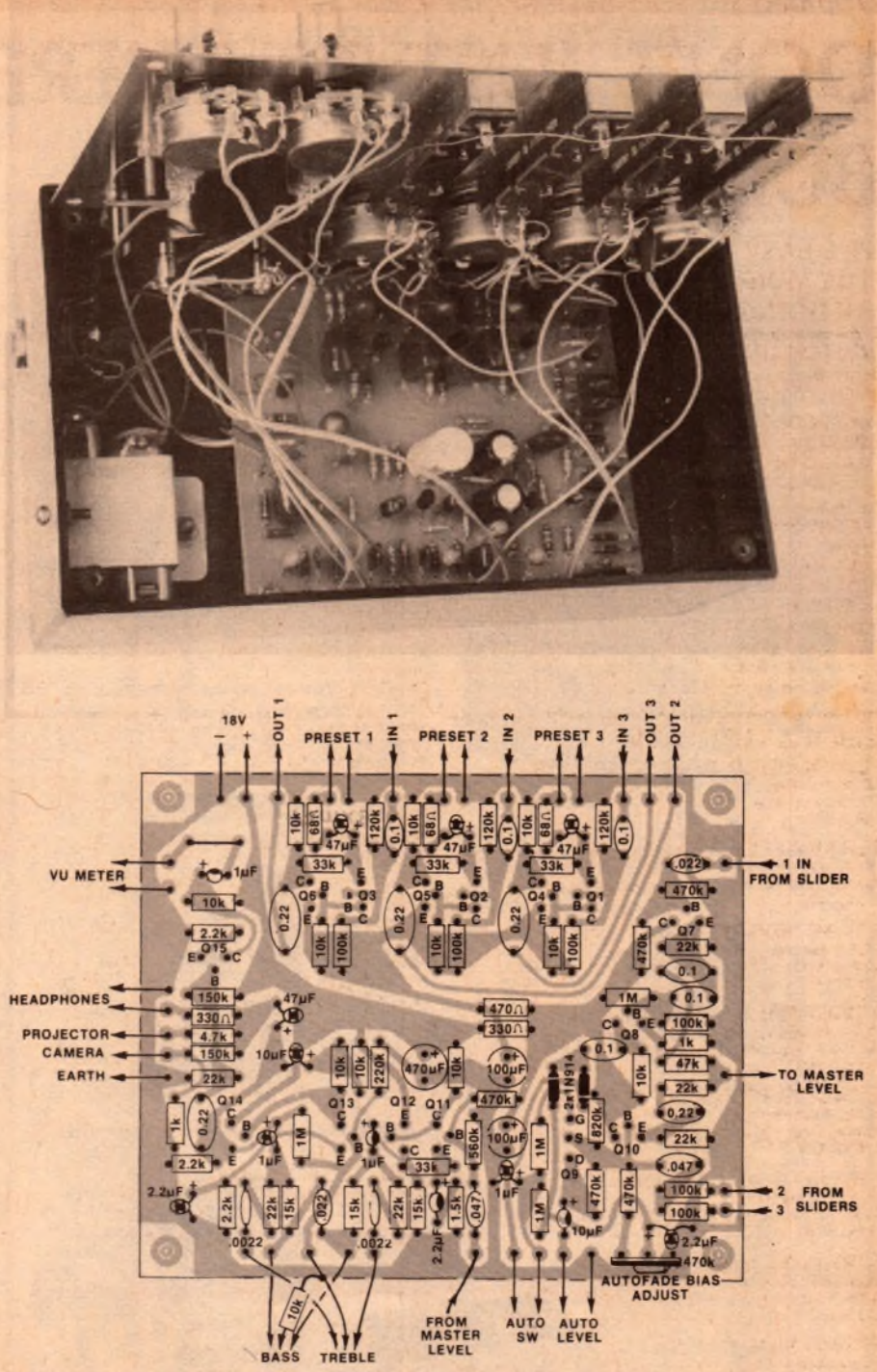
As you can see from the photographs, the mixer is built in one of the low cost "zippy" boxes, available from a number of suppliers. The box measures 197 x 113 x 59 mm, and has an impact-resistant plastic body with an aluminium front panel. The box I used came from Dick Smith Electronics, and is listed in their catalog under number H-2752.

There are quite a few controls on the front panel, as you can see, but there is no undue crowding. In the upper left-hand corner of the panel is the level meter, with the switches and tone controls beneath it. Then in the lower centre of the panel are the three input channel sliders, with their respective preamp gain controls above them. Finally at the right-hand end of the panel is the master level slider, with the autofade level control above it.

There are a couple of small "VU" meter movements available which would be suitable for the mixer, and these can be obtained from a number of suppliers. The meter I have used measures 52 x 49mm on the front, and is identified as "MRA-45" on the lower part of the scale. It came from Dick Smith Electronics, who have it listed in their catalog under number Q-2050.

Another, slightly smaller meter movement is also available, the model KM-48 from Kyoritsu. This measures 48 x 42mm on the front, and would also be quite suitable. It is stocked by Radio Despatch Service in Sydney, and possibly by other suppliers as well. Like the other meter it has an inbuilt rectifier bridge and VU-meter scale.

The front panel of the prototype was made by hand, using a hand nibbler to



Above is the wiring diagram for the mixer PCB, with a view of the inside of the complete mixer at the top. Use these in conjunction with the circuit.

MOVIE MIXER

cut out the large hole for the meter barrel. The slots for the slider pots were made by drilling some small holes at the ends, cutting down the slots with a hacksaw blade and then finishing off the slots with jeweller's needle files (quite a job, I can testify!). The panel was then finished off with a self-adhesive label sheet made from 3M "Scotchcal" photosensitive aluminium

PARTS LIST:

1 Plastic/metal case, 196 x 113 x 60mm
1 PC board, 120 x 100mm, code 78mx9
1 VU-type meter, 52 x 49mm or similar
2 SPST miniature toggle switches
4 3.5mm jack sockets, with contacts
1 5-pin DIN socket (180 degree)
1 6.5mm stereo phone socket
2 9V batteries, 216 type
2 Connector leads to suit batteries
6 Small knobs as desired
4 Knobs to suit slider pots

SEMICONDUCTORS
6 BC549 or similar low noise NPN
4 BC548 or similar NPN
4 BC559 or similar low noise PNP
1 2N5459, MPF105 or similar FET
2 1N4148 or similar diodes

RESISTORS
5% ¼ watt: 3 x 68 ohm, 2 x 330 ohm, 1 x 470 ohm, 2 x 1k, 1 x 1.5k, 3 x 2.2k, 1 x 4.7k, 16 x 10k, 3 x 15k, 6 x 22k, 4 x 33k, 1 x 47k, 6 x 100k, 3 x 120k, 1 x 150k, 1 x 220k, 5 x 470k, 1 x 560k, 1 x 820k, 4 x 1M
3 20k log potentiometers
1 50k linear potentiometer
4 50k linear slider pots, 45mm travel
2 100k linear potentiometers
1 470k linear tab pot (vertical PCB type)

CAPACITORS
Low voltage plastic ("greencap" or similar): 1 x .0015uF, 2 x .002uF, 2 x .022uF, 2 x .047uF, 6 x 0.1uF, 5 x 0.22uF
1 1uF 35VW tantalum
3 2.2uF 35VW tantalum
2 10uF 16VW tantalum
4 47uF 16VW tantalum
2 100uF 25VW single-ended electro
1 470uF 25VW single-ended electro

MISCELLANEOUS
Connecting wire, nuts and bolts, solder lug, scrap of aluminium for battery clamp, solder, etc.
NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible.

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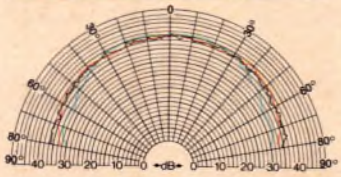

Frequency Dispersion of the L110

~ at 400Hz ~ at 2kHz ~ at 10kHz

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Specs with a purpose!

Sansui's new amplifiers

Sansui's all-new integrated amplifiers have absolutely astounding specifications. Compare them with any others in their class, and Sansui comes out far ahead. But what really makes Sansui's new amplifiers so superior is that all these great specs have a single purpose — outstanding sound quality.

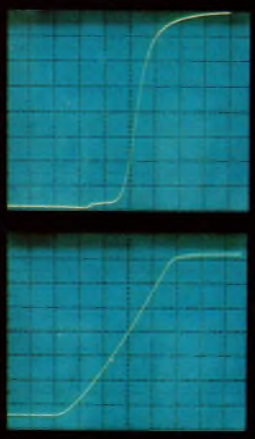
Take response speed, for example. Your amplifier doesn't move, but it does respond. The more rapid its response, the cleaner and the more accurate the sound. That's why the AU-717, for example, features an advanced DC power amplifier design. Sansui's DC amplifier eliminates all capacitors in the signal path and even in NFB loop so amplification is direct without coloration and phase delay. Response is astoundingly rapid — the proof is in the ultra-high (60v/μsec.) slew rate and ultra-rapid rise time (1.4μsec).

But Sansui didn't strive for such outstanding specs just to be able to print impressive figures. On the contrary, Sansui research showed that to achieve accurate reproduction and reduce signal loss, lightning-fast response was essential.

In addition, special circuits were incorporated to achieve new levels in stamping out TIM (transient inter-modulation distortion), a type of distortion that is now receiving high priority. Still another important benefit of Sansui's DC amplifier is the ultra-wide frequency response from zero (DC) to 200,000 Hz.

The final result is music with a purity and clarity that must be heard to be believed. All the dimensions of complex musical sounds — the wide dynamic range, the sudden pulsive signals, the nuances of barely perceptible but critical overtones in the ultra-high frequencies — all these are now crystal clear, all are proof of Sansui's new levels in superior sound quality. Impressive power is 85 RMS watts per channel, 20 — 20k Hz, and total harmonic distortion at rated output is 0.015%. That means it can be considered non-existent as far as the human ear is concerned.

SLEW RATE & RISE TIME



AU-717
Slew Rate: 60V/μsec.
Rise Time: 1.4 μsec.
V: 10V/div.
H: 1 μsec./div.

A CONVENTIONAL AMP.
V: 10V/div.
H: 1 μsec./div.

Keep in mind that though the AU-717 is special, it's not special for Sansui. Each and every amplifier on the left-hand page embodies the same Sansui commitment to outstanding sound quality. All controls have been carefully thought out and designed for their specific purposes. Sansui has no place for gadgets and gimmicks in its dedication to the ultimate in hi-fi.

The AU-517 and AU-317 also feature the same DC power amplification as the AU-717, and offer 65 and 50 RMS watts respectively. The AU-217 and AU-117 offer 30 and 20 RMS watts respectively, but are not to be under-rated. In fact, they represent exceptional values in low distortion and true hi-fi performance.

Sansui for specs with a purpose — outstanding musical quality.

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Technically speaking, the system incorporates a piezo-electric crystal built into the woofer cone that monitors and converts the acceleration of the cone into an electric signal. The acceleration of the cone is linearly translated back to the original signal driving the loudspeaker. This signal is fed back to a comparator circuit in the amplifier incorporated in the enclosure and compared with the original signal. This enables the loudspeaker to be immediately corrected at the slightest deviation. And, in this way, the acoustic behaviour of the woofer can be completely controlled.

Practically speaking, the results are dramatically simple. A drastic reduction in distortion. Flawless clarity – from the fullest bass notes to the most detailed treble extremes. And a remarkable compactness in enclosure and speaker construction.

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Technical specifications Model 541

Volume:	8 litres; 4.5 litres acoustic
Power of amplifier:	30 W cont. sine wave power
Frequency response:	35-20,000 Hz

Model 544

Volume:	15 litres; 9 litres acoustic
Total power of amplifiers:	60 W cont. sine wave power
Frequency response:	30-20,000 Hz
Amplifier for woofer:	40 W cont. sine wave power
Amplifier for squawker and tweeter:	20 W cont. sine wave power

Model 567

Volume:	30 litres; 20 litres acoustic
Total power of amplifiers:	60 Watt cont. sine wave power
Frequency response:	27-20,000 Hz
Amplifier for woofer:	40 W cont. sine wave power
Amplifier for squawker and tweeter:	20 W cont. sine wave power

Model 545

Volume:	70 litres; 50 litres acoustic
Total power of amplifiers:	100 W cont. sine wave power
Frequency response:	20-20,000 Hz
Low note filters:	– 5 dB at 200 Hz – 5 dB at 60 Hz – 3 dB at 55-160 Hz
Bass Control:	from + 10 dB to – 10 dB at 60 Hz
Treble filter:	continuously variable, 0-20 dB per octave
Amplifier for woofer:	50 W cont. sine wave power
Amplifier for squawker:	35 W cont. sine wave power
Amplifier for tweeter:	15 W cont. sine wave power

All specifications are subject to modification without notice.

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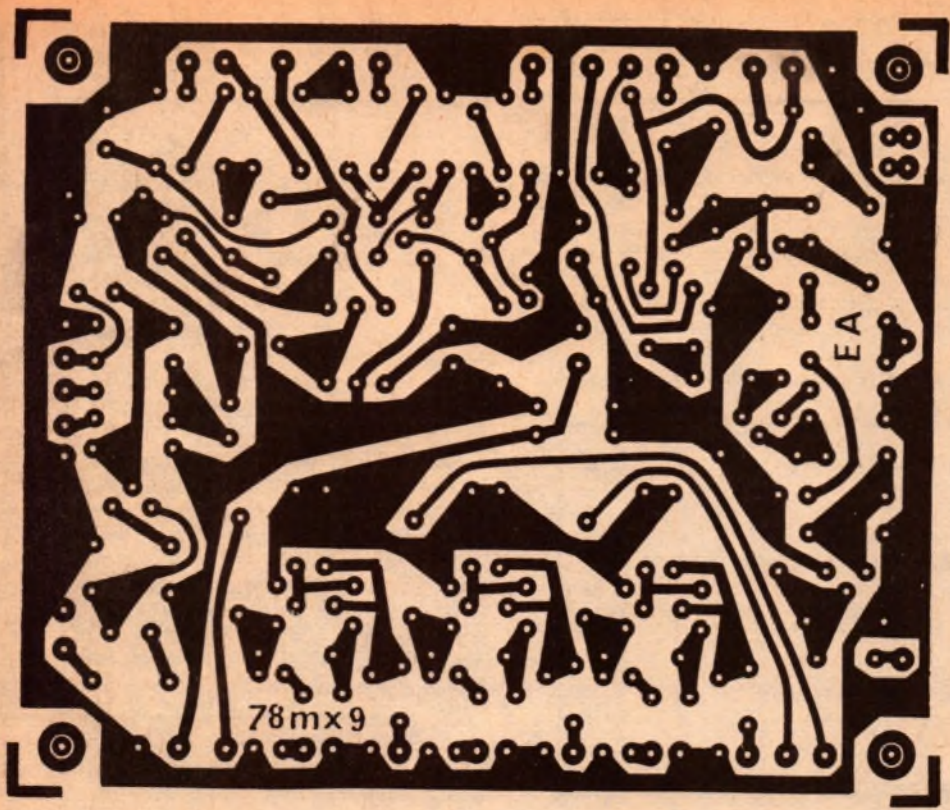
We want you to have the best



Here is the PCB pattern for the mixer, reproduced actual size for those who may care to produce their own board by tracing or photography.

An actual-size reproduction of the front panel artwork is shown on these pages, for those who wish to follow the same course. However I understand that at least one kit supplier is likely to have prepunched and etched panels available for the project, so that you may be able to produce your front panel with rather less work than mine!

Inside the box, just about all of the circuitry is on a small printed circuit board (PCB). The board measures 120 x 100mm, and is coded 78mx9.

Wiring of the PCB should be fairly straightforward using the overlay diagram and the internal photograph as a guide. The main points to watch are that you fit the transistors, diodes, and electrolytic capacitors (including tantalums) with correct orientation.

It is also a good idea to orientate the resistors so that their colour coding bands read consistently "North-South" and "East-West", to make it easier to check later.

I would recommend that you use PC-pins for all of the external connections to the PCB, as this simplifies assembly. You can finish the PCB, mount it into the bottom of the case and then connect it up to the various front-panel controls and connectors

Note that apart from the front panel controls, the meter, the input and output sockets and the batteries, the only other parts not mounted on the PCB are five 10k resistors and a .0015uF capacitor. One of the resistors connects directly between the rotor (centre) lugs of the bass and treble pots, while the other four are each connected between the rotor lug and "top" element lug of a slider pot (one per slider!). The capacitor connects from the top of the master gain slider to one of the earthed lugs on the adjacent autofade level pot.

Note also that the metal front panel of the case should be connected to the circuit "earth", to provide some shielding and also to prevent feedback coupling. This can be arranged easily by slipping a solder lug under one of the meter mounting nuts, and connecting the lug to the earth wire used for the sliders and preamp gain pots.

When you are wiring up the various rotary and slider pots on the front panel, check against the circuit so that you wire them for correct action. The small arrows on the circuit indicate clockwise rotation for rotary controls, or upward movement for sliders.

The two 216-type batteries used to power the mixer are clamped in position beneath the tone controls, using a small scrap of aluminium. The two batteries are connected in series, with the resulting +18V lead connected to the PCB positive input via the front-panel power switch. The negative lead connects straight to the PCB negative input.

The wiring for the headphone socket will depend upon whether you wish to use a matching transformer or not. If not, simply wire the stereo headphone jack so that the two wires from the PCB connect to the tip and ring contacts. This will result in the two stereo headphones being connected effectively in series, giving greater volume.

As explained earlier, the mixer will deliver more output at lower distortion if a matching transformer is used to increase the load impedance. Miniature "transistor output" transformers are available very cheaply from a number of suppliers, and most of these are small enough to be fitted inside the mixer case if desired.

Almost any transformer described as a "transistor output" type is likely to be suitable, as long as it is capable of stepping up a few ohms into a few hundred ohms and handling a couple of hundred milliwatts. Among those suitable are those listed in the Dick Smith catalog under numbers M-0226 and M-0216.

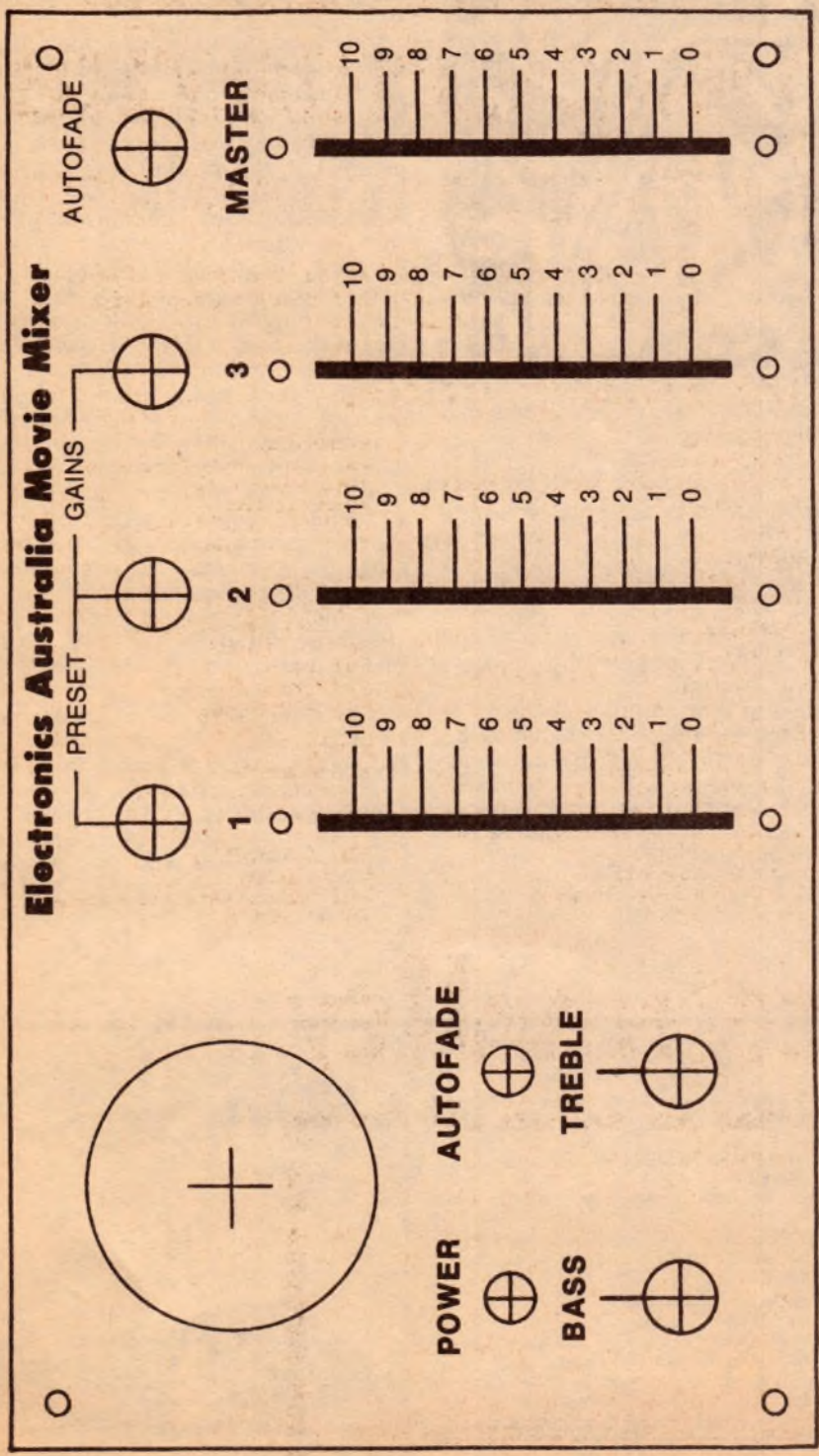
If you decide to use a transformer, connect its high impedance primary to the two PCB output pins, and its low impedance secondary to the stereo headphone socket. In this case the tip and ring contacts should be connected together and to one end of the secondary, with the sleeve connecting to the other end of the secondary. It is also a

good idea to connect the sleeve to the mixer PCB earth, to prevent possible feedback effects.

If the leads between the input connectors and the PCB are kept short, it appears to be quite satisfactory to use normal hookup wire rather than shielded cable. Similarly the rest of the mixer interconnections may be made in hookup wire, providing that you don't make them unduly long. The wiring is not particularly critical, but it is a good idea to keep the input leads well away from the output wiring.

There is only one setting-up adjustment to be made when the mixer is complete. This is the bias adjustment for Q9, the autofade control FET.

To set this control, which is the small preset pot on the PCB, you will need a source of fairly steady signals. A sinewave tone from an audio oscillator is ideal, but if you don't have access to one of these instruments a recording with some music of reasonably constant volume will do at a pinch.



Here is the front panel artwork for the mixer, again reproduced actual size.

Feed this signal into either channel 2 or 3, with the autofade switch off, and turn the slider and preset gain pot for the channel concerned, together with the master gain slider, until the level meter is indicating around normal recording level. This will be at the "0dB" or "100%" mark for a tone, or an average of about "60-70%" with occasional peaks into the red area for a musical signal.

It is a good idea to plug in a pair of headphones at this stage, to confirm that the signal is undistorted under these conditions.

Now turn the front-panel autofade level pot to the minimum level position (fully anticlockwise, or minimum resistance), and the PCB autofade bias pot tentatively to the full bias position. This is the position with the rotor at the earthy end, adjacent to the PCB mounting screw alongside.

Make sure that the channel 1 slider pot is pushed right down, to the "0" setting. Next switch on the autofade switch. Nothing should happen at this stage, if everything is in order.

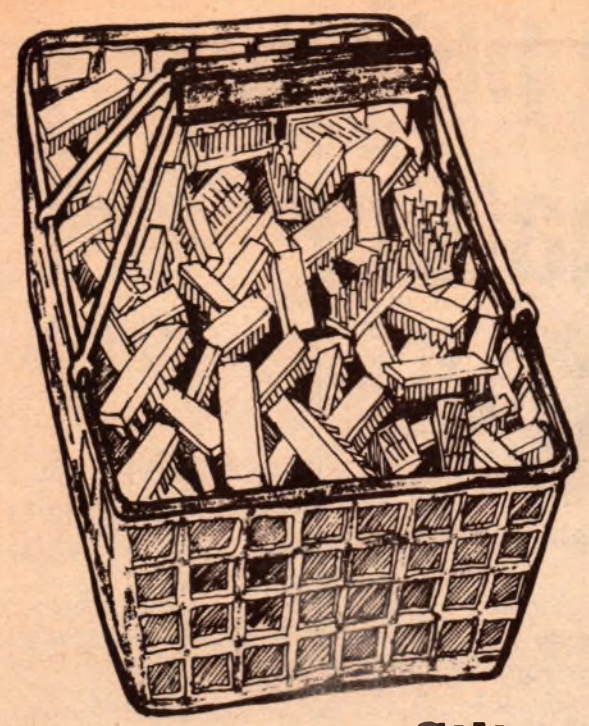
Now slowly turn the PCB autofade bias pot back towards the opposite extreme, listening to the headphones and watching the meter. Stop turning the pot as soon as you detect the incidence of an "edge" of distortion, and/or a drop in the meter reading. Then turn the pot back slightly, until all edginess disappears. This is the correct setting for the pot, and the adjustment is complete.

Should you find that you can turn the pot right to the far end without producing any effect, don't despair. This probably only means that you have a FET with a rather low cutoff voltage. Just leave the pot set to the far extreme (furthest from the PCB mounting screw), and all should be well.

To check that the autofade operates correctly, plug a microphone into the channel 1 input and turn the channel 1 preamp gain pot fully clockwise for a full gain. Then, speaking about 300mm away from the mike, gradually move up the channel 1 slider. As soon as the voice signals reach a certain level the tone or music should drop to a very low level. Then if you stop speaking or lower the channel 1 slider, the tone or music should smoothly fade up to its former level.

If you turn the front-panel autofade level pot to different settings, you should be able to adjust the level to which the tone or music fades when the voice signals are present.

All that remains is for me to wish you happy sound movie making, with our new mixer to help you achieve satisfying results on the sound side.



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How to pick up the amateur satellites

by NEVILLE WILLIAMS

Perhaps you've collected verification cards from every quarter of the globe and are looking for new worlds to conquer with your high-performance DX receiver. Well then, why not look up, instead of around, and keep an on-air rendezvous with an orbiting satellite?

To many people, the idea of tuning directly to the signals from a satellite will come as a new thought. If they think about them at all, they envisage satellites as being crammed with highly sophisticated electronic gadgetry, accessible only to earth stations equipped with steerable radar-like antennas and highly specialised receivers.

In the general case, that impression would be substantially accurate but it does ignore two satellites that are currently in orbit, and which cross Australia several times a day; they are known as "OSCAR 7" and "OSCAR 8".

The term OSCAR is an acronym for "Orbiting Satellite Carrying Amateur Radio". The figures indicate that the two currently in orbit — and active in the radio sense — are numbers 7 and 8 in a series.

Both these satellites can be heard at certain times, using a good quality communications receiver and an outdoor antenna — typically a CB base station type or an ordinary wire aerial suitable for short-wave reception.

But more about that in a moment; let's sketch in a little of the background to the two OSCAR satellites.

When the Russians launched the first man-made satellite, back in October, 1957, it emitted beep-beep-beep signals from its radio beacon on 20MHz. Amateurs and hobbyists were able to tune them directly on sensitive shortwave receivers.

Noting the strength of the signals from that original Russian "Sputnik I", amateurs realised that it should one day be feasible to build and launch a satellite, which would radiate a similar beacon signal on one or more of the amateur bands. Better still, it might even be possible to have an orbiting satellite "repeater", receiving signals from amateur stations on the ground and re-transmitting them from space.

It took just over four years for the dream to become a reality, during which time amateurs had to learn how to build a radio beacon which would perform reliably in space. They also had to convince the US authorities that they should omit a little of the trimming ballast from one of their space shots and substitute an amateur-built satellite beacon instead!

Success crowned their efforts in both directions and the first amateur satellite, OSCAR 1, was launched from the Vandenberg Air Base in December 1961. It carried a simple radio beacon on 144.98MHz, radiating the Morse message "Hi" — at the one time a greeting and amateur jargon for a laugh. Despite the very modest power level — a mere 100 milliwatts — more than 5000 reception reports were received from 28 countries covering the 15 days in which it remained operative.

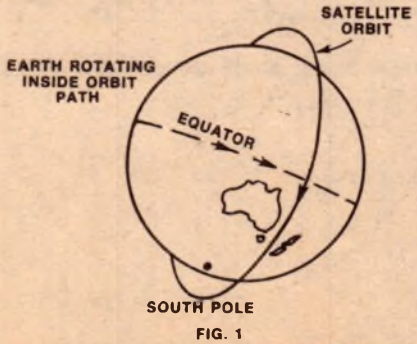

FIG. 1

The orbital track of Oscar 7 and Oscar 8 is nominally over the poles, with the Earth rotating inside the orbit, as shown.

OSCAR 2, more or less a repeat of OSCAR 1, was launched in June of the following year and operated for about 20 days. While still carrying only a beacon transmitter, it provided amateurs with further experience in space tracking and reception, ready for the true, orbiting repeaters which were to follow.

OSCAR 3, launched in March 1965, was the world's first non-government free-access communications satellite, receiving signals on 144.1MHz and re-transmitting them on 145.9MHz, at a power level of 1 watt. Also battery-powered, OSCAR 3 failed after 15 days but, in that time, it provided the means for several historic "firsts" in amateur communication and set a pattern for the future.

It was followed by OSCAR 4 and, in January 1970, by OSCAR 5 which, incidentally, was designed and built in Australia.

In fact, OSCAR 5 was the last of the series built by independent groups of enthusiastic amateurs. In the meantime, AMSAT, the Radio Amateur Satellite Corporation Inc. had been founded in Washington DC to coordinate and regularise amateur satellite initiatives. From the outset, AMSAT has enjoyed the support of international amateur groups, financial sponsorship by individuals and companies, and spare-time technical back up from NASA engineers, many of whom are active amateurs.

OSCAR 6, the first of the new generation AMSAT satellites, was launched in October 1972 and remained serviceable until June 1977.

Oscar 6 differed from earlier satellites in that it carried a "transponder" rather than a "repeater" for two-way working. The difference is important: a repeater receives one discrete frequency only and transmits on another discrete frequency. A transponder accepts signals anywhere within a specified band and frequency shifts them for transmission in another specified band. It can handle a number of signals simultaneously within the respective bands and even in different transmission modes, so that a number of amateur stations may communicate through the satellite at the one time.

As we said at the outset, there are currently two AMSAT (amateur) satellites in orbit and active in the radio sense, and these are the ones that you'll want to try for.

OSCAR 7 was launched on November 15, 1974, into a nominal polar orbit at a mean altitude of about 1460km. It completes an orbit each 115 (approx.) minutes.

This is illustrated in Fig. 1 which depicts a satellite orbiting over the Poles, with the Earth rotating inside the "stationary" orbiting path. As shown, the satellite is approaching Australia from the north. Fairly obviously, 12 hours after the situation depicted in Fig. 1, when the Earth will have rotated by one half-turn, the satellite will be approaching Australia from the south.

To carry your thinking a little further, Fig. 2 is, as it were, a "plan" view of the Earth looking down on the North Pole. It is rotating, of course, in an anti-clockwise direction. The Sun is shown at the right, with the "day" and "night" areas on Earth depicted by shading.

The line drawn obliquely across the Earth represents the approximate orbital path of OSCAR 7, with the arrows indicating its direction of travel across the Northern Hemisphere. As mentioned earlier, the orbital track of the satellite is "stationary", in the sense that it always presents the same declination to the Sun, roughly as depicted. It is known as a "Sun synchronous" orbit.

If you look carefully at Fig. 2, you will realise that it must always be morning on most parts of the Earth's surface which are passing under or adjacent to the north-south traverse of OSCAR 7. Similarly, it must be evening when passing under the south-north traverse.

It is not difficult to appreciate that, no matter where on earth a listener may live, he/she can expect to hear signals from OSCAR 7 only when their part of the Earth's surface is adjacent to its orbital track. And that will happen for most listeners during their local morning and evening. It would be quite useless listening at other times, eg, during the afternoons or the small hours after midnight.

In the foregoing paragraphs, we have been careful to suggest that a listener needs only to be adjacent to — not necessarily under — the orbital track to hear signals from OSCAR 7. This is due to the fact that the satellite is at an altitude of 1460km and is therefore visible, in the radio sense, from quite a large area of the Earth's surface.

The area of "visibility" at any instant, or the so-called "footprint" of OSCAR 7, approximates a circle of diameter 7800km. As the circle sweeps across the Earth's surface, it can be envisaged as a track 7800km wide, as shown in Fig. 2. Because of the width of this track, any given spot on earth is likely to lie within the coverage of at least two successive passes during each morning and each evening.

An Australian listener, for example, may hear signals during an orbit that passes somewhere over the Pacific or the Tasman, followed by the next over the continent, and a third over the Indian ocean, making a maximum of three consecutive passes. On other days, one of the passes may be just out of reach over the Pacific or over the Indian Ocean, leaving only two effective passes for that morning or that evening.

Thus the pattern for Australia for OSCAR 7 is two or three passes 115 minutes apart, beginning sometime after 5.00am in the mornings, and two or three passes beginning sometime after 7.00pm in the evening. To be more precise than this involves a certain amount of figuring, which we will get around to explaining later.

The latest AMSAT (amateur) satellite, OSCAR 8, launched on March 5 this year follows a very similar orbital track to OSCAR 7, but with a mean altitude of 880km and an orbital period of 103 (approx) minutes. For the same reasons as explained in Fig. 2, OSCAR 8 also provides a pattern of morning and evening passes.

Having less altitude, OSCAR 8 is visible (in the radio sense) to a smaller area of the Earth's surface at any one instant — represented by a circle approximately 6500km in diameter.

Fig. 3 will give you some idea of what the coverage of OSCAR 7 and OSCAR 8 would be at the instant when they were positioned exactly over Sydney. The somewhat misshapen "circle" and the unfamiliar outline of Australia is due simply to the fact that they are represented on a great circle projection of the Earth centred on the South Pole. Why we used this projection will become apparent when you see the detailed follow-up article, hopefully in our next issue.

By taking Fig. 2 and Fig. 3 together one can narrow down the earlier statements about availability of the satellites to any given location:

- Access to OSCAR 7 and/or OSCAR 8 is available only during the morning and evening periods, as previously defined, and
- They are available only during specific periods, morning or evening, when the respective "footprints" cover the relevant location.

Expanding upon the last point, it takes a maximum of 22 minutes for the OSCAR 7's footprint to traverse a given point on the Earth's surface, and a lesser time for the fringes of the footprint to pass.

Expressed in more technical terms, the maximum access time to Oscar 7 is 22 minutes for an overhead orbit, and progressively less than 22 minutes for orbits to either side. Therefore access opportunities to OSCAR 7 in Australia are typically limited to two or three periods each morning or evening, with no period longer than 22 minutes.

Maximum access time to OSCAR 8 is shorter, at 18 minutes per pass.

Because the orbits in both cases are slightly out of synchronism with the Earth's own rotation, the passes do not occurr at regular times. It is therefore not possible to nominate any fixed time

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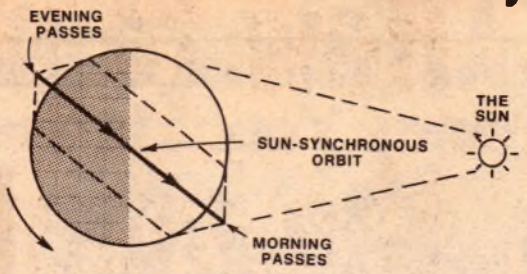

FIG. 2

Because the Oscar 7 and 8 orbits have a substantially fixed relationship to the Sun, most population centres on Earth pass under the orbital tracks during the morning or evening periods. You won't hear the satellites during the afternoons or the small hours after midnight.

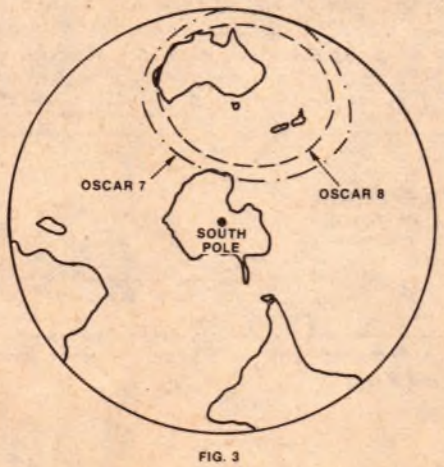

FIG. 3

This diagram shows the extent of the radio coverage or "footprint" of Oscar 7 and Oscar 8 as it would be when they were exactly over Sydney.

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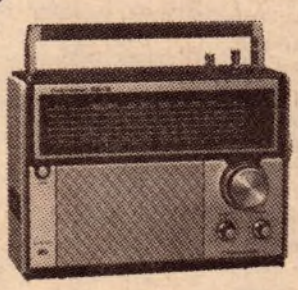

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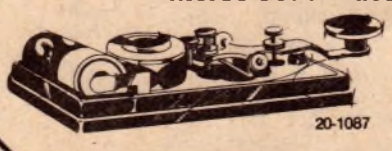
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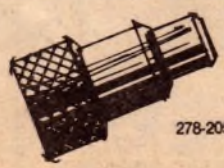
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during which access can be assured. If anyone is interested to hear one of the OSCARs, but not so interested as to discover appropriate access times, all they can do is to leave a receiver tuned to one or the other of the satellites' beacon frequency and hope to hear it, during the course of a morning or evening.

It would be nice to say that this "lottery" situation could be avoided by acquiring tables from somewhere which would list the local time and the duration of every single pass for both Oscar satellites, for every day of the year and for a variety of population centres throughout Australasia. However, the difficulty and cost of publishing such lists would make their appearance most unlikely. Anyone requiring the information will have to derive it from less detailed — but available — sources.

Basic predictions are published by AMSAT and reproduced on a month by month basis in magazines such as "Amateur Radio", published by the Wireless Institute of Australia. They are also included in the weekly WIA broadcasts over amateur band stations. The predictions give the time in UTC of the first south-north equator crossing for each day, and the longitude where the crossings will occurr.

Working from these data, it is possible to predict the time and the orbital track of passes for that day adjacent to any given location. It can be done by tedious longhand methods or by resort to a suitable computer or programmable calculator. Yet another option, which we will hopefully describe next month, is to make up a circular calculator which will display times and tracks, when fed with the key figures for each day.

A SIMPLE METHOD

In the meantime, there is a simple approximation method which will indicate access times with about an 85% chance of being right. Suggested by John Dennis of the Dick Smith organisation, it provides a lot better chance of success than by simply relying on luck! This is what you do:

1. Refer to the prediction data for the particular satellite and note the first Equator crossing time for the day; it will be expressed in UTC. To let you try your hand, we publish the data herewith for the month of September.
2. Add this time to the figures given in the tables below remembering that, when adding minutes, anything over 60 represents 1 hour, which you carry to the hours column. The answer will be in local standard time for the particular city (or state).
3. The calculated time usually gives the first of three possible passes. Listen at intervals of 1 hour 55 minutes for successive OSCAR 7 passes, and at 1 hour 43 minute intervals for OSCAR 8.
4. The times indicate when the respective satellites will be on the same latitude as the cities indicated. Start listening about 10 minutes earlier for the start of each pass.
5. When summer time is in operation, add 1 hour to the calculated times.

As an example, say you needed to work out the first evening pass of OSCAR 7 on September 1 for Sydney. From the prediction tables, you would obtain the figure 0012. Now add 1927 from the foregoing instructions to obtain the figure 1939 in EST, or 7.39pm.

So start listening at 7.29pm, for up to 20 minutes. Try again at 9.24pm and at 11.19pm.

Or suppose you were interested in OSCAR 8 for the same day. The prediction table gives a crossing time of 0011 and the evening pass figure from the table is 1827. Adding 0011 to 1827 gives 1838, or 6.38pm. Again, start listening about 10 minutes earlier, then listen again at 8.11 pm and at 9.54 pm.

Two obvious questions remain to be answered as far as the enthusiast listener is concerned: On what frequency can one expect to hear signals from the satellites and what form do they take?

Amateurs transmitting to OSCAR 7 and OSCAR 8 do so mainly in a frequency segment just below 146MHz and, to a lesser extent in a segment above 432 MHz. On certain days, transmissions from the satellites are confined to these same amateur bands and are therefore accessible only to those who have the appropriate receiving equipment.

OSCAR 7			OSCAR 8		
CITY	MORNING	EVENING	CITY	MORNING	EVENING
Sydney	0522	1927	Sydney	0551	1827
Melbourne	0523	1925	Melbourne	0552	1826
Brisbane	0520	1929	Brisbane	0549	1829
Adelaide	0451	1857	Adelaide	0521	1757
Perth	0517	1922	Perth	0534	1810

SATELLITES — Cont

However, on other days, when the satellites are operating in what is referred to as "mode A", they transmit in the "10 metre" amateur band, between frequency limits of about 29.4 and 29.5MHz. These signals are, of course, accessible to anyone with a high quality general-coverage communications receiver.

OSCAR 7 transmits in mode A one day in every 3. In fact the pattern BBA, BBA commenced on Jan. 1, 1978 and, if you want to, you can go through a calendar and mark it accordingly. OSCAR 8 operates on mode A during weekdays. As a further guide, the mode for each day is usually indicated in the same tables which list crossing times. Fairly obviously, there is no point in worrying about a satellite on days when the 29MHz signal is not going to be available anyway.

One other point to watch is that the mode changes at midnight GMT, which corresponds to 10am EAST. Therefore morning passes near Australia which occur before 10am EAST will still be in the mode for the previous day.

You may have noticed that we used the "about" in an earlier reference to frequency. This was quite deliberate because of Doppler effect. As a satellite speeds towards the receiving point, its signal in the 29MHz band appears to be about 550Hz high. It assumes its nominated frequency when the satellite is overhead (or at the same latitude) and then moves towards 550Hz low as the satellite speeds towards the distant horizon. Therefore, while satellite transmitter frequencies can be nominated, listeners must be prepared to nudge the tuning, as necessary.

The transmissions on the 29MHz band are normally in CW (code) or SSB (single sideband telephony) and the communications receiver must be used in CW and/or SSB mode, preferably upper sideband. Fairly obviously, it must be of a type which is sufficiently stable to cope with 10-metre SSB and calibrated with sufficient accuracy to be set to the required frequencies.

If you are expecting an OSCAR 7 pass, set the receiver to 29.502MHz and listen for bursts of 20wpm code. This will be the on-board beacon signal, which serves to identify the satellite and also to indicate various parameters within which the equipment is working. Having heard the beacon, explore the band 29.4 to 29.5MHz, on the alert for amateur traffic. Expect only brief exchanges, because satellite QSOs are not of the protracted, wordy kind.

For OSCAR 8, the beacon operates on 29.402MHz but traffic is in the same segment as for OSCAR 7: 29.4 to 29.5MHz. Reports indicate that the signal from OSCAR 8 is usually the stronger of the two, presumably because it is at a lower altitude.

Last but not least, there is the matter of receiving antennas. Amateur operators who are keen on satellite communication may well end up with complicated beam arrays, which are both steerable and tiltable, in order to transmit and receive the strongest possible signals. Fortunately, a listener on 29MHz does not need to go to these lengths to add a satellite to his/her list of conquests.

As we mentioned earlier, one can usually do reasonably well with a CB base station antenna, or with an outdoor wire antenna.

However, a contributor to QST magazine has suggested a type of antenna which, he says, works particularly well. Suspend a loop of wire 10.4m long, hopefully about 3m above ground; it can be in a circle, square or triangle, which ever is convenient. Where the ends come together, attach a quarter-wave matching stub (1.7m of 70-ohm coax. cable) and then carry on to the receiver with 52-ohm coax. We haven't tried it, but it's an interesting idea. One other interesting suggestion is worthy of a mention: If you can't cope with the code at 20wpm, record it on an open-reel tape machine and play it back later at reduced speed. However, most enthusiasts will be happy enough merely to identify the signal and to tune to the hasty chatter of amateurs using SSB telephony.

UTC: FIRST S-N EQUATOR CROSSING

DATE	OSCAR 7	OSCAR 8
Sept 1	0012 B	0011 A
Sept 2	0106 B	0017 J
Sept 3	0005 A	0022 J
Sept 4	0060 B	0027 A
Sept 5	0154 B	0032 A
Sept 6	0053 A	0037 X
Sept 7	0148 B	0043 A
Sept 8	0047 B	0048 A
Sept 9	0141 A	0053 J
Sept 10	0040 B	0058 J
Sept 11	0135 B	0103A
Sept 12	0034 A	0103 A
Sept 13	0128 B	0114 X
Sept 14	0028 B	0119 A
Sept 15	0122 A	0124 A
Sept 16	0021 B	0129 J
Sept 17	0116 B	0135 J
Sept 18	0015 A	0140 A
Sept 19	0109 B	0002 A
Sept 20	0009 B	0007 X
Sept 21	0103 A	0012 A
Sept 22	0002 B	0017 A
Sept 23	0057 B	0023 J
Sept 24	0151 A	0028 J
Sept 25	0050 B	0033 A
Sept 26	0144 B	0038 A
Sept 27	0044 A	0043 X
Sept 28	0138 B	0049 A
Sept 29	0037 B	0054 A
Sept 30	0132 A	0059 J

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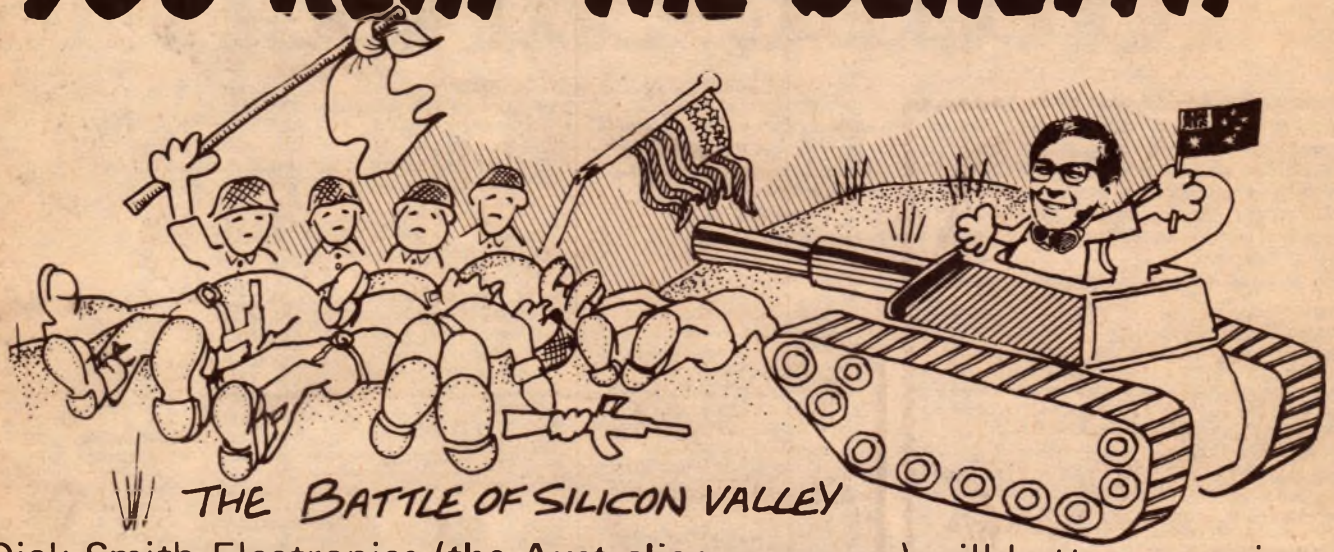

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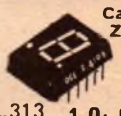

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78XX series (3 terminal 1 amp positive voltage regulators)
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7812 (12V) Cat Z-6552 .. .. .. $1.25
7815 (15V) Cat Z-6554 .. .. $1.25
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7905 (5V) Cat Z-6555 .. .. $1.75
7912 (12V) Cat Z-6556 .. .. .. $1.75
7915 (15V) Cat Z-6557 .. .. .. $1.75

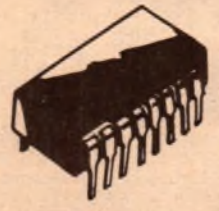
PLEASE NOTE:
Where possible, all components supplied will be of the type no. shown here. However, during times of component shortages, substitutions may be necessary.

Where substitutes are supplied, they will be the exact electrical equivalent. In many cases, they will simply be other manufacturer's markings on the same component.

DIODES

OA91 (germanium general purpose – great for crystal sets!) Cat Z-3040 .. .. 25c each
1N914(silicon general purpose signal diode) .. .. Cat Z-3120 .. .. 12c each
1N4002 (silicon rectifier diode – 1A, 100V) .. .. Cat Z-3202 .. .. 15c each
1N4004 (silicon rectifier diode – 1A, 400V .. .. Cat Z-3204 .. .. 20c each
1N4007 (silicon rectifier diode – 1A, 1000V .. .. Cat Z-3207 .. .. 30c each
DS5404 (silicon rectifier diode, high power 200V, 3A) .. Cat Z-3222 .. .. 45c each
1N5408 (silicon rectifier diode, high V & I 1000V, 3A) .. Cat Z-3228 .. .. 65c each

4000 SERIES C–MOS



4000	Dual 3 input NOR gate plus inverter	Cat Z-5600	39c each
4001	Dual 2 input NOR gate	Cat Z-5601	39c each
4002	Dual 4 input NOR gate	Cat Z-5602	39c each
4006	18 stage static shift register	Cat Z-5606	$2.00
4007	Dual complementary pair plus inverter	Cat Z-5607	39c each
4009	Hex buffer/converter, inverting	Cat Z-5609	89c each
4011	Quad 2 input NAND gate	Cat Z-5611	39c each
4012	Dual 4 input NAND gate	Cat Z-5612	39c each
4013	Dual D type flip-flop with reset	Cat Z-5613	$1.00
4014	8 stage static shift register	Cat Z-5614	$1.75
4016	Quad bi-lateral switch	Cat Z-5616	$1.00
4017	Decade counter/divider	Cat Z-5617	$1.75
4018	Presettable divide by 'N' counter	Cat Z-5618	$1.75
4021	8 stage static shift register	Cat Z-5621	$1.75
4022	Divide by 8 counter with 8 decoder o/p	Cat Z-5622	$1.65
4023	Triple 3 input NAND gate	Cat Z-5623	39c each
4024	7 stage ripple counter	Cat Z-5624	$1.35
4025	Triple 3 input NOR gate	Cat Z-5625	39c each
4027	Dual JK flip-flop with reset	Cat Z-5627	$1.00
4028	BCD to decimal decoder	Cat Z-5628	$1.50
4029	Presettable up/down 4 stage counter	Cat Z-5629	$1.35
4030	Quad exclusive OR gate	Cat Z-5630	70c each
4049	Hex buffer/converter, inverting	Cat Z-5649	$1.00
4050	Hex buffer/converter, non inverting	Cat Z-5650	$1.00
4051	8 channel multiplexer/demultiplexer	Cat Z-5651	$1.35
4068	8 input NAND gate	Cat Z-5668	39c each
4071	Quad 2 input OR gate	Cat Z-5671	39c each
4081	Quad 2 input AND gate	Cat Z-5681	39c each
4416	Double pole double throw switch	Cat Z-5710	80c each
4426	Decade counter/7 seg. dec/ driver	Cat Z-5715	$2.50
4449	Economy Hex inverter	Cat Z-5720	55c each
4511	BCD to 7 seg. latch/decoder/driver	Cat Z-5730	$1.75
4518	Dual BCD up counter	Cat Z-5740	$1.95
4520	Dual 4 stage binary up counter	Cat Z-5742	$1.95
4528	Dual re-triggerable monostable multi.	Cat Z-5748	$2.00

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Upgraded 200MHz digital frequency meter

2nd article completes the construction details

In this second article on the Upgraded 200MHz digital frequency meter, we complete the description of construction and give details of setting-up adjustments and calibration. Also included are useful trouble-shooting procedures and some hints on using the new frequency meter.

by LEO SIMPSON

Construction proceeds with installation of the rotary input switch. Cut the switch shaft to a suitable length for the knob to be used and loosen the clicker plate so the switch can be rotated easily. This is done by bending the clicker plate with a screwdriver to reduce the tension on the detents.

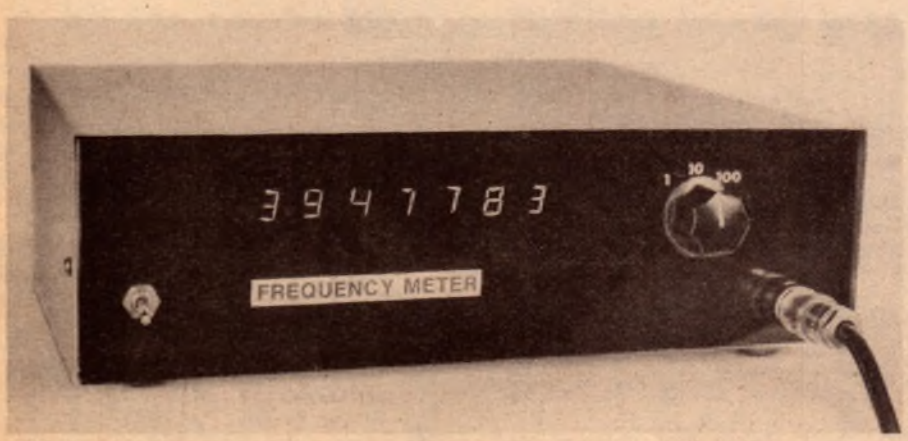
Now refer to the wiring diagram on page 44 of last month's issue. Note that one of the shielded cables has its shield terminated to the underside of the PCB. Cut and strip a 50mm length of shielded cable (any of the lighter audio shielded cable will do) and terminate it at the PCB, leaving the other end free.

Fit Richco 10mm supports to the PCB and mount the whole assembly in the chassis. Alternatively, use screws and nuts or spacers to support the PCB assembly 10mm off the chassis. Fit the regulator IC to the chassis. Its three terminals should be perpendicular to the chassis (rather like the dead flies in the flyspray ads). Connection is made via short tinned copper wires from the regulator terminals to the appropriate PC pins.

Now connect the pair of wires from the transformer secondary to the PCB and you are ready to switch on. Do not complete the remainder of the wiring at this stage. This can be finished after initial checks are made, so check the power supply wiring and then turn the unit on. Check the 5V and 9V supply rails. The 5V rail should be between 4.8 and 5.2V while the 9V rail is less critical — say 8.5 to 9.5V.

While you are at it, you should also check that the 5V supply is actually connected to the supply pin of each of the IC's.

All digits should be alight and all should be zero, except the last on the right which may show "1". The fun begins if you find missing segments or digits. If this occurs you should be able to trace the fault by following the following text.



Always use shielded input cables to minimise the pick-up of random noise.

Faults such as these can be traced with the aid of a multimeter switched to a low resistance range. Switch off the power to the frequency meter and remove the mains plug from the wall socket.

Remember the following points to help localise the fault. First, the three most significant digits are associated with the left-hand 74C926, while the other four are associated with the right-hand 74C926 (looking from above the PCB). Second, within the above two groupings, all segment lines are common.

Table 1 shows the pin connections to the LT-303 LED displays and the corresponding terminals of the 74C926's. This enables the segment and digit drive lines to be checked for continuity. One point which may confuse the issue when these checks are made is that pins 1, 7, 8 and 14 of the LT-303 device are omitted and so are not shown on the leadout diagram.

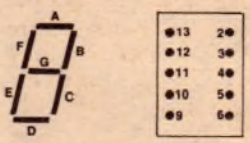


TABLE 1

	LT-303	74C926
segment A	pin 13	pin 15
segment B	pin 12	pin 16
segment C	pin 11	pin 17
segment D	pin 6	pin 1
segment E	pin 5	pin 2
segment F	pin 3	pin 3
segment G	pin 4	pin 4
decimal point	pin 10	—
cathode	pins 2, 9	—

TABLE 2

	74C926
1st digit	pin 7
2nd digit	pin 8
3rd digit	pin 9
4th digit	pin 10

Table 2 identifies the lines connecting the bases of the digit driver transistors to the 74C926. Another wrinkle to remember here is that the left-hand

74C926 does not drive its "1st" digit, ie, pin 7 has no connection.

We can provide a few illustrations of how trouble-shooting this part of the circuit might proceed. If, for example, the second most significant digit is extinguished, check continuity between the appropriate transistor base and pin 9 of the left-hand 74C926. These and other continuity checks can be made without removing the PCB from the chassis.

If there is continuity, apply power and short the digit drive transistor between collector and emitter. If the digit lights, try connecting a resistor of a few hundred ohms between base and collector of the transistor. If the display lights up again, the transistor is exonerated and the 74C926 is defunct.

If, on the other hand, the LED display refuses to light with the above tests, try shorting pin 9 of the display to pin 9 of the adjacent display. If it now lights, check continuity in the transistor's collector and emitter circuits. If the display has still not lit, it is probably headed for that great big PCB in the sky!

In comparison with diagnosing missing digits, missing segments are easy to pick. Note that, at this stage, you cannot check the "G" segments since they are not lit when zeros are displayed. If you are really keen to check the "G" segments, short pin 4 to pin 3 of any LT-303 and all the "G" segments of that particular group of three or four digits should light.

Note that when we are suggesting shorting across components, it should only be done briefly to avoid possible damage.

With all LED displays functioning, you can now proceed to the next step. This consists of checking the 10116 input stage. It is possible, that during the foregoing tests, all LED displays were not showing zeros. Some of the least significant digits may have been showing random counts up to several hundred. It should be possible to reduce this count to zero or a very low figure by tweaking the 1k preset pot association with the 10116.

Now put your finger on the input to the 10116. The display should now show a large random count which is updated once every two seconds. That being the case, remove finger and check that display reverts to zero. If no count appears, there is trouble with the 10116 or following 7490A and 7400.

The most likely place for the trouble will be with the 10116 and the level translator, T2. Voltages, around this area can be checked. As noted previously, the 10116 is a triple differential amplifier. It has differential inputs and outputs, all operating at ECL (emitter-coupled logic) levels of between 3.2V and 4.2V (at room temperature).

Pin 11 of the 10116 should be around 3.7V while the collector of T2 should sit at about 0.5V or 2V. If these voltages are not within within reasonable limits then the most likely cause is open-circuit or bridged PCB tracks.

A rough and ready check of the 7400 and 7490A can be made in the following way. Connect the wires associated with S1c (wires 2 and 3). Apply power and put your finger on the 10116 input again. At the same time, switch the range selector between "x1" and "x-10". The resulting random counts should show a ratio of approximately ten.

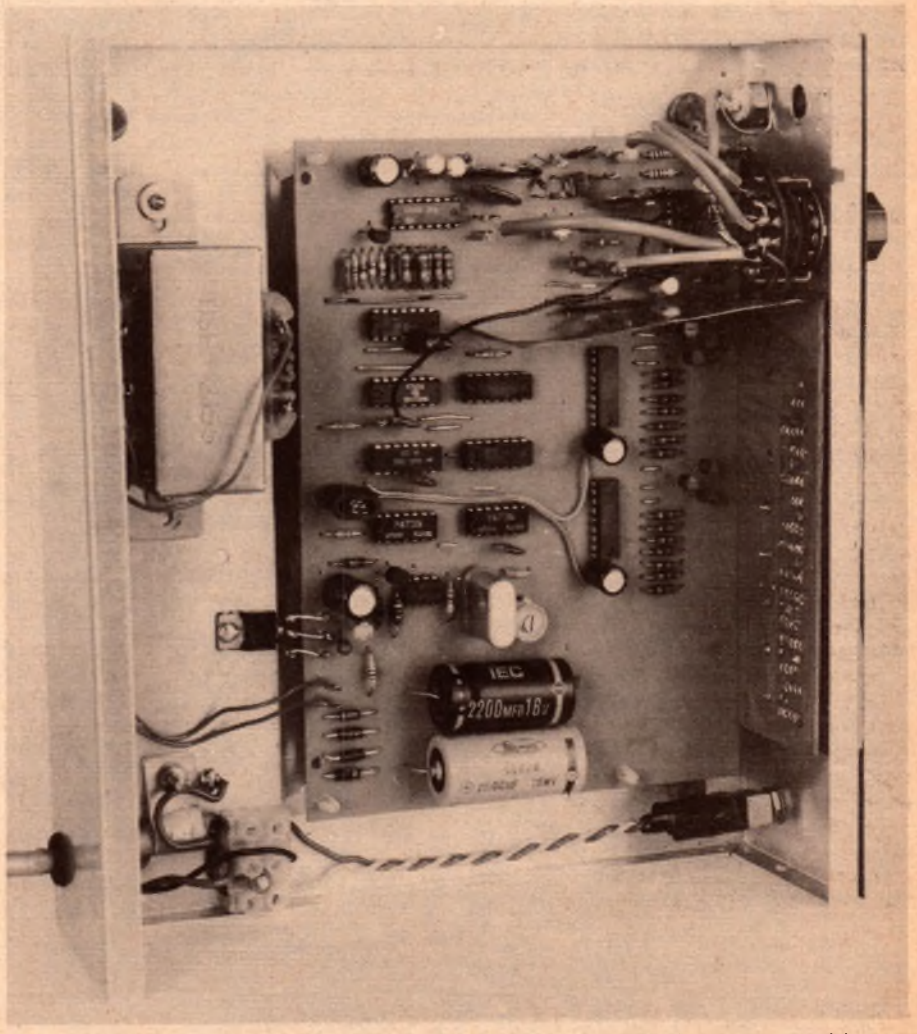
Now connect the remainder of the cables to the input switch. Fit the lid to the case and apply power, with the range set to"x1"; the readout should be zeros. Now take a low value resistor and use it to connect yourself to the input socket (the "finger" signal again). This should give a large random count on the readout. Removing this noise signal should revert the display to zeros.

If both of the above tests are negative, ie, the display shows a random count with no input signal, then the shields shown in the PCB photos last month must be installed. The reason we have left it till this late stage to suggest installing the shields is that with some units it will not be necessary.

The random count is largely a result of the high impedance input circuitry of the FET responding to the hash radiated by the multiplexed displays. You can get some idea of the intensity of this hash signal by positioning a portable radio near the display.

We made our shields using tinplate from tin cans. The shield for the top of the PCB is approximately 90 x 50mm, with a small rectangular cutout from the corner near the top of the front panel. This cutout measures approximately 5 x 15mm and provides clearance to enable the PCB assembly to be removed from the chassis. The shield is soldered to three PC pins on the board, as shown in the wiring diagram and photos.

The top shield can be installed without removing the PCB assembly from the chassis. With it installed, it may cure the hash count problem. If not, remove the PCB assembly and mount the small shield on the underside of the board. The same three PC pins are used for location and solder-



With PCB standoffs and single-screw fixing of the regulator, the PCB assembly can be quickly removed from the chassis.

ing. This should cure the problem.

Final test for hash pickup should be with lid fitted and secured with screws, and with no input cable. An open-circuit input cable can pick up substantial signals from the immediate environment. More about this later.

The foregoing tests and procedures are by no means exhaustive and more searching tests can easily be made with the aid of a wide-bandwidth oscilloscope and signal generator. However, it is possible to check the workings of the "housekeeping" circuitry with the aid of a multimeter switched to a range 10V DC or lower. For example, you can check for the existence of 0.5Hz logic pulses on the "reset" and "latch enable" lines to the 74C926's (pins 5 and 13 respectively). Checking for the existence of reset pulses would be necessary if the display continued to increment by a fixed amount every two seconds and did not revert to zero when signal was removed. This would be most likely due to an open circuit in the "reset" line.

It is not possible to tell whether the 95H90 prescaler is working without the aid of a suitable signal source of 10MHz or more. At this stage of completion, switching to the "x100" range will probably produce a random count of the last three digits.

Calibration may now be performed. This consists of setting the timebase accurately and adjusting sensitivity of the 10116 front end and the 95H90 prescaler.

Without calibration, the frequency meter should have a typical accuracy of .01% $\pm$1 count, which will be adequate for many applications. If calibration is to be performed, the frequency meter should be run for 15 minutes or more with the lid on to allow internal operating temperatures to stabilise.

Calibration is performed by tweaking the trimmer capacitor associated with the 5369 oscillator/divider chip. The trimmer provides only a small range of frequency adjustment. Any attempt to provide a larger range is likely to make the oscillator unreliable at the extremes of adjustment.

By far the easiest way to perform calibration is to use a CB transceiver or amateur transceiver for the 28MHz band as the reference source. There is no need to make any connection from the frequency meter to the transceiver. Just connect a short length of wire to the centre-pin of the input socket and dangle it close to the antenna or dummy load for the transceiver.

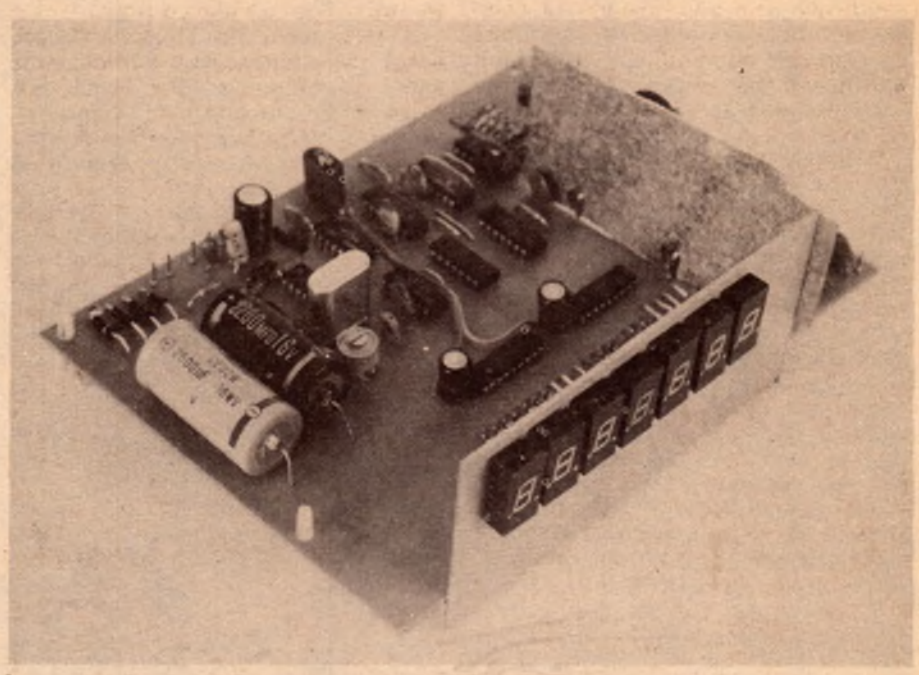
The frequency meter must be switched to the "x10" range, otherwise no sensible reading will result. Note that when there is no signal from the transceiver, the short input wire will pick up ambient noise to produce a random count. This will be swamped out when the transmitter is keyed. The transmitter should be set for AM, not SSB, and there should be no modulation.

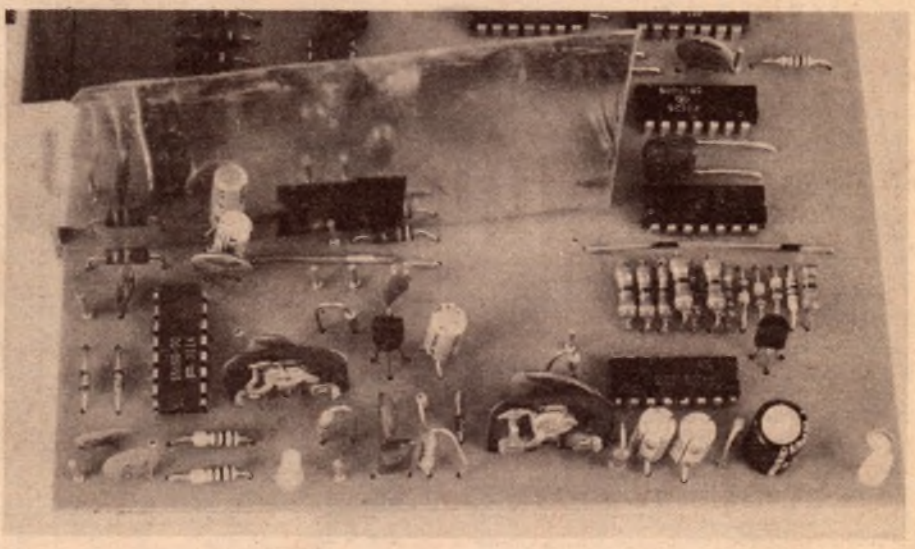
This means of calibrationassumes that the transmitter frequencies have been accurately set. If there is any doubt on this score, then the validity of the method is dubious.

Another method of calibration is to make comparison measurements with a frequency counter of known accuracy. Yet another method is to use a signal generator and a broadcast or shortwave receiver. Set the generator for zero beat against a station of known frequency (and precision). Then measure the output of the signal generator.

This method, like the others before it, is likely to involve some residual error. In this case the error would be mainly due to the difficulty of obtaining an exact zero beat. A typical error figure for this method could be 50Hz or more, plus the error involved in the transmitter frequency.

However, as long as the accuracy is within about 10 parts per million or so, you are probably achieving as good a result as can be expected from the modest timebase system employed. Higher precision is only available by employing an oven-controlled





These two views of the PCB assembly show the main tinplate shield mounted. We made provision for decimal point switching on the PC patterns but omitted it in our prototype because it exacerbated hash pick-up.

timebase oscillator.

Sensitivity adjustment of the 10116 front end is not particularly critical and does not have a marked effect on the sensitivity. The adjustment is a compromise between sensitivity and noise pick-up, and need only be made if it is anticipated that the unit will be used for measuring audio signals of 100mV RMS or less.

If the unit has a high response to noise, ie, both internally generated hash and externally induced noise, the frequency displayed will be higher than actual. The effect will be worse at lower frequencies, as explained in the following paragraphs.

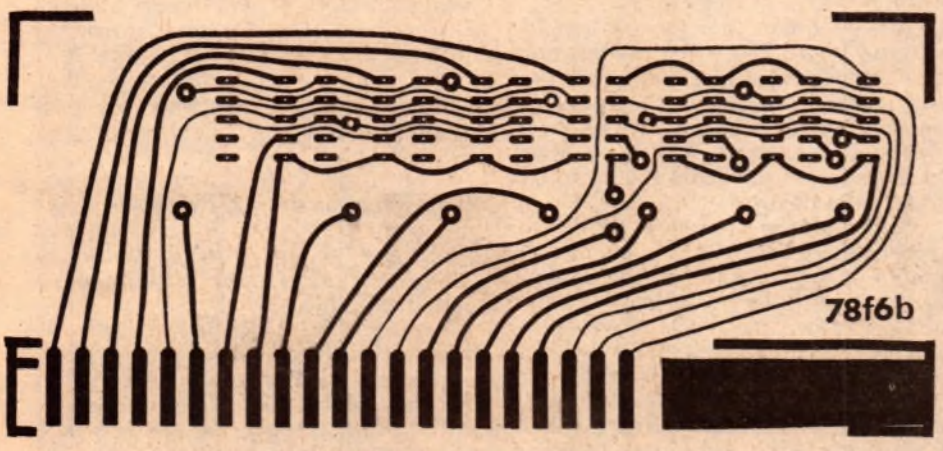
The first two amplifiers in the 10116 increase the input signal by a fixed order of gain which usually means that the second amplifier stage is driven to clipping. For large input signals the output from the second stage amplifier is heavily clipped and almost a square wave — the Schmitt trigger (third amplifier) then produces a clean square wave with short rise and fall times.

Note that the audio oscillator must be connected to the frequency meter via a shielded cable. Using unshielded wires, even short lengths, is sure to lead to errors due to induced noise.

If you have no source of low amplitude audio signals, do not worry about adjustment of the 10116. Just leave the 1k pot centred.

The 95H90 prescaler can be adjusted for optimum sensitivity in the following way. Feed in a VHF signal at 100MHz or higher and adjust the 500 ohm pot until a stable reading is obtained. If the source is a transmitter rather than a signal generator it should be connected via a suitable dummy load and voltage divider feeding no more than 1V RMS into the 50 ohm input.

With too small a signal to the 95H90, the reading will drop from its correct value and vary randomly — or it may drop to zero. With optimum sensitivity, the 95H90 will be sensitive to random noise when no input is applied. The last three digits will show a reading under these conditions. The 95H90 runs quite warm to the touch when the optimum adjustment has been made.



Here is the actual size pattern of the readout PCB, held over from last month.

For small amplitude, low frequency signals, the input waveform may not be clipped at all and the signal takes a relatively long time to make positive-to-negative and negative-to-positive transitions. In one case the Schmitt trigger will make a high-to-low transition at input voltage V1 (say) while in the reverse case it makes a low-to-high transition at input voltage V2. The region between these two threshold voltages is known as the hysteresis of the Schmitt trigger. The longer the input signal is in this hysteresis region the more likely it is that noise spikes superimposed on the signal will produce an erroneous output and therefore a frequency count which is higher than it should be.

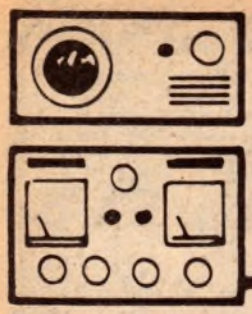
The adjustment on the 10116 affects the input bias and thus the hysteresis of the Schmitt trigger. An audio oscillator is needed for the adjustment. Feed in a low amplitude signal at 1kHz or lower. Note the reading and then increase the amplitude to 1V or more. If the reading is slightly reduced then noise is affecting the former reading.

To conclude, we have a few comments on the components. The 10116 is made by manufacturers other than Motorola. Signetics, for example, list it as GXB 10116. You may also substitute the very similar 10114 device if the 10116 is unavailable.

The Texas TIL-303 is definitely not an equivalent to the Liton LT-303 LED display. We are informed that the Dialight 745-0019 (distributed by Elcoma) is a suitable substitute.

If you built the previous frequency meter featured in March 1977 it is possible to adapt the readout PCB. The readout PCB cannot be attached to the main PCB, due to the fact that the edge connectors are more widely spaced and in a different order. Note that last point. You will have to attach the old readout PCB to the front panel by means of stand-offs and make connections with short lengths of wire.

An error has been found in the main PCB pattern. Pins 2, 3, 4, 6 and 10 of the 7490A should be earthed.



The Serviceman

More than an intermittent — a real challenge

Now and again every serviceman encounters a situation where all the cards appear to be stacked against him. It will demand all his skill, both technical and diplomatic, to ensure that he finishes up with a satisfied customer. It can be a tough challenge, but very rewarding to both ego and reputation if he succeeds.

The story I am about to tell is a classic example; so much so that I would like to think that it, or a story like it, should be compulsory reading for anyone who aspires to be a serviceman. It has all those real life ingredients which one seldom finds discussed in text books or classrooms, but which occur all too frequently in practical service work.

As is usually the case, it started simply enough. The customer walked into the shop and said he was having trouble with his (monochrome) TV set and asked, a little diffidently I felt, whether I thought I could help him. His diffidence made me suspect that this might be a sticky one and, as the story came out, these suspicions were confirmed.

It seemed that he had moved into the district several months ago and, shortly after, the set started playing up. He was quite vague about the nature of the fault, and I didn't press the point at this stage. Suffice it to say that he called in another serviceman and that was when his problems started.

The serviceman established that the fault was intermittent and, on this basis, took it back to the workshop; all of which seemed quite reasonable so far. Subsequently, he returned the set to the owner and assured him that it was now quite OK. In fact, it wasn't very long before the set exhibited exactly the same symptoms as it had before.

So the owner approached the serviceman again, complained that the fault was still in evidence, and requested that he have another look at it. This time the serviceman attempted to correct the fault in the customer's home, but with no more success than before.

This exercise was repeated several more times over the following weeks, and always with the same result; an apparent cure which lasted anything from a few hours to a couple of weeks, but invariably failed eventually.

At this point the serviceman apparently became fed up with the whole deal and opted out by simply ignoring the customer's request that he have another try to fix the set. Which more or less brought the story up to date, because it was then that the customer sought my help.

Having listened patiently to all this, the first thing I wanted to know was the nature of the fault. The customer went to some trouble to explain what I already knew; that it was intermittent. When he finally came to the crux of the problem he described the picture as ". . . becoming very grey and smoky." He went on to explain that this varied from being difficult to watch to being virtually unwatchable.

I then asked about his aerial system, and exactly where he lived. It transpired that his location was not a particularly good one, and I was rather shocked when he went on to say that he was using only a pair of "rabbit ears". I don't like rabbit ears at the best of times, regardless of signal strength, and I certainly would not have suggested them for his location. I decided that it just could be that his trouble was nothing more than the variable signal quality which such a setup could produce.

Accordingly, I made an appointment to visit his home the next day and, hopefully, see the trouble for myself. When I was finally ushered into his lounge room I recognised the set as one which Philips produced in the early '70s, being a hybrid type using modular construction.

The customer switched on the set and, when it warmed up, I was surprised to see that it was producing very good quality picture, rabbit ears notwithstanding. There were no serious ghosts and, while there was a little snow, it was not distracting at a normal viewing distance.

When I commented on the quality of the picture, the owner was not impressed. "Just wait a while", he said, "In a few minutes it will go all smoky, or the screen will go black and we won't get anything."

So we waited. And chatted. And his wife made a pot of tea. And we waited. And talked. And — of course — nothing happened. The set continued to deliver a normal picture. I pulled the back off, had a good look around, prodded and tapped in likely places, but all to no avail.

The customer was somewhat embarrassed by all this. Following the story about the other serviceman's abortive efforts, he felt that it made him look like some kind of crank who only imagined the fault.

I assured him that I had no such illusions, that the situation was quite common, and that it would probably take several attempts to come to grips with the fault. I suggested that he keep me informed and try to contact me when the set was actually faulty, so that I could check it immediately.

A couple of days later he was back in the shop. The set was really bad now; failed nearly every time it was switched on. He was sure that if I came around that afternoon I would be able to see the fault.

I wasn't as optimistic as he was — I've been caught too often — but I kept my fingers crossed and duly turned up at the suggested time. Alas for our hopes; the exercise was a virtual repeat of the first one. All I could do was indulge in some detective type questioning in the hope that I might get a better idea of what was happening, but this was not much help.

The only conclusion I could come to was that the set might be voltage senstive. If this was so the best chance of it happening was in the early evening during the peak cooking period, so I suggested that I come back at about 6 o'clock and try again.

I was hoping that I would see the fault occur naturally but, having latched onto the voltage sensitive idea, I wasn't above giving nature a helping hand if necessary. Accordingly I fished

out my trusty Variac and took it along.

As before, the set refused to misbehave so, after waiting a reasonable time I connected the Variac and, starting at 240V, gradually wound it down to about 210V. At this point things started to happen. First the picture bloomed, then the screen blacked out completely. By carefully adjusting the brightness control downwards, a weak picture could be produced, but any attempt to lift the brightness would black it out.

These are classic symptoms of EHT failure, normally caused by low emission in either the line output valve, EHT rectifier, or boost diode. More important they were, according to the customer, the same symptoms that he had been observing all these months. I felt quite jubilant at having run the culprit to ground.

I pulled the back off, withdrew the 6CM5 line output valve, replaced it with a new one, and tried again. Unfortunately, this made little difference, so I changed the 1S2 EHT rectifier. This time I struck oil. The set behaved normally at 210V and even at 200V, so I considered the point proved.

In cases like this I make it a point to impress on the customer that they should contact me immediately if the fault shows again. And, just to make sure, I also make a point of dropping in a few weeks later, at a convenient time in my rounds, and enquiring whether the set is still behaving. While normally only a gesture, it is good public relations.

I went through the same routine with this customer, confident that I would hear no more about the problem, then took my leave. It came as something of a shock, therefore, as well as a blow to my ego, when I found a note under the shop door one morning saying that the set was still giving trouble.

It went on to explain that he had left the note because he would be out of town for a few weeks, and that he would contact me when he returned. Which left me with the puzzle hanging over my head for the next couple of weeks; a most frustrating situation. Still, that's all part of the game.

When he did return, he elaborated somewhat on his note. It seemed that the set was now so bad as to be virtually useless and, more to the point, was bad all the time. And while the customer was rather disturbed about this last point, it was the best news I had had so far — if, in fact, it was true.

A little while later, when he ushered me into his lounge room and switched the set on I knew he was right; the set was, as he described it, ". . . smoky all the time." More correctly, it had all the symptoms of a sick picture tube; low contrast and poor brightness such as occurs when a tube's emission drops.

Which was all very well except for one very important point; I have known picture tubes to have a wide

variety of intermittent faults but I have never seen one with intermittent low emission. Granted the tube was some six or seven years old, but my reaction when I had first inspected the set was that the tube was in first class condition.

Yet it was now fairly obvious that it had been going through cycles of apparent low emission over a period of several months.

As I removed the back of the set I decided that, if the tube itself was not faulty, the most likely culprit would be the heater supply. Sure enough, a glance into the neck of the tube suggested that the heater was working at well below normal brilliance.

This set has a small printed board sub-assembly on the end of the picture tube. The tube socket is mounted directly on the board which also carries various components associated with the tube elements, and serves as a terminal point for the supply lines to the tube.

I connected the multimeter across the two heater leads where they joined the board and was rather surprised to find a healthy 6.4V. Since this didn't tally with my observation of the heater, I took a closer look at the printed board assembly. The lugs from the tube socket pass through holes in the board and are bent over onto their respective copper tracks and soldered.

Working very gently, I placed the test prods directly on the two filament lugs of the socket. It was a different story here; barely 3V for the poor old heater. Small wonder the tube looked sick.

Closer inspection with a glass revealed a hairline crack in the soldered connection between one of the lugs and the copper pattern. I resoldered this, and all the other socket connections to be on the safe side.

Naturally, the set came good immediately, and it was then simply a matter of tidying up. The customer was quite elated when he realised that I really had found the trouble, but no more than I was.

That was many weeks ago, and a couple of checks with the customer since then have confirmed that, ". . . it hasn't missed a beat." And so everything ended happily. Even if I didn't make a lot of money out of the exercise I now have a customer who is a walking advertisment for my business.

This story could well end there, having sufficient technical novelty to stand on its own feet. But I feel that there is a lot more to be learned from it than the simple technical fact that caused the trouble.

First, where did the other serviceman go wrong? While it might not be fair to be too critical of his actions, since I have not heard his side of the story, the fact remains that he elected to opt out when he was not making any progress.

Regardless of his technical competence, it seems that he lacked patience; an essential requirement in tracking down intermittents. And this applies not only to serviceman, but also the customer, and the serviceman must be able to inspire sufficient confidence in his ability to solve the problem to ensure this patience.

This isn't always easy. After all, the customer is experiencing the frustration of trying to use an unreliable set; of having it fail half way through his favourite program or even being denied it altogether. While not always practical, the best approach is to provide a spare set for the customer and keep his on your own bench as long as necessary.

Alternatively, try to take advantage of any holiday break the customer may be planning. In the story just related, a golden opportunity was missed because the customer had left before I realised there was still a problem.

The monetary cost to the customer must also be considered. Charging a full service call fee for each visit, even though no fault is evident and no work is done, is the surest way to destroy the customer's confidence and patience.

But the most important lesson to be learned is how easy it is to be caught, and two aspects of the story illustrate this. First, I was in fact caught by finding a completely different fault which produced similar symptoms and being led to believe that it was the one in question. Only my insistence that the customer call me if the fault returned saved me on that one.

Second, I could have been so easily caught by the behaviour of the picture tube. Had my introduction to the set been at a time when the fault was evident, and had I not known — or had overlooked — the history of intermittent behaviour, I would have almost certainly diagnosed a faulty picture tube. Nor would there have been anything unreasonable about such a diagnosis, considering its age.

Had I done so I would have been faced with the embarrassing situation of involving the customer in a very expensive repair, only to find that the fault was just as much in evidence as ever. It doesn't take many mistakes like that to put a nasty dent in one's reputation.

In short, it is not sufficient to be technically competent, though this is essential. One must also be able to establish a rapport with the customer and gain his confidence, be able to sort out the genuine symptoms from the red herrings the customer will invariably produce, and be astute enough to give them all their due consideration before reaching a conclusion. And dare I add that you sometimes need an element of luck?

If you feel that such a list of requirements is too demanding then I'm afraid service work is not for you.

Circuit & Design Ideas

Conducted by Ian Pogson

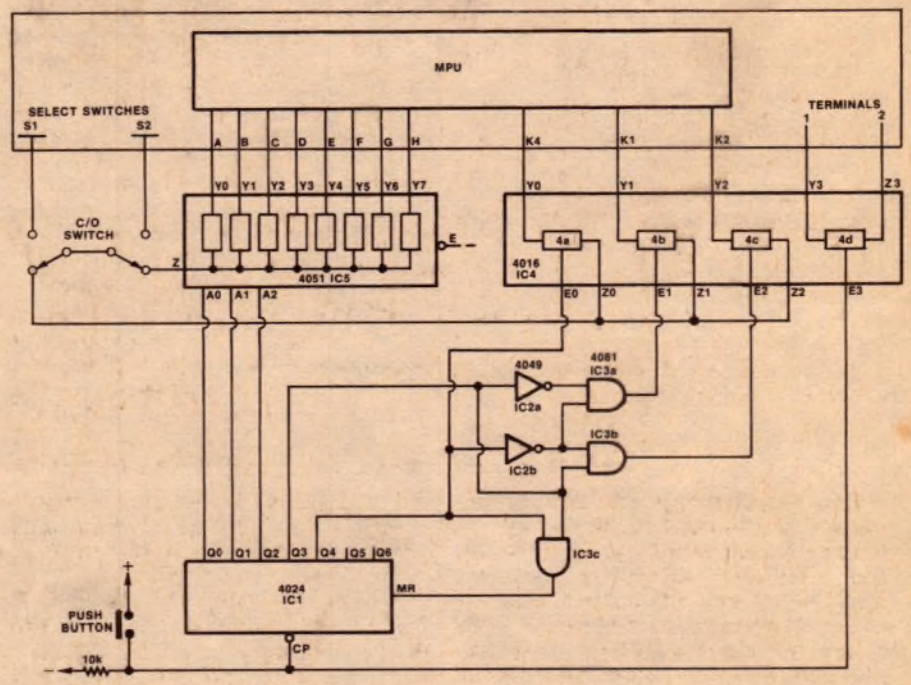
Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Automatic stepping for Chroma-Chime door chimes

To increase the novelty of the Chroma Chimes as described in April 1978, the option of playing a different tune automatically each time the button is pressed has been added. The suggested modification provides an alternative to the "tune select bridge" formed by S1 and S2. The operation of an additional switch bypasses S1 and S2 and the bridge is now formed by a 1 of 8 and a 1 of 3 bilateral switch in series. These bilateral switches are operated sequentially to count 1 to 24 by the outputs of a binary counter. The counter is stepped one each time the button is pressed.

The logic circuit required for the auto-stepping facility is provided by a printed circuit board assembly about 75mm x 75mm. The board is mounted on the rear dust cover of the Chroma Chimes in the space provided by mounting the chimes on rubber feet. The changeover switch is mounted on the chimes case. Interconnection between S1 and S2 contacts and new PCB is made by wiring directly onto the chimes IC socket pins. The track connecting the S1 and S2 wipers is cut in the middle and both halves wired to the changeover switch.

The circuit description is as follows: With push button contacts closed, IC4d switch places a loop across chimes terminals 1 and 2, the chimes hunts for the S1, S2 loop and then plays. With push button contacts open, loop removed from terminals 1 and 2, counter IC1 steps one and moves the tune select loop to the next position. The chimes continue to play until the end of the tune. The bilateral switches of IC5 and IC4 are turned on sequentially as the counter steps, IC5 steps for each step of counter while IC4 steps on the 9th, 17th and 25th steps. On the 25th step the output of AND gate IC3c goes high and resets the counter to position 1.



The power supply may be from the same or a separate battery to the chimes because IC4d acts as an interpose relay. Ideally, the circuits would be supplied from a common 15V battery. This is sufficient voltage for the chimes and the maximum specified for the additional ICs.

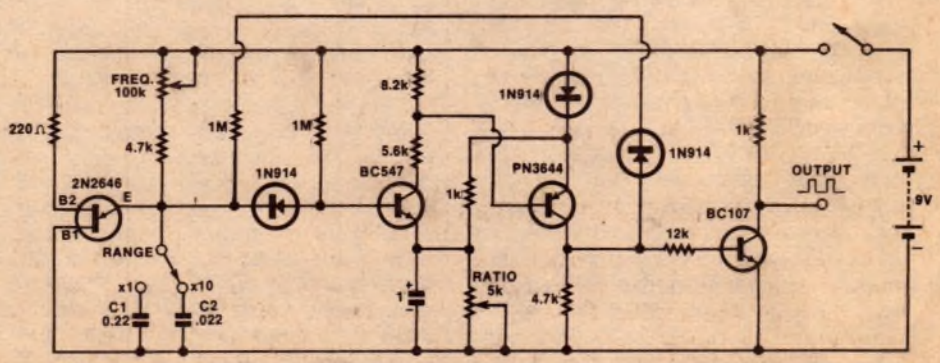
(By Mr W. N. Paddison, 10/2 Kardella Court, Condell Park, NSW 2200.)

Pulse generator with variable frequency and mark-space ratio

This circuit is based on a design from the GE Transistor Manual. The frequency ranges from about 60Hz to 1kHz with C1 in circuit and about 600Hz to 10kHz with C2 in circuit. The mark-space ratio is variable over a very wide range. The output is a train of pulses with an amplitude of 9V P-P.

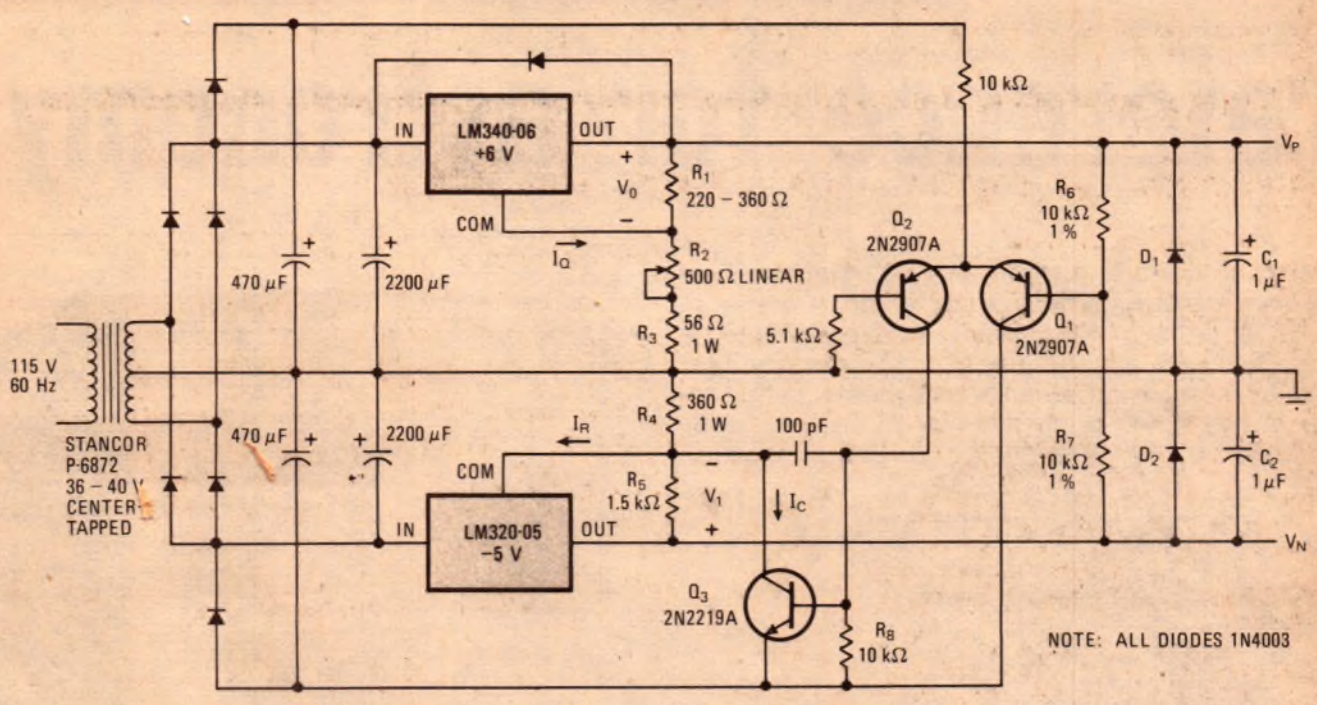
The UJT is used as a conventional relaxation oscillator. A positive voltage swing is produced at the collector of the PN3644 when the UJT emitter voltage is more positive than the BC547 emitter voltage, as determined by the setting of the ratio potentiometer.

The loading of the relaxation oscillator by the transistors is compensated by feeding current from the PN3644 collector to the emitter of the UJT. This makes the pulse frequency independent of the ratio control setting. The output of the PN3644 is inverted by the BC107 which operates as a saturated switch.



(By Mr P. Heggie, 2/2a Boonong Avenue, Seaford South, Victoria 3201.)

Fixed-voltage regulator pair forms bipolar power supply



Two fixed-voltage regulators and suitable feedback circuitry can form a bipolar power supply that combines the excellent voltage regulation, trackability, and high current capacity of the three-terminal integrated circuit voltage regulator with the voltage adjustability of more expensive supplies. This unit provides bipolar voltage from 8 to 20V at 1A. The trackability, defined for an adjustable power supply as the voltage difference remaining between the bipolar ports at the desired output voltage, is 1%. Regulation for both line and load is about 100mV.

The diagram shows the regulated supply that employs two popular three-terminal regulators and a three-transistor feedback circuit. Approximately 40V across the centre-tapped transformer secondary is rectified and filtered to generate plus and minus 27V to the input of the respective regulators.

The LM320-05, which is a -5V regulator, and transistors Q1 to Q3 form a slaved configuration. A differential amplifier composed of transistors Q1 and Q2 monitors the difference in magnitude between Vp and Vn through a precision voltage divider R6 and R7 and compares it to a zero reference. Normally, the voltage at this junction is zero, because Vp = —Vn. Any error voltage is amplified to cause a change in the collector current of Q3, which in turn changes the voltage across R4 and consequently Vn.

The high output current that can be produced by the supply generates several points where power generation dissipation is great. Components must be selected to ensure that those levels can be adequately handled. The maximum current through Q3 is 78mA. The maximum power consumption is about 500mW. The 2N2219A transistor is used for this application. Both regulators should be mounted on suitable heat sinks. Resistor R3 prevents excessive current through R2 when its value is low.

Heavy common-mode loads may cause difficulty in the operation of the feedback network during start-up unless diodes D1 and D2 are used to clamp the circuit outputs. C1 and C2 are tantalum capacitors for improved transient response.

(By S. K. Wong, in "Electronics".)

Aerial pruning made easy

When erecting dipoles, a bit of pruning is usually necessary to bring the system into resonance at the selected portion of the band. It can be quite a task if the antenna is cut too short.

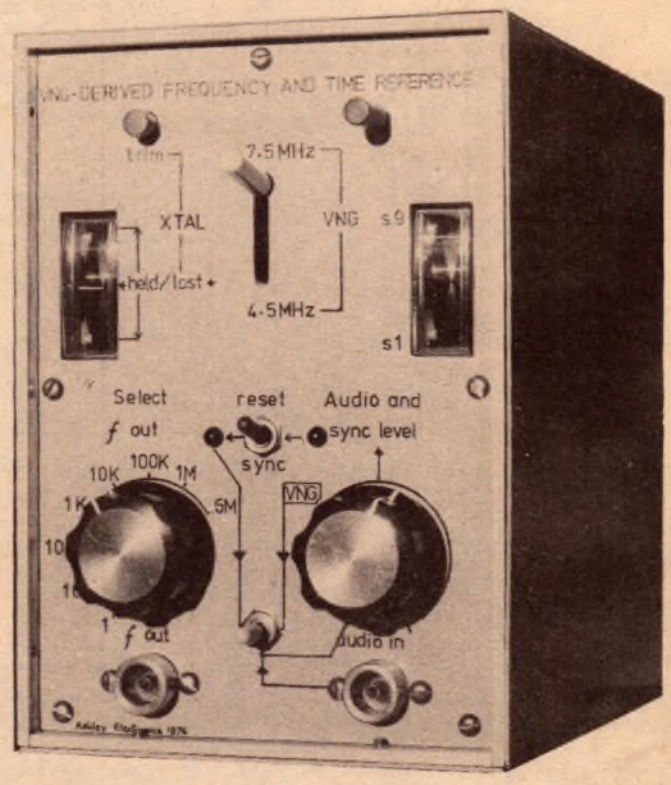
A method that I use is to cut the antenna slightly short of the calculated length and then solder on an additional length of about 12 gauge copper wire at each end, making the total length a little longer than the calculated figure. It then comes a simple matter to prune a little at a time until the antenna is precisely where you want it. Usually the added wire is found to be between one and five inches long and it is self supporting.

(By Bill Tucker, W4FXE, in "QST".)

Adapting the VNG-derived reference for astronomy

Using as a starting point the VNG-Derived Frequency Reference design published in our April 1975 issue, two of our readers have produced a modified reference unit specifically designed for use as a time reference for astronomy. In this article they give brief details of the way they modified the original design for this purpose.

by DR B. ASHLEY and M. ASHLEY



A double conversion receiver and the ability to receive VNG on 4.5MHz and 7.5MHz are features of the new unit. Reference frequencies are available in decades from 1Hz to 1MHz, and also at 6MHz.

When the Derived Frequency Reference from VNG first appeared in April, 1975, it was greeted enthusiastically in our household. For the first time it seemed that it would be possible to determine easily which oscillator circuits were drifting and in which direction. One member of the family, with interests in astronomy, envisaged for himself a source of precision time signals. Further discussion introduced the idea of reference frequencies in addition to the 1.5MHz of the design, and from there it was a small step to decide that it would not be difficult to provide an audible 1Hz pulse to take the place of VNG when the latter faded into inaudibility. Often at the critical astronomical moment!

The instrument which we have produced has the following features: (a) It receives VNG on 4.5MHz or 7.5MHz at the flick of a switch. (b) The receiver has been modified to a double conversion type in which the second IF of 455kHz is fed to a ceramic filter. This greatly improves the selectivity and makes VNG listenable more often than before.

(c) A small audio amplifier and loudspeaker have been added primarily to make listening more convenient (d) VNG-derived reference frequencies, in decades from 1Hz to 1MHz, and also 6MHz, are selectable by switching at DC levels. (e) Simulated VNG pulses, including the five modified tones and the silent interval before each minute, are generated and may be fed to the audio amplifier instead of the real VNG, or used for precision starting and stopping of suitable digital timers.

(f) VNG-derived reference frequencies and simulated VNG tones are synchronised initially with VNG and remain precisely in step so long as the crystal is controlled by VNG. The error incurred during periods when control is lost is that due to the 6MHz crystal and its associated oscillator circuit. Although it accumulates, it is negligible unless reception is very poor, and resynchronisation can be regained at any time when the signal returns.

(g) The instrument may be transferred from mains to battery power and vice versa without interrupting reception or accuracy.

Some of the circuit changes and additions used to realise the above will now be described.

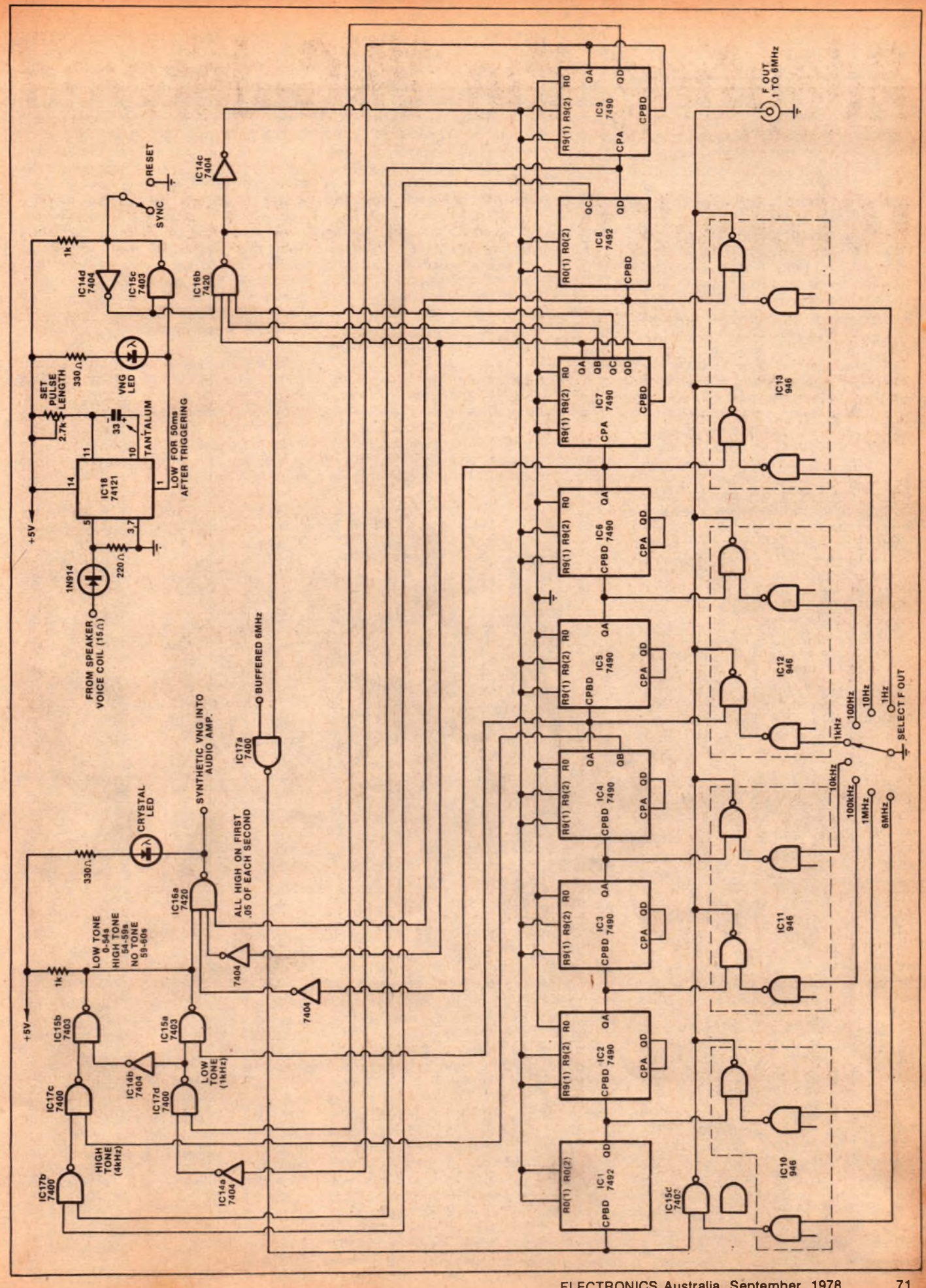
Front end overload on very strong signals was countered crudely but effectively by incorporating a switchable resistive "crowbar" from aerial to earth.

Switch selection of either 4.5MHz or 7.5MHz was included as suggested in the article. It has been a valuable feature since there are now few occasions when a usable signal is not available. Coil turns were increased to 19 which allowed both channels to be peaked by 5-40pF trimmers without having to use large values of additional parallel capacitance.

Selectivity could not be improved significantly by the addition of more IF transformers or stages. The double conversion solution finally used is appealing because it combines excellent performance with simplicity of circuit, and ease of modification of the original circuit.

It is worth noting that the purpose of the double conversion is to improve the audio reception. Coincidentally, AGC is made more specific for VNG but there is no direct effect on crystal control because this is still derived from the

The circuit diagram (facing page) shows most of the relevant parts as referred to in the text. The receiver section has been omitted to save space. It is similar to that originally given in the April, 1975 issue, with the exception of the modifications described.


RESET
SYNC
IC14c 7404
IC14d 7404
IC15c 7403
IC16b 7420
1k
SET PULSE LENGTH
2.7k
330Ω
VNG LED
33µ
TANTALUM
IC18 74121
LOW FOR 50ms AFTER TRIGGERING
+5V
220Ω
1N914
FROM SPEAKER VOICE COIL (15Ω)
BUFFERED 6MHz
IC17a 7400
SYNTHETIC VNG INTO AUDIO AMP.
CRYSTAL LED
ALL HIGH ON FIRST .05 OF EACH SECOND
IC16a 7420
LOW TONE 0-54s
HIGH TONE 54-59s
NO TONE 59-60s
IC15b 7403
IC15a 7403
IC14b 7404
IC17c 7400
IC17d 7400
LOW TONE (1kHz)
HIGH TONE (4kHz)
IC17b 7400
IC14a 7404
IC9 7490
IC8 7492
IC7 7490
IC6 7490
IC5 7490
IC4 7490
IC3 7490
IC2 7490
IC1 7492
IC15d 7402
IC13 946
IC12 946
IC11 946
IC10 946
F OUT 1 TO 6MHz
1Hz
10Hz
100Hz
1kHz
10kHz
100kHz
1MHz
6MHz
SELECT F OUT

VNG frequency reference

1.5MHz of the first IF. In practice, once locked to VNG the LM1351 circuitry is able to maintain crystal frequency even when VNG is almost inaudible and even when there is powerful adjacent channel interference.

The double conversion stage is placed electrically between TR4 and TR5. It takes its input signal from the emitter of TR4 and feeds its output into the base of TR5. The input 1.5MHz first IF signal is converted to the second IF of 455kHz by means of a self-oscillating mixer, as used in the AM/FM tuner described in September, 1975. The coil is a standard Jabel type 7348 tuned to 1955kHz with the slug, and fine tuned with a concentric trimmer forming part of the tuning capacitance. This has been brought out to the front panel as adjustments are necessary to accommodate oscillator drift.

The new IF is then fed into a 455kHz ceramic filter and the output from this goes to the original audio detector. A small value of coupling capacitance on the ceramic filter gives a bandpass which is adequately narrow.

The increased number of TTL devices and the desire to operate from a car battery led to a higher voltage, higher current transformer being installed and to the use of IC regulators for the +5V and +12V supplies. A diode in series with the battery inlet serves to protect the power supply and regulators from mistakes in battery polarity connection. Although 0.7V is lost across the diode, its inclusion is prudent. Current drain is about 0.53A and the circuit operates happily from the car battery and down to 12V input even though the regulator is not functioning properly.

The 6MHz crystal oscillations can reach the dividers only through a NAND gate. This gate is enabled by a VNG pip as follows. VNG pips are amplified by the audio amplifier and fed not only to the speaker but also to the Schmitt trigger input of a 74121 monostable IC. When pips of sufficient amplitude are available the monostable is triggered and produces an active low pulse with a nominal duration of 60mS. These pulses are made visible by a front panel LED connected to the monostable output. In practice the amplifier volume is increased until the LED is lighting reliably on each VNG pip.

The divider chain is conventional except that two ICs are connected as BCD counters for reasons associated with the simulation of VNG pulses, and that the decade dividers are reset to 9. The 6MHz from the crystal is first divided by 6 by a 7492 IC to yield 1MHz. It is then passed through five divide by 10 stages consisting of 7490s connected as symmetrical dividers, which gives a 10Hz symmetrical square wave. This is then fed into a 7490 connected as a BCD counter. The Qd output of the 7490 is thus a 1Hz asymmetrical square wave, high for 0.2S and low for 0.8S.

The method of switching the reference frequencies produced by the divider chain uses the wired-OR configuration described by Waddington in his design for a digital meter in "Wireless World" for March, April and May, 1973. Although it may appear an extravagant use of ICs it avoids having to route square waves at these frequencies to and from switches. We used DTL946s for all except the 6MHz signals. Open collector type 7403s could also be used with a pull-up resistor on the output line, and would give better performance on the higher frequencies.

When making astronomical observations it is often necessary to have a reliable and reasonably accurate source of time signals, to within about .05S. The synthesised VNG incorporated in this instrument can be synchronised to the VNG time signal hours before it is required, thus ensuring a reliable source of time signals during periods when VNG is inaudible. It is also possible to start the synthesised time signal manually so that relative time intervals can be obtained when it is not possible to synchronise the device to VNG. These relative times can then be converted to absolute time by comparing the synthesised signal with VNG at a later time

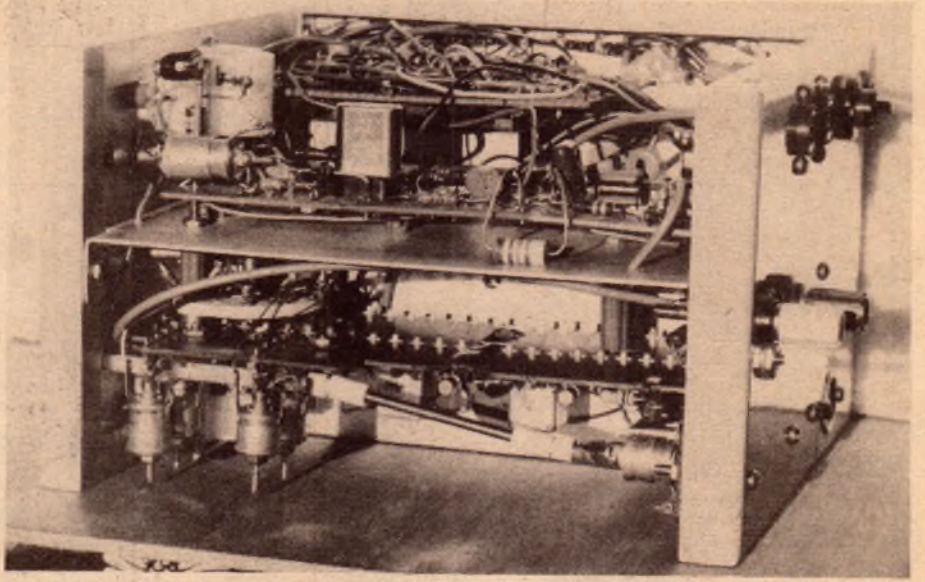
The synthesised signal sounds quite similar to that from VNG. It would be possible to make the zero second of each minute longer, or of a different tone from the other pips but it is not easy and the added complication was deemed unnecessary.

The continuous tones present on the output of the open collector NAND gates are converted into .05S pulses with their leading edges at the beginning of each second. The length of the burst can be increased or decreased by appropriately changing the inputs of the relevant IC. In practice we found that 0.1S bursts were too long and that .05S bursts were just about right.

The .05S pulse output is then used to drive a LED as a visual indication of the time bursts. We mounted this LED close to the LED on the output of the monostable so that very small errors in synchronisation can be detected. Note that the length of the monostable pulses should be slightly longer than that of the VNG pulses, otherwise double triggering will occur, which could be undesirable for some purposes although it will not affect synchronisation.

1Hz pulses are available on the front panel for synchronising digital stopwatches and other devices, to the synthesised time signal.

Obviously our modifications could again be considerably modified to take advantage of more modern components and to reduce power consumption. It would also look a lot better inside if we had used new miniature components instead of some of the bulky and ancient ones and by using a PC board for the dividers.



View inside the completed frequency reference. The unit may be powered from the mains, or by a +12 battery.

Editorial note: The article as originally submitted by the authors has been considerably abridged because of space considerations. Also unfortunately, we have had to omit part of the circuit diagram. However, the authors have kindly agreed to furnish further information to interested readers. Requests for a copy of the circuit and possibly a one or two page photocopy of some extra explanatory notes, should be accompanied by a self-addressed envelope and two stamps. They should be addressed to Dr B. Ashley, 25 Melrose Drive, Mawson, ACT 2607.

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2μA suspension movement — 0.05mA/1mV resolution.
Double protection — fuse & Si diode.
Constant 1MΩ input impedance (ACV) — RF-diode rectified current direct to movement.

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44μA meter movement — Si diode protection against pulse input.
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Performs as low resistance ohmmeter besides insulation tester.
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(N-501)
● ±DCV 0-60m 0-0.3-1.2-3-12-30 0-120-300-1.2k-30k (w/HV probe) ● ±DCA 0-2μ 0-0.03-0.3-1.2-3-12-30m 0-0.12-0.3-1.2-12A ● ACV 0-3-12-30-120-300-1.2k ±2.5% Freq. 20Hz to 50kHz ● ACA 0-1.2-12 ● Ω ×1-×10-×100-×1k-×10k-×100k (max. 200M) Batt. 1.5V ×1 & 9V ×1 ● dB −20 to +63

(AX-303TR)
● ±DCV 0-0.3-3-12-30-120-300-1200 ● ACV 0-6-30-120-300-1200 ● ±DCV 0-60μ-3m-30m-0.3-12 ● Ω ×1-×10-×1k-×10k (max. 20M)

(U-60D)
● DCV 0-0.1-0.5-2.5-10-50-250-1k-25k (w/HV probe) ● DCA 0-50μ-2.5-50-500m ● ACV 0-2.5-10-50-250-1k ● Ω ×1-×10-×100-×1k (max. 5M)

(BX-505)
● ±DCV 0-0.12-3-12-30-120-300-1200-30k (w/HV probe) ● ±DCA 0-30μ-3m-30m-0.3-12 ● ACV 0-6-30-120-300-1200 ● ACA 0-12 ● Ω ×1-×10-×1k-×10k (max. 20M)

(CAM-250D)
● ACA 6-30-60-300 ● ACV 300-600 ● kΩ 0-50k ● Batt. 1.5V×1

(PDM-500/C)
● V/Ω rated 500V/100M ● Scale range 0-0.1-100-200M (1st effective scale range underlined) ● Ω 0-100Ω ● Power source AM or UM-2×3

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sanwa

Simple, economical design has 10M input impedance:

Sensitive FET-input AC-DC voltmeter

While the average multimeter is adequate for routine measurements, its sensitivity and lack of bandwidth can be a severe limitation in measuring many of today's circuits. The simple instrument presented here is an answer to that problem. It uses one FET-input op amp IC and a handful of other components.

Most electronic hobbyists have access to some sort of multimeter and typically it will have a sensitivity of 20,000 ohms/volt on DC voltage ranges and 10,000 ohms/volt on AC voltage ranges. While this can be adequate for most routine testing, most multimeters are quite inadequate for measuring low AC and DC voltages in high impedance circuits.

For example, if a multimeter has a 1V range and its sensitivity is 20,000 ohms/volt, this means it will load the circuit being measured with 20,000 ohms. In many circuits, a load of this magnitude would prevent circuit operation. To put it another way, the impedance of the circuit being measured would have to be 2000 ohms or less for the act of measurement to have slight effect.

Active voltmeters, such as the one presented here, are designed to overcome this problem of sensitivity. Commonly, an active voltmeter for general purpose use is designed to have an input impedance of 10 megohms. More precisely, it will have an input resistance of 10 megohms shunted by capacitance of about 10 to 30 picofarads.

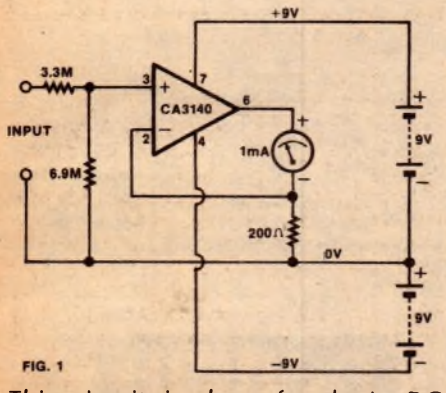

FIG. 1

This circuit is that of a basic DC voltmeter. The input impedance is determined by the input resistors.

The input impedance remains constant, regardless of the range selected and whether AC or DC is being measured.

Our active voltmeter presented here is a FET-input operational amplifier IC voltmeter, but since that is quite a mouthful we shall refer to it as a FET voltmeter. The heart of the circuit is a CA3140 IC which, as might be gathered from the above, is an operational amplifier with FET input stages.

In comparison with common op-amps like the 741, the CA3140 is very similar except that some specifications, such as slewing rate, are enhanced. In fact, the CA3140 is a direct drop-in replacement for the 741 op-amp in most applications.

The greatest dissimilarity between these two devices is with regard to the input currents. Whereas a 741 has a typical input bias current of just under 100 nanoamps at room temperature, the equivalent figure for a CA3140 is 10 pico-amps. In other words, the MOSFET input stages of the CA3140 draw 10,000 times less current than the 741 input stages. So it is much easier to obtain high input impedances with the CA3140.

Referring to the complete circuit, the CA3140 is connected in a configuration which may look similar to a unity-gain voltage-follower, but is really a voltage-to-current converter with a meter movement and associated components in the feedback loop. Fig. 1 shows a simplified version of the circuit.

Before describing the operation of the circuit of Fig 1, perhaps a brief rundown on operational amplifiers is appropriate. Op amps have two inputs known as the inverting input and the non-inverting input. These are so-named because, when a signal is applied, the output signal is in phase with the non-inverting input and 180 degrees out-of-phase with the inverting input.

The two inputs are, in fact, differential inputs and the output is a product of the difference in signal applied to the two inputs, multiplied by the gain. The gain figure is extremely high, a figure of 200,000 being typical. In practical circuits, most of this gain is traded for desired performance characteristics by applying negative feedback.

The circuit of Fig. 1 has balanced positive and negative 9V supply rails, provided by two batteries. The non-inverting input of the CA3140 (pin 3) is biased from the zero volt line (ie, the common connection of the two batteries) via the input voltage divider. Since negligible current flows, pin 3 is very close to OV when no external input signal is applied.

At the same time, the inverting input (pin 2) is biased from the output via the negative feedback network.

Now when connected in this fashion, an op-amp always operates to bring its two inputs close together in potential, ie, zero potential difference. This means that if the non-inverting input is set at OV, the inverting input must also rest at OV. And since negligible input bias current flows from the output to this latter input, then the output must also rest very close to OV.

So, with no signal applied, both inputs and the output of the CA3140 rest very close to OV. This means that no current flows through the meter movement (not enough to shift the pointer off the rest, anyway).

Now imagine that a positive voltage of 300mV is applied to the input of the circuit. This is reduced, via the voltage divider, to approximately 200mV which is applied to the non-inverting input of the CA3140. The CA3140 operates via the feedback mechanism described above to raise the inverting input to the same potential of 200mV.

This means that 200mV is applied across the 200 ohm resistor connected from the inverting input to the OV line. As a result one

by LEO SIMPSON and DAVID EDWARDS

milliamp flows through the resistor and that same current (which is supplied from the output of the op amp) flows through the meter, causing the pointer to deflect full scale.

The circuit can be used to measure AC voltages by a small modification. If an AC voltage of 300mV RMS is applied to the circuit input, the voltage divider will act as before and apply 200mV RMS to the non-inverting input. This means that 200mV RMS is applied across the 200 ohm resistor, and an alternating current of one milliamp RMS flows through the resistor and the meter movement.

Ordinarily a meter movement would not indicate this current, but when connected within a bridge rectifier it will show the current. And even though the input voltage to the op-amp is quite low, the voltage losses and non-linearities of the bridge rectifier tend to be cancelled by virtue of it being within the feedback loop.

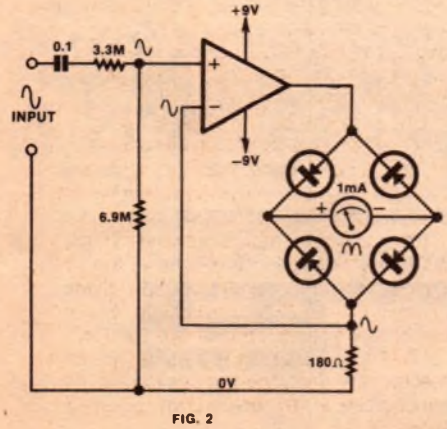

FIG. 2

Compare this circuit with that of Fig. 1, to see how an AC range is added to the basic DC meter.

This does not overcome all the problems of reading the value of an AC waveform. AC voltmeters are normally required to indicate the RMS value of a sine wave signal. However, moving coil meter movements respond to the average value of their driving current. The average value of a sine wave voltage (or current) is very close to 90% of its RMS value. Accordingly, for our op-amp circuit to read sine wave signals correctly, the value of the current sink resistor must be reduced by 10 per cent, to 180 ohms. Fig 2. shows how the basic circuit has been modified to read AC signals. The addition of the capacitor at the input of the circuit prevents it from responding to DC signals.

Referring back to the complete circuit diagram, we can now discuss the input voltage divider. This has the desirable feature of providing voltage ranges which increase in 10dB steps, arranged by making the ratio between consecutive ranges is close approximation to the square root of ten, 3.1622 . . . As you can see this has been achieved using preferred value resistors and without the need for parallel combinations. The total divider adds up to just over 10 megohms.

Six voltage ranges are provided, with FSD values of 316mV, 1V, 3.16V, 10V, 31.6V and 100V. The voltage divider is frequency compensated with capacitors shunting each resistor in the divider. The idea behind this is "swamp out" the effects of the input capacitance of the op-amp (typically several picofarads) and the stray capacitance of the input switch and associated wiring.

To this end, the highest value resistor in the divider chain is shunted with a 47pF capacitor. The capacitors shunting consecutive divider resistors increase by the same proportion (3.16) as the ratio between consecutive ranges. The total effective capacitance of the capacitors shunting the divider string (not including the 3.3M resistor) is 36 picofarads which gives a time-constant for the divider of 248 microseconds.

To nullify the severe high-frequency roll-off effect that this time constant would otherwise have, the 3.3M input resistor is bypassed with a parallel combination of a 68pF capacitor and 10-pF trimmer. This enables the AC performance of the circuit to be optimised for flat respnse to beyond 100kHz.

A few other aspects of the circuit remain to be discussed. The 10k resistors in series with the two inputs of the op amp, together with protection diodes on the chip itself,

PARTS LIST

1 plastic case with aluminium lid, 197 x 60 x 112mm
1 screen-printed and punched control panel
1 meter movement, 1mA FSD, to suit case
1 PCB, 78mv8, 87 x 74mm
1 2-pole, 6-position rotary switch
1 4-pole, 2-position toggle switch
1 2-pole, 2-position toggle switch
2 Eveready 216 9V batteries plus connectors
2 banana jack sockets, one red, one black
1 knob

SEMICONDUCTORS
1 CA3140 FET-input op amp
4 OA91 or similar germanium diodes

CAPACITORS
2 x 100uF/16VW PC electrolytic
1 x 0.1uF/600VW polycarbonate
3 x 0.1uF polyester or ceramic
1 x .01uF polyester
1 x .0047uF polyester or polystyrene
1 x .0015uF polyester or polystyrene
1 x 470pF polystyrene
1 x 150pF polystyrene
1 x 47pF polystyrene
1 x 68pF polystyrene
1 10-40pF ceramic trimmer (Stettner)

RESISTORS
(¼ or ½W, 5% tolerance, unless otherwise specified)
1 x 4.7M/1W, 1 x 3.3M/1W, 1 x 1.5M, 1 x 470k, 1 x 150k, 1 x 47k, 4 x 22k, 2 x 10k, 1 x 1k, 1 x 220 ohms, 1 x 150 ohms, 2 x 8.2 ohms, 1 x 10k trimpot, 1 x 470 ohms trimpot

MISCELLANEOUS
4 rubber feet
12 PC pins
Aluminium battery bracket, hook-up wire, tinned copper wire (22 B&S or thicker), shielded cable, solder.

Note: Capacitors and resistors with higher ratings may be used if physically compatible. Where capacitor voltage ratings are not quoted, the rating is unimportant.

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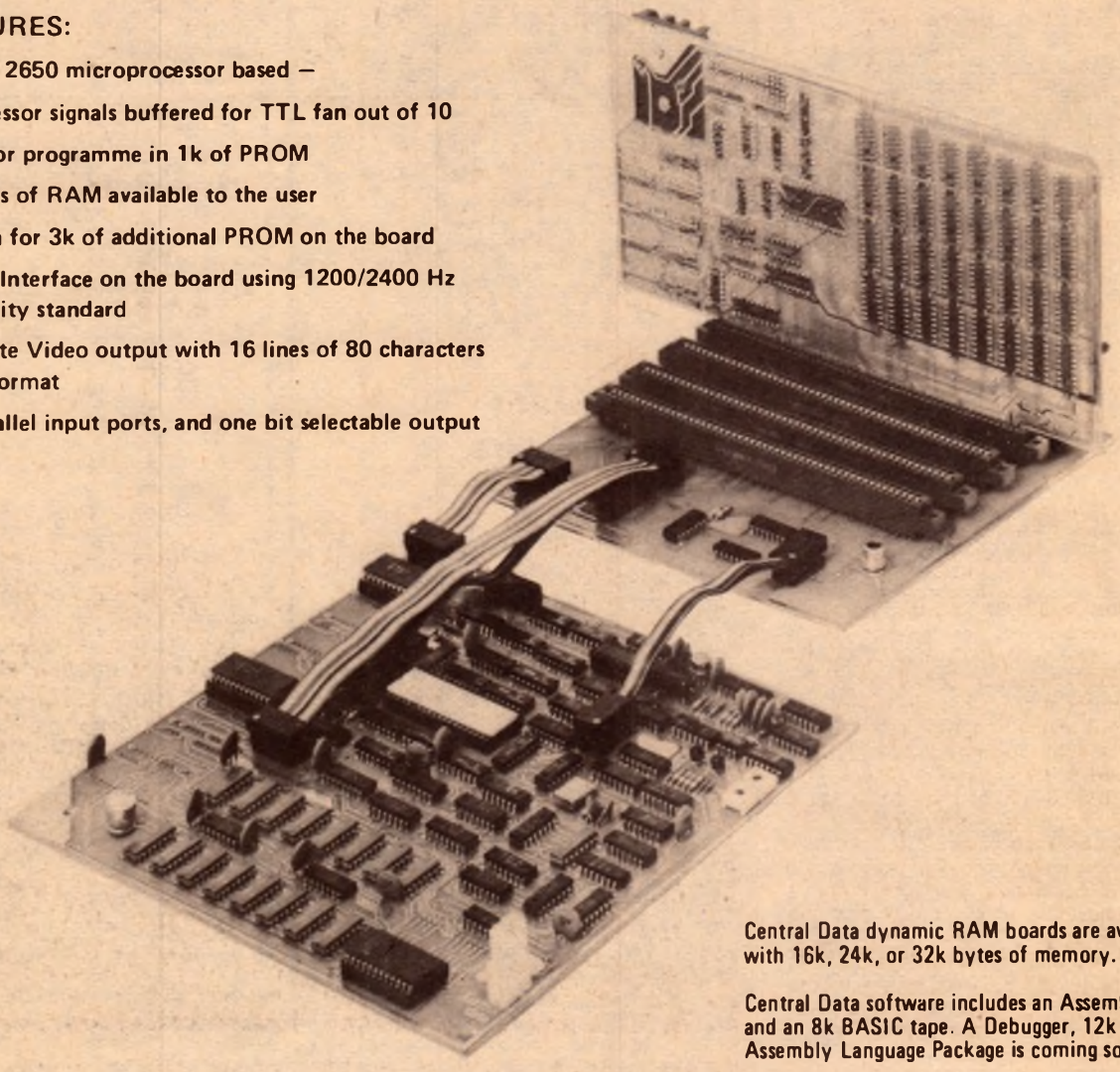

The Central Data System Board CDYSBDA facilitates the writing of programmes in Hexademical with only the addition of a TV monitor, ASCII Keyboard and power supply.

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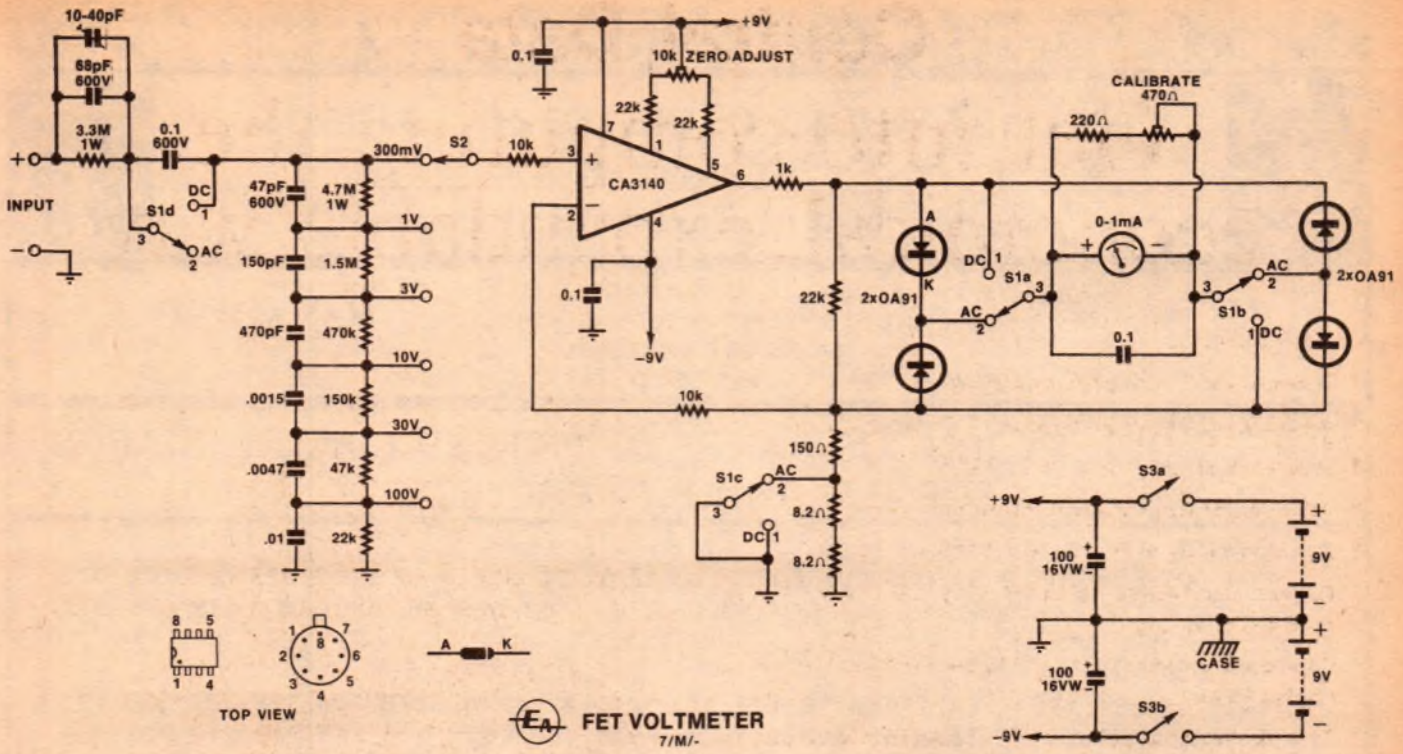


ABOVE: The complete circuit of the new voltmeter. Compare it with Figs. 1 and 2.

protect the MOSFET input transistors against excessive input voltages. The 1k resistor in series with the output of the op-amp gives a degree of protection to the meter movement. The 22k resistor in the output circuit shunts the bridge diodes and assures that some current flows in the feedback network when no signal is applied. This resistor and the 0.1uF capacitor shucting the meter assure stability of the circuit.

The 220 ohm resistor and 470 ohm trimpot across the meter provide a range of adjustment for calibration. The current drawn by this adjustable shunt means that the current sink resistors have to be reduced in comparison to those shown in Figs. 1 and 2.

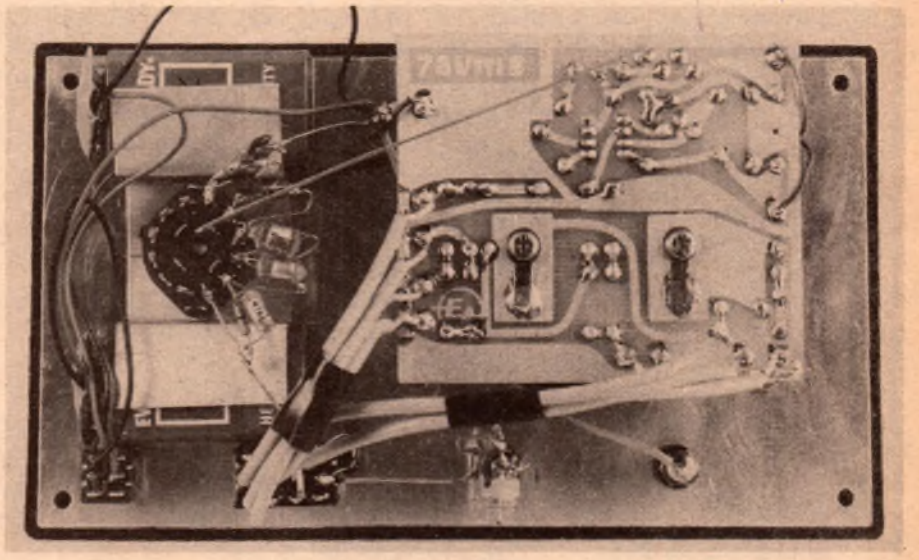
Other features: the resistive network between pins 1 and 5 provide for a range of offset adjustment. The output offset voltage shows up as a small deflection of the meter. This network allows the meter to be zeroed.

To assure low supply impedance over the whole bandwidth of the instrument the batteries are bypassed with 100uF electrolytic capacitors and 0.1uF ceramic or polyester capacitors.

Input impedance of the instrument is 10 megohms shunted by approximately 27pF. Bandwidth is from less than 10Hz to beyond 300kHz at the minus 3dB points.

Our prototype was housed in a plastic box measuring 197 x 60 x 112mm (W x H x D) and available from most parts suppliers. Most of the components, with the exception of the voltage divider and switches, are accommodated on a PC board measuring 87 x 74mm, coded 78vm 8. The PCB mounts on the rear of the meter movement and is secured by the meter terminal screws.

For a high impedance circuit such as this it is essential that the PCB has the highest possible insulation resistance. Preferably



All components, including the meter movement, are fitted directly to the front panel.

FET VOLTMETER

the PCB should be made of fibreglass but in any case, check it on the highest range of your ohm meter. The insulation resistance between two adjacent tracks of the PCB should be several hundred megohms or more.

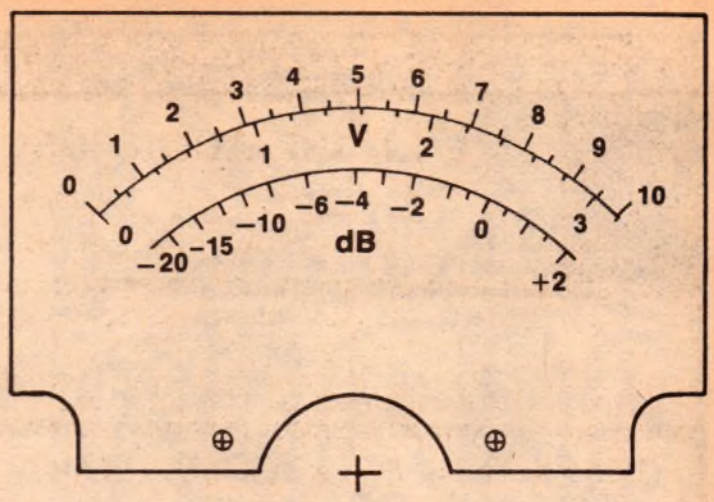
Assembly can begin with the front panel hardware. The dress panel of the prototype was made from photosensitive aluminium, as was the meter scale. We hope that commercial panels will be available in due course but if not constructors can still make their own using Letraset. We have published the artwork as a guide.

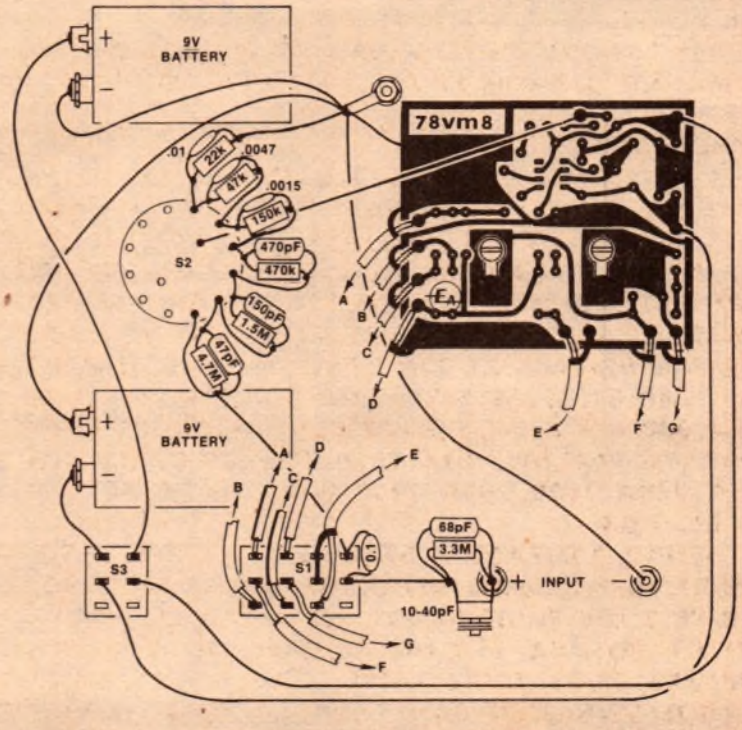
The two nine volt batteries are held with a clamp made from a piece of aluminium approximately 90 x 40mm. It is held in place by the range selector switch. The voltage divider resistors and capacitors are wired directly to the range switch. The rest of the input components are suspended from the positive input terminal and AC/DC switch. The wiring diagram shows the details.

Ideally, the input voltage divider should use close tolerance components. We used a mixture of 1 per cent and 5 per cent resistors and 10 per cent capacitors, but still managed to obtain overall accuracy within ±2% at full-scale deflection on all ranges.

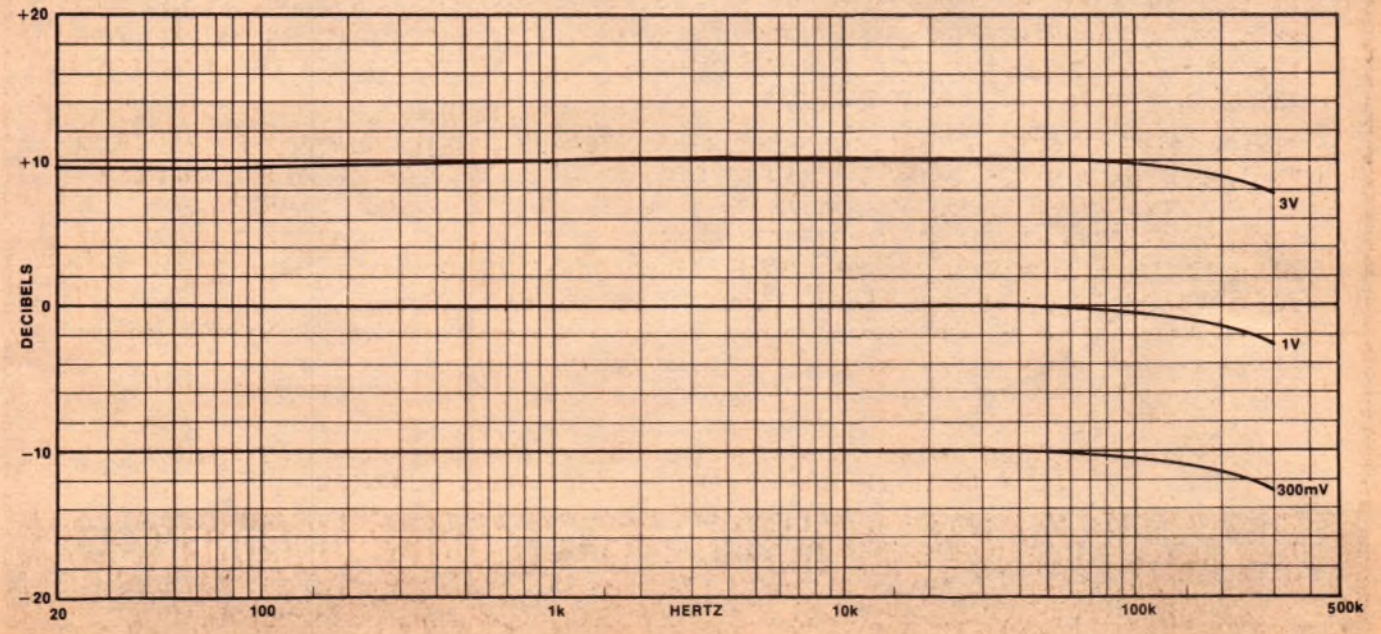
The meter we used was a one-milliamp movement measuring 100 x 82mm, available from Dick Smith Electronics. It requires a panel cutout 60mm in diameter.

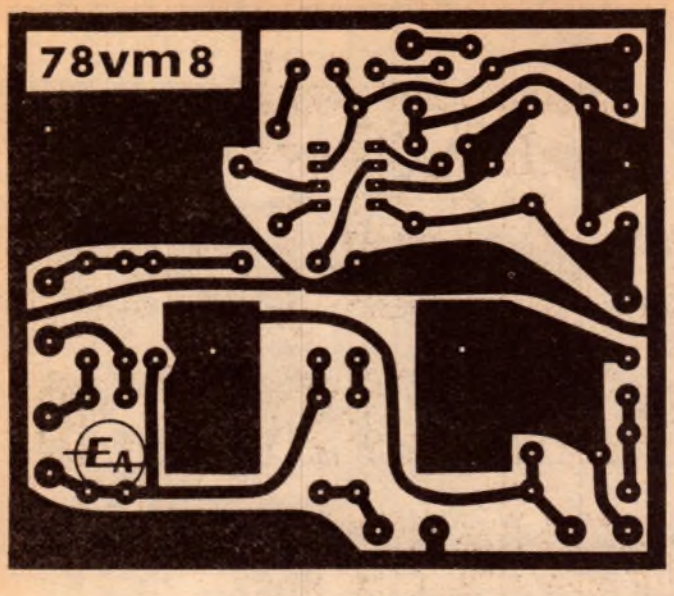
The front panel must be connected to the centre-tap of the battery supply. Use a solder lug secured by one of the meter mounting screws.

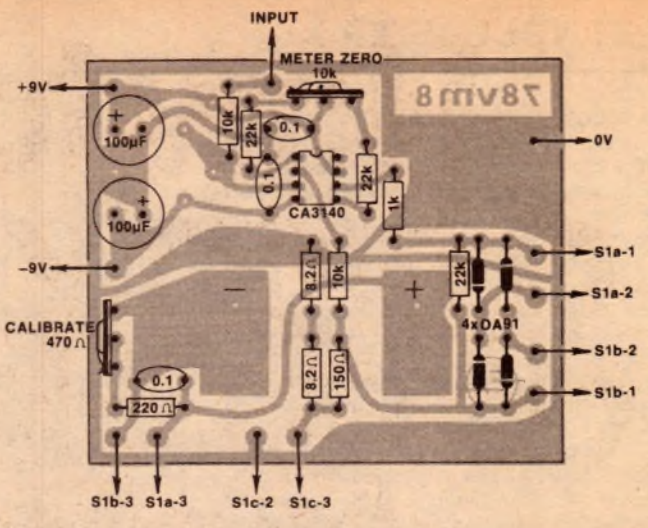




At the top is a full size reproduction of the meter scale. Use the wiring diagram at the right to wire the range switch and to complete the remaining wiring. The frequency response curves for the three lowest ranges are shown below.







The PCB pattern to the left is actual size. The overlay diagram is reproduced above.

With the front panel wiring virtually complete, the PCB can be assembled.

Depending on the manufacturer, the CA3140 op-amp will be supplied in a TO-5 package with leads either in a circular pattern or formed to fit a dual in-line (Minidip) socket. If yours has the leads in a circular pattern they will have to be bent to fit the PCB. The IC should be pushed down so that it is as close as possible to the PCB. This is to provide clearance between the IC package and the meter housing. For the same reason, several of the capacitors will have to be laid flat.

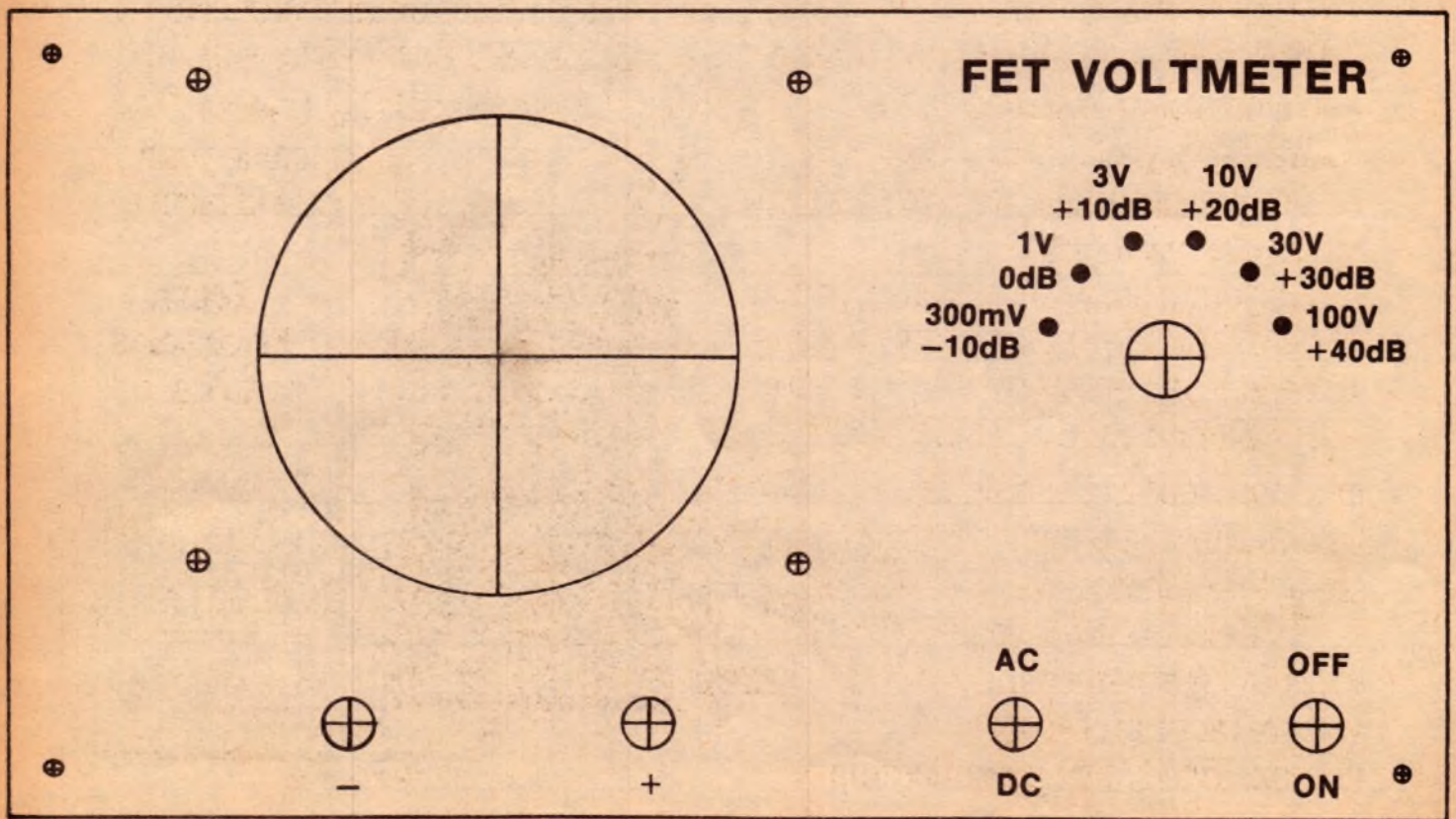
The front panel artwork is reproduced actual size below, and can be copied or used directly.

The PCB is secured to the meter housing by the terminal screws. Put a solder lug under each screw and solder it to the PCB pattern. Use PCB pins for the interconnections. The shielded cables have their shields terminated at the perimeter of the PCB, with all but one left unconnected at the AC/DC switch to avoid earth loops. The wire connecting the range selector to the PCB is a length of tinned copper wire straightened and bent to suit.

With wiring complete, the unit should be double-checked before it is turned on and calibration performed. Before turning on, check that the meter indicates zero. If not, adjust the meter screw. Now turn on and check that the meter again reads zero. This check should be done with the AC/DC switch set at DC. Adjust the offset trimpot if necessary.

The meter can be calibrated with a multimeter of known accuracy, if you have access to one. A digital instrument would be ideal. Just connect the two meters in parallel with a suitable voltage source. With the DC ranges calibrated, the AC ranges should also be correct, within the tolerance of the components used in the feedback network.

The frequency compensation trimmer capacitor can be adjusted with the aid of an audio oscillator with a flat response to 300kHz or so. If such an instrument is not available. adjust the trimmer for about 70 per cent of its capacitance setting.



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Software routines for your ultra-low cost VDU

In this second article describing his ultra-low cost video display for microprocessors using the software-driven DMA technique, the author presents some software routines for its use. These demonstrate the flexibility of software control compared with hardware, and also serve to provide the display with facilities similar to those of a conventional video terminal.

by DAVID L. CRAIG 134 Victor Street, Holland Park, Queensland

Owing to space limitations, the PC board patterns and wiring diagram were held over from last month and are shown in this article. Using these diagrams you should be able to produce a PC board for the VDU and also wire it up easily. Note that the board is designed to connect to Motorola CPU boards using the 6800 microprocessor, as explained last month, although it should be capable of being connected to a variety of other CPUs.

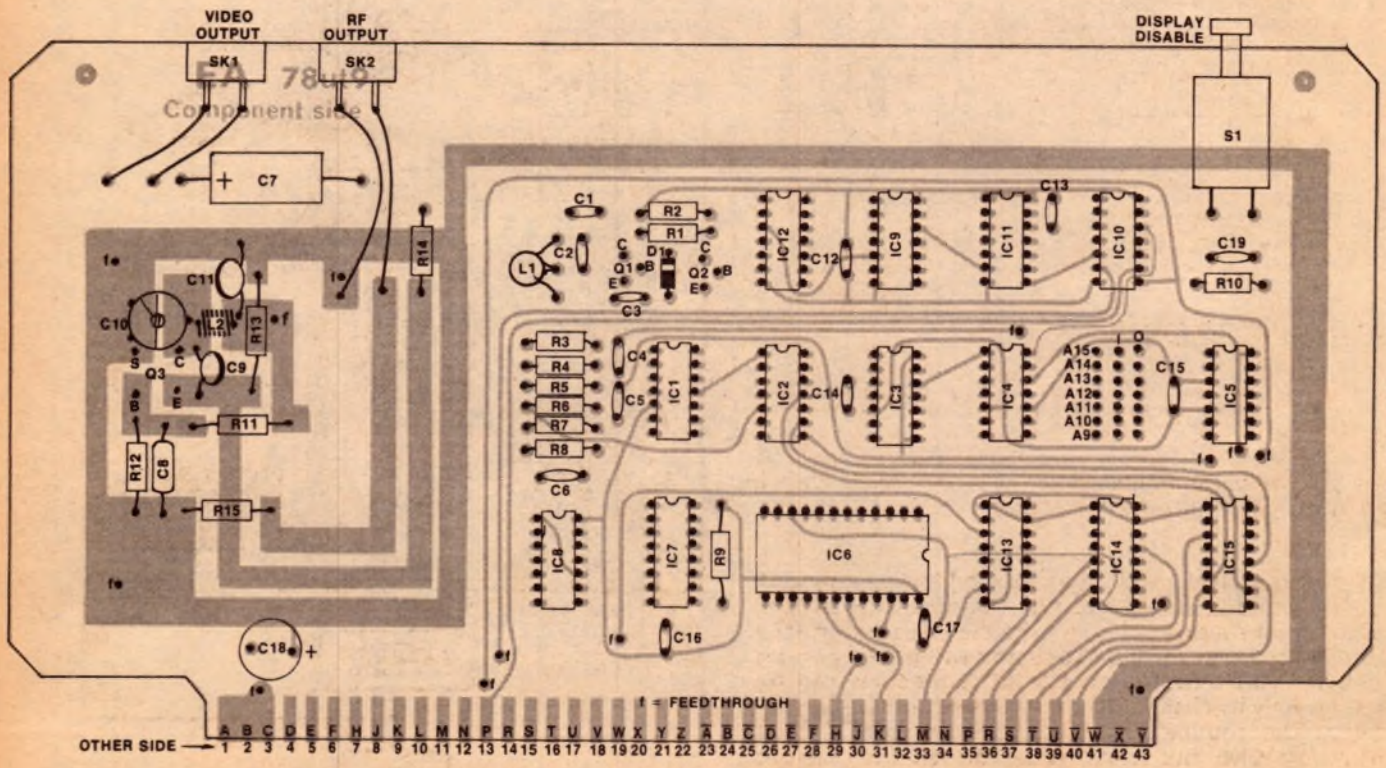
Once construction is complete, the VDU can be used immediately, simply by addressing the required display memory location and changing the contents to the ASCII code for the character to be displayed. This can be done using the "Memory Change" function of the microprocessor system monitor ROM, or by having a user program store data at the location. Where random changes to the display are required, e.g., in video games, this method is probably best.

However, where changes to the data displayed are to be made in some fixed format, it is more efficient to use a program subroutine to control the output of data and to keep track of the address of the next location to be sent data. An important example is the serial output of data to a teletype or a conventional VDU.

To demonstrate the flexibility of using software to control the output of data to the display, a subroutine which allows the display to simulate the operation of a conventional VDU is presented below. This is useful not only as an example of the flexibility of the VDU, but because many programs a user may acquire are written to output data to a teletype or a conventional VDU (which merely simulates a teletype printer).

Programs written to work with a teletype generally use a subroutine to control the output of characters to the printer. For example, programs written for Motorola 6800 systems using MIKBUG or MINIBUG monitor ROMs generally output a character by loading the A accumulator with the ASCII code for the character, and then jumping or branching to a subroutine called OUTCH in the monitor ROM which actually outputs the character to the teletype.

The subroutine presented here, called VIDEOP, replaces the MIKBUG or MINIBUG OUTCH routine when this



The wiring diagram for the PCB of the VDU. Use it with the circuit given last month.

'VIDEOP' SUBROUTINE LISTING

Subroutine to output an ASCII character to the VDU

```
00F2          TEMP1   RMB 2              Temp.pointer storage
00F4          TEMP2   RMB 2              Temp.pointer storage
00F6          TEMP3   RMB 2              Temp.pointer storage
00F8  --00    VIDPTR  EQU VDSTRT         Video display pointer
00FA  --00    VDSTRT  EQU $--00          Display buffer start address
00FC  --00    VIDEND  EQU VDSTRT + $0200 Display buffer end address +1
00FE  --20    VIDLI2  EQU VDSTRT + $0020 Start address 2nd display line

0144  36      VIDEOP  PSHA               Save accumulators
0145  37              PSHB
0146  DE FC           LDX VIDEND
0148  DF F6           STX TEMP3
014A  DE F8           LDX VIDPTR         Load display pointer
014C  8A 80           ORAA #$80          Normalize left most ASCII bit
014E  85 60           BITA #$60          Test for control character
0150  27 21           BEQ CCHAR          Go to control char. routine
0152  8D 19           BSR OPCHAR         Output character

0154  9C FC   PAGEND  CPX VIDEND         Test for end of page
0156  26 0C           BNE CURSOP         Output cursor
0158  DE FA           LDX VDSTRT
015A  DF F4           STX TEMP2
015C  DE FE           LDX VIDLI2
015E  8D 40           BSR MCOPY          Shift display up 1 line
0160  DE F4           LDX TEMP2          Clear last line and set
0162  8D 4F           BSR VIDBLK         pointer to start of last line

0164  DE F8   CURSOP  LDX VIDPTR         Output ASCII underline
0166  C6 DF           LDAB #$DF          as cursor
0168  E7 00           STAB 0,X

016A  33      VIDRET  PULB               Restore accumulators and
0168  32              PULA               return
016C  39              RTS

016D  A7 00   OPCHAR  STAA 0,X           Store character
016F  08              INX                Update pointer
0170  DF F8           STX VIDPTR
0172  39              RTS

0173  81 8D  CCHAR    CMPA #$8D          Test for carriage return
0175  26 0C           BNE NOTCR
0177  86 A0           LDAA #$A0          ASCII space
0179  C6 1F           LDAB #$1F          Mask to test for new line
017B  8D F0   CCHARI  BSR OPCHAR
017D  D5 F9           BITB VIDPTR + 1    Test for new line
017F  26 FA           BNE CCHARI
0181  20 D1           BRA PAGEND         Test for end of page
0183  81 88   NOTCR   CMPA #$88          Test for backspace
0185  26 0D           BNE NOTBS
0187  9C FA           CPX VDSTRT         Ignore BS if pointer is at
0189  27 DF           BEQ VIDRET         start of buffer
018B  86 A0           LDAA #$A0          ASCII space
018D  A7 00           STAA 0,X           Store space
018F  09              DEX                Update pointer
0190  DF F8           STX VIDPTR
0192  20 D0           BRA CURSOP         Output cursor

0194  81 8C   NOTBS   CMPA #$8C          Test for form feed
0196  26 D2           BNE VIDRET         Ignore input
0198  86 A0           LDAA #$A0          ASCII space
019A  DE FA           LDX VDSTRT         Clear display and set
019C  8D 15           BSR VIDBLK         pointer to start
019E  20 C4           BRA CURSOP         Output cursor

01A0  A6 00   MCOPY   LDAA 0,X           General purpose subroutine
01A2  08              INX                for copying a block of
01A3  DF F2           STX TEMP1          data from one set of
01A5  DE F4           LDX TEMP2          memory locations to another
01A7  A7 00           STAA 0,X
01A9  08              INX
01AA  DF F4           STX TEMP2
01AC  DE F2           LDX TEMP1
01AE  9C F6           CPX TEMP3
01B0  26 EE           BNE MCOPY
01B2  39              RTS

01B3  DF F8   VIDBLK  STX VIDPTR
01B5  86 A0           LDAA #$A0

01B7  A7 00   MCONST  STAA 0,X           General purpose subroutine
01B9  08              INX                for storing a constant
01BA  9C F6           CPX TEMP3          in a block of memory
01BC  26 F9           BNE MCONST
01BE  39              RTS
```

Here are the author's listings of the VDU service routines, with a flowchart for the main routine.

VDU is used. The ASCII representation for the character to be output is loaded into the A accumulator and the VIDEOP subroutine called to write the character into the display. In this way existing programs written for use with systems with MIKBUG or MINIBUG monitors can be used simply by changing the output subroutine jump address. The routine described below is written for a Motorola 6800, but could readily be rewritten for use with other CPUs.

'OPHEX' SUBROUTINE LISTING

Subroutine to output a data byte to the VDU as 2 hex characters followed by 2 spaces

```
011A  37      OPHEX   PSHB               Save accumulator B
011B  8D 1D           BSR MDIS2          Separate 2 hex characters
011D  8D 0F           BSR HEXASC         Convert hex to ASCII
011F  8D 23           BSR VIDEOP         Output MS hex character
0121  17              TBA
0122  8D 0A           BSR HEXASC
0124  8D 1E           BSR VIDEOP         Output LS hex character
0126  86 A0           LDAA #$A0          ASCII space
0128  8D 1A           BSR VIDEOP         Output 2 spaces
012A  8D 18           BSR VIDEOP
012C  33              PULB               Restore accumulator B
012D  39              RTS
012E  81 0A   HEXASC  CMPA #$0A          Test hex value for number
0130  2B 05           BMI NUMBR          or alpha
0132  80 09           SUBA #$09          convert alpha to ASCII
0134  8A C0           ORAA #$C0
0136  39              RTS
0137  8A B0   NUMBR   ORAA #$B0          Convert number to ASCII
0139  39              RTS

013A  16      MDIS2   TAB                Move low half word
013B  C4 0F           ANDB #$0F          of A to B, and high
013D  84 F0           ANDA #$F0          half word of A to
013F  44              LSRA               low half word of A
0140  44              LSRA
0141  44              LSRA
0142  44              LSRA
0143  39              RTS
```

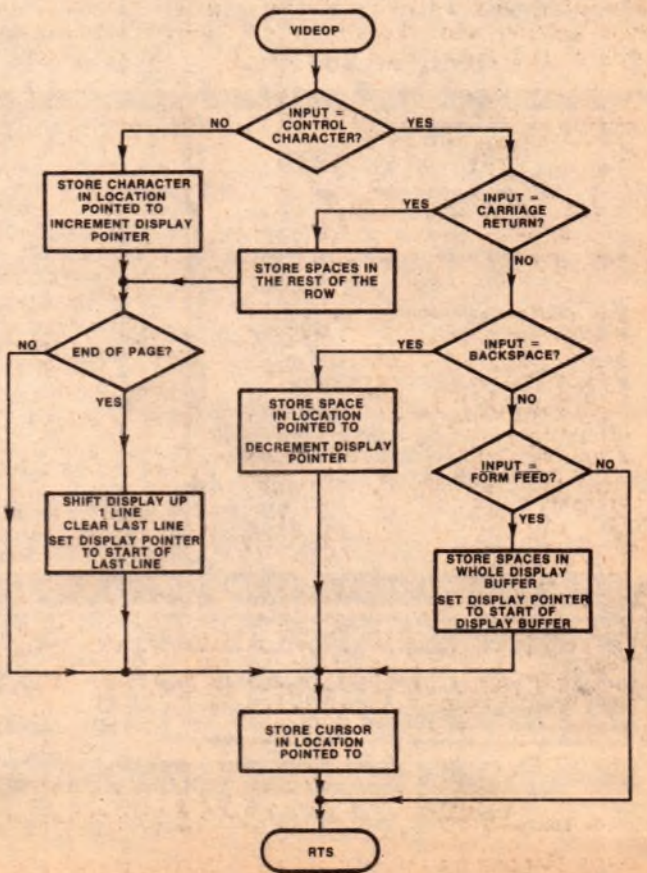
'OPSTRG' AND 'OPXSTG' SUBROUTINE LISTINGS

Subroutine to output string of ASCII data to VDU

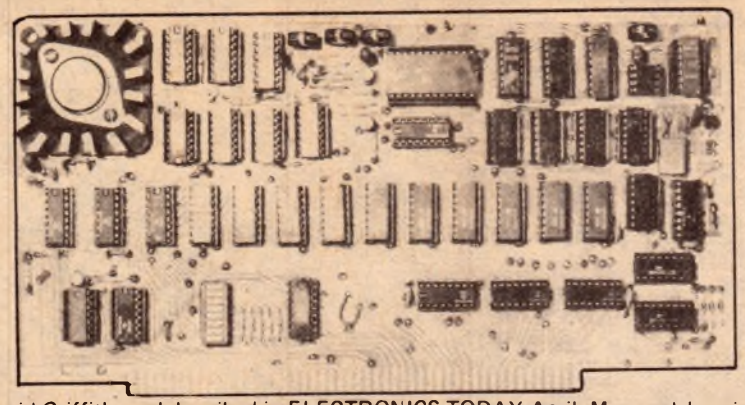
```
00F0          STRING  RMB 2              Temp. string pointer storage

0100  DF F0   OPSTRG  STX STRING         Save pointer
0102  A6 00           LDAA 0,X           Load data
0104  8D 3E           BSR VIDEOP         Output data in ASCII
0106  DE F0           LDX STRING         Recover pointer
0108  08              INX                Update pointer
0109  5A              DECB
010A  26 F4           BNE OPSTRG         All bytes output?
010C  39              RTS
```

Subroutine to output string of data bytes in hex to VDU

```
010D  DF F0   OPXSTG  STX STRING
010F  A6 00           LDAA 0,X
0111  8D 07           BSR OPHEX          Output data in hex
0113  DE F0           LDX STRING
0115  08              INX
0116  5A              DECB
0117  26 F4           BNE OPXSTG
0119  39              RTS
```



DG 640 SOFTWARE CONTROLLED VDU



This superb design by David Griffiths and described in ELECTRONICS TODAY April, May, and June issues is possibly one of the most useful peripherals you can add to any microprocessor system.

Conforming to the hobby computer standard S100 bus, the DG640 is software controlled to produce

16 lines of 64 characters
Upper and Lower case
Black on white reversed characters
Flashing characters
Chunky graphics
Direct RAM access

We are pleased to offer our EXCLUSIVE DG640 OWNERS MANUAL which expands the original ETI articles and covers such things as; step-by-step assembly, setting up and troubleshooting procedures typical waveforms, address decoding and software examples for use with 2650, 6800, 8080, Z80 microprocessors.

ATTENTION 2650 USERS: Ian Binnie has written a special operating system called "BINBUG" which is specifically designed to operate with the DG640 VDU and emulate "PIPBUG" thus ensuring that all software in the 2650 USERS GROUP is fully compatible and no I/O changes need be made. BINBUG is documented in the DG640 users manual and occupies 1K of RAM. Cassette tapes and a preprogrammed 2708 EPROM are available on request.

We are proud of the quality of the DG640 which uses a top grade plated through fibreglass PCB, reflow solder tinned and hard gold plated edge connectors. All components are prime quality and sockets are provided for all RAMS and the character ROM. The DG640 is not a beginners project but will suit even the most demanding microprocessor enthusiast. Each kit is backed by our famous technical support and warranty service (full details with each kit).

DG640 KIT COMPLETE WITH MANUAL **$140 (tax paid)** **$126 (tax exempt)**

DG640 PCB with manual **$35 (tax paid)** **$31.50 (tax exempt)**

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BINBUG IN PREPROGRAMMED EPROM **$25.00**

2650 SYSTEMS

EA2650 expandable to 4K as described in E.A. May and using the latest 2114 4K RAMS an ideal beginners project. We supply all parts except case and transformer (suitable cases and transformers available separately).

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KT9500 FULLY BUFFERED CPU

This popular kit enables you to expand your 2650 system to a fully buffered system with 2 8 bit bidirectional I/O ports, RS232 interface, TTy interface and on board clock.

. . . . . **$199.00**

NEW E.A. VIDEO DISPLAY TERMINAL

Described in E.A. Feb/April 1978 this is an ideal serial terminal for microprocessor applications. It is not software controlled like the DG640 and is ideal for beginners who need only a serial interface to the computer.

KIT 1: VDU LOGIC BOARD complete with all components, plated through PCB, assembly and troubleshooting manual **$99.50**

KIT 2: ENCODER/UART/78UT4 complete kit with all components and instructions but without transformers (see Kit 5 option) **$39.50**

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Each time the subroutine is called, the data in the A accumulator is stored into the next location in the display memory buffer. The subroutine maintains a pointer (VIDPTR), pointing to the next location in which data will be stored. An on-screen cursor displays this location. The cursor consists of an underline character stored in the display buffer where the next character will be written.

As characters are output to the buffer, the pointer is incremented by the subroutine. This results in an automatic carriage return/line feed (CR/LF) at the end of each display line. At the end of the display page, the display is scrolled up 1 line, the last line cleared, and the cursor pointed to the beginning of the last line. The contents of the first line are destroyed. Scrolling occurs each time the last line is filled, so that the previous 15 lines entered are always visible.

Three non-printing control characters are recognized by the subroutine. All others are ignored. Those recognized are Carriage Return (CR), Backspace (BS) and Form Feed (FF). They produce the following results:

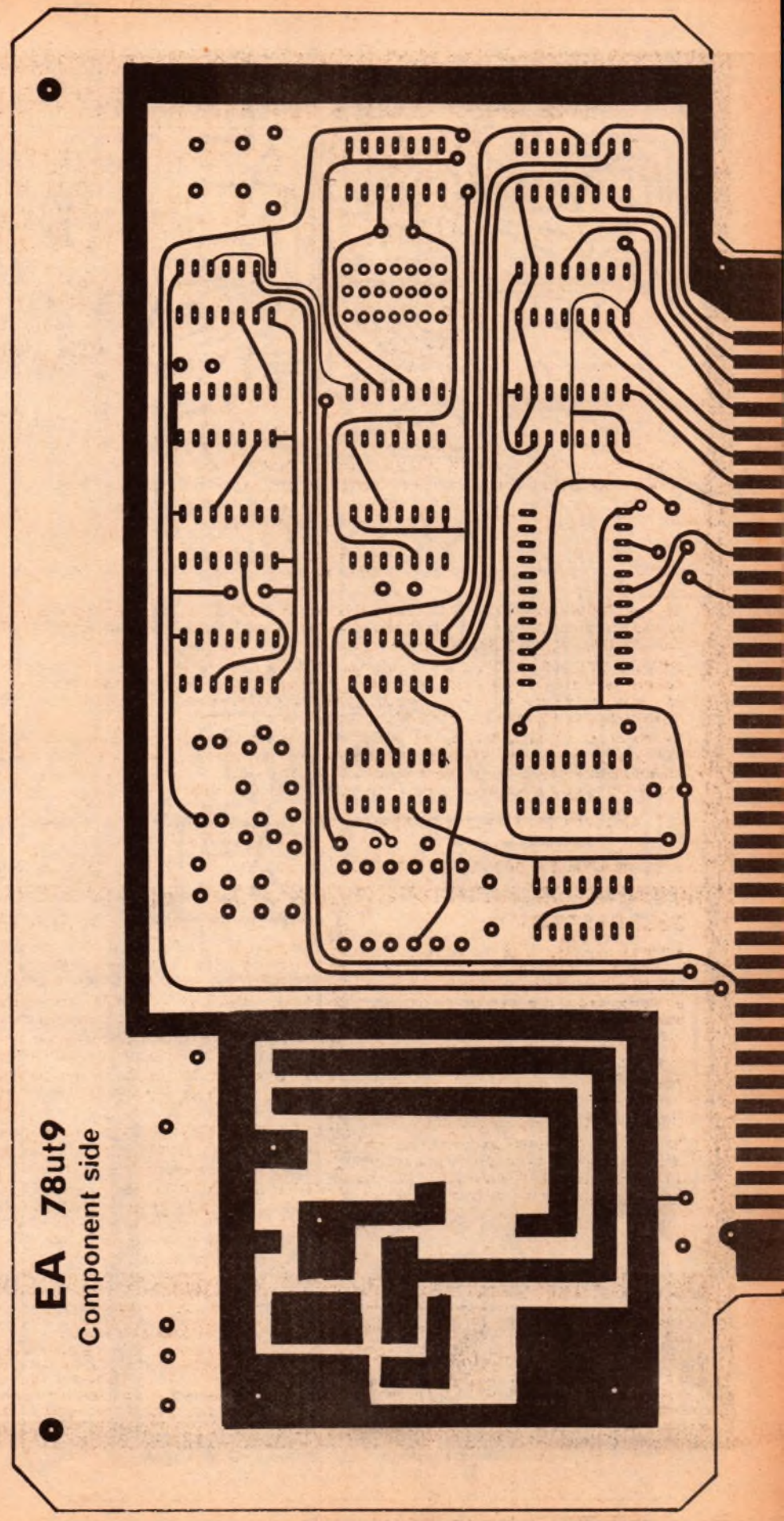
- CR (ASCII $0D) causes a combined CR/LF function, leaving the cursor pointing at the start of the next line.
- BS (ASCII $08) causes a destructive backspace, leaving the cursor pointing at the previous location.
- FF (ASCII $0C) clears the display and returns the cursor to the top of the display.

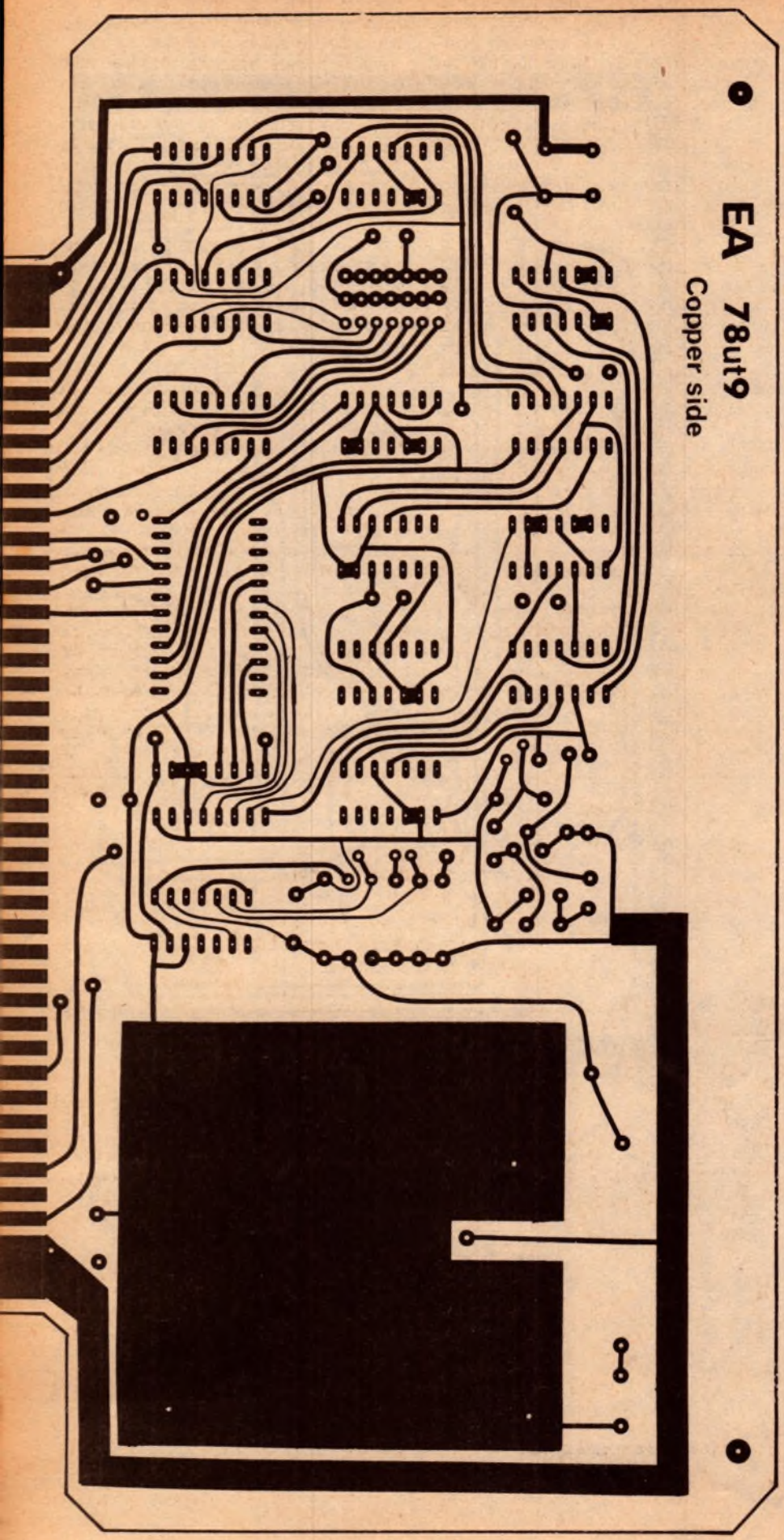
It should be noted that although only 6 bit ASCII codes are used by the VDU hardware to display characters, the full 7 bit ASCII must be output to the VIDEOP subroutine via the A accumulator to allow recognition of the control characters. The eighth bit (leftmost) may be either 0 or 1.

Operation of the subroutine should readily be understood by examining the flowchart. A full listing of the subroutine is also given. The subroutine itself requires 123 memory locations and is relocatable, i.e., it can be loaded into any 123 consecutive memory locations without any alteration. The addresses given are simply for reference. In addition, 14 memory location are required for data. These are fixed at $00F2 — $00FF, and are not relocatable unless all references to these locations in the subroutine are changed. The entry and exit conditions for the subroutine are as follows:

- entry — accumulator A contains the 7 bit ASCII code for character to be output
- exit — accumulators A and B unchanged, index register X entry value destroyed.

At right is the actual-size pattern for the component side of the PCB. That for the copper side is shown overleaf.





LOW COST VDU

As will have been seen from the above description, using the VDU with VIDEOP provides a display device with all the facilities of a conventional VDU. If more facilities are required, e.g., if more text editing facilities are required, or additional control characters need to be recognized, it is a fairly simple matter to modify the subroutine to incorporate the changes.

Within the VIDEOP subroutine itself are two general purpose and very useful subroutines called MCOPY and MCONST.

MCOPY can be used to copy a block of data of any length from one area of memory to another. The entry conditions are:

X = FROM start address
TEMP2 = TO start address
TEMP3 = FROM end address + 1

The exit conditions are:

A = entry value destroyed
X = TEMP1 = FROM end address + 1
TEMP2 = TO end address + 1
TEMP3 = unchanged

A point to watch with this subroutine is that if the FROM and TO address ranges overlap, the routine can only be used if the TO start address is less than the FROM start address.

MCONST is a subroutine which will store a constant value into a consecutive block of memory locations of any size. The entry conditions are:

A = constant to be stored
X = start address
TEMP3 = end address + 1

The exit conditions are:

A = unchanged
X = end address + 1
TEMP3 = unchanged

The MCONST and MCOPY subroutines can be used on their own to manipulate data for the display. For example, MCOPY can be used to save a page of display for later use by copying the display buffer to another 512 word block of memory. MCOPY can then be used to reload the display with the same page at a later time. MCONST can be used to clear, or to load the one character into, a number of lines or the whole display.

Also included in the listing are three other useful subroutines which extend the power of the VIDEOP subroutine. These are OPHEX, OPSTRG, and OPXSTG.

These are very simple subroutines which should be easily followed directly from the listing. No flowchart is given. They occupy 68 bytes and can be relocated without change provided they stay in the same position relative to VIDEOP. Two fixed data bytes are also required.

OPHEX is a subroutine to output a

data byte to the VDU as 2 hexadecimal characters followed by 2 spaces. The entry condition is:

A = data byte to be output

and the exit conditions are:

A, X = entry values destroyed

OPSTRG is a subroutine to output to the VDU a string of up to 256 ASCII characters stored in consecutive memory locations. The entry conditions are:

B = No. of characters in string
X = start address of string

and the exit conditions are

A, B, X = entry values destroyed

OPXSTG is a subroutine to output to the VDU a string of data bytes as groups of 2 hex characters separated by 2 spaces. The entry and exit conditions are the same as for OPSTRG.

The ASCII string output routine OPSTRG is useful in outputting messages to an operator in an interactive situation. A number of messages may be stored as part of the program in a compressed form using carriage returns to terminate lines and then output in the required format by specifying the start address and the number of characters and calling OPSTRG.

The hex output routines enable the contents of all 8 bits in memory locations to be displayed at once. (Remember that the ASCII output routines only use 6 of the 8 bits in each byte). This allows the VDU to be used as a "super front-panel" for the microprocessor. Using OPXSTG the memory contents of any 128 consecutive memory locations can be displayed at once for examination. BCD data coded as 2 digits per byte can also be displayed using these routines.

Finally, here are some further ideas for using the VDU.

Because a conventional VDU can only receive and store characters serially at the rate of 1 character per TV frame, the variety of things that can be displayed is limited. On the other hand, this VDU is much more flexible in what it can display because random access is available for writing to the display memory.

While it is possible to display a list of values as a result of series of calculations, a much more convenient and easily interpreted method is to use a graph. A graphical display can only be obtained using a conventional VDU by completing all the calculations and storing the results in a buffer which is then output to the VDU. With this VDU plotting a graph is very simple. Because random access to the display buffer is available, points can be plotted on the display immediately they are calculated. Any character can be used to represent a graph point, but + or * would be good choices. Axes can be put on the graph using ! characters for the vertical axis, and — for the horizontal axis. Scales can be added using numeric characters. Obviously resolution is limited with a 16 x 32 alphanumeric display, but it would be adequate for many purposes.

Video games become feasible with this VDU, because of the random high-speed memory access capability. Simplified versions of the currently popular "ping-pong" style TV games can be produced by setting up static boundaries in the display memory, feeding in bat position information through a PIA and calculating ball position. Bat and ball motion is easily displayed on this type of VDU. On-screen scoring can also be provided. Displays for noughts-and-crosses and many other games can be programmed. Simple video art displays with movement may also be produced.

Pages of display are easily saved on cassette and later reloaded because the VDU shares the CPU memory. The 512 word buffer accessed by the VDU can be dumped directly onto cassette using the PUNCH routine of many system monitor ROMs, and then reloaded directly using the monitor LOAD routine. By organizing the storage on cassette with file gaps between pages, any page can be readily located and reloaded into the display for examination or editing and then saved back on tape. Such a scheme could form the basis of a simple information storage and retrieval system. Depending on the length of file gaps used on the tape, a single C90 cassette would hold 100 or more pages of information.

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CHROMDIOXID.
The day BASF introduced this product, is the day Hi-Fi quality came into cassette technology.
This cassette is the standard for Hi-Fi quality. It delivers an improved dynamic range and crystal clear, high level output. Particularly in the high frequency range, the distortion factor remains remarkably small.

The cassette started life as a controversial item and quite understandably was not taken too seriously.

In the past Hi-Fi quality could only be obtained from reel-to-reel tapes, but now chromium dioxide cassettes from BASF have also reached this Hi-Fi level.

In fact, BASF's chromium dioxide tape set the Hi-Fi standard to which most manufacturers still refer.

Where this improvement has taken place is mostly in the magnetic surfaces used to coat the tape. And, this is where another controversy reared its ugly head; the chrome controversy.

BASF have a straightforward position on chromium dioxide; it's the best.

Now BASF has introduced the new Chromdioxid Super.

By today's high standards of cassette technology, this is the ultimate cassette.

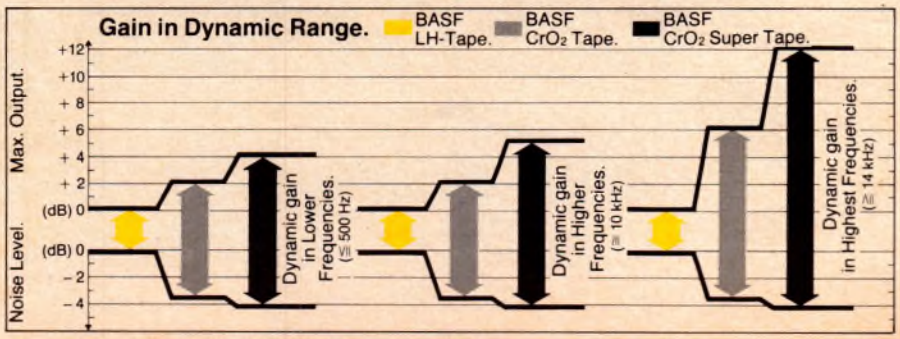
On the surface of things chromium dioxide is better.

Chromium dioxide is man-made and the individual particles are 'grown' in much the same way as crystals are 'grown'. Ferric oxide on the other hand, has to be ground down to a suitable particle size. Whereas each chromium dioxide particle is a long, thin crystal, a ferric oxide particle is usually made up of a number of shorter crystals that have irregular off-shooting branches.

Through careful quality control during the production of the tape's surface, the uniformity of the chromium dioxide 'needles' (particles) can be merged to provide a better covered, more sensitive surface.

They all fit neatly together because they have no off-shooting branches which cause gaps or 'voids' between the particles. Signals cannot be recorded on these 'voids', therefore the CrO_2 density of particles delivers higher output especially at high frequencies. You can examine this in the diagram that shows the gain in dynamic range of BASF Chromdioxid Super compared with BASF Chromdioxid and BASF LH.

Each CrO_2 particle is one, individual non-porous crystal with one magnetic 'domain'. Because a ferric oxide particle is made up of a number of crystals each capable of holding their own signal, de-magnetization can occur, lowering the tape's recording efficiency.



Tested according to the Bias-setting of the Recorders.

story on chrome.

NEW CHROMDIOXID SUPER.

By today's high standards of cassette technology, this is the ultimate cassette.

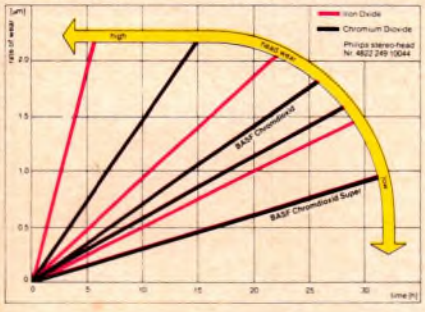
BASF Chromdioxid Super delivers up to 10dB better high frequency headroom over the leading chrome substitutes in the 11-20kHz range. There is less headwear than with cobalt-doped cassettes. And, at least 2.4 dB lower noise level than competitive products.

The end of the headwear rumour.

Very simply, CrO_2 does not wear the tape head any worse, and in many cases a lot better, than ferric oxide tapes. (See diagram.)

Head Wear of Cassettes

CrO_2 and other tapes recommended for CrO_2 bias setting and 70 µs equalization



Du Pont, the giant American chemical company wrote: "Our tests showed CrO_2 to be fully competitive in headwear characteristics with non oxide tapes, and in many cases superior." The choice of the oxide formula is not a significant factor in headwear. The main cause of contention over this issue results from a confusion between chrome, which is a hard material, and chromium dioxide, which is a different material with completely different properties. The hard chrome is not inserted into the highly sensitive tape surface.

One tape is as good as the next.

Chromium dioxide is a uniform surface for the tape, which means that the quality and performance is uniform.

One BASF chromdioxid cassette bought one day, will perform as well as another BASF chromdioxid cassette, bought another day. And, the Security Mechanism, SM, which is patented to BASF, ensures the smooth running of the mechanics inside the cassette making sure the tape is transferred smoothly and accurately from one spool onto another.

SM Special Mechanism
Patents Pending

Switch to BASF Chromdioxid.

One last thought. The value of chrome is clearly recognised by all equipment manufacturers who have all fitted the 'chrome switch' to their best recorders.

So, if you want genuine 'Hi-Fi' performances from your cassette recorder, switch to BASF chrome cassettes.

BASF Cassettes. Purest quality across the range.

BASF4

The competition don't like the sound of this at all.

For quite some time, other manufacturers have been trying to produce tape with the qualities of the Maxell UD-XL. At the same time, Maxell have been quietly perfecting an even better series.

The UD-XL I and UD-XL II tapes are designed to attain maximum performance at the ferric and chrome position on your tape deck. Whichever tape position you choose, Maxell can give you a better performance.

UD-XL I TAPE, FOR FERRIC (norm.) POSITION (120*us*)

UD-XL I offers an excellent sensitivity of 1 dB higher than even UD-XL. MOL performance is also 1 dB higher over the entire audio frequency spectrum. The result is a new standard in ferric tape, with wider dynamic range and less distortion than ever before.

How does the UD-XL I compare then, with ordinary low-noise tapes?

Sensitivity is higher by 2.5 dB, and MOL performance by as much as 6 dB.

Yet, for all this UD-XL I requires no special bias or equalization. Simply set your tape selector as you normally would at the ferric position – but there the comparison ends.

UD-XL II TAPE, FOR THE CHROME POSITION (70*us*)

UD-XL II tape is such a dramatic improvement on most other tape that can be used in this position, that comparison is really unfair.

For example, if you're familiar with conventional chromium-dioxide tape, you'll know of the associated problems of poor output uniformity – plus low maximum output level and rather high distortion.

UD-XL II tape offers you excellent MOL, sensitivity, and an output improvement of more than 2 dB over the entire frequency range.

Maxell's unique 'Epitaxial' process gives you absolute sensitivity and stability, and no drop-out problems. What's more, the shells are moulded in diamond cut dies, and made to tolerances 5 times greater than the Philips standard. And, like all Maxell tapes, UD-XL II has the 5-second cleaning leader.

In short, if you're recording in the chrome position, you can now achieve all the advantages – with none of the drawbacks.

A prospect we think you'll find very exciting – even if the competition don't.

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WT3/79

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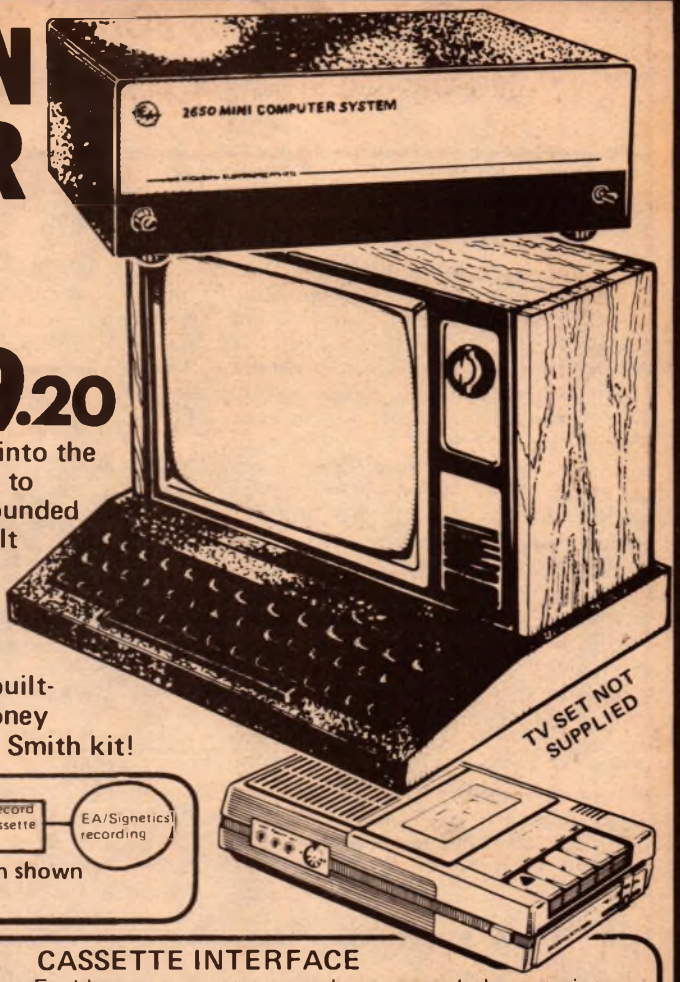
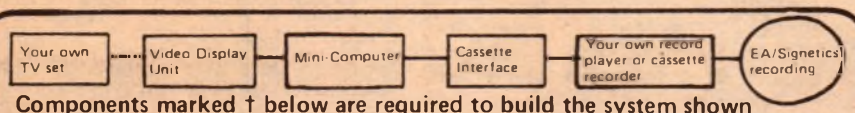


Here it is – the first system that enables you to break into the big time without spending big money! You don't have to know about computers to start – just imagine the astounded looks on your friends' faces when you tell them "I built it myself!" When you've built the system you can play games with your computer right away using the special EA/Signetics disc. Then, when you've gained some programming experience, you can use your computer for an incredible variety of tasks. A similar built-up system would cost well over $800 - think of the money you'll save by building it yourself. It's easy with a Dick Smith kit!



Components marked † below are required to build the system shown in this block diagram. They make a total of only $369.20!

2650 MINI-COMPUTER (See E.A. May'78)

Fantastic new 2650 Mini Computer. Complete kit includes all electronic parts, PC board and power supply plus case, Marviplate lid and deluxe brushed aluminium front panel.

Complete kit for above: Cat K-3447.....$115.00†

SEPARATE PARTS

PCB (78 up 5) fibreglass: Cat H-8341.....$5.00
2650 microprocessor chip: Cat Z-9201 .....$28.50
2608/CN0035 pip bug 8k ROM: CatZ-9309.....$19.75
2114 ROM chip: Cat Z-9306.....$14.50

VIDEO DISPLAY UNIT (See E.A. Feb & May'78)

Incredibly low cost Video Display Unit uses your own TV set as the monitor.

Basic Video DisplayKit: CatK-3460.....$97.50†
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SEPARATE PARTS

UART IC S1883/MM5303N/TMS6011: Cat Z-9204 .$5.90†
Keyboard Console Metalwork: Cat H-3130 .....$24.50†
Keyboard (fully assembled): Cat X-1180.....$55.00†

CASSETTE TAPES

AC/DC cassette recorder ideal for this system.

Cassette recorder Cat A-4092.....$39.95
Cassette tapes: C60 LN Cat C-3350 .....$1.50
C90 LN Cat C-3352.....$2.00

CASSETTE INTERFACE

Enables your cassette recorder or record player to interface with mini-computers such as the 2650. Kit includes PC board and all components except power transformer. The complete PC board assembly will fit inside your 2650 mini-computer case, the 2650's transformer providing the AC power. We believe this kit to be the best available on the market to suit the 2650 system.

Complete kit (as above) Cat K-3465.. .. ..$24.50 †
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SOFTWARE RECORDING

This is a 33-1/3rpm recording of useful 2650 system software. Use it on your record player or dub onto a cassette and use it in your cassette interface system. Then you can program the 2650 for new programs and games. It contains 22 programs you can run.

Record Cat B-6300.....$2.80 †

PAPER TAPE READER KIT

See page 33 of our new catalogue for full details. Ideal for use with the 2650 mini-computer. Kit includes all electronic components, handsome black anodised aluminium case, ribbon interface cable and complete assembly and interface instructions, schematics and software.

Tape Reader Cat K-3466.....$95.00

Ask at any of our stores for your FREE copy of our new Mini-Computer brochure. Contains full details of our computer kits.

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Microcomputer News & Products

National ACE

National Semiconductor has released a new software-programmable asynchronous communications element (ACE). The INS8250 device is similar to a UART, but in addition provides programmable baud rate and data format, status reporting and complete modem control.

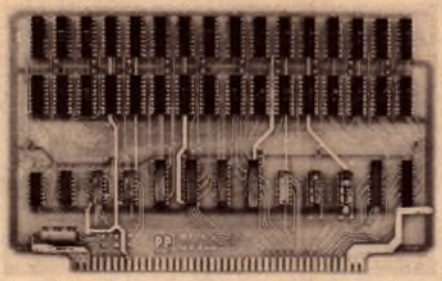
Easily interfaced to most microprocessors, including the 8080A, SC/MP, PACE, Z-80 and 8085, the ACE device includes an on-chip baud rate divider that accepts any clock input from DC to 3.1 MHz, dividing it by a programmed factor to produce any baud rate from 50 to 56k baud. All normal data communication formats are programmable, and the contents of the control register may be retrieved for inspection.

The INS8250 operates from a single 5V power supply, typically drawing 65mA. It comes in a 40-pin DIL package, and has low-leakage, Tri-state input and output connections.

16K RAM card

Pennywise Peripherals has released a new 16K byte static RAM card using the latest 2114 4k-bit memory chips. The PCB measures 247.5 x 152.2mm, and has an edge connector for the Motorola Exorcisor bus as used by the popular MEK6800D2 kit. However the control logic is jumper selectable for a variety of other schemes, such as the 8080/85, 2650 or SC/MP. The PCB has plated-through holes and is coated with solder resist.

The 16K bytes on the card are divided into two 8K blocks, each of which may be switch selected to any of eight positions within the 64K memory space. All bus signals are buffered with Schottky TTL and the bidirectional data bus is driven by Tri-State Schottky TTL



buffers. The card requires only a single +5V supply.

The new memory card is available both as a kit, either with or without 2114s, and as a fully assembled and tested module. Further information from Pennywise Peripherals, 19 Suemar Street, Mulgrave, Victoria 3170.

Printer options

Italian firm Ing. Guido Gay Misuratori Elettronici has expanded its "Printina" range of alphanumeric printers. Seven basic models are now available, with a wide range of options. New options available include quartz clock and counter, clock with autoprint, line buffer and hexadecimal keyboard. All models use noiseless non-impact printing.

One model which may be of particular interest is the Printina CSR, which is in a desk-top cabinet and has a hexadecimal keyboard and display. It is intended as a small and inexpensive terminal for microcomputers, and features paper flowing upward, 24 column line buffer, and bit parallel character serial input.

A comprehensive technical data sheet is available from The Dindima Group Pty Ltd, P.O. Box 113, Balwyn Victoria 3103.

BASIC for 2650

A BASIC language interpreter is now available for 2650 based systems. Known as TCT Basic, it is distributed by Applied Technology. The body of the interpreter is 4K bytes long, and can be stored in either RAM or ROM. It uses Pipbug routines, and must be located between 0800 (Hex) and 17FF (Hex). RAM scratchpad is required from 0440 (Hex) to 07FF) Hex), while user programs start at 1800 (hex) and extend through available RAM.

The program is available in Pipbug — compatible cassette format, with a 110 baud binary bootstrap loader for faster program loading. A comprehensive user manual, which includes a full listing, is also supplied.

The statements available include LET, GOTO, IF, PRINT, INPUT, FIX, GOSUB, RETURN, FOR, NEXT, DO, UNTIL, REMARK, STOP and PIPBUG. This latter statement allows a return to the Pipbug

monitor program.

An unusual feature is the provision of DO UNTIL loops as well as FOR NEXT loops. This allows a loop to be repeated until a specified condition is met. As well as the usual arithmetic operators, (+, —, * and /), the functions ABS, MOD, INT and FRAC are provided.

In addition, either RND or SIN may be implemented, but only one can be used at a time. Twenty-six numerical variables are provided, and 10,000 string variables. Strings are identified by numbers rather than letters, and so may be referenced by calculations.

Comprehensive error messages are provided, as well as a DUMP command so that programs can be stored on tape. A load command is not required, since the dump format is compatable with normal line input procedure.

We evaluated the interpreter on a 2650 system with 7k of RAM. Loading took about 10 minutes, with another minute or so being required to make the recommended corrections (our tape had a few bugs). Once these were made, operation of the program was completely satisfactory.

Recommended retail price of the TCT Basic package is $29.50, which includes the cassette tape and manual. Full software backup (notification of errors and further additions) is also provided. Enquiries regarding the package should be directed to Applied Technology Pty Ltd, 109-111 Hunter St, Hornsby 2077.

Alternative keyboard for Low Cost VDU

We have recently had several inquiries from readers asking how the Southwest Technical Products KBD-5 keyboard with inbuilt ASCII encoder can be used in conjunction with the Low Cost VDU described in our February and April 1978 issues. In this article, we describe the necessary modifications.

by DAVID EDWARDS

The low cost VDU (video display unit) described in our February and April 1978 issues used a keyboard switch assembly which has no ASCII encoder of its own. Accordingly, we provided a suitable encoder circuit as part of the design. However a number of readers have written to ask if it is possible to substitute a different keyboard, the Southwest Technical Products type KBD-5, which is already provided with an encoder IC.

The KBD-5 comes as an assemble-it-yourself kit, consisting of a fibreglass PC board, a bag of switches and keytops, an encoder chip and a few minor electronic parts. It has provision for encoding both upper and lower case letters, as well as the usual numbers and special characters. It can also be programmed with wire links to provide either a positive or negative "key-pressed" strobe signal.

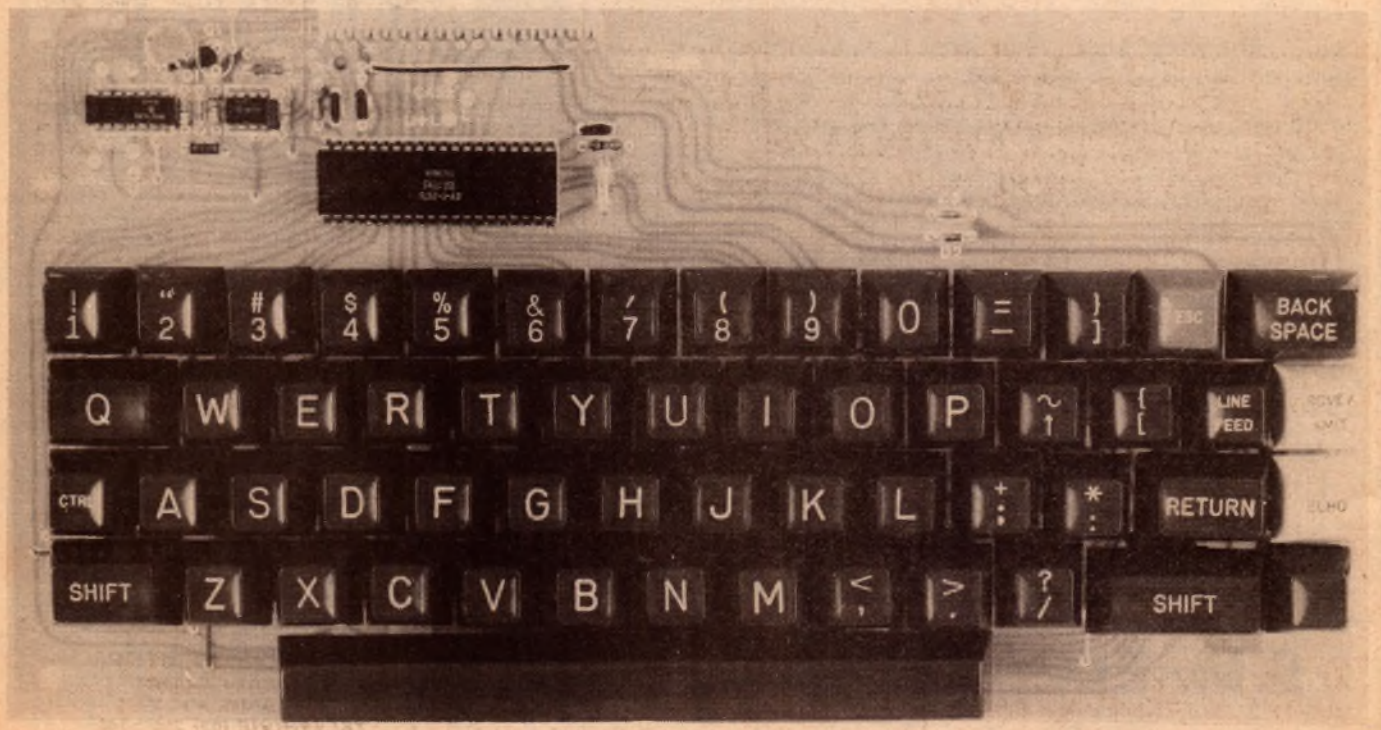
The encoded outputs from the keyboard are only available in parallel form, so if you wish to construct a serial interface, parallel to serial conversion is required. This is most easily provided by a UART.

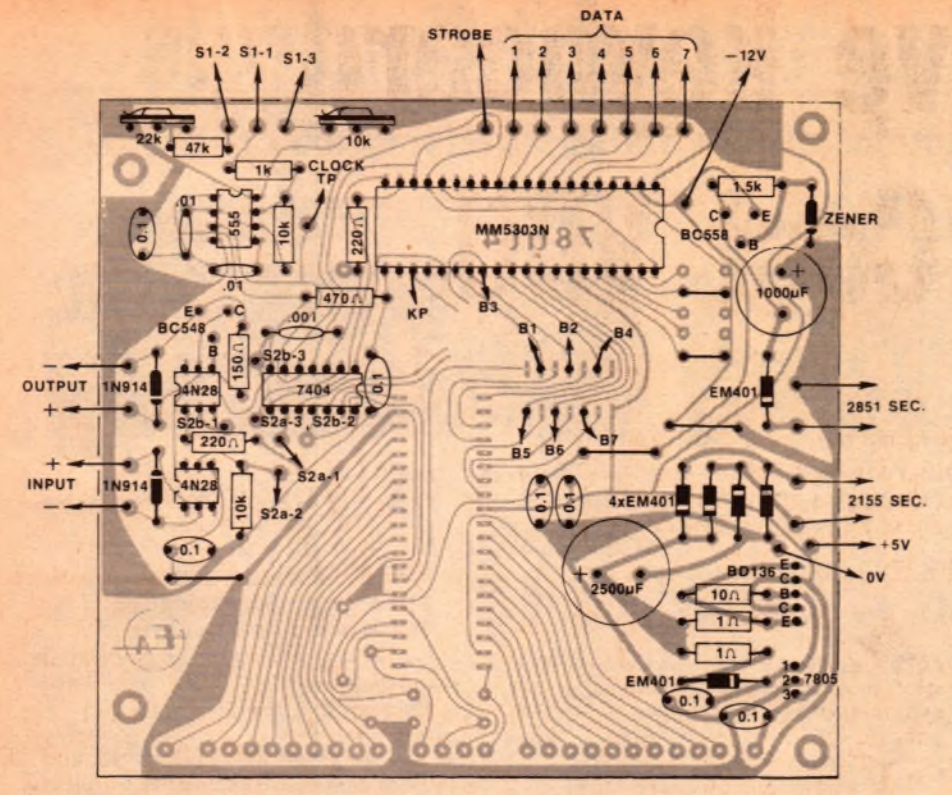
The April 1978 issue described a PCB assembly, coded 78up4, which provided a UART, power supply and standard 20mA serial interface, as well as a keyboard encoder chip. In order to use the KBD-5 unit with this it is only necessary to leave out the original keyboard encoder chip and associated components, and to make two small modifications to the PCB pattern.

Refer to the modified overlay diagram included with this article, and compare it with the original as published on page 53 of the April 1978 issue. As you can see, several components have been deleted, and two small cuts made in the PCB pattern.

Wire the link options of the KBD-5 unit for upper case characters only, and for a negative key-press strobe. Make the eight connections between the two boards using a short length of rainbow cable. The KP signal goes to pin 23 of the UART, while data outputs B1 to B7 connect to pins 26 to 32 respectively.

The completed KBD-5 unit is shown below.





Use this overlay diagram to wire the interface board.

The power requirements for the KBD-5 unit are +5V and —12V, and these can be supplied by the 78up4 board without exceeding the ratings. But we suggest that you check out the operation of the KBD-5 board as detailed in the assembly manual before completing the wiring to the 78up4 board.

We have not provided any mechanical construction and mounting details, as we felt that these could best be determined by individual constructors. The KBD-5 kit is available from Radio Despatch Service (869 George Street, Sydney), Davred Electronics (104-106 King Street, Newtown, Sydney), Silicon Valley (PO Box 898 Crows Nest, NSW) and Willis Trading (429 Murray Street, Perth, WA).

The Australian CB SCENE

NOVICE AMATEUR: The logical next step for a keen CBER

Over the past twelve months, an increasing number of CB operators have been looking to amateur radio as a means of expanding their new found interest. This article deals in particular with the Novice level examination, by way of which many CBers have already qualified to operate their own amateur radio station.

by JOHN KOLM*

The Novice class examination and licence caters for those aspiring to amateur status, who lack the knowledge necessary to qualify for a limited or a full licence. The Novice concept is proving a boon to many CBers who, having acquired an interest and experience on 27MHz, find that they can study to Novice examination level without undue effort. In fact, many seem thoroughly to enjoy the experience.

Among the successful Novice examination candidates there has also been a number of women — the wives of licenced amateurs — who have rounded out by study what they have picked up from their husband's never-ending technical "nattering".

While a Novice licence provides plenty of immediate opportunity for its holder, it is by no means a limiting document. At any time the licence holder feels that he/she can tackle a higher level examination, they can hopefully upgrade their licence. But that is another story.

The Novice examination and syllabus saga is a long and somewhat involved one. Its present status is the result of the hard work and helpful suggestions of a large number of people, both inside and outside the WIA — the Wireless Institute of Australia.

To the teacher or prospective Novice reading this article, it is offered as a presentation of the facts as they currently stand. Two areas have been covered; firstly, the Trial Novice Examination Scheme, and secondly, the situation concerning the official Novice examination.

THE TRIAL NOVICE EXAMINATION is run by state branches of the Youth Radio Clubs Scheme of Australia (YRCS or YRS). Despite the connotation, anybody is welcome to sit and it is not necessary to be either a youth or a member of a club!

The idea behind the Trial Novice Exam is simple: to enable anyone interested to sit for a realistic Novice licence examination under genuine examination conditions. But what, you say, is the point of that? Surely if you have done the study, passing the exam will be routine.

Perhaps it ought to be but, exams being what they frequently are, sadly, it just isn't so! I believe that most Novice candidates underrate the effect of nerves on their examination performance. You may be letter-perfect while sending Morse to your amateur friend from across the road; but it is a different thing to repeat the performance in front of a stranger who addresses you by your exam number, especially if you cannot stop your hand from quivering like a neurotic jellyfish! Don't laugh, it happens . . .

I am not trying to make the prospective candidate suffer a mild coronary, — or take up knitting as an easier alternative! It is undeniable that people have passed the exam purely by listening to Morse tapes and studying textbooks. However, it is equally true that candidates have failed because of nervousness in a strange environment.

I base this comment on remarks made by candidates, one of whom wrote: "I for one will go on record as stating that there is no way known to man or beast that I would have passed the Novice Morse exam without having attended the trial . . . and that goes for quite a number of other candidates also." (This quote is reprinted by kind permission of CB Action magazine.)

There has to be a moral somewhere in this scene at the Melbourne Trial Novice Examination, as a relaxed Morse examiner Daurel Coolidge (VK3NCS) chats with an unnamed male candidate.

*11 Vista Ave, Kew, 3101. John Kolm is the Victorian Examiner for the Youth Radio Clubs Scheme and a member of the WIA Federal Novice Examination Subcommittee. He compiled the initial Novice Examination question bank (discussed in the article) which is now attended to by the WIA. The Author gratefully acknowledges the assistance of Graeme Scott (WIA Federal Education Coodinator) in preparing the paper.

The Australian CB SCENE

The Victorian Trial Novice Exam results also provide data for an examiner's report (still being compiled at the time of writing). This will pinpoint general "trouble spots" and should be useful to instructors; hopefully it will appear in "Electronics Australia".

The most recent Trial Novice Exam was held in April in Victoria, New South Wales, and Queensland; there were 171 enrolled candidates in Victoria alone. Trial Novice exams are held roughly a month before Official Novice exams, and the next one is therefore scheduled for late September or early October. There will be plenty of advance publicity.

If you do not live in one of the three abovementioned States and would like the YRCS (or if no YRCS, your WIA Division) to run a trial exam, please get in touch with me. A YRCS/WIA directory is provided below:

ACT: WIA (ACT Division), Box 1173, Canberra City, 2601.

NSW: K. Hargreaves, 52 Marlin Avenue, Floraville, 2280.

Vic.: Supervisor — F H Whittom, 204 Churchill Avenue, Braybrook, 3019 Exams — J. Kolm, 11 Vista Avenue, Kew, 3101.

Qld.: WIA (Qld Division), GPO Box 638, Brisbane, 4001.

S.A.: G. Preston, 13 McGowan Rd., Para Hills, 5096.

W.A.: WIA (WA Division), GPO Box N1002, Perth, 6001.

Tas.: R. K. Emmett, 111 New World Avenue, Trevallyn, 7250.

The Trial Novice Examination in Victoria is run by the Author. Part of the idea behind the last Trial Exam in April was to try out a theoretical, streamlined, computerised system for speedy processing of examination results. The system appears to have been an unqualified success, and readers may be interested in a brief description of how it was done.

The last Victorian Trial Novice Examination was held at seven examination centres. The main exam. centre was at Melbourne University and was attended by 98 candidates; another 73 candidates were distributed over the other six centres. Five of these remaining centres were "country centres"; the only requirements for anybody wishing to run a "country centre" were that:

(i) the centre must be 50 or more miles from Melbourne.
(ii) there must be at least one fully licensed amateur to act as Supervisor and Morse sending examiner.
(iii) there should be a minimum of, say, ten candidates.

An aspiring Novice Amateur hard at work during the Morse sending test at the April 1978 Trial Novice exam in Melbourne. In the panel below are six of the 30 multiple choice questions which comprise the Regulations paper. The time allowed was 30 minutes.

As it turned out, no requests to run a country centre were turned down. The one remaining examination centre was a special one for disabled candidates, run in South Melbourne by courtesy of the Disabled Radio Amateurs' Club.

Each of the six examination supervisors received an instruction pamphlet and was required to make the usual undertakings concerning security. The exam papers were sent by registered mail a few days later. The Morse receiving test was provided on cassette, complete with spoken instructions and pauses; it merely had to be played as it was.

The system ran without a hitch, including the security arrangements. It is worth pointing out that the security factor associated with auxiliary examination centres is considered to be adequate by the organisers of the Victorian Higher School Certificate Examination; one can, therefore, scarcely be worried about similar arrangements for a Novice exam!

The main examination centre at Melbourne University was attended by an official observer from the Postal and Telecommunications Department, who expressed satisfaction with the way in which the Trial Exam was conducted. One interesting variation was the use of a language laboratory for the Morse receiving test. Each candidate sat in a booth with its own volume control, and the technical facilities ensured first-class audio quality.

Candidates recorded their answers to the multiple-choice theory and

TRIAL NOVICE EXAM: REGULATIONS

2. The erection of aerial masts by the licensee of an amateur station is usually governed by:
   A. the Department of Industry
   B. the Postal and Telecommunications Department
   C. State and Commonwealth law
   D. local government and civil aviation requirements
8. A particular amateur station is known to be causing television interference. The District Radio Inspector must be called:
   A. if the complainant refuses to cooperate in remedying the problem
   B. when tests are conducted to determine the cause of the interference
   C. whenever the station is to be used
   D. whenever the interference becomes evident
13. The frequency on which a ship would normally transmit a distress call by radiotelephony is:
   A. 500 Hz
   B. 2182 kHz
   C. 8364 kHz
   D. 8600 kHz
15. The friend of an amateur licensee requests him to establish radio contact with another licensee who has the friend's parents at his station, in order to save the cost of an interstate telephone call. Both licensees:
   A. must refuse to perform the service requested
   B. may perform the service on frequencies above 52 MHz only
   C. may perform the service, but only once
   D. may perform the service provided they refuse payment
18. Which one of the following items does NOT have to be entered in the station log book?
   A. the date and time of each transmission
   B. the type of emission used
   C. the signal report received
   D. the locality used, if mobile
27. The abbreviation "QSV?" means:
   A. "Are you ready?"
   B. "Shall I send a series of V-s?"
   C. "Do my signals vary?"
   D. "When will you call me again?"

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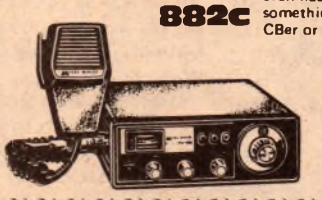

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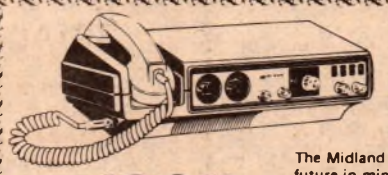

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At last, reliable, convenient CB communication.

The Philips 40 channel FM 320 UHF. It's what CB radio is coming to.

This ultra-high frequency unit is made here by Philips - Australia's largest manufacturer of two-way radio equipment. With its arrival, CB radio in Australia reaches maturity. Why? Because current CB legislation provides for the allocation of 18 channels for AM/SSB use. Philips FM 320 UHF, with 40 channels, more than doubles this availability.

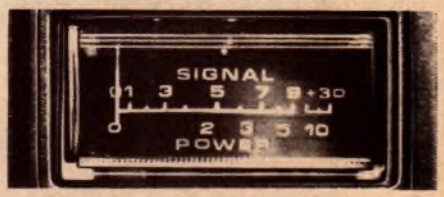
But that's not all. Because UHF operates on FM, interference such as static, vehicle ignitions, industrial activity and electrical storms will have little effect on reception. Every CBer knows that such interference plays havoc with 27 megahertz equipment, while these rigs provide television interference of their own.

Again, UHF does not generate any television interference as it operates on FM.

In city areas, Philips FM 320 UHF takes the uncertainty out of CB communication. High-rise buildings, bridges and other structures won't affect reception clarity or constancy. In effect, the UHF signal passes through the concrete canyons, instead of bouncing around them.

In conditions of heavy air traffic, Philips FM 320 UHF will capture the strongest signal on a given channel and temporarily silence any other which would otherwise cause interference. On the open road, mobile operators won't be interrupted by foreign "skipping" signals.

The Philips FM 320 UHF features Phase loop synthesiser and 5 watt RF output. A 40 channel L.E.D. readout selector can be push-button operated one channel at a time, or continuously until the desired channel is selected. Built-in remote control change on the microphone allows safe mobile operation. Channel changes are accompanied by an audible "click". Many more exciting features are built-in, like automatic call channel reset.



You can choose from a 15 cm quarter-wave tuned high gain type aerial, or perhaps the most universal aerial, the co-axial dipole. Its independence of a ground plane allows positioning almost anywhere on a vehicle.

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regulations papers on a special answer sheet, using an ordinary pencil. These answer sheets were subsequently marked by a microcomputer machine which processes them at a rate of one per second. The entire marking procedure was completed in less than three minutes.

A feature of the machine is that it prints a red bar next to every wrong answer; this seemed to be of value to candidates when their answer sheets were returned.

The final stage was handled by a full-sized computer which, among other things, printed out and addressed a statement of examination results for every candidate. This same computer sent examination slips to every candidate before the examination, and is presently being used to compile relevant statistical data.

The only thing computers didn't do was lick the envelopes! The exam was held on a Saturday; results were ready and in envelopes by Monday evening.

The general feeling among candidates was that they now felt much happier about the actual exam day, by then looming on the horizon.

NOVICE EXAMS AND ALL THAT: For quite some time, a number of enthusiastic amateurs have been evolving a provisional Novice Licence Study syllabus under the auspices of the WIA. The availability of a reliable syllabus is essential for the production of examination papers and for the information of teachers and candidates alike. Until recently, no official syllabus existed.

As a result of negotiations between the WIA and the P&T Department Central Office, the Department has issued an official Novice syllabus. The WIA has itself produced a Study Guide, which is written in the form of the syllabus, but much more detailed, and the P&T Department has officially approved it. It is hoped that this will make life easier for students, teachers, and examiners to determine exactly what is required to pass the Novice Licence examination.

The WIA has published an inexpensive handbook containing the official P&T Department syllabus, the WIA Study Guide, and some additional useful information for candidates and teachers. This handbook is currently available for 65c (postage included) from: WIA Federal Executive, PO Box 150, Toorak, Vic. 3142.

The publication of this syllabus delineates the subjects and subject depths of the Novice examination. Its final version has been the result of considerable consultation between the WIA and officials of the P&T Department. The discussions were held in a spirit of co-operation and the original syllabus underwent various deletions and modifications in the process of reaching mutual agreement on the level of knowledge required of a competent Novice operator.

As a further activity, the author of this article, some months ago, produced a Novice examination question bank. The question bank contained several hundred theory and regulations questions taken from numerous sources, and filed by subject in a card-file system.

This bank was adopted by the WIA, and, at about the eame time, a Novice Education Subcommittee was formed. This group held a number of working sessions during which all the questions in the bank were reviewed; some were rejected, others added. The most recent, and also the largest session was held on the 10th and 11th of June in Melbourne and was attended by interstate as well as local participants.

The present WIA/P&T Dept. Novice Examination item bank has become bigger and better than its original parent, and some of its contents have already been forwarded to the P&T Department. Indications are that they have been used in an exam, and there has been a very favourable reaction from teachers and candidates.

I would like to stress that we are only too pleased to receive multiple choice Novice exam questions for possible inclusion in the question bank. If you have exam questions to submit, please send them to the WIA Federal Education Co-ordinator at the WIA address given previously.

The WIA will shortly release a number of theory and regulations examination questions, which will be published by the Institute and made available at minimum cost. These can be taken by teachers and students as a representative sample.

TRIAL NOVICE EXAM: THEORY

3. An equivalent unit to the "cycle per second" is the:
A. Hertz
B. Coulomb
C. Maxwell
D. Marconi

16. The range of audible frequencies is approximately:
A. 2 Hz to 20 kHz
B. 2 kHz to 20 kHz
C. 2 kHz to 200 kHz
D. 20 kHz to 200 kHz

17. In a class C amplifier, the term "class C" refers to:
A. the frequency range for which it is designed.
B. the DC bias used
C. the audio quality of the output
D. the output power

23. In comparison with a dipole antenna, the impedance of a folded dipole antenna is:
A. higher
B. lower
C. the same
D. almost zero

40. The resonant frequency of a coil and a capacitor can best be determined using a:
A. cavity resonator
B. wavemeter
C. cathode ray oscilloscope
D. grid dip oscillator

45. An increase in output power of 3 dB represents a numerical power gain of:
A. 0.3
B. 2
C. 10
D. 100

49. The wires inside a 3-core mains power cord are coded: brown; blue; green with yellow stripe. These colours correspond, respectively, to:
A. active; earth; neutral
B. active; neutral; earth
C. neutral; active; earth
D. neutral; earth; active

Here are 7 out of the 50 multiple choice questions which comprised the Theory paper at the Trial Novice exam in Melbourne during April. Time allowed, 1 hour.

The Australian CB SCENE

The Examination question bank is being finalised at the time of writing and will shortly be forwarded in its entirety to the P&T Department. The bank will be kept under security and used for setting future Novice examinations, which will consist of questions randomly selected from each subject.

Questions in the bank will periodically be deleted, modified, or increased in number, by a joint WIA/P&T Department Committee.

Learning should be a pleasant experience; being examined should be a fair and tolerable one. In producing fair Novice examination questions, as I believe these to be, there can be no guarantee that every candidate will get the results he wants. However, it will at least help to ensure that each candidate gets the result he genuinely deserves!

The WIA has done its best to set a standard which is neither too low for competence nor too high for examination. It is the belief of the WIA that the present Novice syllabus contains nothing which cannot be learnt with average intelligence and moderate determination, and yet ensures that the gaining of a Novice Amateur Licence is an achievement of which every candidate may justifiably feel proud.

A handset for mobiles

Designated as HS-6000, this mobile radio handset is manufactured by Primo in Japan.

It is imported into Australia by Paradio Electronics, and sold through distributors such as Radio Despatch Service. It meets specifications laid down by the FCC and by the Radio Branch of the Australian PMG Department.

The HS-6000 is fitted with an 8-ohm headphone and a 500-ohm microphone.

Two switching functions are provided: one in the cradle is actuated when the handset is withdrawn, being used typically to silence a monitor loudspeaker. The other is a normal press-to-talk lever in the centre portion of the handle.

The handset and holder is available in either black or beige.

For further information: Paradio Electronics, P.O. Box 380, Darlinghurst, NSW 2010.

AMATEUR RADIO

by Pierce Healy, VK2APQ

Strong amateur reaction to proposed 5A expansion

The federal government's announced policy to expand the use of TV channel 5A has created a strong reaction within the amateur ranks, by reason of likely interference problems. The nature of these problems, and the steps amateurs should take to change the policy are dealt with in these notes.

Announcements that extended use is to be made of television channel 5A (137MHz — 144MHz), for additional (ethnic) TV services, are receiving widespread attention by Australian amateurs. They are concerned at the real possibility of mutual interference between channel 5A and the international amateur band 144MHz — 148MHz, particularly in weaker channel 5A signal areas or within close proximity to an amateur station.

On behalf of Australian amateurs, the matter has been taken up with the Minister of Posts and Telecommunications, Mr A. A. Staley, by the Wireless Institute of Australia federal president, Dr David Wardlaw, VK3ADW.

Letters from the WIA president pointing out the likely problems, resulted, at the request of mr Staley, in an hour long discussion on the points raised by the WIA. The minister stressed that he regarded the amateur arguments as substantial, though the decision was a cabinet, rather than ministerial, matter.

Itmwas agreed that the WIA would present a fully prepared case to justify its contention that allocation of channel 5A was undesirable because of the inevitable social consequences that would follow from interference to transmissions on this channel.

Many amateurs have taken the matter up with local members of parliament and all amateurs are being urged to do so. A number of varying types of reply are reported to have been received.

In a reply to an objection by Steve Gregory, VK30T, of Hamilton Victoria, his local member of federal parliament, the Prime Minister, Hon. Malcolm Fraser, stated in part; "While it is unlikely that interference will be caused to amateur radio, I am informed there is a likelihood of occasional interference to the television reception of residents living in close proximity to an amateur radio installation. The Minister has advised me that if this occurs it may be necessary to limit the hours of operation of amateur radio as has been the case in other areas where channels 0 and 5A are being utilised."

Also, it is known that in at least one marginal electorate there are more than sufficient amateurs to unseat the present government member if political decisions, and not technical factors, decide the allocation of ethnic telecasting frequencies. This fact is being actively canvassed among amateurs in that electorate.

In any approach to a member of Federal Parliament (preferably in writing) take care not to "knock" the ethnic TV service concept as such. On the contrary, point out that this service can still be provided, free of interference problems, in the UHF band.

It is also worthwhile questioning the validity of suggestions that using UHF for the additional channels would be more costly than using channel 5A. In either case there will be a substantial basic cost in providing a transmitter, mast, buildings, and other facilities. Against such a cost, the difference between a VHF and UHF transmitter may well be negligible

The amateur's case should emphasise both the contributions which the amateur has made to society in the past, and the hardship and loss he will suffer if this band is lost or restricted.

The cost of amateur equipment is one example. Modern equipment is expensive; in some cases more expensive than a colour TV set. On top of this is the personal effort of self education necessary achieve an amateur licence. Amateurs invest such sums of money, and make such efforts, because the allocation of a band has encouraged them to do so. Are they then not entitled to some guarantee that their interest and investment will be protected?

As well as their personal equipment, Australian amateurs have helped finance several amateur satellites, two of which are currently active, with a third under construction. The benefits of these have ranged well beyond the amateur movement, from pilot schemes for locating downed aircraft, to general education. In the latter case they provide incentive for studying mathematics, geography, the solar system, and foreign languages.

Australian amateurs have also contributed a great deal of time and effort in assisting various youth organisations. These not only provide a healthy environment for young people, but have opened the door to a successful career for many; a career which they may never have been able to embrace otherwise.

If Australian amateurs are deprived of their most active band they will not be the only losers; the community in general will have lost something as well.

Australia is a member of the United Nations specialised agency — the International Telecommunication Union. At WARC 79, what will be Australia's explanation for setting up services within the radio frequency spectrum which are likely to cause interference on international space research frequencies or an internationally recognised amateur service band, including the international amateur satellite projects.

All amateurs are being urged to write, individually, to their local federal member and put a case for the UHF system, based on the points raised above, plus any others that come to mind. Individual letters have far more impact than form letters or petitions.

Act now! It will be too late when cabinet announces its decision.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent to Pierce Healy at 69 Taylor Street, Bankstown 2200.

IARU REGION III

With the 1979 World Administrative Radio Conference now only months away, a topic of conversation with

AMATEUR RADIO

overseas stations could well be about the action needed to ensure that amateur requirements are fully appreciated by national administrations, particularly in Region III. Unfortunately, Region III has a very widespread amateur population of many nationalities. In many areas the number of amateurs are insufficient to form a national amateur society. However, they will be affected by decisions made at WARC 79 and should be urged to advise their local administrations of the value of amateur radio within the community.

If the number of call sign prefixes heard from the Pacific area is compared with the following list of amateur societies (Region III, IARU members) the results may be surprising

Country	National Society	Prefix
Australia	WIA	VK
Hong Kong	HARTS	VS6
India	ARSI	VU2
Japan	JARL	JA etc.
Korea	KARL	HM
Malaysia	MARTS	9M2
New Zealand	NZART	ZL
Pakistan	PARS	AP
Papua/N.G.	PNGARS	P29
Philipines	PARA	DU
Singapore	SARTS	9V
Sri Lanka	RSSL	4S
Thailand	RAST	HS
USA	ARRL	W, K

(List acknowledgement to Region III News Feb. 1978)

Remember, amateurs have efficient, modern and flexible communication equipment available today; use it to publicise the amateur's value to the community by expressing your interest and concern for its well being at WARC 79 deliberations.

Let the world know that amateurs are internationally bonded through the International Amateur Radio Union and all amateurs are members of a non-commercial, self educating, self displined, non-political, non-sectarian, international communication service. It is the only such service recognised by the United Nations specialised agency — The International Telecommunication Union.

Above all, help you national society to finance its activities on behalf of the amateur service. You do not necessarily have to be a member. Your help is essential.

Channel 5A — The Problem

From the amateurs' points of view there appear to be several reasons why use of channel 5A should not be expanded. The most obvious one is that individual TV receivers, particularly those in fringe areas, may suffer interference from nearby amateur transmissions.

A less obvious, but more serious, problem involves any translators associated with channel 5A transmitters. Translators serve areas within the master station service area but which, by reason of shielding in one form or another, receive inferior signals.

The translator takes the signals from the master station and retransmits them into the problem area on any available VHF channel. In many cases the translator takes its signals "off-air" from the master station and it is the possibility of an amateur transmission getting into a translator that is causing concern, because all viewers using the translator would then experience this interference.

At present there appear to be two NSW 5A translators in operation, but some proposals envisage a number of translators operating from a single 5A master station.

In view of such likely problems, amateurs feel that the authorities should consider the alternative approach; that of putting the additional channels in the UHF band. Provision has already been made for such a move, manufacturers are including UHF tuners in most modern sets and, since the move will be made eventually, why not now? Even those sets without UHF tuners could be accommodated by adding a relatively inexpensive converter.

As well as solving this interference problem, expansion into the UHF region would have other advantages. Channel 5A has always been something of a black sheep in the TV allocations. As well as being threatened by interference from the internationally approved amateur band on one side, it can, and has, caused interference to an internationally approved space research channel (136-137MHz) on the other side.

A move into UHF would leave the way open for eventual phasing out of the existing 5A transmitters, with benefit to all concerned.

RADIO CLUB NEWS

Time is running out for radio clubs to forward details for inclusion in the December 1978 — Radio Club Directory.

The closing date is 20th October, 1978. Format details the same as last year.

This listing can mean substantial publicity and is a service to those who wish to update to amateur radio.

Do not let your club down — do it now.

SOUTH WEST ZONE CONVENTION (NSW): Wagga is the venue for this very popular event, organised by the Wagga Amateur Radio Club on behalf of the South West Amateur Radio Society. Amateurs, their families, and frinds are invited to visit Wagga and participate in the activities. A special effort is being made to cater for the whole family.

The dates are Saturday, 30th September and Sunday, 1st October 1978.

For field contestents the Wagga standard will be maintained. Events will be tough and mind-boggling, as the contest committee has had a lot of experience in setting unusual tasks.

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IC701 HF digital solid-state transceiver	$1,380.00
IC701PS matching power supply / speaker	$279.00
IC202E 2m ssb portable (new model)	$219.00
IC502 6m ssb portable	$219.00
IC402 70cm ssb portable, coming soon!	
IC22S 2m fm mobile transceiver	$335.00
RM-3 Remote controller	$169.00
ICSM2 condenser-electret desk mic	$56.00
IC245 2m fm digital mobile transceiver	$575.00
IC211 digital 2m all mode	$785.00

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IC-280 2m fm transceiver

REMOTABLE COMPUTER CONTROLLED 144-148 MHz

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TS520S HF transceiver	$789.00
TS820S HF transceiver	$1,279.00
SP820 matching speaker with filters	$66.00
SM220 station monitor	$335.00
TL922 Linear Amplifier	$1,450.00
AT200 matching antenna tuner	$185.00
TV506 6m transverter	$236.00
TV502S 2m transverter	$290.00
TR3200 70cm fm portable transceiver	$229.00

KENWOOD TS-820S transceiver

TS-820S features: • Factory installed digital frequency readout • 160 thru 10 meter coverage • Integral IF shift • RF speech processor • VOX • Noise blanker • PLL • Built-in 25 KHz calibrator • CW sidetone & semi-break-in • IF OUT, RTTY, & XVTR • 200 W PEP input

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Features: • 160-10 meter coverage • Optional DG-5 digital frequency display • New speech processor w/audio compression amplifier • AC power supply (DC optional) • RF attenuator, front-panel activated • Provisions for sep. receive antenna & phone patch • 200 W PEP input.

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Model DR7500S medium duty	NEW	$189.00
Model DR7600S heavy duty		$259.00

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CX-2L 1.8 thru 170 MHz, 100w pep max	$48.00
CX-2H 1.8 thru 450 MHz, 200w pep max	$69.00

COAXIAL SWITCHES (DAIWA)

CS201 2 position, high pwr, up to 500 MHz	$25.00
CS401 4 position, high pwr, up to 500 MHz	$59.00

SPEECH COMPRESSORS (DAIWA)

RF440 phasing type, 6dB gain	$135.00
RF550 filter type, 6dB gain	$179.00

MORSE KEYS

HK702 deluxe key with marble base	$39.00
HK708 economy key	$21.00
HK706 operator's key	$25.00
MK701 manipulator (side swiper)	$43.00
EK103Z electronic Keyer	$169.00
Palomar IC Keyer	$149.00

MICROPHONES

VM-1 noise cancelling, dynamic, low Z	$9.50
VM-2 Desk mic, dynamic, low Z	$29.80
MC-50 Kenwood Desk mic	$58.00
MC-35S Kenwood hand ptt mic	$20.00
Icom hand ptt, low Z	$14.50

MOBILE SUPPRESSORS

Hansen NB-2 heavy duty type for alternators	$9.50
Hansen truck 100 amp alternator filter	$22.00

TRAP DIPOLES

MIDY VN 80-10M, 23.5M long	$109.00
AL48DXN 40/80M dipole	$68.00
AL24DXN 20/40M dipole	$65.00

TRAP VERTICALS

V4JR 40-10M, 5.2M high, no guys	$99.00
V5JR 80-10M, 6.7M high, no guys	$165.00
14AVQ/WB Hy-Gain, 40-10M	$109.00
18AVT/WB Hy-Gain, 80-10M	$155.00

DIPOLE KITS

A4VPN 40M dipole kit	$32.00

2M ANTENNAS

Scalar M22T ¼ wave whip	$7.00
Scalar M25T 5/8 wave whip	$17.50
Bases for above	$4.00
Magnetic Bases	$19.00
ARX-2 Ringo base antenna	$49.00

DISCONE ANTENNAS

9DX-1 80-480 MHz	$84.00
SCAN-X 65-530 MHz (Receiver Only)	$35.00

DIP METERS

TRIO DM800, ideal for hams	$145.00

70cM BEAMS (JAYBEAM)

88/70cM, 18.5 dBd gain, 88el, length 3.98M	$102.00
48/70cM, 15.7 dBd gain, 48el, length 1.83M	$79.00
PBM18/70, 18el, 14.9 dBd gain, length 2.8M	$71.00
D8/70cM, twin 8el, 70cM, 12.3 dBd, 1.1M	$62.00

antennas

SWR/PWR METERS

VC2 twin meters, 3-150 MHz cal chart	$34.00
SWR200 Oskerblock 2-200 MHz	$75.00
SW410A 140-500 MHz, direct reading	$129.00
SW210A 1.8-150 MHz, direct reading	$96.00
SWX777 up to 30 MHz, professional	$131.00

LOW PASS FILTERS

FD30M 32 MHz Fc, 1 Kw max, 3 stages	$35.00
FD30LS 32 MHz Fc, 200w max, 3 stages	$20.00

NOISE BRIDGES

Omega TE7-01 up to 100 MHz	$49.00
Palomar up to 100 MHz	$79.00

BALUNS

AS-BL for beams	$31.50
BL50A 50 ohm 4 Kw model for dipoles	$26.00
BL70A 70 ohm 4 Kw model for dipoles	$27.00

VALVES

6146B for Uniden, Kenwood, Yaesu	$13.00
6KD6 for early Yaesu linears	$13.00
6JS6C for FT101 series	$13.50
572B for Yaesu linears	$59.00

2M BEAMS

5Y/2M Jaybeam, 7.8 dBd, length 1.6M, 5el	$39.00
8Y/2M Jaybeam, 9.5 dBd, length 2.8M, 8el	$47.00
10Y/2M Jaybeam, 11.4 dBd, length 4.4M, 10el	$79.00

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Gold Coast	32 2644	Hobart	43 6337
Canberra	82 3581	Melbourne	836 8635

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The convention site will be a rural area out of town, with caravan sites available. There are also on-site vans available in town. The whole accommodation of one motel has been reserved for visitors.

The program will include an 80 metre contest for those enroute to the convention on Saturday. Contacts must be within the novice licence segment of the band.

Talk-in facilities on 80 metres, channel 3 repeater, and 10 metres will be maintained continuously throughout Saturday and most of Sunday.

There will be VHF and HF scrambles, two and ten-metre talk-in events, and VHF transmitter hunts.

Events will also be held for the ladies and children.

Trade displays have been arranged, and there will be demonstrations of RTTY and amateur TV.

The official convention dinner will be held at the Wagga Leagues Club on Saturday night. Baby sitting facilities have been arranged for young children during the dinner.

Do not leave accommodation bookings to the last minute. Send details of your requirements to the Secretary, Wagga Amateur Radio Club, PO box 71, Kooringal, Wagga 2650

CAPRICORNIA AMATEUR RADIO FESTIVAL: The Central Queensland Branch, WIA is holding this festival on the 16th and 17th September, 1978, at Rockhampton. The venue is the National Fitness Centre, Northern End of Fitzroy Bridge, Rockhampton.

If you are looking for an excuse to visit that area of Queensland then go to the Springtime Festival in Rockhampton from the 9th to 17th September, 1978.

The CARF program commences at 1030 Saturday 16th September with registration, arrangement and acceptance of competitive entries and displays; 1300 lunch, barbeque facilities available; 1400 official opening; 1430 female fun hour, film lecture, hidden transmitter hunt, mobile frequency check, 1700 free time; 1830 smorgasbord dinner; 1930 guest speaker; 2000 - 2200 entertainment.

Sunday 17th WIA news broadcast; 0930 judging competitive items, ladies and gents; $000 swap and sell, ladies interest segment, disposals auction; 1030 hidden transmitter hunt, technical talk, scramble; 1200 presentation of prizes; 1300 barbeque; 1400 conclusion. For further information write to:— WIA, CQ Branch, PO Box 496, Rockhampton Q. 4700.

WORKED-ALL-QUEENSLAND AWARD: Issued by Queensland Division of the WIA.

1. zthis award is divided into two sections — Worked all Cities and Towns, and Worked all Shires.
2. Any amateur or shortwave listener may apply for the award, provided that applications comply with the rules.
3. Only one award is issued to an individual station but this will be updated upon receipt of further contacts.
4. Worked all Cities and Towns: There are 20 incorporated cities and towns in queensland. The initial award: 15 contacts with radio amateurs operating from these cities or towns. A silver sticker will be issued if all 20 are worked.
5. Worked all Shires: There are 111 shires in Queensland. For this award the 1976 listing is considered to be the correct one. The population figures in these shires range from 250 to well over 25000. Initial award; 51 contacts, with stickers for 61, 71, 81, 91, 101 shires, with a gold sticker if all shires have been contacted.
6. Modes and bands: All legitimate modes and bands may be used, LF, HF, VHF, UHF, OSCAR, EME etc., but cross-band contacts are now allowed.
7. Special VK-rules: As a number of areas are not very active, DX-peditions to these areas are encouraged . . . to help the award hunter to get that rare Queensland shire, town or city. The following will apply: a. The Queensland awards manager or his appointed delegate shall be advised in writing of the intended VK/P operation in those areas which are not too active or are non-active. If approximate operation dates are available, advance publicity could be given and you may become a much sought after rare DX station.

b. A copy of the VK/P log shall be forwarded to the Queensland awards manager for use as a check list. The VK/P operator will automatically be credited with "having worked" that particular area, if: (I) At least 50 contacts were made with a minimum of four VK call areas, or (II) at least 30 overseas contacts are logged.

8. Method of application: A certified list of contacts, as per CHC rules, to be sent to: The WIA (Q) Awards Manager, GPO Box 638, Brisbane, Queensland 4001, Australia. Together with either $1.00 (Aust) or 10 IRCs for the initial award. Subsequent stickers will be issued free, although return postage will be appreciated.
9. Contacts made as from 1st January 1976 will be valid for this award.
10. Queensland amateurs, as a matter of courtesy, should include the town, city or shire in which they reside on their QSL cards.

Space does not permit the inclusion of the list of cities, towns and shires. However, the details are available from the address given above.

TRIAL NOVICE EXAMINATION

The next P & T Department examination for the amateur novice licence will

AMATEUR RADIO

be in October, 1978. To give candidates first hand examination experience, the WIA Education Service has organised a trial examination on Saturday 16th September, 1978, from 2.00 pm to 4.30 pm.

The theory paper will be based on the syllabus recently approved by the P & T Department.

An examination fee of $1.00 will apply. Instructors or individual candidates who wish to take advantage of this project may obtain full details from the — Education Officer, WIA (NSW) Education Service, PO Box 109, Toongabbie, 2146.

WICEN & "CITY TO SURF"

As these notes went to press, Sydney members of WICEN were preparing for their biggest exercise to date; providing radio communication for the famous "City to Surf" race on August 13.

The exercise planned to use some 40 WICEN members, with about as many sets, to provide the following services.

Within the Town Hall, pre-race, a low power base station and four pedestrian mobiles, one for each of four senior officials. These were to use 145MHz simplex, on low power.

Outdoors, two repeaters; channel 1 (main) and channel 2 (reserve). These were to cover the administration centre at the Town Hall, nine intermediate (medical) points en route, and a medical centre and the official finishing point (VIP stand) at Bondi.

In addition, a lead vehicle to provide position reports on the lead runners, and a tail vehicle to pick up stragglers.

At Bondi, another local (pedestrian) net on 146MHz for four first aid attendants and five officials.

Backup circuits were also planned, in case of traffic congestion, using HF, six metres, and UHF.

AN APPRECIATION: Amateur radio provided valuable communication for David Gosden, VK7HG during a voyage from Hong Kong to Lae in Papua New Guinea, with the Aston family on their 46 foot sailing cutter.

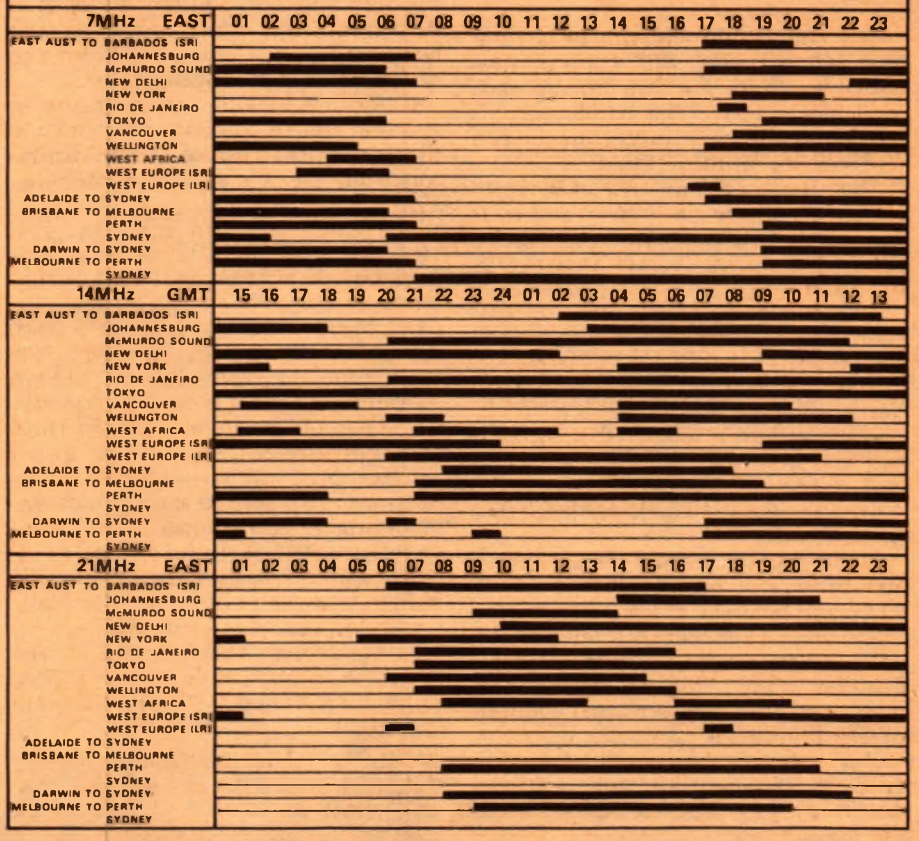
Using the call sign P29GD/maritime mobile, he was initially in contact with Keith Ford, P29EJ, who provided a welcome voice from the destination port.

As the yacht approched Papua New Guinea contact was lost with Keith on 14MHz. A lower frequency could not be used because the loading unit would not work into the short antenna on the stern of the yacht. However, a 14MHz relay was provided by Lin Rhodes, VK2IB, Tuross Heads, with Morice Burleigh, VK7JU, Launceston, standing by if needed.

Two other networks provided very useful services.

IONOSPHERIC PREDICTIONS FOR SEPTEMBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 9.78



One was the Pacific Maritime Mobile Network co-ordinated by Ted Mulholland, VK4AEM and Noel Curtis, ZL1CU. The yacht checked in each day to report its position and course. It was reassuring to know that help could be provided if required.

The other network was the Pacific Inter-island Network which operates mainly in the USA administrated groups of Mariana, Marshall and Caroline Islands.

NOVICE STUDY PACKAGE

The review of this package, on page 108 in the August issue, unfortunately omitted the address of the publisher. This is: Ann Davis Publications, P.O. Box 200, Alderly, Queensland 4051.

However, it also provides communications with other Pacific islands and amateur radio equipped vessels. Dixie, KG6JIO on Guam provided regular weather forecasts and Dick KC6AQ on Palau gave the yacht crew much assistance during their visit to Palau. As the yacht approached Palau, Dick advised the best passage through the narrow coral reef entrance and also where they could get supplies and a hot shower; very welcome information after a week at sea.

David, VK7HG is convinced that amateur radio is more than just a hobby and wishes to thank all those who assisted with the communications.

AMATEUR RADIO STAMP

In 1976 Japanese amateurs celebrated the 50th anniversary of the Japan Amateur Radio Leabue, which was established on 12th June, 1926. However, it was not until 10th September, 1927 that the first government licence was issued.

In commemoration of this genuine 50th anniversary of amateur radio, Japan issued a 50 yen postage stamp featuring a horn shaped speaker and a telegraph key on 24th September, 1977.

AMATEUR RADIO

FDK Multi-800D 2-metre transceiver

Sideband Electronics Imports, of Springwood, NSW, have submitted a sample of the FDK Multi-800D 2-metre transceiver made by the Fukuyama Electronics Co, Ltd, of Japan. Many Australian amateurs are already familiar with this company's products, particularly the "Multi-7" 2-metre transceiver of a few years ago.

The standard of modern transceivers is so high that, in terms of basic performance, it is difficult to pick one unit over another. Receiver sensitivity, for example, and for all practical purposes, turns out to be almost identical for units in the same class.

The same applies to most other basic specifications, so that the final choice is more likely to be based on the features which a particular unit offers.

Having said that, it will come as no surprise when I say that the Multi-800D performs very much as we have come to expect modern 2-metre transceivers to perform; the effective sensitiveity is excellent, there is complete freedom from spurious signals, and there was no sign of cross modulation effects. Similarly, the transmitter performed well in every way.

So let us look first at the features which this transceiver has to offer. As is common practice, it uses a phase locked loop synthesiser for frequency selection, and covers the full 4MHz of the 2-metre band in 5kHz steps.

The novelty in this case is the method of frequency selection. It is by an internal counter which is activated by a panel knob with a choice of three different counting speeds, plus a one (5kHz) step-at-a-time facility.

The knob is spring loaded and is turned clockwise for an increase in frequency and anti-clockwise for a decrease. The first position in each direction gives the one step at a time, or notching, facility.

The second position steps across the band at a rate of 20kHz/sec., which is quite slow, the next position at 100kHz/sec., and the final position at a fast 500kHz/sec. This last covers the entire band in approximately four seconds. When the counter reaches either end of the band it skips back to the opposite end, and commences over again. While counting, the set emits an audible tone every 100kHz.

A memory circuit allows any selected frequency to be held while another frequency is selected and used. Any frequency which has been selected, or stored in the memory, is retained when the set is switched off, provided this is by means of the panel knob only.

The frequency is read out on a four digit LED display, giving the last MHz figure, followed by the 100kHz, 10kHz and 5kHz figures. It is a bright red display, readable in any reasonable ambient light condition.

A feature associated with this is an external display unit, available as an optional extra. It connects to a multi-pin socket on the back of the set via a cord about two metres long and mounts by an adjustable bracket. It is intended primarily for mobile use, to allow the frequency readout to be presented in the most convenient place, such as the top of the dashboard. The figures are slightly larger than the main display, and are green rather than red.

An auxiliary switch provides for simplex or repeater operation, with +600kHz and -600kHz splits, and a free split position. This permits any combination of transmit/receive frequencies to be used, in conjunction with the memory circuit. When split frequencies are being used the digital display changes with the change from receive to transmit.

The transmitter is rated at 25W output, rather than the more common 10W rating, yet the set is not significantly larger than other makes. The power output is continuously adjustable from 1W to 25W by means of a panel knob — a feature not found on many other sets.

A small panel meter serves as an "S" meter for receive, and as an RF power indicator on transmit, but is a relative indicator only in the latter mode, without calibrations.

There are two auxiliary speaker sockets on the rear panel. One drives the external speaker only; the other allows both the internal and external speakers to function.

The set is sturdily built and well finished. It is provided with a handle which doubles as a stand for bench use, and a versatile mounting bracket. It fits in runners in the side of the set, thus simplifying fitting it to, or removing it from, the vehicle.

Tested on the air, in a typical amateur situation, the set performed extremely well. Effective receiver sensitivity, as judged subjectively, was at least as good as others in its class or, in some case, marginally better. However, the difference was more academic than practical.

The method of frequency selection takes a little getting used to but, once the strangeness wears off, it can be used very effectively. Naturally, the fast count is used for major moves and the slower ones as the required frequency is approached. The last few 5kHz steps are notched up.

Reports on the transmission were all favourable, with some spontaneous comments on "... a nice audio quality."

The instruction manual contains a circuit diagram and a block diagram, as well as normal set description and operating instructions. The circuit diagram has been reduced considerably, but is still quite legible. However, the instructions suffer badly from "Japanese English" in places, to the point where some would be confusing if taken literally. However, we doubt whether this would worry many amateurs.

For the amateur who needs one set for both base and mobile use, the external readout, the extra power, and convenient mounting arrangement are worthwhile features. The extra power may also appeal to the poorly sited amateur, as an aid to working distant repeaters.

Details of price and availability of both the basic unit and the optional extra display unit may be obtained from Sideband Electronic Imports, PO Box 23, Springwood, NSW 2777. Phone (047) 51 1395. (PGW)

YAESU from DICK SMITH

WHEN YOU REALLY CONSIDER THE ALTERNATIVES – THERE ARE NONE!

Fabulous FRG-7 Communications Receiver

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Terms available

CAT. D-2850

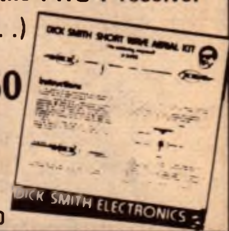
See the review in MAY 1978 E.A.

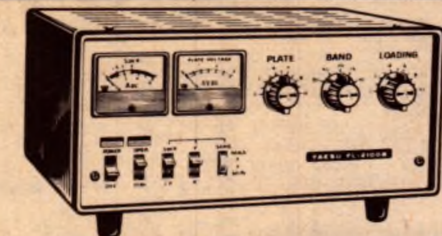
NOW: A short wave antenna kit for the FRG-7 receiver (and any other shortwave receiver . . .)

Designed specifically for Dick by a short-wave expert, this antenna kit needs no soldering, is complete and ready to assemble and has full instructions. Get the most out of your receiver with a good antenna.

$9.50

VALUE! Cat K-3490





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Yes! It's been a long time coming — but the wait was well and truly worth it . . . . The Yaesu FRG-7000 offers the serious SWL the ultimate in a communications receiver.

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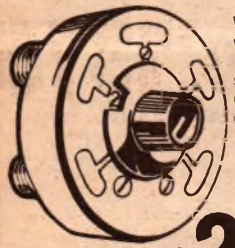

Why take chances with your finals? A proper co-ax switch also reduces TVI, increases efficiency. Insertion loss is negligible, VSWR less than 1.2:1. Up to 150MHz.

Cat. D-5208 **$29.50**

Why not build your whole station around YAESU?

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RSL-145	6M/2M ant	D4104	$23.95
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RSL-7	40M antenna	D4112	$19.95
RSL-14	20M antenna	D4114	$20.95
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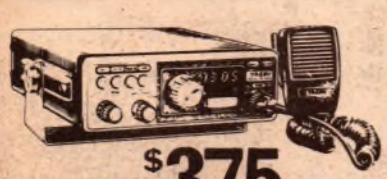

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Carbon Steel. **$3 dozen**
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WEIGHT 1¾ lb
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200 MA 24 volt, ½in push movement.
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8ft in 6 tapered sections, copper plated steel no base **$9.50**.
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$1.75	**$4.25**
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AN5735-1 Air Operated.
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Weight: 2kg
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16MM SOUND PROJECTORS IN GOOD WORKING ORDER

240 volts operated complete with Speaker and Amplifier.
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SORRY NO C.O.D.

SHORTWAVE SCENE

by Arthur Cushen, MBE

Radio Nederland links relay bases via satellite

Radio Nederland, with its studios in Hilversum, Holland, and its relay bases on Bonaire and Madagascar, is now broadcasting over these transmitters using a new satellite and undersea cable link.

Both the new Colombus underwater cable (between Holland and the relay station at Bonaire) and the satellite over the Indian Ocean, linking Hilversum and the Madagascar relay base, are now in regular operation. These new communication links mean that programs are now broadcast live simultaneously over all transmitters from the studios in Hilversum.

It has meant that not only is reception of news bulletins of better quality, but all programs are now much more topical than they have been in the past. For instance, DX Jukebox material from the various reporters had to be recorded at least a month in advance so that the tapes could be flown to Holland, the program made up and then the tapes flown back out to the relay base for broadcasting on the schedulued date. This time has now been reduced to 10 days between the time of recording material in Invercargill until its subsequent broadcast from Radio Nederland from the transmitters in Holland, Bonaire and Madagascar.

At present the DX Jukebox program can be heard every Thursday as follows: 0750-0825GMT on 9715 and 9770kHz and 0850-0925GMT on 9715kHz. The Pacific DX Report is heard on the first Thursday of each month, followed by Jan Tuner with a Scandanavian report on the second Thursday, Glen Hauser with the North American report on the third Thursday, and Victor Goonetilleke with an Asian report on the fourth Thursday.

The use of satellite and underwater cable for a continuous broadcast is the first of its type to be undertaken by an international short-wave station. To introduce the new communication systems, the Happy Station program of Radio Nederland went on the air for 24 hours with Tom Meyer and this was an outstanding success, as the station received telephone calls from listeners throughout the world. These calls were broadcast live as they were received at the studios in Hilversum.

Radio Nederland's Tom Meyer went on air for 24 hours to celebrate the opening of the new links to the relay bases.

The most distant call was from Invercargill.

The use of the new links means that programs can be diversitied, with many of the programs now only put together the day before their actual broadcast. And, of course, news and current affairs can now be broadcast live.

The BBC has, at times, linked its relay station in Singapore with a satellite link to London. However, this has only been done for news broadcasts when the tranmission, which is normally picked up off the short-wave signal and rebroadcast, is suffering from sunspot activity or other disturbances.

NORWAY SCHEDULE

Radio Norway in Oslo is using some new frequencies for the period up to November 4. The service to Australia and New Zealand 0700-0830GMT is now on 11850kHz, which replaces 9590kHz. At the same time, the transmission is carried on 15135 and 15175kHz.

The broadcast 1100-1230GMT to Indonesia and Western Australia is now on 17800kHz (replacing 15175), while 21730 carries the same service. For the service to North America 0300-0430GMT 6180 replaces 9645, 9550 replaces 11895, and 9645kHz replaces 11860kHz.

For the transmission 0500-0630GMT, we find that 17800 replaces 17795 and 9645 replaces 11895kHz. The English transmission is heard on Sundays for the last 30 minutes of the broadcast, as well as on Mondays at 0200, 0400 and 0600GMT.

TURKEY INCREASES POWER

The Voice of Turkey at Ankara is now using a further two 250kW transmitters and has been heard with an English transmission to Europe, the Middle East, Africa and America from 2130GMT. Four frequencies are now used to carry this English broadcast and they are 7170, 7270, 9515 and 9665kHz.

The best frequency for reception in this area is 9665kHz, which suffers only light interference from Radio Moscow on the same channel. The other three frequencies suffer from some degree of interference when the transmission commences: 7170 from the Voice of America, 7270 from Radio Poland and the Italian Radio, and 9515kHz from the Italian Radio.

The new service from Ankara is also being broadcast to South-East Asia on new frequencies. The broadcasts from 1200-1300GMT and to the Middle East from 1300-1500GMT are now on 15145kHz in place of 9665kHz. The English program is 1200-1300GMT.

LATIN AMERICAN NEWS

BOLIVIA: Radio Batallon Colarados, with the call sign CP9, has been heard opening at 1100GMT on 6185KHz. Jack Buckley of Coogee, NSW also reports reception of this station at around 1130GMT. Radio Stentor, which was recently reported on 6173kHz, has returned to 6125kHz and is heard at 1100GMT. Radio Crystal has been heard

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

SHORTWAVE SCENE

on 5050kHz when operating all night during the Bolivian elections. This station is also announcing 6195kHz and is located in La Paz. Brian Dodgson of Melbourne, reporting in "DX Post", states that Radio Emisora Bolivia has been heard at 0930GMT on a slightly higher frequency than the Colombian station Nuevo Mundo on 4755kHz.

CHILE: Radio Universidad Concepcion has been heard opening at 1200GMT and the signal, on 6135kHz, is mixed with South Korea. A long news bulletin in Spanish generally follows the opening.

CUBA: Radio Moscow is relayed by Radio Havana Cuba at 2315GMT in English and at 2330GMT in Spanish on 7150, 7215, 7400, 7410, 9610, 11790 and 15100kHz, according to "Sweden Calling DXers".

COLOMBIA: Radio Mira, in Tumaco, is currently commencing transmission at 1127GMT on 6015kHz with instrumental music, followed by opening accouncements and Todelar network news after 1130 in Spanish. Peter Bunn of Melbourne, reporting in "ADXN", says that this is a new sign-on time for Radio Mira, which previously opened transmission at 1100GMT.

Radio Surcolombiana at Neiva, which operates 24 hours a day on 5010kHz, has been heard at 0600GMT. At this time we heard a station announcement and this was followed by news from the Caracol Network.

COSTA RICA: Radio Universidad, S. Pedro Montes de Oca, which is listed on 6105kHz, has been heard by Ray Crawford of Invercargill, NZ. The station opened at 1200GMT on the new frequency of 6100kHz.

DOMINICAN REPUBLIC: Radio Television Dominicana, in Santo Domingo, has been observed on the new outlet of 5975kHz, with instrumental music after 1000GMT. Peter Bunn of Melbourne, reporting in "ADXN", observes that the station seems to vary its 49m channel almost nightly, using either 5975 or, alternatively, the long-established outlet of 5970kHz. Signals are good on either channel, though 5975 is blocked after 1100GMT when China opens transmission on the frequency.

VENEZUELA: Radio Nacional Caracas has been heard opening at 1000GMT on 6170kHz. The station suffers light interference from a Philippine signal on the same frequency.

NEW AUSTRALIAN FREQUENCIES

Radio Australia's new schedule, effective September 3, lists some new frequencies for the broadcast from the studios in Melbourne. The new channels are: 5955kHz 1730-2030GMT; 5970 1230-2030; 11835 0645-1000; and 11855 2300-0100.

Radio Australia broadcasts around the clock in English, and has transmissions in Indonesian, Standard Chinese, Cantonese, Thai, Vietnamese, Japanese, French and Melanesian.

JAPAN TESTS FROM SINES

Recently, Radio Japan carried out a series of tests from the transmitters of Trans Europe at Sines in Portugal and these transmissions, both of 30 minutes duration, were received in this area. Radio Japan has had difficulty in serving Europe with its transmissions for some years.

The first broadcast was from 0700-0730GMT on 9685kHz and here interference was experienced from the Armed Forces Radio and Television Service on the same frequency. The second broadcast was between 2200-2230GMT on 9670kHz, and provided much better reception in New Zealand.

HAVANA BROADCASTS IN ENGLISH

According to the latest schedule of Radio Havana, Cuba, the broadcasts in English are on the air to Europe and South America from 2010-2140GMT on 17855 and 17750kHz. To North America there are transmissions from 0100-0800GMT in English and these are split up into several transmission times: 0100-0450 11930kHz; 0100-0600 11725kHz; 03330-0600 11760; and 0600-0800GMT 9525kHz. The address of the station is PO Box 7026, Havana, Cuba.

VOICE OF PEACE

One of the last remaining pirate radio stations is the Voice of Peace, which has been broadcasting off the coast of Israel for some years. The station was scheduled to close down in February because a survey conducted by the Israel Broadcasting Authority showed that the pirate radio station had few listeners.

Abie Nathan, owner of the Peace Ship, made a last minute appeal for listeners to meet in a Tel Aviv square. 60,000 people turned up, advertising flooded in, and the Voice of Peace remained on the air.

So far, the station has raised more than $2 million for worldwide charities. According to the "New Zealand DX Times," transmissions are still being heard on short-wave on 6250kHz and on medium-wave on 1538kHz.

AUSTRIAN CHANGES

The Austrian Radio at Vienna recently made changes to some of its services, and it is expected that these will remain in force after September 3. The major change for Australian listeners is the service to this area 0700-0900GMT which includes English at 0830GMT. The frequency of 9605kHz has been used, but because of complaints of interference from Radio Morocco on 9615kHz a new frequency had to be found.

The broadcast from Vienna 0700-0900GMT is now on 9585kHz, while from 0900-1300GMT the new frequency is 17855kHz. For the broadcast to Europe 0500-1900 and 1900-2200GMT, the first transmission remains on 6155kHz, but from 1900 it is on 5945kHz.

LISTENING BRIEFS

EUROPE

BULGARIA: Radio Sofia broadcasts in English to the following schedule according to the BBC Monitoring Service: from 0000-0100GMT to North America on 15330kHz; 0430-0500 to North America 11750; 1830-1900 to Africa 15310 and 17825; 1930-2000 to Great Britain and Ireland 9700 and 11720; 2030-2130 to Africa 11735, 11765 and 15310; 2130-2200 to Great Britain and Ireland on 15135 and 11750kHz.

SWITZERLAND: "Swiss Radio International" is to be the new slogan of the Swiss Broadcasting Corporation overseas service, according to an announcement from the station. Berne broadcasts to New Zealand and Australia in English daily 0700-0730 and 0900-0930GMT on 9560, 11780, 15305 and 21520kHz. Italian is broadcast at 0730, French at 0800 and German at 0830GMT.

AFRICA

SAO TOME: Signals from Sao Tome on 4807kHz have been observed in New Zealand around 1800GMT, with announcements in Portuguese. The station has also been noted by Barry Williams of Auckland, reporting in the New Zealand DX Times and heard opening at 0530GMT with a weak signal.

SIERRA LEONE: Freetown has been heard on 5980kHz, having moved from 3316kHz. According to Peter Bunn, reporting in "ADXN", the station has been noted closing in English at 0002GMT. Signals have been noted on this frequency as early as 2130GMT.

ANGOLA: Radio Nacional Luanda now has a daily Spanish transmission for Cubans resident in Angola on 7245 and 9660kHz at 2100-2130GMT, according to Richard Ginbey reporting in "Sweden Calling DXers".

ASIA

NEPAL: According to "DX Digest of India", Radio Nepal is testing on different days between 1220-1520GMT on 15195 and 17795kHz.

PAKISTAN: Radio Pakistan at Karachi has been noted on 15405kHz with English news at 1100GMT. This transmission was formerly on 15115kHz. The transmission time of the World Service is 0700-1100GMT, when both 15405kHz and 17665kHz are used. The news bulletin at 1100GMT in English is read at slow-speed.

Radio Pakistan has also been noted on 21730kHz by Tim McSweeney, Mount Isa, Queensland. The station was heard at 0240GMT with a news bulletin in English, and closed at 0245GMT.

Classical Recordings

Reviewed by Julian Russell

Charpentier — Louise: new version of a lovely opera

CHARPENTIER — Louise. Complete Opera. Ileana Cotrubas (Louise); Palcido Domingo (Julien); Jane Berbie (Mother); Gabriel Bacquier (Father) and countless other minor characters with the New Philharmonia Orchestra and Ambrosian Opera Chorus conducted by George Pretre. CBS Stereo with libretto in English/French and German. S3BR 220614. (Three Boxed Discs).

I never cease to wonder why, outside France, Charpentier's Louise has proved such a poor stayer in the opera stakes. It is tuneful in a unquie way, for the most part made up of short phrases almost in the Wagnerian leit motif manner — though that is its only likeness to the German's works — and has only one aria, the evergreen and delicious "Depuis le Jour". The composer, by the way, wrote his own first class libretto.

Louise was one of the first, if not the very first, of the verismo operas — that is, an opera in a modern setting with the players wearing street clothes and behaving like normal people. There are no gods and godesses, no dukes and duchesses, no period costuming. Instead Louise gives a perfect picture of life in a Parisian working-class family but without the often beautiful tarting up of the atmospheres as in Puccini's La Boheme, great work though the latter is.

The period of Louise is Paris during La Belle Epoque. Despite its very large cast it has only five chief characters — a painter (Julien) in love with a young dressmaker who lives opposite, her disapproving "respectable" father and mother, and last but by no means least, the city of Paris.

Frustrated at home the girl runs away to live with her artist lover, and is ecstatically happy with him until she is tricked into returning home by her harsh mother. There she is watched like a prisoner, even by her doting father, until she can stand it no longer and again runs away, this time for good. The final scene is as dramatic as any I can recall in opera and the end of the first act one of the most touching.

The whole is coloured by typical Parisian scenes and characters common at the beginning of this century — clochards, playboys, street sweepers, hawkers, workgirls and, since it is set for much of the time in Montmartre, feckless but exhuberant near-artists. The great Mahler himself regarded the opera as a masterpiece and made a personal friend of the composer, inviting him often to stay with his family. But Frau Mahler was not so keen on his visits, as he was given to spitting on the floor.

It is sparklingly scored for large orchestra and the characters are all presented "in the round". Yet with all this going for it a performance outside Paris is a rare event indeed. This makes the new recording all the more welcome, the more so since it is splendidly sung, well acted vocally, and the whole well held together by the conductor, Georges Pretre. Although the singers are nearly all continental the orchestra is English, the New Philharmonia, and so is the chorus, the Ambrosia Opera Chorus.

I have only one quibble with the production — the voices are often recorded a little too forward so that the orchestra, which plays such an important role in the work, is sometimes drowned out. I did improve this to an appreciable extent by raising the volume and sitting an extra long way away from the speakers. But I readily forgive its occasional blemishes in gratitude for a new version of this lovely opera.

So far as I know this is only the second time it has been recorded. Philips put out a recording which was far from satisfactory right at the beginning of the LP period. In that version you could hardly hear the orchestra at all.

Charpentier caught to perfection the Paris when it was truly the City of Light, without its present day skyscrapers, traffic snarls, Americanisations and other such degradations. Indeed as you progress through the opera you will realise that the chief character of Louise is Paris.

If you enjoy French music, I urge you to buy this record set.

Isaac Stern: "fastidious musicianship"

SAINT-SAENS — Violin Concerto No. 3. CHAUSSON — Poeme for Violin and Orchestra. FAURE — Berceuse, Op. 16. CBS Stereo Cassette RC887.

French music of roughly a generation earlier than Charpentier's opera, reviewed above, is on this cassette of a violin recital by Isaac Stern. The major work is the Saint-Saens concerto though I enjoyed the other two works more.

Stern plays the concerto with immense authority. He treats this not very weighty work with complete seriousness and without the slightest hint of condescension. His playing of it has the effect of increasing its significance, which I consider no slight feat.

The work has all Saint-Saens' characteristics — immaculate workmanship and tunefulness of the most easily appreciated kind. Stern's style is always masterful, even in moments of the most extreme delicacy. Even if he does sound a little too assertive in the matter of balance with the orchestra in the first movement, he never completely drowns out the orchestra. I think the work would sound commonplace nowadays under any but this type of treatment.

The Finale goes with real boyish bounce — and Stern is far from boyhood nowadays. While there is never a jarring bar throughout the entire work there is very little that could be described as exciting anywhere if one excepts Stern's brilliant technique and fastidious musicianship. Daniel Barenboim and the Orchestra de Paris supply a completely satisfactory accompaniment and the sound is first class.

In Chausson's Poeme, Stern changes his style to a fitting mood of sensitive romanticism. The smoothness of his phrasing demonstrates that the long French legato has no mysteries for him. He never pulls the music about with exaggerated rubatos or use a tone like the tremulant stop on a cinema organ.

Yet his reading is never short of pas-

sion of the most refined kind. He plays Faure's delectable Berceuse with exactly the simplicity that robs it of none of its innocence. And I might add that this is not the innocence of the Christopher Robin kind but that of a supreme master of his art.

☆ ☆ ☆

LISZT — Annees de Pelerinage. Second year, Italy. Played by Alfred Brendel (piano). Philips Stereo Cassette 7300 404. (Also on disc.)

Here is another romantic performer but this time in the present day manner. This cassette gave me constant delight, not only in Brendel's playing but also in the beautiful reproduction of the sound by the cassette engineer. The fidelity of the piano tone, the audibility of Brendel's subtlest variations of sonorities, the complete lack of background noise, and perhaps above all, Brendel's playing makes this an enjoyable listening session.

Till I heard this cassette, Arrau has always been my favourite Liszt player. Now I'm not so sure. Let's say I've found in Brendel another to give me equal pleasure.

Liszt's Second Year of Pilgrimages, as he called them, takes in Italy. (The first was about Switzerland.) It is not the country he describes but his response to some of the works of art found there. The items where written at different times over a fairly long period and then revised and issued in the form we have here some years later.

So radical were some of the revisions that many musicians, pianists among them, will be surprised to learn that the three beautiful Petrarch Sonnets were originally composed for high voice.

Until we reach the last of the seven items in this recital there is no showy virtuosity about Brendel's interpretation. If it were possible to prove by comparison I think that this is the way Liszt would have played them himself. Many of them demonstrate the astonishing originality often found in some of Liszt's works. There is one passage at the end of the first item, "Sposalizio", that might well have been written by Debussy a couple of generations later.

Moreover, Brendel plays it as the later composer would have liked to hear it; to quote him "as if the piano had no hammers." Brendel uses this same exquisite touch in others on this cassette with ravishing effect. And you don't even have to go past this first item to appreciate Brendel's superb control in the building of a huge climax.

The second item, "The Thinker", has nothing to do with the great statue by Rodin. Instead, the subject is Michelangelo's brooding statue on the tomb of Guiliano de Medici in Florence. To quote from Humphrey Searle's perceptive and all too brief annotations that accompany the cassette: "Liszt's music catches the statue's attitude of brooding melancholy, and at the end the music dies away with a chromatic descending passage which anticipates Wagner's Tristan of 20 years later."

But then, Wagner's occasional pinching from Liszt has been notorious for years. This item is a study in sombre beauty, its sadness caught to perfection by composer and executant alike.

No. 3, "Canzonetta del Salvator Rosa," is based on a song written by a Byronic character who caught Liszt's fancy. It is a fairly straightforward setting of the song itself, but demonstrates Brendel's sense of a beautiful smooth melodic line.

Then come the three Petrarch Sonnets. Petrarch was, of course, a famous poet of another age and the combination of Liszt and Brendel brings out all the music's musing poetry of the first and the more agitated mood of the second. The third is again in quieter mood, and includes a marvellously played series of short, almost staccato chords.

The last work, headed "After Reading Dante", and sub-titled "Fantasia quasi Sonata", is perhaps better known as the Dante Sonata and is no stranger to present day concert goers. It is, as one might guess, more overtly dramatic than any of the preceding pieces and demands a full share of the player's virtuosity.

The whole production is another example of the spectacular improvements Philips have made in the cassette recording technique. I advise both Lisztians and even non-Lisztians not to miss it.

☆ ☆ ☆

THE ART OF MISCHA ELMAN (violinist) — an album of his favourite pieces by various composers. Vanguard Stereo Disc VSD 71173. (Also on cassette).

I don't know the difference between the ages of Stern and Elman, but there is a generation's difference in their styles. In Elman's recital there is only one piece that is included in Stern's — Faure's Berceuse — and nothing could demonstrate better the different temperaments of the two players. For while Stern's interpretation is strictly though elegantly classical, Elman's is as romantic as you can get. Elman exploits his golden tone, sensuously muted, in this unaffected modest little piece. And he continues in this mood throughout the recital of what could be regarded as a collection of little encore pieces.

Kreisler called his contribution "La Precieuse" (in the style of F Couperin), but Elman's treatment of it is far from what I have always considered to be Couperin le Grand's style.

Technically, Elman can play very fast, but even at that game I'd back Heifetz or Stern at 100 to 1 on. And while speaking of technique, Elman's harmonics at the end of the Espejo work are quite painful to listen to. It is strange to find in a recital of this kind a composition by Australian composer Arthur Benjamin — "From San Domingo". It is not very impressive and sounds to me like a very early work or one commissioned to be finished in a hurry.

Debussy's "La Plus que Lente," also played muted (con sordino), is full of Saccharine phrasing and distortions. And so it goes throughout the recital of 10 items, all played in Elman's swooning style that might well have provided, with the lights dimmed, an invaluable aid to dumb seducers in a less sophisticated age. He is ably accompanied by Joseph Seiger.

Although just issued in Australia the disc was recorded in 1966 and is also offered on cassette.

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CLASSIC RADIO

245 PARRAMATTA RD, HABERFIELD 2045. PHONES 798-7145, 798-6507.

Lighter Side

Reviews of other recordings

Devotional Records

FRED FIELD And Friends. Stereo, Maranatha HS-031. (From S. John Bacon Pty Ltd, (PO Box 345) 12-13 Windsor Ave, Mt Waverley, 3149.)

Fred Field, pictured as a young man with a wife and young son, must have been a very busy person during the production of this album in 1976. He wrote most of the lyrics and most of the music, did most of the vocals and took a turn on guitar, fiddle, mandolin, banjo and piano — sometimes on the same tracks, and presumably with the aid of multi-recording.

The lyrics are fringe Gospel with environmental and sociological overtones, and are set out in full on an inner sheet: Warms Away The Coldest Night — The Last Train To Heaven — Falling — Building A House — He Lives — Good Ol' California — Suffer the Little Ones — Country Life — That Morning — Home.

The Music varies widely from rock, through C & W to touches of Hawaiian, but all of it performed by the young for the young. If you like the very modern Gospel idiom, Fred Field could well gain you as yet another friend; if you don't, then look elsewhere. (W.N.W.).

☆ ☆ ☆

MESSIAH. George Frederick Handel. The Choirs of the Hood College and the US Naval Academy, conducted by John Talley. Stereo, Richardson, RRS-2. (From M. R. Acoustics, PO Box 110, Albion, Qld. 4010.)

Recorded by Charles A. Richardson in 1976, this is one of a series of albums that aims to preserve, as closely as possible, the character and acoustics of the original performance. While still mastered on tape, it involves a single special microphone and a minimum of console manipulation.

The result is very clean sound, wide dynamic range, and choruses with organ and orchestra that would seldom be equalled in weight and clarity. And, if you have the facilities, a spot of 4-channel ambience will envelop you in the massive sound of the "Hallelujah Chorus". Thrilling indeed!

But, against this, some of the solo work sounds unduly remote, perhaps because, in a sound-only re-creation, the visual is not there to reinforce the audio image. Could not this vital difference be a fundamental subjective gap in the purist argument for a single microphone? Add to it a sprinkling of incidental and audience noises and you have the basis for a counter-argument favouring additional closer mikes, at least for the solos.

Musically, the performance covers what the jacket notes describe as the "Christmas section" of the Messiah: recitatives, plus "And the Glory of the Lord", "For Unto Us A Child" Pastoral Symphony, "Glory To God", "His Yoke Is Easy" and "Hallelujah".

When it comes to "Messiah" this Richardson recording has a lot of competition, particularly in terms of the performance itself. But its claim to attention lies in the "purist" approach to the recording. (W.N.W.)

☆ ☆ ☆

SCHWEITZER PLAYS BACH. Mono, World Record Club Retrospect series. WRC-3178.

For anyone at all interested in the late Albert Schweitzer as a person, or as an authority and exponent on the works of J. S. Bach, this record should commend itself automatically. Compiled from the EMI archives by Bryan Crimp, it contains eight tracks as under:

Side 1: Toccata and Fugue in D Minor, BWV 565; Prelude and Fugue in C Major, BWV 545; Fantasia and Fugue in G Minor, BWV 542. These were recorded during 1935 at the organ of All Hallows Church, Barking-by-the-Tower, London.

Side 2, Choral Preludes: Jesus Christus, Unser Heiland; O Mensch Bewein Dein Sunde Gross; Christ Lag In Todesbanden; Liebster Jesu, Wir Sind Hier; Prelude and Fugue in E Minor. These were recorded in 1936 at the organ of Ste Aurelie, Strasbourg.

Side 1 is the better of the groups, with a clean though somewhat dated sound. Side 2 lacks the clarity and definition but not to the extent that will prevent you from appreciating the playing of the famous organist.

The cover carries a portrait of Schweitzer at the console (he would have been 60 in 1935), while there are biographical notes on the back. Retrospect, indeed. (W.N.W.)

Instrumental, Vocal and Humour

L'ENFANT ROI. FRANCK POURCEL And His Grand Orchestra World Record Club WRC R 03709

Franck Pourcel's Grand Orchestra is certainly well named. As a group of experienced musicians, they produce a sound that is very pleasing, with renditions of twelve mainly modern tunes: L'Enfant Roi — Mamy Blue — Don't Let It Die — "Opus 35" — We Shall Dance — Io E Te — Jesus Christ SuperStar — Venise Va Mourir — Charlie — Comme Juliette Et Romeo — The Fool — Butterfly.

The sound quality and exploitation of the stereo image is superb, putting the record into the "demo disc" class without a doubt. But it would also be ideal for a quiet evening's relaxation or for that special dinner party. (N.J.M.)

FRANCK POURCEL. SHE'S A LADY. World Record Club WRC R 03317

Fourteen modern hits from such pens as George Harrison, Paul Anka, Cat Stevens and Bert Bacharach, get the big orchestra treatment from Franck Pourcel and his Grand Orchestra in this very enjoyable album. Originally from the Columbia list, it is released here by the World Record Club.

The Titles are: My Sweet Lord — If You Could Read My Mind — She's A Lady — For All We Know — Sad Lisa — To Sir With Love — Let It Be Me — Love Story — Close To You — Lara's Theme — Je T'Aime Moi Non Plus — I'll Never Fall In Love Again — Theme From Borsalino — Raindrops Keep Falling on My Head.

It is interesting the difference such treatment makes to tunes that one hears ad nauseum on radio in their pop form. (N.J.M.)

Reviews in this section are by Neville Williams (W.N.W.), Jamieson Rowe (J.R.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.), David Edwards(D.W.E.), Greg Swain (G.S.), and Danny Hooper (D.H.).

SERENADE. RON GOODWIN AND HIS ORCHESTRA World Record Club WRC S/2459

Ron Goodwin's big British orchestra does a splendid job on twelve "serenade" type numbers on this Parlophone recording released by World Record Club, with such titles as: Sunrise Serenade — Theme from "Romanoff & Juliet" — Elizabethan Serenade — London Serenade — Clair de Lune — March from "Serenade For Strings" — India — Puppet Serenade — Elizabeth & Essex Love Theme — Serenade to Double Scotch.

This is music in the tradition of Mantovani and Pourcel and ideal for the easy listening situation. The overall quality is excellent. (N.J.M)

World Record Club recordings reviewed in these columns can be obtained only through the Club, membership of which involves purchasing not less than one record per year. For details: World Record Club Pty Ltd, 605 Camberwell Road, Hartwell 3124. Tel. (03) 29-3636.

HAPPY HOFBRAUHAUS. The Jo Ment Orchestra. Stereo, World Record Club W.R.C. R-04250.

If you have ever responded to the happy communal sound of hofbrauhaus or a variety of other central European situations, here's your chance to re-awaken the experience with a generous album of orchestra, chorus and audience, unbroken except for the break between sides. There are no separate tracks as such.

The numbers are listed but don't expect to repeat them; the titles are all in German and there's twenty-eight of them, all told! The two lonely English titles are "Beer Barrel Polka" and "Clarinet Polka".

An Ariola recording, released in Australia through the W.R.C., the quality is notably clean and relaxed with good balance and wide stereo separation. But, of course, these qualities will be wasted on you, if you don't like the "happy hofbrauhaus" kind of sound. (W.N.W.)

☆ ☆ ☆

BODY LOVE, Klaus Schulze. Island L 36491 Festival release.

This is one of those records that is hard to define. The first side consists of one track and the second of two only, of synthesizer music written as additional material for a movie of the same name. It tends to grow on you, something like Ravel's Bolero. The tracks are: Nowhere Now Here — Stardancer — Moogetique.

The cover one would tend to hide from sensitive eyes, with its naked ladies cavorting through uncomfortable poses. There is a fair amount of rumble in the recording but, apart from that, the quality is okay. (N.J.M.)

☆ ☆ ☆

LOVE'S UPS AND DOWNS. Barbara Mandrell. ABC Dot stereo DO 2098. Distributed by RCA Ltd.

Barbara Mandrell is a C & W artist who can belt out the numbers in best Nashville style but without the exaggerated nasality that has become associated with this idiom. This latter feature will make Barbara acceptable to a wider audience. The instrumental backing is good with a strong rhythm section. Recording quality is good so it adds up to enjoyable listening.

There are ten tracks in all: Your Love Has Lifted Me Higher And Higher — Don't Hand Me No Hand Me Down Love — If I Were A River — The Magician — Woman To Woman — Tonight — Let The Rain Out — A Fancy Place To Cry — Walking Home In The Rain — How Long. (L.D.S.)

☆ ☆ ☆

LOUIS ARMSTRONG At The Pasadena Civic Auditorium. GNP Crescendo L45785/6 Festival release

There is no evidence of recording dates on this double album, but Armstrong fans certainly get their money's worth with 16 of Louis' favourites: Sleepy Time Down South — Indiana — Someday — Ole Miss — Tin Roof Blues — My Bucket's Got A Hole In It — Perdido — Dardanella — How High The Moon — The Gypsy — Undecided — Blues — That's My Desire — Kokomo — Sleepy Time Down South — Didn't He Ramble.

Vocals are handled by Louis and Velma Middleton with Trummy Young Edmond Hall, Billy Kyle, Arvell Shaw, Barrett Deems and the Teddy Buckner Band. The record quality is good and captures the sounds and sensations of a live performance before a large and enthusiastic audience. One of the photos inside the cover shows Louis before a huge birthday cake with "70" on the top; perhaps it was a birthday concert. (N.J.M.)

☆ ☆ ☆

LYNN ANDERSON CBS SBP 237044

If you like your ballads with an upbeat country flavour, you could do much worse than listen to this record, made in Nashville. The quality is really good, with a competent backing from the Lea Jane Singers, together with Janie Frick, Buddy Skipper and Lisa Silver.

They put together ten tracks: He Aint You — Desperado — The Angel In Your Arms — It's Your Love That Keeps Me Going — My World Begins And Ends With You — I Love What Love Is Doing To Me — We Got Love — Right Time Of The Night — Sunshine Man — Will I Ever Hear Those Church Bells Ring.

If you become bored with the record, you can get to work on the sleeve with a pair of scissors as it is printed in the form of paper doll cut-outs of Lynn Anderson, complete with horse and four changes of costume! (NJM)

☆ ☆ ☆

SHIRLEY BASSEY, YESTERDAYS. United Artists L36516. Festival Release.

Shirley Bassey fans get their money's worth in this album, no doubt released to coincide with her visit to this country.

There are twelve titles on the disc, all old favourites: My Melancholy Baby —

AN EVENING WITH JULIE ANDREWS. Live concert recording. Stereo, RCA JPL1-1230.

Recorded live, in September 1977, in the Festival Hall at Osaka, Japan, this performance was enjoyed thoroughly by the huge audience.

And I hasten to add: it was enjoyed no less by my own family audience when I reviewed it. Perhaps it was because it had not been put together from multiple takes but flowed, rather, as an unbroken display of the Julie Andrews talent; from the sentimental and the sacharine, through stage musicals to belting jazz.

Full marks must be given also to the principal accompanists, to the "String Fantastic Orchestra" and to "Nabuo Hara with his Sharps And Flats."

Track titles are: I'll Play For You — I'm Old Fashioned — Wouldn't It Be Loverly — This Is My Beloved — Being Alive — Medley (jazz, etc) — Whistling Away In The Dark — Medley (Sound of Music, etc) — Medley (musicals) — The Sound Of Music — I'd Rather Leave While I'm In Love.

Allowing for the fact that the whole performance was recorded before a very live and a very enthusiastic audience, the sound quality is very good indeed. This is one that I can heartily recommend. (W.N.W.)

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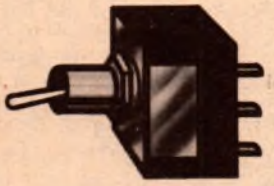
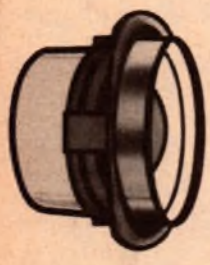
Rotary, lever key, toggle, thumb wheel, touch activated including illuminated.



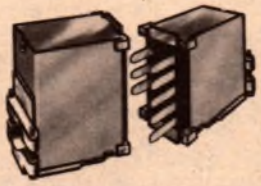


Speakers – Foster & Fostex
Speakers ranging from guitar, woofers, mid range, tweeters, horns, full range and elliptical, all are available.

Optoelectronic devices
Including LDR'c, LED'c photodiodes, phototransistors, photocouplers and 7 segment, alphanumeric and cold cathode displays.

"E" Cell
The "E" Cell device suitable for a number of applications such as repetitive timing and control, pulse counting and memory, timing, current-time integration, use-time measurement.

Service and elapsed time indicator
For trucks and other vehicles, trains and stationary engines – where ever there's a suitable power source to indicate elapsed time and when service is due.



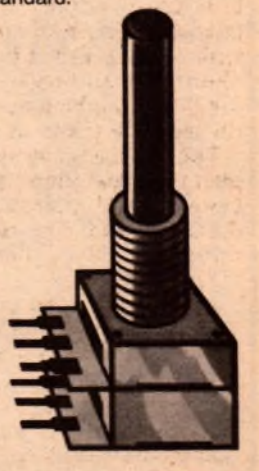
Batteries – Saft
Nickel cadmium (rechargeable) cells and batteries, for domestic, heavy industrial, emergency power, military and aviation.

Potentiometers
Moulded carbon track and wire-wound of both commercial and professional standard.

Sonalerts – Mallory
Electronic audible signals providing a startling innovation in warning devices, producing a penetrating sound by purely electronic means. Circuitry is all solid state for maximum efficiency, lowest current requirements, and highest reliability.

Connectors
A multitude of connectors including the Multicon range consisting of 2, 4, 6, 8, 10, 12, 18, 24, and 33 pole. Also the 159 range of plugs and sockets ranging from 7 to 71 poles. Gold flash on contacts and solder tags for long term protection against tarnishing. Also the 22 range of marine and aviation connectors.

Capacitors
Capacitors for a wide variety of applications, ranging from tantalum, chip ceramic, long-life and electrolytic.



Lamps and indicators
Consisting of filamentary, neon and LED styles designed for all general illumination applications.

Speaker Enclosures
One of the range of Plessey Foster and Fostex speaker enclosures.

Dry reed inserts and relays
Suitable for most switching functions the inserts have proven extreme reliability, long life, and the ability to operate in grossly unfavourable environments.

PLESSEY

Plessey Australia Pty. Limited
Components Division
Christina Road,
Villawood NSW 2163
Telephone 72 0133 Telex 20384
VIC: Plessey Australia Pty. Ltd.
North Melbourne 329 0044;

AD 105

THE LIGHTER SIDE — continued

I'm In The Mood For Love — I've Got You Under My Skin — Time After Time — Don't Get Around Much anymore — There I've Said It Again — You Made Me Love You — Over The Rainbow — Taking A Chance On Love — As Time Goes By — I Only Have Eyes For You — Love Is Here To Stay.

The sound quality is excellent. If you have seen any of the current series on ABC television, you can appreciate the exuberance the lady puts into every performance. In a word, enjoyable. (N.J.M.)

☆ ☆ ☆

JIVE TO STAY ALIVE. Dennis Garcia. Indigo. DG/IN001. Astor release.

This album can be introduced by Dennis Garcia:— "I am currently exploring the field of bio-feedback combining I.B.M. 5100, Roland MC 8 and Digital Synthesizer, also using a number of analogue and digital musical instruments. The purpose of my musical experimentation is to combine bio-feedback devices, computers and synthesizers to create bio-electronic music."

The result is an album somewhere between Rick Wakeman and Giorgio Moroder, possessing a disco appeal.

All of the eight tracks were composed by Dennis Garcia and recorded in Melbourne. A listen to this new bio-electronic music is recommended. (D.H.)

☆ ☆ ☆

STAN GETZ PRESENTS, Jimmy Rowles, The Peacocks. CBS SBP 237106

Stan Getz gets together with some of the top names in the business to provide thirteen tracks of enjoyable, restrained jazz.

Others appearing are Jimmy Rowles, piano; Buster Williams, bass; Elvin Jones, drums; John, Judy and Michelle Hendricks and Beverly Getz on vocals. The tracks are: I'll Never Be The Same — Lester Left Town — Body And Soul — What Am I Here For — Serenade To Sweden — The Chess Players — The Peacocks — My Buddy — The Hour Of Parting — Rose Marie — This Is All I Ask — Skylark — Moaic/Would You Like To Take A Walk.

The quality is excellent, particularly that of the solo piano tracks, but I do wish they would re-work the sleeve design; it tends to be rather off-putting. (N.J.M.)

☆ ☆ ☆

ERUPTION. Eruption. RCA. VPL1 4067.

These five black musicians — four males and one female (namely Precious Wilson) have recorded a brilliant album. The musical arrangement and vocals are excellent.

The opening track on the album is a 6½ minute version of the smash hit single — "I Can't Stand The Rain" that erupted it's way into the National Top 3 in Australia and London.

Seven out of the ten tracks can be categorised as disco. The remaining three tracks were slower, including a brilliant version of "The Way We Were".

In summary, this album is excellent. Every song possesses very clear vocals with dynamic music accompanying the vocals. A listen to this album, if not a purchase, is a must for disco followers. (D.H.)

☆ ☆ ☆

FORMALLY OF THE HARLETTS. Sharon Redd, Ula Hedwig, Charlotte Crossley. CBS SBP 237129.

These three ladies have released an album which is predominantly soft-

BLESS THIS HOUSE. Stuart Burrows (Tenor) with Eurfryn John (Piano and Organ). Stereo, World Record Club WRC-S/5313.

Born in 1933, Welsh tenor Stuart Burrows made his operatic debut with the Welsh National Opera Company, singing Ishmael in Verdi's "Nabucco". Subsequently he filled engagements in Ireland, America, England and Europe.

In this album he is quite a different role with a mix of songs of faith, songs from Ireland and drawing room ballads: Passing By — Oft In The Stilly Night — Thora — Macushla — Roses of Picardy — I'll Walk Beside You — Bless This House — Because — Gortnamona — I Hear You Calling Me — Maire My Girl — Trees — The Holy City — Ave Maria.

The performance is straightforward — well known solos and traditional piano accompaniments — but so capable that it can scarcely fail to appeal to anyone who would respond to the track titles. Organ is used, by the way, in "The Holy City" and "Ave Maria", again in the usual settings.

While the recording may have a slightly dated sound, it is nevertheless completely clean and as "honest" as the performance which it carries. Playing time is over 40 minutes. (W.N.W.)

RECKLESS. The Sports Mushroom. L 36571. Festival release.

The Sports are a Melbourne based band with a predominant sixties background but, although the roots of this band do lie truly in early rock 'n' roll rhythm and blues, they capably translate their influences into songs which possess a genuine '78 sound.

This album contains the single "Boys (What Did The Detective Say)", which received considerable air play throughout Australia. Ten out of the eleven tracks are Australian compositions. All songs contain strong guitar backings and a thumping rhythm — no wonder Sports are basically a good-time dance band.

This album is very good and, with further releases, Sports could become one of Australia's top bands. (D.H.)

Continued from previous page . . .

centred, with some disco. Two well-known solo performers make appearances on the album — Bette Midler and Peter Allen.

Bette Midler's contributio has fairly obviously influenced the harmony, as some of the songs on the album are very similar to her own work.

However, despite the contributions of Bette Midler and Peter Allen, the album is not more than routine. The vocals in all cases are excellent but the musical arrangements could be better.

Three out of the eight racks on the album that do appeal are: Can't Dance — Ain't No Man Worth It — Now (Sweet Lover Man). (D.H.)

☆ ☆ ☆

I HAD TO FALL IN LOVE. Jean Terrel. A&M Records Inc L 36506. Festival Release.

Jean Terrel is a former lead singer of the now legendary Supremes (she replaced Diana Ross), so it comes as no surprise to discover that this album is styled largely on the "Mowtown sound".

There are, in my opinion, two outstanding tracks on this album. These are the title track "I Had to Fall in Love," a ballad with a country & western flavour and "That's the Way Love Grows", a powerful up-tempo disco number.

The remaining racks are rather too stylised for my liking: Don't Stop Reaching for the Top — No One Like My Baby — Rising Cost of Love — Change — How Can You (Life Without Love) — You've Been So Good For Me — No Limit

My advice is to listen before buying. Recording quality is excellent, with negligible surface noise. (G.S.)

☆ ☆ ☆

EL TORO, Music Of The Bullring. IMAGE ILP-4978. Astor release.

Featuring La Banda Taurina, this record of Spanish bullfight music, although excellent in quality, becomes boring after a few tracks, with the sameness of the content and the clockwork precision of the percussion. There are 12 titles, including: El Gato Montes — El Relicario — Paso Doble Te Quiero — Espana Cani — Mi Jaca — Pepita Greus.

My opinion of bull-fighting does not bear repeating in public so perhaps I'm biased but this is one record I would pass up. (N.J.M.)

New Products

YAESU FRG-7000 PERFORMS WELL

A new and interesting release from the Yaesu Musen Company is the FRG-7000 communications receiver, which features digital readout of the frequency to which the receiver is tuned. It also includes a digital clock displaying local time and GMT, and doubling as an off-on equipment timer.

The FRG-7000 has obviously been developed from the well known and popular FRG-7, which was reviewed, in its latest form, in the May issue. The two receivers will presumably continue in the Yaesu range at their quite different price levels.

Physically, the FRG-7000 is a little wider at 360mm than the FRG-7, a little deeper at 295mm, but not quite so high, at 125mm. The weight is the same, at about 7kg.

Like the FRG-7, the new receiver is a triple-change superhet using the Wadley loop principle.

Incoming signals pass through an initial low-noise FET RF amplifier stage to an up-converter, which shifts them into an IF channel 1MHz wide, centred on 55MHz. They are then down-converted to a second IF amplifier, also 1MHz wide, centred on 2.5MHz. The locally generated frequencies necessary to effect these two conversions are synthesised from a crystal-locked system, with the further refinement that any residual drift tends to cancel rather than add in the end result.

In effect, this front-end serves to shift all desired incoming signals into the range 2MHz to 3MHz, substantially drift-free. This makes it relatively simple for the "back end" of the receiver to convert, amplify and demodulate the signals, using a precision single-range oscillator, a 455kHz IF channel, BFO, product detector and audio system.

The wording in the foregoing paragraphs is very similar to what we said about the FRG-7, for the simple reason that both use similar circuitry. In fact, many of the specifications are identical: modes, AM, AM with ANL, USB, LSB, CW; AM sensitivity, better than 2μV at S/N 10dB; SSB sensitivity, better 0.7μV at S/N 10dB; drift, less than $\pm$500Hz at any 30 minutes after warm-up; speaker impedance 4 ohms; audio power output 2W.

There are, however, significant differences. The FRG-7000 has an extra filter in the 455kHz IF channel which halves the original bandwidth when it is switched to CW or SSB: ie. to $\pm$1.5kHz at —6dB and $\pm$4kHz at —50dB.

The upper frequency limit remains at just above 30MHz but the lower limit has been extended downwards to 250kHz. This has necessitated the provision of five rather than four channels on the RF preselector, with a system of color coding to minimise possible confusion.

Again, the analog scale on the main tuning dial has been replaced by a clearly visible digital readout which shows the frequency to which the receiver is tuned directly into MHz (or kHz on the low range) readable to 1kHz. In effect the "MHz selector" knob sets the figures 0 to 30, to the left of the decimal point, while the main tuning knob sets the figures to the right of the decimal point.

The other notable addition is a digital clock panel to the right of the main frequency readout. It operates from the main 1MHz crystal in the front end and remains operative while ever the receiver is plugged into an active power point — even when the remainder of the circuitry is switched off. It shows hours to 24, minutes and seconds, and has the usual "Fast", "Slow" and "Hold" switches to permit very accurate setting of the time against standard broadcast signals.

The clock can be set to display local time and GMT, at the flick of a switch, while it can also be set to switch the receiver on and off at pre-set times. An in-built low-voltage switch, operating in conjunction with the timer, can be used to activate external relays and to switch other equipment as, for example, a tape recorder.

One other major point of difference is that the option for an external 12V supply or internal D-cell supply has been deleted, the FRG-7000 being equipped only for mains operation at a power drain of 25W; this compares with 14W for the FRG-7 — a difference of almost 2:1.

Other facilities and the method of tuning are basically the same as detailed for theFRG-7 in the May issue. Perhaps because we were used to the earlier receiver, it took a little longer to react intuitively to the digital display. On the other hand, it might have helped if we had looked at the instruction book before — rather than after — putting the receiver into operation!

Sufficient to say that it didn't take long to come to terms with the new receiver and to appreciate the precision with which it could be set to specific frequencies. Nor was there any doubt about the operation of the narrow filter for the SSB and CW modes, in producing a true "single signal" effect.

Some may argue for a slower tuning rate to facilitate SSB tuning but this would have made the receiver tedious for general listening to other signals. As it was, we found no special difficulty in tuning SSB stations by means of the main knob and without resource to the "fine tune" knob similar to that fitted to the latest FRG-7s.

And, once tuned, they stayed put!

The FRG-7000 was submitted for review by Bail Electronic Services of 60 Shannon St, Box Hill North, Vic. 3129. Phone (03) 89 2213. See their advertisement in the July issue for specifications, warranty details and interstate representatives. (W.N.W.)

Seif DM-2000 3½-digit DMM

A new arrival in the digital multimeter market is the Seif DM-2000 Digi-tester. It is a low cost 3½-digit unit, and can mea ure AC and DC volts, alternating and direct currents, as well as resistance. It operates from internal dry cells or an external DC supply.

The DM-200 is mounted in a black plastic case, measuring 66 x 147 x 161mm. Weight without batteries is 650g. A four digit LED display is provided, along with 6 discrete LEDs to serve as range indicators. The display character height is 11mm.

Power supply is by four AA cells, or an external 6V/300mA DC source. No provision has been made for the use of rechargeable batteries. A pair of red and black test leads are supplied, as well as an instruction manual.

The DC voltage ranges have full scale readings of 199.9mV, 1.999V, 19.99V, 199.9V and 1999V. On this last range, however, readings are restricted to 1000V max. Input impedance is better than 100 megohms on the 199mV range, and better than 10 megohms on the higher ranges.

Rated accuracy is ±0.2% of the reading ±0.1% fsd and ±1 digit. The input is protected to 1000V DC or peak AC on all ranges by a zener diode network. The resolution is 100uV on the lowest range, rising progressively to 1V on the 1000V range.

The AC voltage ranges are basically similar to the DC voltage ranges, except that on the highest range, the maximum input voltage is 700V. The bandwidth on all ranges is from 16Hz to 10kHz. Rated accuracy is slightly poorer, at ±0.6% rdg, ±0.3% fsd and ±1 digit. The resolution, input impedance and overload rating are the same as on the DC ranges.

Five DC current ranges are provided, with full scale readings of 199.9uA, 1.999mA, 19.99mA, 199.9mA and 1.999A. Resolution is 100nA on the lowest range, rising to 1mA on the highest range. Overload protection is via a 2A fuse on all ranges, and the maximum voltage drop across the meter is 2V. Accuracy is stated as ±0.3% rdg ±0.1% fsd and ±1 digit on the four lowest ranges, and ±0.7% rdg ±0.5% fsd and ±1 digit on the 1.999A range.

The AC current ranges are similar to the DC current ranges, but with reduced accuracy. The figures quoted are ±1.2% rdg, ±0.5%fsd and ±1 digit on the four lowest ranges, and ±1.5% rdg, ±0.7% fsd and ±1 digit on the 1.999A range.

The five resistance ranges provided have full scale readings of 1.999k, 19.99k, 199.9k, 1.999M and 19.99M. Resolution is 1 ohm on the lowest range, and 10k on the highest range. The test current is 0.77mA on the lowest range, falling in decade steps to 0.077uA on the highest range. Maximum applied voltage on all ranges is 0.2V.

The quoted accuracy is ±0.7% rdg, ±0.1% fsd and ±1 digit. As far as we were able to tell with our limited test equipment, the unit met or exceeded all accuracy specifications

These accuracy figures are quite impressive, and compare very well with other DMMs in the same and slightly higher price brackets.

Automatic polarity indication is provided on all DC voltage and current ranges. The display is updated every 400mS, and input overloads are indicated by blanking the three rightmost digits of the display. This is not in agreement with the instruction manual, which states that this is done by flashing the display.

Banana jacks are used for the input connectors. A potential safety hazard exists with these, however, as they are not recessed and bare metal is available on both the sockets and the plugs for the unwary operator's fingers to find. This requires extra care on the high voltage ranges, or when measuring lower voltages or currents at a high potential with respect to ground.

To sum up, the Seif DM-2000 is a compact, versatile and solidly made DMM which offers a high order of accuracy. As such it should be suitable for both amateur and professional use.

The DM-2000 is available from Dick Smith Electronics stores and dealers, and has a recommended retail price, including tax, of $145.00. Further enquiries should be directed to your nearest DSE store or dealer. (D.W.E.).

Digital readout system for machine tools

The Teledyne Gurley (USA) range of electronic digital readout systems for machine tools is now available in Australia. These complete off-the-shelf systems, trade-marked "Pathfinder", can be easily retrofitted to existing machine tools such as milling machines and lathes etc.

A pre-packaged, linear, glass incremental scale and readout head is attached to the machine worktable for each axis of motion. Scale lengths up to 366cm are available, according to user requirements.

The electronic outputs from the reading head are connected to a keyboard entry and LED display unit. The position of the work table can then be instantly displayed to 0.01mm (0.0005in) using Model 8780, and to 0.002mm (0.0001in) using Model 8775.

Main features of the display unit include bright LED readouts, pushbutton operation, and advanced microprocessor based circuitry. Leading zeros are suppressed for clarity, and a warning shows in the event of a momentary power failure.

Installed on a machine tool, the Pathfinder will: convert the machine for inch or metric operation; eliminate backlash and leadscrew errors (important for older machines which may be worn); reduce scrap by reducing operator errors; and increase productivity.

For further information contact Demco Machinery Co. Pty Ltd, PO Box M88, Sydney Mail Exchange, NSW 2012.

NEW PRODUCTS

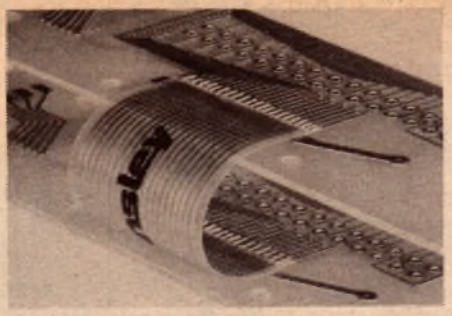
Power supply kit

Latest addition to the range of educational kits developed and marketed by Selectronic Components is the 138 power supply kit. This assembles to provide a neat, strong and versatile nominal 12V/2.5A DC supply, suitable for bench or workshop use. It can be used to power CB radio transceivers and also to charge batteries. The output is fully protected and has current limiting. The kit comes complete with all parts and comprehensive instructions.

Typical output voltage is 13.8V, with 0.68% regulation up to 2.5A.

Further information from Selectronic Components Pty Ltd, 17 Barry St Bayswater Vic. 3153. Telephone (03) 729-2992.

PCB jumpers



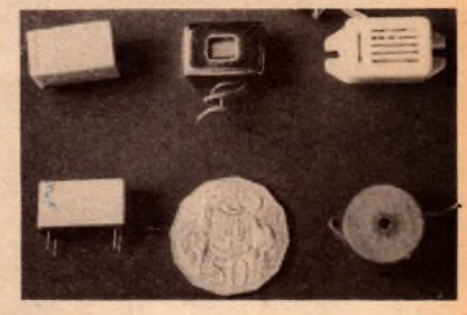
To provide closer spacing of jumper leads on PC boards, Ansley Electronics has added to its range a new series of Flex Strip jumpers on .075in centres. Primarily designed for soldering to PCB pads, the jumpers have flat wires inside the insulation for maximum flexibility, but round ends for easy soldering. The jumpers feature Teflon insulation and come in a range of standard lengths with four different pin end configurations.

Further information and samples from Ansley Electronics, Box 91 P.O. Brookvale NSW 2100. Telephone (02) 938-1713.

Solid state "buzzers"

A range of miniature piezo ceramic audio indicators is available from Instrument Technics. Low in current drain, they offer freedom from the RFI and other electrical interference produced by electromechanical buzzers. Typical models offer an acoustic output of 85dBA at 3M distance for 8mA drain (3-30V supply), and feature long life and a wide temperature range.

Output frequency options are at either 3kHz or 500Hz nominal, both corresponding to peaks in human audio response. Various terminal con-



figurations are available. The devices are available from parts stockists, with prices starting from around $2.

Further information is available from Instrument Technics (AI information), Box 224 P.O. Doncaster Vic. 3108. Include three 20c stamps to cover cost.

Digital thermometer

The Digitron 1750 is a pocket-sized battery operated digital thermometer which uses Chromel-Alumel thermocouple sensors to measure over the

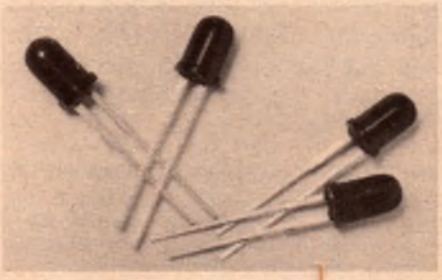
range from —50 to +1200 C. A large bright display indicates temperature with an accuracy of 0.5% of reading +0.5 degree. An advanced auto-ranging system enables a resolution of 0.1 degree between —50 and +185 degrees C.

Also available from the Digitron range is the model 2754 bench-type mains powered digital thermometer. This uses a platinum resistor sensor to cover the range from —150 to +800 degrees C, with an accuracy of 0.2 degrees. An analog output, directly proportional in mV to the temperature reading in degrees C, is provided.

For further information on these and the other instruments in the Digitron range apply to Cortek Instruments, P.O. Box 184, St. Leonards NSW 2065.

Low cost LEDS

High quality light-emitting diode lamps in standard diffused-red 5mm diameter packages are available in quantity at attractive prices from Diggerman Electronics. The LEDs offer typically an output of 800 microcandelas at 20mA and 25 degrees C, with peak output centred on 0.65uM.



Unit price for small quantities is 17c, falling to 12c each in 100 lots and 11c each for 1000 off. Mounting bezels are 3c each regardless of quantity.

Further information is available on request, also a sample LED may be obtained by sending a 20c SAE to Diggerman Electronics, Box 33 P.O. Coramba, NSW 2466.

360° prism magnifier

The Zi-Tech Inspector is a pocket-sized prism magnifier which shows a full 360-degree inside view of holes. It automatically focuses on contact with the surface and requires no operator training, allowing potentially costly drilling faults such as spiralling,

roughness and burring to be instantly detected. In electronics production, checks on PCB holes for plating voids, smoothness and solder flow can be made quickly and at low cost.

Further information is available from C & K Electronics (Aust.) Pty Ltd, P.O. Box 101, Merrylands NSW 2160. Telephone (02) 682-3144.

IC handling tools

Micro Electronic Systems have added a new range of IC inserion and extraction tools to their well-known DIP-A-DIP line. The model 112 insertion tool is designed for 0.4in wide LSI chips, and has stainless steel side plates to allow earthing for MOS devices. Three new extraction tools are also available for 0.4in, 0.5in/24/28 pin and 0.6in/36-40 pin devices.

Further informmation from Royston Electronics, 22 Firth St, Doncaster, Vic. 3108.

The Trio CO-1303G 75mm CRO: ideal for the amateur "shack"

Designed with an obvious eye to the radio amateur market, the Trio CO-1303G 75mm Oscilloscope is primarily intended for use in checking transmitters. It is a versatile instrument in this field and it should appeal to all who have an interest in monitoring and checking radio transmissions, be they amateur, CB or commercial.

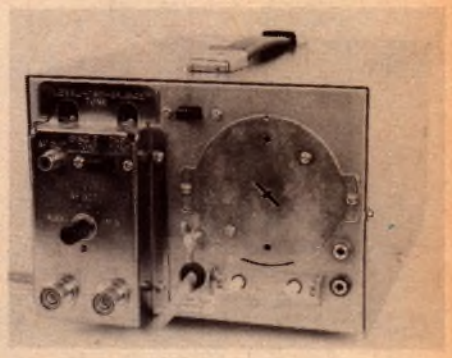
A cathode ray oscilloscope, or CRO for short, is one of the most useful instruments available in the electronics field. With such a device, one is able to actually view many of the waveforms which occur in a wide range of electronic equipment. By so doing, it is often possible to check whether or not a device is functioning normally and to identify possible problems and solutions.

When a CRO is designed with some specific purpose in view, redundant facilities can be eliminated, thus reducing the price tag. At the same time a specialised instrument may have added features so as better to serve the function for which it was designed.

In the context of transmitters, a CRO may be used to view and check the modulation envelope of an AM transmission. By so doing, the percentage of modulation may be ascertained, along with other factors such as whether the modulation is linear or not, whether there is clipping of the positive-going peaks, whether the negative-going cycles are being cut off, etc. Such checks may be made under conditions where a constant tone is fed into the transmitter, or under more typical conditions where speech is being processed.

Single sideband operation of a transmitter may also be checked. By means of the two-tone technique, the output may be checked for correct linearity, overdrive, bias adjustment, etc. Where CW operation is used, the keying characteristics of the transmitter may be assessed.

As mentioned at the outset, the Trio CO-1303G is a specialised instrument in that it is intended primarily for checking and adjusting radio transmitters. This has resulted in a somewhat simpler unit than some of the more sophisticated general-purpose instruments with dual-trace facilities, wideband calibrated amplifiers and calibrated timebase. On the other hand, the CO-1303G provides direct access to the vertical deflection plates via terminals on the back panel so that transmitter modulation envelopes may be displayed. The sensitivity under these conditions is quoted as being higher than 1W/division with a 50-ohm load. Associated with this facility is an RF attenuator to control the level of RF being fed to the vertical deflection plates.



This rear view of the instrument shows the attachment at the left which provides access for RF to the deflector plates and also houses the two-tone oscillator. To the right are focus and intensity controls, and Z-axis (intensity modulation) facilities, together with a means of rotating the tube slightly for exact vertical and horizontal traces.

Another feature is a built-in single tone and two-tone audio oscillator. A single tone of 1000Hz is available for testing AM systems, while the two-tone facility includes 1575Hz for testing SSB signals. The inclusion of the audio tones into this instrument makes it virtually self-contained for tests of the sort so far outlined.

It should be pointed out that although transmitter testing is an important function of the CO-1303G, there are many other uses to which it may be put. These include testing of audio amplifiers for frequency response, distortion, square wave performance, etc. Tests involving the use of Lissajous figures may also be made. Also, it is possible to use the CRO for making RTTY tests and adjustments.

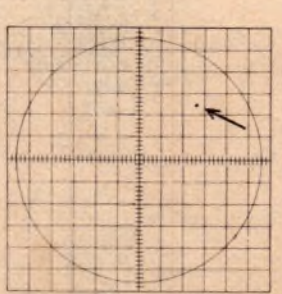
In fact, it would not be unreasonable to say that this instrument may be used for most purposes where a general-purposed CRO is used, provided that a dual trace and accurately calibrated amplifiers and time base are not essential.

The unit is supplied with a comprehensive Instruction Manual running to 36 pages. A general description is given of the instrument, together with operating instructions. Maintenance and alignment of the instrument is also covered, along with a complete circuit diagram. The current price is quoted at $343.85, including tax.

Further information on the CO-1303G may be obtained by contacting Parameters Pty Ltd, 68 Alexander Street, Crows Nest, NSW 2065. (I.L.P.)

PARAMETERS/ELECTRONICS AUSTRALIA GRAND INSTRUMENT CONTEST NO. 3

First prize of a TRIO 1303D oscilloscope was won by:
Mr M. Henry,
Campbell,
ACT,
and second prize of a B&K Digital Multimeter was won by:
Mr N. Crawford,
Dulwich Hill,
NSW.



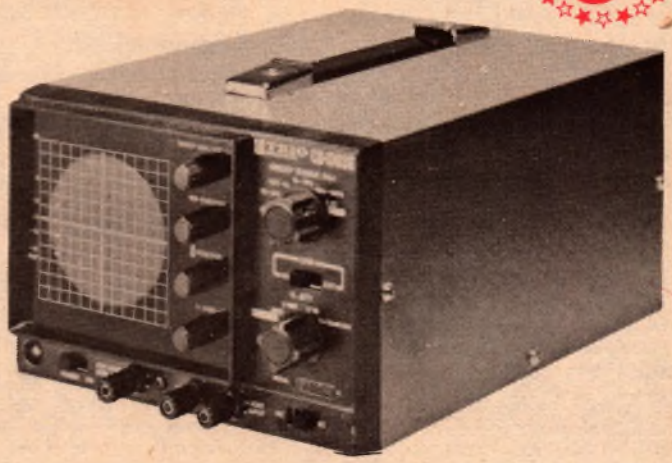
Where was the dot? . . .
This diagram shows the exact location.

Our congratulations to Mr Henry and Mr Crawford, and our thanks to the several hundred other readers who participated.

PARAMETERS/ELECTRONICS AUSTRALIA

GRAND INSTRUMENT CONTEST No. 5

TRACE THE TRACE AND WIN...



TRIO 1303G OSCILLOSCOPE

Monitor Frequency Range: **1.8 to 54MHz (1-500W)**
Two Tone Generator: **1kHz and 1.575kHz (1kHz in single tone)**
Oscilloscope capability: **DC to 5MHz at 10mV**

Designed for the amateur radio enthusiast, the CO1303G is a versatile monitor scope with many useful features. Two M-type connectors on the rear enable the scope to be connected into the antenna coax so that transmitted waveforms may be observed. A built-in two tone generator aids checking and mic gain adjustment etc.

In addition, the 10mV/div vertical sensitivity and broad bandwidth from DC to 5MHz, makes this instrument ideal for general service and lab work.

Hurry with your entries for Contest 1 — you could win a TRIO 1560A 15MHz scope!!

Our "Spot the Dot" contest proved so popular, that we've decided to run another one like it. This one is just a bit more difficult — you have to work out the shape and position of the trace. Then the TRIO 1303-G scope reviewed alongside could be yours!

This time we fed the output of a typical 4W AM tranceiver operating in the 27-29MHz band into the Y-plates of the 1303G with the input attenuator set at maximum sensitivity. The output was terminated with a 50ohm resistive load and there was no modulation.

All you have to do is decide the shape and position of the trace. All entries will be placed in a container and the first correct coupon pulled out wins the Trio scope. If there is no correct entry, then the winner will be the entrant whose trace is closest in the estimation of the editor of Electronics Australia.

ENTRY COUPON

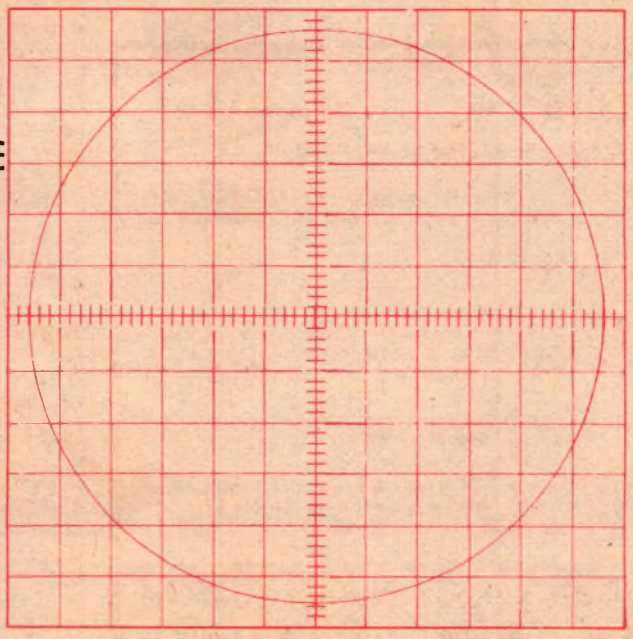
Parameters/E.A. Grand Instrument Contest No 5

TRACEtheTRACE

Simply draw the trace as you think it appeared. Fill in your name and address and mail the coupon to:

Parameters/Electronics Australia
Grand Instrument
Contest **No 5**
P.O. Box 163,
Beaconsfield, N.S.W. 2014

All entries must be in by **October 9th** when the winner will be chosen.
The decision of the editor is final and no correspondence will be entered into.
Permit No. TC 1209A issued under the Lotteries and Art Unions Act.



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_____

ADDRESS _____

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Where do you normally make your electronic purchases?

_____

I agree to abide by the rules of the contest -

Signed: _____

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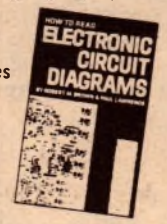

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DICK SMITH ELECTRONICS

Books & Literature

Novice exam guide

MANUAL OF QUESTIONS & ANSWERS FOR THE NOVICE LICENCE, by Keith Howard, VK2AKX. Sixth edition. A Westlakes Education publication. Soft covers. 100 pages, 240mm x 180mm. Illustrated with numerous diagrams.

The instructional literature produced by Keith Howard and the Westlakes Radio Club has become something of a legend wherever amateur exams and study material is discussed. Produced originally in duplicated form this particular book quickly earned a reputation which resulted in nearly 4000 copies being sold last year.

In the introduction, the author explains that the book has been compiled around questions asked in previous novice examinations, at the same time pointing out that this does not make it a comprehensive guide to all possible questions.

There are 15 sections, under the following headings. (1) Units. (2) Electrons at Work. (3) Circuits. (4) Components. (5) Power Supplies. (6) Propagation. (7) Modulation. (8) Operating (9) Transmitters. (10) Receivers. (11) Meters and Measurements. (12) Calculations. (13) Services (Morse code). (14) Supplement (Tips and facts). (15) Examination (An actual novice paper).

Each section consists of a detailed text covering the particular subject, followed by a serious of questions, on that subject, taken from previous examinations. Each question is discussed and the method of arriving at the correct answer shown.

The quality of the instruction material appears to be quite high. Each section starts at an elementary level and, in an easy-to-read style, builds up in logical stages until it is dealing with relatively complex aspects.

At the same time, there are obvious omissions from what one has come to expect from standard text books. There is, for example, no detailed explanation of resonance; only a description of a tuned circuit, and the purpose for which it is used. We imagine that this is deliberate, to avoid confusing the student with material he is unlikely to need at this level.

As well as the technical text, there are notes on applying to sit for the examination, addresses of licensing branches, and a replica of the application form.

Summing up, this appears to be an excellent book for the aspiring novice, regardless of whether other texts are available or not. And, at the price, extremely good value.

Our copy from Dick Smith Electronics, who quote their price as $3.75 at all Dick Smith stores, or by mail post free. (PGW)

. . . and for the AOCP

HAM EXAM CRAM BOOK. By Ivan Botha, VK2B10. Published by the author. Soft covers, 34 pages, 190mm x 160mm, illustrated by circuits and diagrams. Price in Australia $2.00 postpaid.

It would be unwise to dismiss this booklet on the basis of its modest size and price; on the contrary, the conciseness with which the material is presented is one of the book's features.

As the name implies, it is intended for those studying for the AOCP theory exam. It evolved out of the author's studies and notes associated with his own approach to the exam.

One thing the book is not — and the author emphasises this point himself: it is not a substitute for in-depth study, or the classic textbooks normally specified for this exam. Rather it is an additional text to supplement these studies.

In particular, it will help bridge the gap between the formal studies and the exam itself by listing the most vital pieces of information which the student needs to remember.

While there were a couple of points which I felt may mislead a student, perhaps by being over condensed, the material is accurate and pertinent. At the very least this book will be a useful addition to any examinee's library; at the most it may make the difference between passing and failing the first time. Recommended.

Our copy direct from the author at 316 Grey St, Glen Innes, NSW 2370. (P.G.W.)

Microprocessors

MICROPROCESSORS: FROM CHIPS TO SYSTEMS, by Rodnay Zaks. 2nd Edition, 1977. Sybex, Inc, Berkeley, California. Soft covers, 139 x 217mm, 416pp. Price in USA $9.95.

As we have noted before, the way to achieving an understanding of

Books & Literature

microprocessors is not easy. If you have no understanding of computer concepts at present, no one book — no matter how good — is likely to make you an instant expert. But I must report that this is one of the best introductory books on the subject that I've seen to date.

The author, Dr. Rodnay Zaks, is an experienced microprocessor system designer and an established author and lecturer. This book is essentially a distillation of a number of training course texts he has written over the last few years, and as a result it is well polished. The material is well organised and clearly presented, and should go a long way towards helping beginners on their way.

There are 10 chapters, titled as follows. 1 — Fundamental Concepts; 2 — Internal Operation of a Microprocessor; 3 — System Components; 4 — Comparative Microprocessor Evaluation; 5 — System Interconnect; 6 — Microprocessor Applications; 7 — Interfacing Techniques; 8 — Microprocessor Programming; 9 — System Development; 10 — The Future. The book ends with 6 data appendices.

Some of the diagrams and tables have been reduced rather too much, and have become rather difficult to read. However in all it seems a very worthwhile addition to the introductory literature on micros, and one I can recommend.

The review copy came direct from the publisher, but I understand that copies are available from Computerland. (J.R.)

. . . and again

AN INTRODUCTION TO PERSONAL AND BUSINESS COMPUTING, by Rodnay Zaks. Sybex, Inc, Berkeley, California, 1978. Soft covers, 140 x 217mm, 245pp, many illustrations. Price in USA $6.95.

Another introductory book by Dr. Rodnay Zaks, in this case intended more for the potential hobbyist or business user who needs an introduction to the basic concepts of computers at the system level. It could also be of value to those seeking to go into the subject deeper, but who currently lack the background.

The treatment is pitched at "inteligent layman" (layperson?) level, and does not attempt to give more than a basic familiarity with system concepts and the main items of hardware. But within this realistic context, it is clearly and concisely written, and well illustrated.

There are 14 chapters in all, covering everything from basic definitions to the economics of selecting a business system. There are also six data appendices, covering things like logic concepts, binary notation, communications concepts and lists of manufacturers.

In short, a highly readable introduction to small computing systems for the non-technical hobbyist or business user.

The review copy came direct from the publisher, but I understand that copies are available from Computerland. (J.R.)

Battery patents

PRIMARY BATTERIES, Recent Advances. Edited by Robert W. Graham. Published by Noyes Data Corporation. Hard covers, 363 pages, 230mm x 150mm. Price in US, $42.00.

SECONDARY BATTERIES; Recent Advances. Edited by Robert W. Graham. Published by Noyes Data Corporation. Hard Covers, 398 pages, 230mm x 150mm. Price in US, $42.00.

We reviewed a forerunner of these books in our August 1975 issue (Storage Batteries and Rechargable Cell Technology) and the current edition on second batteries is, in fact, an update on this. The one on primary batteries appears to be the first of a new series on this subject.

While the titles of both books sound intriguing to anyone interested in batteries, they are likely to be disappointed if they expect an advanced text book on the subject. In fact, both books are simply reference books, compiled from patent applications lodged with the US Patent Office.

To quote from the foreword, "The US patent literature is the largest and most comprehensive collection of technical information in the world. There is more practical, commercial, timely process information assembled here than is available from any other source."

In this sense these books would undoubtedly be extremely valuable to anyone involved in research at an industrial level, particularly in preventing wasted effort by duplicating work by other researchers, and already on record.

On the other hand, they cannot in any sense be regarded as textbooks which will introduce the student to subject; on the contrary, by their very nature they presuppose that the reader is already deeply involved in the subject, and interested only in the various advances being made.

On this basis, these books must be regarded as being suitable only for a highly specialised market and, particularly by reason of their relatively high price, difficult to justify at any other level.

Our copies direct from the publishers, Noyes Data Corporation, Park Ridge, New Jersey, USA. (PGW).

INFORMATION CENTRE

MICROCOMPUTERS: I am interested in microcomputers. I am a form five student and the school has a Canola SX100 programmable calculator. I have read somewhere that it can produce graphs, parabolic curves, etc but I cannot find how to do it. I have scoured the instruction manual to no avail. Could you help me, as such a facility would be invaluable in physics and chemistry, and I would also gain a greater understanding of programming as such. (I. K., Victoria.)

● Sorry, I.K., but this is the kind of question which is outside the scope of our query service. We have to restrict this service to helping readers who are in trouble with one of our own projects. We simply are not set up to handle queries of a general nature, such as this one. Perhaps a letter to the makers might be more fruitful.

PLAYMASTER 40/40: I have constructed two Playmaster 40/40 amplifiers, both of which operate very well. After the two volts drop across the 100 ohm resistors had stabilised, I left the meter connected to the resistor and I placed the lid on the amplifier, running the meter leads under the lid. After the lid was on for only a couple of minutes, I noticed the voltage drop was over four volts and still increasing steadily.

I realise that this occurred due to temperature effects but I wonder what the voltage drop would be after a few hours. Should I use a different setting, depending on whether I operate the unit with lid on or off. I hope I don't sound too confusing but this is bothering me. I am now running both amps with the lids off to avoid doing damage or at least too much current being drawn with the lids on. (Not signed, Wollstonecraft, NSW.

● The quiescent current setting in the Playmaster 40/40 is not particularly critical. If you had left the amplifier on for some time you should have found that, after some initial overshoot, the quiescent current would stabilise at some value not too far removed from the initial setting. It is immaterial whether the amplifier is operated with lid on or off, since the quiescent current transistor (T15, T115) is in thermal contact with the output transistors via the chassis.

LOW COST VDU: I plan on building your Low Cost VDU and keyboard encoder described in the February and April 1978 editions respectively. As I have a SC/MP microprocessor which requires +5V at 350mA and —12V at 200mA, I was wondering if it is possible to use the VDU power supply for the microprocessor also? (B.F., Winston Hills 2153).

● No extra circuitry can be powered from the VDU power supply, as this is already fully utilised in supplying the VDU. It would be possible to use a larger transformer and a regulator with a higher current capability, although this would involve considerable redesign.

Notes & Errata

FET VOLTMETER (September, 1978, File No. 7/M/55: The printed circuit board No. 78/mv/8 listed in the parts list should read No. 78/vm/8.

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The system consists of:

Stereo Tuner (ST-9030) with wide and narrow IF bands.

Stereo DC Preamp. (SU-9070) with phono signal-to-noise ratio of 88dB (for 2.5 mV input).

Stereo Universal Frequency Equaliser (SH-9010) for exact response control in any acoustic environment.

Peak / Average Meter Unit (SH-9020) for exact response measurement.

Stereo / Mono DC Power Amplifier (SE-9060) with all-stage direct-coupled pure complementary symmetry circuitry. Total harmonic distortion is 0.02%.

Each individual component offers a degree of fidelity in sound reproduction, and a flexibility and ease of operation that makes it a natural choice for the audio fan who cannot be content with less than the best.

National Technics hi-fi

For a National Technics Catalogue, please write to:
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