ELECTRONICS Australia HIFI NEWS SEPTEMBER, 1975 AUST 80c* NZ 80c

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LISTENER...

SONY PS 5550 Photo-Sensitive Auto Return Turntable
(no mechanics means a smoother trip)

Sony ends the old argument about automatic versus manual turntables magnificently with the new PS 5550.

Now you can enjoy the convenience of automatic return without the wear and tear, noise and other problems usually involved in mechanical detection.

The Sony PS 5550 really is an electronic marvel. Not only is the automatic return detection operated by photo-electric means, the large D.C. motor is electronically speed controlled.

Sony's renowned engineering excellence shows throughout the brilliant PS 5550. Performance is nothing less than sensational with wow and flutter at an amazingly low under 0.08% (DIN 45539) and signal/noise better than 65dB (DIN 45539).

How does Sony do it?

Firstly, rotation is always stable and accurate because the large, slow-speed D.C. motor is servo controlled.

Every micro-fluctuation in current automatically generates its own correction so the speed of motor and platter never vary. Then the turntable mounting is shockproof, effectively insulating it from external vibrations, and even pushing the control buttons does not affect stability, because the controls and turntable sections are mounted on separate bases.

An illuminated stoboscope, with two vernier speed adjustment knobs, allows accurate control of pitch.

The tone-arm is a precisely engineered S type, statically balanced, with both direct-reading tracking-force gauge and anti-skate compensator. The headshell is the universal plug-in type. Operating controls are all neatly grouped in a strip on the front. They provide automatic set-down and arm return. Auto reject and manual operation is also provided.

Aesthetically, the PS 5550 is slim and beautifully simple. To sum it up, may we quote Australian Hi-Fi Test Laboratories: ‘A superb turntable’

SONY®
Research Makes the Difference
Here is a combined AM-FM stereo tuner that should make a worthy addition to any hi-fi system. The unit offers many attractive features, including AFC, delayed front end AGC and off station muting for FM, two tuning meters, and a dual selectivity AM tuner. See page 48.

Those who built the Fluorescent Readout LSI Digital Clock featured in the April issue should find this crystal-controlled 50Hz drive unit of particular interest. It will enable you to power your clock from a standby battery in the event of mains failure, or to adapt your clock to complete battery operation. Full details on page 74.

On the cover
A general view of the Cleo Tokomak apparatus used for nuclear fusion research at Culham Laboratory, UK. Part of the control room and diagnostics area are shown in the foreground, with the toroidal plasma confinement device in the background. For a description of current fusion research and the tokomak plasma confinement technique, readers are referred to an article entitled ‘Fusion Power: Energy for the Future’ published last January. (Picture courtesy U.K.A.E.A.)

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500-5,000Hz and it's almost flat. How's that for about $50 worth!

It's the performance curve of Philips new mid range speakers. That curve is so flat it gives a variation of as little as ± 1 dB over the same frequency spread. And even beyond those levels the drop is gradual on either side. And to think this performance is now available for about the $50 mark. Not bad for a 50 Watt dome squawker speaker. For further information please contact ELCOMA Electronic Components & Materials, Box 50, P.O. Lane Cove, NSW 2066 or telephone 42 1261 or 42 0361. Branches in all States.

ELCOMA
Editorial Viewpoint

By way of explanation

Like most magazines, we at EA get quite a few letters from readers concerning magazine content. Many are complimentary, but inevitably some are critical. Whichever the case we read and consider each one, because they all provide valuable feedback information. Without them we would find it very much harder to produce a successful magazine.

Now I'm not saying we enjoy getting critical letters far from it. No one enjoys learning that they have blundered, any more than they enjoy learning that they have a disease. But like nasty medicine, valid criticism is good for you in the long run, as Socrates pointed out long ago.

What we would like our critics to remember, though, is that we are simply a group of people trying to earn a living by providing a magazine you will hopefully find of interest and value each month. We don't claim to know all the answers, or to never make mistakes.

This applies particularly where our practical construction projects are concerned. In the university or government research lab, there is almost no limit to how far one can go in pursuing performance and design elegance. Even in a normal industrial situation, there is usually the opportunity to rationalise and go through a preproduction run before a design is crystallised.

Quite frankly, the economics of the magazine publishing are such that if we tried this sort of procedure, we'd go out of business. All we are able to do is produce a working prototype, test it as thoroughly and as stringently as we can, and if the results are good we publish.

We wouldn't be human if we didn't find it frustrating. Often we would love to be able to upgrade a design or make it more elegant. But we console ourselves with the belief that you would rather have a magazine with projects having occasional bug, than have no magazine at all!

Also consoling is the knowledge that big manufacturers, despite their rationalisation and pre-production runs, still have to issue modification lists for some time after their designs have gone into production. As our serviceman noted in his column last month even an experienced and respected firm like EMI has had to do this with their colour TV sets, so perhaps we shouldn't feel too bad about a few small errors in a project like our EDUC-8 computer system.

So if we do produce a design now and again which gives you a few problems, I'd ask you to bear in mind the limitations under which it was produced.

Jamieson Rowe
What do **SCOPE** Superspeed Irons do best?

**SCOPE TRANSFORMER**
This transformer is specially designed to provide a safe low voltage power source for Scope Superspeed Irons (and Vibroscope etching tools).
An earthed isolation shield prevents capacitive coupling with possible voltage leaks.

---

1. **Provide intense heating power:**
The patented heating concept located right behind the tip provides tremendous heat output to get the iron hot fast; then keeps the temperature under your control to complete every joint faster.

2. **Let you control the power:**
Should you encounter a heat sink which would rapidly drain away tip heat (e.g. thick metal or a need for plenty of molten solder) your finger switch provides another burst of heat to keep the copper tip at correct temperature. Normally only heavy irons have this capacity and take a long time to heat — and cool.

3. **Put this heating power right at the tip:**
A perfect iron has its heat source right at the surface of the tip — inefficient irons have theirs up the barrel. The Superspeed range generate their heat on the copper tip itself, hence the intense concentration.

4. **Let the tip run cool when not actually soldering:**
The tip stays tinned longer and lasts much longer because it switches off when you let go the handle. This feature plus a low heat conductivity stainless barrel keeps the handle cooler.

5. **One iron replaces several:**
With normal irons, you need several different sized irons to cope with various jobs and avoid the risk of dry or weak joints. Scope has designed an iron that does the work of any other iron from 10 watts to 150 watts.

Scope products are available from all electrical wholesalers.

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**SUPERSPEED USER SELECTION DATA**

<table>
<thead>
<tr>
<th>Low heat conductivity barrel</th>
<th>Superspeed</th>
<th>Mini Superspeed</th>
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<tr>
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<tr>
<td>Weight (without leads)</td>
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<td>Heating up time for hard silver solder from cold (630°C)</td>
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<td>Choice of copper tip shapes</td>
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</tr>
<tr>
<td>Cable lugs fitted</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**User Preference Guide:**
- Electronic Service work: TV with vac. tubes, Solid State equipment
- Electronic and Hi-Fi hobbies: 2nd pref., 1st pref.
- Electricians and Linemen: 1st pref.
- Home Handymen and Farmers: 1st pref., not recommended
- Model making — Mechanical Hobbies: 1st pref., 2nd pref.

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ELECTRONICS Australia, September, 1975
AMPLIFIERS EXPLAINED:

An amplifier amplifies, or strengthens, the sound signal from your turntable or tape deck to your speakers. Obviously, the better the amplifier the better the sound from your speakers. Below are three excellent examples of what good amplifiers should be. They start at around $200.00. And go up to around $600.00. Which is another thing you must learn about Hi Fi equipment. Talk is cheap. Good sound reproduction is not. Ask to see the full range of Kenwood Hi Fi equipment at any good Hi Fi Centre.

KENWOOD

KA-1200G**
Power Output: 13 + 13 watts RMS into 8 ohms load at 1,000 Hz. Both channels driven. Total Harmonic Distortion: 0.8% at rated power into 8 ohms load. Power Bandwidth: 20 Hz to 40,000 Hz. $180.00*

KA-4006**
Power Output: 32 + 32 watts RMS into 8 ohms load at 20 Hz-20,000 Hz. Both channels driven. Total Harmonic Distortion: 0.5% at rated power into 8 ohms load. Power Bandwidth: 8 Hz to 45,000 Hz. $399.00*

KA-1600G**
Power Output: 20 + 20 watts RMS into 8 ohms load at 1,000 Hz. Both channels driven. Total Harmonic Distortion: 0.8% at rated power into 8 ohms load. Power Bandwidth: 20 Hz to 40,000 Hz. $285.00*

*Recommended Retail Price.
**Averaged manufacturers' specifications subject to change without notice.

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ELECTRONICS Australia, September, 1975
Consumer Electronics Show report

In the role of US correspondent for "Electronics Australia", well known writer George Tillett reports on his visit to the Ninth Annual Consumer Electronics Show held recently in Chicago. While his concern was mainly with high fidelity equipment, he has some interesting observations about pocket calculators and the rapidly expanding Citizens Band market.

by GEORGE TILLETT

The ninth annual Consumer Electronics Show was held as usual in Chicago’s large exhibition hall - McCormick Place. Here nearly 40,000 dealers looked at more than 450 stands spread out over half-a-million square feet. The more energetic also took the time to see some of the hundred or more demonstrations which were held in hostels all over the town!

On show were calculators, Citizens Band radios, television sets, telephone answering machines, receivers, amplifiers, loudspeakers and tape recorders. A sizeable proportion of these products originated in the Far East and will be familiar to Australian readers so I will pick out some of the American and European items of particular interest.

But first a few words about the quadraphonic scene; the claims and counterclaims are still to be heard but the excitement has died down and the new medium is accepted as an alternative to (2-channel) “stereo”. Sales estimates vary from 5% to over 50% and dealers who take the trouble to demonstrate properly find it very much worthwhile. Shortage of records didn’t help but there are now more than 1000 CD-4 and matrix available.

More than 500 FM stations broadcast matrix records involving CBS-SQ or Sansui QS encoding. The National Quadraphonic Radio Committee has completed its field tests of various non-matrix systems and a draft report will be submitted to the FCC in due course. All the so-called discrete systems tested (RCA, Zenith, GE, etc) degrade the signal-to-noise ratio by 4 to 8db and it is quite on the cards that no system will be recommended. We shall see.

Meanwhile, back at the Show, a demonstration called Quad-a-Rama was well attended and there were a great number of new quadraphonic receivers to be seen. Onkyo still make the only receiver with automatic CD-4 to SQ switching and Sylvania showed four new models with special controls which can rotate the sound image 90, 180 or 270 degrees. I can’t think of any use for such a control unless you want to play at being a recording engineer and “pan” a soloist around the room!

The majority of receivers provide both CD-4 and SQ facilities, with Sansui and one or two others giving a choice of QS decoding as well.

There were more than 40 calculator manufacturers represented, with models ranging from $10 to over $200 for print-out units. One of the $10 models is made by Commodore and it features algebraic logic, floating decimal with seven digits and provision is made for an AC adaptor - fantastic value for money!

But a unit that really intrigued me is called the CheckMaster which is a trifle larger than a cheque book. Open it up and your bank balance is displayed on LED indicators. When you issue a cheque, press the keys accordingly and the new balance shows. Deposits are

Above: Representing an unusual approach to loudspeaker design, this new 3-way system from the Electrostatic Research Company (ERC) uses a 10-inch woofer firing into the top of an enclosure to cover the bottom end of the range. Attached to the back of the woofer is a structure containing a 3½-inch midrange, facing upwards, and a ring of eight electrostatic tweeters.
DOES IT PAY TO BUY AN AMPLIFIER THIS GOOD?

Sony research takes the art of amplification a giant step forward...

First, Sony developed an entirely new, highpower transistor, the Vertical FET (V-FET). Unlike any conventional bipolar transistor or the regular FET used in FM tuners, this semi-conductor has all the characteristics of the classic triode vacuum tube, assuring a high current utilization ratio and uniform thermal flow for exceptionally stable operation under varying conditions.

Second, Sony used its new V-FET technology to build an amplifier which meets today's exceptional needs: great power delivered with the smooth "open" sound, long thought the exclusive attribute of vacuum tubes. At the same time all the proven benefits of advanced solid state, particularly high stability and reliability have been retained.

Result: The Sony TA 8650, a truly magnificent integrated amplifier which gives 80 + 80 watts of musical sound so "real" it lives.

The fidelity is unsurpassed with distortion levels so low they're nearly unmeasurable!

Pre-amp: 0.03% THD at rated output; Power amplifier: 0.05% or less @ 1kHz, @ 1W; 0.1% or less, 20Hz - 20kHz @ rated output.

Frequency response curves for high level inputs are ruler flat (+0, -2dB) from 10Hz to 100kHz. Phono equalization is also unusually impressive, corresponding to the RIAA curve ± 0.2dB.

Yet these ultra specifications alone can't indicate the unit's unexcelled performance under musical conditions, with transient and phase response never attained in normal solid state construction.

Now, great power and superb, natural fidelity come in a package along with literally dozens of application and facility features, typical of Sony design ingenuity. To list a few: high quality professional LED clipping level indicator to show overload, complete FET protection circuits which prevent circuitry or speaker damage, complex professional controls designed for utmost accuracy and precision, including instant 20dB muting volume control, and level control memory. Tape monitor and dubbing facilities are thoroughly professional and very comprehensive, as are the rear panel connection facilities.

With the arrival of the new Sony TA 8650, perfection in an amplifier is close at hand. Naturally, that costs a little more.
ESS and SAE had new amplifiers rated at 250 watts per channel and Infinity were demonstrating their Class-D amplifier which was in a prototype stage at last year’s Show. Class-D amplifiers are sometimes called “switching amplifiers” as the output stage is switched on and off at a fast rate, the objective being to minimise output stage current and dissipation. Switching rate of the Infinity amplifier is 500kHz but the power supply is also switched so efficiency is very high — well over 90%. The power supply frequency is 25kHz and heat dissipation is quite low. The unit measures 17” wide, 11” deep by only 3” high and turns the scales at 24 lbs. A matching preamp features a dynamic range expander and a noise-signal cross-correlation circuit made in the same way and if you are overdrawn, that amount is shown! The CheckMaster costs just under $40 — but I doubt whether the name will be popular among our Women’s Lib members!

One area where business is booming is in CB (Citizens Band radio) and there are nearly 6,500,000 now in use. Statistics show that 1 car in 33 is equipped and sales forecasts are over 1,000,000 for 1975. There are 23 channels available in the allotted 27MHz band and almost anyone can get a licence. In fact, if the output is 100mW or less, no licence is required.

There were a large number of high power amplifiers on show and one of the centres of attraction was the BGW stand. This relatively small company supplied amplifiers that provided the “earthquake” for cinemas showing the Sensurround film. Banks of horn-loaded speakers were used and the voice coils have to withstand 1000 watts of power.

Makers of the loudspeakers are Cerwin-Vega, a Los Angeles based company noted for high power systems. BGW make amplifiers from 85 watts up to 1000 watts and provision is made for parallel operation if more power is required.

Harman-Kardon were showing their new Citation 16 power amplifier which uses two banks of LEDs for power indication. Rated power is 150 watts per channel at less than 0.1% distortion. Hum and noise is given as 100kHz below rated output and the square wave rise time is 3μs.

Displayed at Chicago, this Accousound system uses an 8-inch driver back loaded into a column which decreases in cross-section until finally terminated by a 10-inch passive radiator. A dome tweeter looks after the high frequencies, which increases signal to noise by 10dB or more.

But for me, the most interesting items at the Show were the loudspeakers and they came in all shapes and sizes and used every known (and unknown) acoustic principle. There was one housed in a glass enclosure (very clinical-looking) and, among the cone materials, were paper, plastics, shot glass, expanded polystyrene, titanium and aluminium. And then there was the Kenwood range using pulp made “from the wood of the Daphne tree”!

In 1972, a company called Ohm introduced a loudspeaker system using a transmission line principle. The driver was a dynamic type but it was vertically mounted so it “fired” into an enclosure underneath. Radiation was from the outside of the cone which was made of paper, titanium and aluminium measuring some 18 inches high by 10 inches in diameter. The whole system was very large and the enormous mass of the cone made it rather insensitive, so a smaller system was marketed a year or so later. Now Ohm have designed an even smaller system using a driver 9 inches high and 8 inches in diameter. It “fires” into a 1 cubic foot enclosure which has a 10-inch passive radiator mounted at the rear to augment the bass.

Another system using a downward mounted woofer is made by ERC but, around the top of this speaker (a 10 inch model) is a circular array of 8 electrostatic elements. They were designed by Arthur Janszen and are single-sided units with a spiral electrode. Provision is made for self polarizing (part of the program signal is stepped up by a transformer and then rectified to give a DC potential of about 900 volts).

A new model was announced at the Show, a 3-speaker version with a 3½ inch cone midrange unit facing upwards.

A more elaborate dynamic-electrostatic hybrid was being demonstrated by RTR; it used two 10-inch bass speakers with a circular array of 24 electrostatic elements, all mounted in a column-type enclosure. Crossover frequency is 400Hz and the amplifier for the ESL section is built-in.

In 1973 or thereabouts, a company called ESS caused quite a stir in audio cir-
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Further information from... Victoria — Danish Hi Fi. Western Australia — Danish Hi Fi. Queensland — Brisbane Agencies. N.S.W. — Convoy.
HIFI NEWS

icles when they introduced the Heil high frequency speaker unit, designed by Dr Oscar Heil. Instead of a piston-like diaphragm, the Heil units use a corrugated ribbon which is mounted in a strong magnetic field. It does not vibrate the air, it squeezes it, so increasing the velocity. It can be considered as an “air motion transformer” giving a gain of 5:1.

Several systems using a Heil unit are available, with crossover frequencies from 400 to 1000Hz, depending on the size. For example, a new model released at the Show used a 12-inch bass speaker with a small Heil unit crossing over at 1000Hz. The total radiating area of the high frequency unit is 22½ square inches and system dispersion is 120 degrees horizontal and 40 degrees vertical. The enclosure is tube vented and measures 24” by 14” by 13”. A prototype Heil unit going down to 30Hz has been demonstrated and Heil headphones were introduced recently.

Accusound were showing a new system using a kind of labyrinth but it differed from the usual arrangement as the duct is terminated in a passive radiator. The duct cross-section decreases progressively so the air is at a high velocity by the time it gets to the passive unit, which has a diameter of 10 inches. The driven speaker is 8 inches and high frequencies are handled by a wide-dispersion 1½-inch dome unit. A larger model has a 6-inch midrange cone speaker with a 12-inch passive radiator and a 10-inch bass speaker.

Flat speakers are not new: there was the Ultra series in England way back in 1932 and the French Orthophase in the 1950’s. The last named used a mylar diaphragm that was tightly suspended so it used an expanded polystyrene diaphragm which was only really suited for electronic organs.

American-made Magnaplanars work on a similar principle but they are much larger, the standard model being about 6 feet high and 4 feet wide. Depth is just over 1 inch and it is folded at the centre so it looks rather like a room divider. The bass and treble sections are normally used with separate amplifiers and overall sound is unusually clean and uncoloured. Because they are doublets, i.e., they radiate in two directions, there is a certain amount of bass cancellation but this is not as serious as you might think.

Wharfedale in England and Yamaha in Japan use the same basic principle for headphones and, in both cases, the transparent sound quality is similar to that given by the best electrostatic types.

Another kind of flat speaker was first evolved by Yamaha some 10 years ago; it used an expanded polystyrene diaphragm that was tightly suspended so it vibrated, instead of moving air like a piston. Harmonic distortion at the lower frequencies was high and the speaker was only really suited for electronic organs.

Two years ago, Fisher introduced a similar model and this one could be hung on the wall as a picture. The inventor was Jose Bertagni, who has just formed his own company—BES Geostatics to make a range of flat speaker systems. They are floor-standing units and, although they look like dipoles, radiation at most frequencies is omni-directional.

(Continued on page 17)

Pioneer have replaced their established line-up of amplifiers with six new models covering the power range from 20W RMS per channel to 110W. The corresponding recommended retail prices range from $159 to $929. A companion release involves 3 new AM/FM tuners, each envisaged as appropriate for two of the amplifiers. Tuner prices are respectively $139 (SX-5300), $249 (TX-7500) and $359 (TX-9500). In the two top amplifier models, input and output connectors have been shifted from the traditional rear panel respectively to the right and left hand sides of the chassis.

(Further information from Pioneer Electronics Australia Pty Ltd, 256-8 City Road, South Melbourne 3205.)
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Automatic Distortion Reduction

AKAI A.D.R. SYSTEM: HOW IT WORKS, WHAT IT DOES

A new circuit arrangement adopted by AKAI for use in their tape equipment should make it possible to record at an increased level relative to system noise, without running into high frequency overload problems. Known as A.D.R., or Automatic Distortion Reduction, it operates by dynamically modifying the high frequency pre-emphasis in accordance with the level of the input signal.

by NEVILLE WILLIAMS

For a tape system to be distortion-free, there must be a linear relationship between the signal input voltage and the ultimate output voltage to the amplifier. Each increment in signal voltage level must produce a proportional increment in output. In practice, this desirable objective is closely approached in good quality equipment, most of the time at most frequencies—assuming proper operation.

Unfortunately, however, the ratio between the loudest and softest passages in some program material is greater than the dynamic range of ordinary recording systems and it is difficult to avoid non-linearity at some frequencies, some of the time!

In a typical tape recording situation, difficulties can—and do—arise if too large a signal is fed through the system in an effort to swamp the inherent noise and achieve an especially high signal/noise ratio.

Quite apart from the actual amplifier circuits, there is a limit to the amount of signal current which can usefully be passed through a recording head. Above a certain level, the head or the tape coating itself becomes magnetically "saturated"; further increases in current do not produce any increase in the strength of the recorded field, and therefore no increase in the ultimate output from the tape into the replay head.

The problem can very easily arise with high-level, high-frequency signals.

As indicated in Fig. 1, most tape (and particularly cassette) recorders include equalisation circuitry which progressively boosts the signal level with increasing frequency—a measure adopted in the interests of ultimate overall response and signal/noise ratio.

Behind the practice is an assumption that, in most common
A Small Segment of the Soanar Range

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WA. 81 5500

Automatic Distortion Reduction

Fig. 4 Comparison of The distortion factor

Of course, Diodes and Rectifiers form only a small segment of the total range of components marketed by Soanar.

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- SUPPRESSORS — Automotive capacitive and resistive types.
- ELECTRONIC PARTS & ACCESSORIES — Bezel, Fuseholders, Jack Plugs & Sockets, Control Knobs, Neon Indicators, all types of Plugs, Terminals, Connectors & Switches.

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WA. 81 5500

Automatic Distortion Reduction

O VU Recording (Low Noise Cassette Tape)

With ADR

Without ADR

Fig. 4 Comparison of The distortion factor

As a result, high frequency transients suffer not only in amplitude but in quality.

Fig. 2 depicts the problem area in graphical form. If the signal components to be recorded are at an amplitude of -30dB or -20dB relative to 0dB VU, all frequencies can be handled without any problem. It is largely for this reason that overall response curves of tape decks are normally performed at -20dB VU—hopefully below head saturation level at all frequencies of interest.

At levels above -20dB VU (depicted as -10dB and 0dB) the plot of recording head current intercepts the saturation limit line well inside the normal audio passband. Instead of following the pre-emphasis contour, the recording characteristic for these higher level signals actually follows the saturation curve downwards with rising frequency. At the very least, therefore, the resulting losses at these amplitudes and these frequencies will equal the separation between the intended and the imposed curve.

In fact, AKAI engineers claim that the effects of magnetic...
saturation are more profound than this. Head losses and tape demagnetisation compound the effect to produce even greater losses, as depicted in their Fig. 2b.

As well, magnetic saturation can lead to intermodulation and distortion at frequencies which would not otherwise be affected.

AKAI's answer to this problem is a system which causes the pre-emphasis characteristic to change dynamically with the nature of the input signal. With low-level or predominantly low frequency input signals, the pre-emphasis remains normal, ensuring optimum overall response. However, high-amplitude high-frequency signals are sensed immediately and the pre-emphasis is reduced to minimise or avoid head saturation.

Circuitry capable of sensing and responding to the amplitude and frequency content of the signal is now commonplace, as in Dolby and other anti-noise systems, and in quadraphonic logic and comparators. AKAI engineers have adapted the techniques to signal-dependent pre-emphasis.

Fig. 3 illustrates the effect of their A.D.R. system. It shows how the pre-emphasis contour is automatically lowered in the presence of a signal containing high frequency components at a level significantly above -20dB VU. While things may not happen quite as neatly as the curve suggests, the clear intention is to avoid the worst effects of magnetic saturation.

![Graph](image)

While the dynamic reduction in pre-emphasis will itself curtail the response to high amplitude treble, AKAI claims (Fig. 3b) that the measured loss is significantly less than is imposed by heavy saturation, followed by self-demagnetisation in the tape. More importantly, other overload phenomena are avoided—notably intermodulation effects and noise products injected back into the audible spectrum.

The end result, so AKAI claims, is a system which can be operated at a higher level with respect to internal noise, with less trauma in the presence of high amplitude treble transients. The transients sound cleaner because the intentional and momentary reduction in bandwidth is much less noticeable than an uncontrolled saturation overload.

An alternative approach would presumably have been to arrange the circuitry so that it would selectively compress high frequency transients, operating more in the manner of a peak limiter. But, rather than leave the pre-emphasis fixed and process the signal, AKAI engineers have come up with the interesting alternative: leave the signal itself untouched and use a dynamic filter to process the pre-emphasis!

**HI FI NEWS—Continued**

diaphragms are shaped to control the various resonances and separate tweeters are mounted at the corners. The voice coils are coupled to the expanded polystyrene diaphragms through special plastic discs which equalise the response.

Finally, I must mention a British speaker which was introduced at the Show; it is made by Jordan-Watts and it consists of a 4-inch full-range unit housed in a ceramic jug. Appropriately enough it is called "The Flagon" and it weighs all of 28 lbs. It seems a great idea for do-it-yourselfers—"what are you doing with all those flagons?" "I'm making sorne speakers dd-dear, thash what!"
We are proud of our handbook series...they have become highly respected and widely used throughout Australia and overseas. Some are prescribed texts or recommended reading for university and college courses—but they are written in language anyone can understand. They cater for all levels—from the beginner to engineer, hobbyist & professional.

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Basic Electronics, now in its fifth edition, is almost certainly the most widely used manual on electronic fundamentals in Australia. It is used by radio clubs, secondary schools & colleges, and in WIA youth radio clubs. Begins with the electron, introduces and explains components and circuit concepts, and progresses through radio, audio techniques, servicing, test instruments, etc.

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$3.00 plus 60c p & p

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Now in its second edition and second re-printing. Digital Electronics has been widely adopted by colleges as a basic textbook. It will help you understand logic and number systems, and, with full circuit diagrams, let you mock up simple logic and counting circuitry to see just how things operate. There's even a full digital demonstrator based on low cost components. This book will give you the fundamentals necessary to gain complete understanding of the EDUC-8 handbook.

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Fundamentals of Solid State is in its second printing, showing how popular it has been. It provides a wealth of information on semiconductor theory and operation, delving much deeper than very elementary works, but without the maths and abstract theory which make many of the more specialised texts very heavy going. Solid State has also been widely acclaimed in colleges as recommended reading—but it's not just for the student. It's for anyone who wants to know a little bit more about the operation of semiconductor devices.

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PROJECTS & CIRCUITS

One of the latest additions to our handbook series, "Projects & Circuits" is just that—constructional projects and circuit ideas which we have reprinted from the pages of Electronics Australia. There are more than thirty full constructional projects which will appeal to all tastes, plus a number of simple circuits & tips, ideal for the hobbyist & experimenter. An ideal companion to Basic Electronics.

$2.00 plus 60c p & p
Sony STR-7035 FM-AM stereo receiver

FM stereo receivers are now a big selling item on the local hi-fi market and most manufacturers have competitive models in several price ranges. Here is the Sony STR-7035 which is rated at 24 watts RMS per channel.

Sony market this receiver in two models, the STR-7025 and STR-7035. They are identical in features and performance except for their rated power output. While the STR-7035 is rated at 24 watts RMS per channel, the STR-7025 is rated at 18 watts per channel.

Styling of the receiver is apparent from the photograph and needs no other comment except to say that you could change the brand name on the front panel to any other Japanese manufacturer and few would be any the wiser. The hi-fi market is becoming very similar to the car market in this respect.

Dimensions are 427 x 149 x 345 mm (W x H x D) and weight is 8.6 kg. Weight of the lower powered STR-7025 is 8.5 kg.

The FM and AM dial calibrations are screen printed on the dial glass so they are visible whether the unit is turned on or off. Frankly, I prefer this to the inscrutable dials of some other receivers which are only visible when you turn them on.

A single tuning meter is provided for correct tuning indication on FM. This is really a worthwhile feature which would be well worth an extra few dollars.

On the right-hand side of the control panel is a large flywheel assisted knob for tuning, with a matching knob on the left-hand side for the volume control. Concentric with and below the volume knob is a small lever for the balance control which operates through an arc of 120 degrees. It is very smooth in action and in some ways it seems more logical than a balance control with an operating range of about 300 degrees.

Four smaller knobs are provided for Speaker Selector, Bass and Treble controls and Function (Source) Selector. Push-buttons are provided for Loudness, Hi-Filter, Muting (FM), Mono and for connection to two separate tape or cassette recorders.

We are not pleased to note the inclusion of a microphone socket on the front panel together with its small mixing knob. I strongly suspect that this sort of feature is included merely because a competitive model has it. Much the same could be said of the Loudness facility and Hi-Filter, which rolls off at only 6dB/octave.

All the controls operate smoothly and effectively. In fact, the receiver is a pleasure to drive.

There are quite a few interesting features inside the receiver. First impression is that the unit is just a maze of hook-up wire. Most of the interboard connections are made via wrapped joints rather than by solder.

Following a recent trend, the power amplifiers utilise integrated circuits of the hybrid thick film variety which are mounted directly on a flat heatsink and soldered to a common PC board. The PC board also accommodates the power supply components, including the relatively high hefty filter electrolytic capacitors.

Thermal cut-outs, one for each channel, are mounted on the flat heatsink to provide protection from excessive power dissipation. These tripped several times during our power tests.

Balanced supply rails are used for the power amplifiers so that the output signal is directly coupled to the loudspeakers. Apart from the thermal cut-outs already mentioned, overload protection is provided by fuses in both legs of the transformer secondary winding.

In most respects, the preamplifier stages appear to be quite conventional. Tone control stages are active, rather than passive as in much Japanese equipment.

FM and AM tuner circuitry is accommodated on a separate large PC board. None of the tuner circuitry is shared—there are in effect two separate tuners. The multiplex decoder circuitry uses discrete components.

A very large PC board stretching across almost the full width of the receiver accommodates all the small signal circuitry and switching. An interesting feature is that the rotary Function and Speaker selector knobs actually operate "straight line" PC mounted switches via a nylon gear on the knob shaft.

A ferrite rod is provided for AM reception and this is housed within the confines of the chassis. This does have the advantage of being protected from damage, but it cannot always be oriented for best reception like an adjustable rod antenna as mounted on the rear of some other receivers we have seen.

Connections are provided at the rear of the chassis for an external 300 ohm ribbon or 75-ohm coax for FM reception.

Rated power of the STR-7035 is 24 watts RMS per channel into 8-ohm loads.

(Continued on page 23)
Sennheiser's revolutionary "Open-Aire" headphone design brings a new concept to stereo sound. This outstanding "Open-Aire" principle has to be heard to be believed, and for the first time 3-dimensional sound is now possible.

But don't take our word for it...ask for a demonstration.

Of course there are several other types of Sennheiser headphones available. There is a type and style for you!

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Sound Technology's 1700A measures THD down to .002%—automatically!

As high fidelity equipment has improved in quality its performance has become increasingly difficult to measure. Now, Sound Technology has produced the model 1700A Distortion Measurement System which pushes back the previous limits to distortion measurement.

In recent years many audio amplifiers have outperformed much of the available distortion measuring equipment. In fact, any amplifier with a total harmonic distortion much below 0.1% is unlikely to be measured with any real precision by the bulk of distortion measuring equipment currently in use.

This is because the residual distortion of the measuring equipment itself, i.e., the residual distortion of the audio oscillator and the minimum distortion able to be measured by the distortion test set, must be at least one third of that of the amplifier or piece of equipment under test.

Thus, if the residual distortion of your measuring equipment is known to be 0.03%, for example, and your tests of a certain amplifier yield results which are all in the region of 0.02 to .04%, say, then the results are utterly meaningless.

Yet these sorts of test results continue to be published in other magazines with absolutely no qualification or mention of their dubious validity.

So there is considerable need of a distortion test set with a residual distortion much less than .01%. The Sound Technology 1700A meets this requirement—its rated residual distortion is less than .002%, and it nulls automatically.

The model 1700A consists of an ultra-low distortion oscillator and a harmonic distortion analyser installed in the one case. The tunable notch filter of the analyser is ganged to the oscillator by the large bank of push-buttons on the front panel. Automatic nulling circuitry fine tunes the notch filter and assures maximum null of the fundamental. Any signal remaining at the output of the notch filter consists of distortion products and noise. This is displayed by the average-reading meter and the ratio of distortion to fundamental is indicated in either percentage or decibels. Switchable active filters are provided to remove hum and noise below 400Hz and high frequency noise above 80kHz. The distortion product waveform can also be fed to an oscilloscope for visual inspection.

Other features of the 1700A include separate voltage and distortion range switches, with the meter scaled for power into an 8-ohm load, fundamental level monitoring without range changing and notch frequency LED indicators to enable the 1700A to be used for distortion measurements involving external frequency sources. The test set inputs are fully floating and the oscillator output can be floating or tied to chassis.

Dimensions of the 1700A are 437 x 220 x 305 mm (W x H x D) and weight is 7.3 kg.

The relatively large size of the 1700A is dictated more by the large number of controls on the front panel than by a mas- (Continued on page 23)
The BDP-100 Turntable and the SA-8200 amplifier are two fine examples from the Rambler Range of Hi-fidelity audio equipment.


Channel it through our SA-8200 multi-purpose, stereo amplifier with its 55 watts RMS per channel output. Harmonic distortion of less than 0.2% at 45 watts RMS per channel. Inputs:— 2 phono, 2 AUX, 2 tape, tuner and mic. Separate base and treble controls on each channel. High and low filter switches and loudness control. Provision for 2 pairs of speakers. These are just some of the many value packed features in these two superb pieces of Rambler Hi-Fi equipment.

"Rambler — The Best Thing That Has Happened to Music."

See and hear the Rambler range of sound equipment at your Rambler dealer now and compare the outstanding performance and value.

SONY STR-7035

or 25 watts per channel into 4-ohm loads. Rated harmonic distortion is 0.8% and frequency response at 1 watt is quoted 30Hz to 40Hz at the -3dB points.

We measured power output at 28 watts per channel into 8 ohm loads and 16 watts per channel into 16 ohm loads. These figures varied only slightly depending on whether both channels were driven together or not.

For 4-ohm loads, power was 25 watts per channel with both channels driven and a relatively high 40 watts with one channel driven by itself. This means, in effect, that the available "music power" is about 80 watts total for 4-ohm loads.

Distortion measurements were considerably better than the 0.8% for rated power would indicate. In fact our worst measurement was a little over 0.2% and, for most of the time, our measurements were below 0.1% regardless of frequency (within the audible range) or power level.

Frequency response checked out exactly as specified. Separation between channels ranged from 36dB at 10kHz to 46dB at 100Hz. Phono sensitivity was 3.2mV at 1kHz while input overload at 30Hz to 40Hz at the -3dB points.

There were two problems with the performance of the FM tuner section as it did not appear to be quite up to the standard set by the rest of the receiver. We did verify that the sensitivity for 30dB signal-to-noise ratio for a mono signal was 1.7uV as quoted. But some other measurements were below specified—although not seriously so.

Harmonic distortion was quoted at 0.3% for 100% modulation on mono signals and we were able to measure it at 0.15%, which is good. By contrast, harmonic distortion for a 400Hz stereo signal 100% modulated is rated at 0.8% and we measured it at just over 1%.

Separation between channels was quoted at 35dB at 400Hz and we measured at 25dB in one direction and 22dB in the other. This may have been improved by a small adjustment.

During listening tests, the receiver performed very well. The only operating fault we noted was that the A + B position of the Speaker Selector did not appear to work.

To sum up, our overall impression of the STR-7035 is that it looks good and its amplifiers perform very well. But its FM multiplex tuner was a little disappointing and possibly would be much improved after a few adjustments.

Recommended retail prices are $395 for the STR-7035 and $349 for the STR-7025. Further information can be obtained from the Australian distributors for Sony equipment, Sony Kentron Pty. Ltd., 469-475 Kent Street, Sydney, N.S.W., 2000. (L.D.S.).

SOUND TECHNOLOGY 1700A

sive amount of componentry inside. True, there is a fairly large bank of push-buttons wired into three P/C boards, but most of the circuitry is accommodated on two large double-sided PC boards. These are mounted horizontally with lots of empty space above and below.

Considerable use is made of operational amplifiers and other integrated circuits to help minimise the component count. High quality components such as metal-glaze resistors and sealed trimpots are used throughout.

The oscillator circuit is basically a Wein bridge which has two operating modes: Low Distortion or Fast Response. The Low Distortion mode is used for distortion measurements while the Fast Response mode is used for frequency response testing where it is important that the envelope amplitude "settles" quickly. The latter mode results in moderately higher distortion.

Automatic null of the analyser notch filter is achieved electronically using phase detectors, floating integrators and photocouplers which control resistors in the phase-shifting and summing networks.

As anyone who has used a conventional manually-nulled distortion meter could report, the 1700A is really a boon to use. It means the end of those fiddly adjustments to compensate for oscillator drift and the other changes that occur during prolonged testing. We understand that there is also an option of "automatic set level" which would greatly simplify distortion versus power measurements and similar repetitive testing.

We must report that there is one irritating hassle with the 1700A and that concerns the unmetered oscillator output level. Surely it would have been a simple matter to provide an extra push-button to enable the output level to be monitored by the voltmeter circuitry. As it stands, the oscillator output must be coupled back into the meter inputs to enable the level to be measured, and this means disconnecting and connecting at least two cables.

Apart from the above small hassle, Sound Technology have certainly produced a really high performance instrument which would be a great asset in any audio design laboratory.

For further information regarding price and availability of Sound Technology equipment, contact the Australian distributors, Arlunya Pty Ltd, PO Box 113, Balwyn, Victoria, 3103. (L.D.S.)

TEST REPORT

"Newest SAE Amp is a Superb Job!"*

"SAE" MARK XXXIB SOLID STATE STEREO POWER AMPLIFIER...one of those amps that simply seem to "disappear" with normal program material and give an ultra-clean, unfettered account of even the finest signal sources.*

SPECIFICATIONS: MARK XXXIB

RMS Power Output, Both Channels Driven-6 ohms—100 watts stereo. 4 ohms—200 watts stereo. 16 ohms—70 watts stereo

RMS Harmonic Distortion—Guaranteed less than 0.1% at any power level or frequency. 20Hz—20kHz. Typical performance less than 0.025%. Absolutely no crossover notches at any level up to full power

Frequency Response—1 watt ± 0.25dB 20Hz—20kHz

50 watts ± 0.25dB 20Hz—20kHz

Signal-to-Noise Level—Guaranteed better than 90dB below 50 watts RMS.

T.H.D.< 0.032% 20Hz to 20kHz

Price: $427

"SAE" MARK XXX SOLID STATE STEREO PREAMPLIFIER...this highly accurate unit coupled with the high power Mark XXXIB combine to create one of the most exciting state-of-the-art systems available anywhere in the world. Whether these units are used together or individually, they will provide the performance the discriminating audio enthusiast seeks.

SPECIFICATIONS: MARK XXX

Frequency Response—High Level Inputs —± 0.25dB 10Hz to 100kHz

Phono Inputs— ± 1dB 20Hz to 20kHz

RMS Harmonic Distortion—Less than 0.03% 20Hz to 20kHz at 2.5 volts. Typical Performance 0.015%

Signal-to-Noise Level—Phono—72dB below 10mv

High Level—90dB below rated output

Price: $318

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*EXTRACT OF Test Report from 'HIGH FIDELITY, MAY 1974.'
Bell develops broadcast resolution CCD camera

Bell Telephone Laboratories engineers have built the first solid-state TV camera that meets the resolution requirements for commercial broadcast TV use.

The experimental camera, measuring only 2.5 x 2.5 x 6 inches, was built to demonstrate the feasibility of high resolution videotelephone systems. Its small size was made possible by the use of a solid-state imaging sensor, called a charge-coupled device (CCD), which was invented at Bell Labs in 1969.

The new CCD used in the camera contains nearly a quarter of a million sensing elements—a significant improvement in resolution over other known solid-state imagers. The imaging area of the new CCD was designed to be equivalent in size to the scanned area of a standard one-inch-diameter vacuum imaging tube used in conventional TV cameras. It has 496 vertical interlaced scan lines and 475 horizontal picture elements.

CCDs offer the possibility of performing electronic functions simply and inexpensively for a wide range of applications both within and outside the telecommunications business. Bell Labs is exploring the possible use of CCDs in small TV cameras for future videotelephone systems, in time-delay and filtering circuits for telephone transmission, and in memory devices for use in electronic switching systems.

digital watch prices set to tumble

Time is marching on, but the sounds of its progress may be getting fainter. If the recent history of the mushrooming popularity of the electronic calculator is any guide, then the electronic digital watch may soon silence the tick-tock coming from many wrists.

Right now, the prices for solid state digital watches range from under $100 up to $300, but as the production processes are made more economical the cost is expected to drop quickly, as it did for the electronic pocket calculator.

At least three companies along the peninsula just south of San Francisco, California (sometimes called Silicon Valley), are working together to bring prices down and yet maintain high reliability and accuracy. These companies include AMI (American Microsystems Inc.) of Santa Clara, and Varian Data Machines and Watkins, both of Palo Alto.

One new production process recently introduced at AMI, a leading manufacturer of electronic watch “works,” is a high technology tester which tests the circuits that make up the watch’s tiny computer. The completely solid state watch has no moving parts, and testing it is no small task considering the required accuracy is about five seconds a month compared with two minutes for most conventional watches.

The test equipment, called an ADATE tester, for Automatic Digital Assembly Test Equipment, is manufactured by the Watkins-Johnson Company. It is a high speed, dynamic tester which can be programmed according to which watch type is being tested. Over 180 tests incorporating some 5,400 measurements are executed in about four seconds.

A compact Varian computer “zaps” the micro-circuit with minute electrical pulses to test the three basic systems in the watch—the oscillating quartz crystal; the counting circuits which divide the oscillations into hours, minutes, and seconds; and the drives connecting the counters to the display.

AMI’s first digital watch module, introduced more than a year ago, was about 360 mils thick, consumed 12 microamperes and required 6 volts to drive its timing circuits and display. In its newest modules, AMI engineers have reduced the thickness to 260 mils, the current to 7 microamperes and the voltage to about 3 volts.

—George E. Toles.
About 4 1/2 billion years ago?
away early in our planet's formation
Apollo landings support
and Urey have found chemical evidence
earlier unmanned lunar flights, O'Keefe
Apollo lunar landing missions and from
considered.
Moon's formation should be seriously
Diego, suggests this fission theory of the
Urey of the University of California, San
Nobel prize winner Professor Harold C.
Flight Center, Greenbelt, Maryland, and
O'Keefe of NASA's Goddard Space
Earth/Moon fission theory
siderable portion of molten iron.
part of a mass which included a con-
that the rocks of the Moon were once
higher density than the Moon. This is due
is the fact that the Earth has a much
metal is quite small as compared to
Earth's.
Prior to the split, the iron in the Earth
would have sunk towards the centre, drawing
with it the gold, platinum and other noble (rare) metals found in the
molten rock originally mixed with the
iron. This accounts for the low density of
the Moon, as well as its low content of
noble metals.

Ion thruster engine
developed by NASA

Payload gains of up to 20 percent in
future NASA spacecraft are predicted as
the result of the agency's development
of an ion thruster engine. The ion electric
thrust device would substitute electric
propulsion for the chemical propulsion
devices presently used for some
spacecraft chores.

The ion engine is presently most
attractive for station-keeping auxiliary
propulsion on geosynchronous satellites.
In addition, ion thruster propulsion
provides encouraging new possibilities
for mission planners, and can make a
variety of new missions possible.

In the ion thruster propulsion system,
the Sun provides energy which is con-
verted into electric power by solar cells.
This power is then tailored to the current
and voltage needed by the ion thruster.
Propellant (mercury, cesium or relatively
stable gases) is ionized in the engine and
electrically exhausted to produce thrust.

NASA's version of the ion engine now
being tested at the agency's Lewis
Research Center, Cleveland, Ohio, has
become the first electric propulsion system
to exceed 10,000 hours of operation,
including 298 successful engine firings
during that period. Lewis Center is con-
tinuing testing toward a new endurance
goal of 15,000 hours.

Ocean temperatures may fuel generators

Electrical generating platforms that
float beneath the ocean surface in a man-
ner similar to icebergs may operate in the
warm coastal waters before the end of
this century. The pollution-free fuel used
to spin the turbine-generators will come
from the Sun's energy stored in the ocean
surface.

Ocean Thermal Energy Conversion
(OTEC), using temperature extremes of
20°C, is a feasible way to produce elec-
tricity according to a nine-month study
conducted by Lockheed engineers under a
National Science Foundation contract.
OTEC could supplement the amount of
electrical energy produced by existing
plants to meet future increased
demands.

The floating plants can be built from
existing components, modified to meet
OTEC requirements. They can produce
electricity at a cost competitive with fossil-fuel plants. A demonstrator plant
could be delivering electricity by 1985.
The OTEC closed-cycle concept
involves heating a liquid until it becomes
a gas which, under pressure, drives a tur-
bine hooked to a generator. Lockheed
proposes to use ammonia as the working
fluid. After passing through the turbine,
the gas is cooled by water from the
ocean depths until it becomes liquid and
begins the cycle again.

US satellite to monitor ozone breakdown

A US scientist plans to use NASA's
Orbiting Astronomical Observatory
-OAO-3 (Copernicus)—to help ascer-
tain the degree to which ozone is being
broken down in the stratosphere, thus
allowing additional ultraviolet light from
the Sun to strike Earth directly. He is Dr
Guenter R. Riegler of Bendix Aerospace
Systems Division, Ann Arbor, Michigan.
The ozone layer in the stratosphere is
a planetary cover which shields the Earth
from most of the Sun's dangerous
ultraviolet radiation. Concern has been
expressed recently that chlorine-
derived from aerosol spray cans—may be
building up in the atmosphere to such an
extent that it will begin breaking up the
ozone layer in the stratosphere before the
end of the decade. This would lead
to an increase in the incidence of skin
cancer, and an increase in the average
temperature of the Earth's atmosphere.

Using OAO-3, Dr Riegler plans to
observe a bright star via the satellite's
ultraviolet spectrometer to measure the
amount of ultraviolet light absorbed at a
particular wavelength—first when the star
is high in the sky, and then as it sinks
below the horizon. The readings will thus
show the amount of chlorine naturally
present in the star's spectrum as con-
trasted with the amount measured once
it sinks below the horizon, at which time
atmospheric effects should be apparent.

By taking readings at regular time inter-
vals for several years, Dr Riegler hopes
to determine the rate of buildup of
chlorine in the atmosphere, if any.

Flywheel-powered vehicles will cut fuel costs, says SRI

Stanford Research Institute (SRI)
researchers are working on a device that
they believe may replace gasoline for
most urban driving within 15 years. The
device is a flywheel—a wheel that stores
up energy by continuing to rotate for
some time after it is brought up to a
speed.

"It now appears we will be able to
build a 350lb flywheel that can store
enough energy to drive a Ford Pinto
about 30 miles," says Peter M. Newgard,
leader of the development team.

Mr Newgard believes that such a
vehicle could be competitive in cost and
performance with a conventional auto-
mobile. "Even at today's gasoline
prices," he says, "it would cost no more
to buy and drive such an automobile than
a conventional one. As gasoline prices
continue to rise, a flywheel-powered
vehicle will become comparatively less
and less expensive."

Newgard visualizes a hybrid auto-
mobile powered by a flywheel and using
a gasoline engine only to replenish
the flywheel's spin on long journeys while
the car is travelling at normal speeds.
Normally, the flywheel would be brought
up to speed with electricity while the car
is parked overnight.

Since about three-fourths of all urban
driving is accumulated in short hauls,
such a hybrid system would greatly
reduce gasoline consumption (and air
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Computer generated models used in ear disease studies

An IBM scientist is using computerized analytical techniques to explore the nearly inaccessible inner ear and learn more about the hearing defects that originate there. He is Dr Alfred Inselberg of IBM's Scientific Center in Los Angeles.

Dr Inselberg's research is currently centred on developing a series of mathematical models that describe the complex function of the cochlea—the snail-shaped organ that contains the receptor cells of the brain's auditory nerve. These models are used in a joint study by IBM and the Ear Research Institute of Los Angeles into disturbances of the cochlea and associated hearing defects. Of particular interest is Meniere's disease, characterized by low frequency hearing loss, and by dizziness and nausea.

The research project is also providing clues as to the causes of presbycusis—the diminishing ability to discern high-pitched sounds as a person gets older.

Mathematical models are necessary for this type of work because the cochlea is so delicate that it may be destroyed by direct experimentation. However, considerable information does exist about the cochlea's physical structure and properties, and the physical laws that govern its dynamics are well known.

"Using this knowledge, it's possible to formulate a mathematical model that describes the function of the cochlea in a series of complex equations," Dr Inselberg says. "Then we generate a computer model, based on the solution to these equations, and we can perform experiments on the computer that can not be done on the cochlea itself."

Dr Inselberg has so far developed three models of the cochlea, each more complex than the last, and he is currently preparing a fourth. Using an IBM System/370 Model 145, he experimentally alters the properties of the computer model to investigate the relationship between the organ's physical structure and its functions.

"We are learning how different parts of the cochlea affect various hearing qualities," he says. "By isolating hearing defects in terms of these qualities, we hope to pinpoint the most likely internal cause."

For example, Dr Inselberg's experiments show that the ear's high frequency threshold is determined by the properties of the cochlea fluid, such as viscosity, and the stiffness of the membrane.

"We know that people lose the ability to hear higher frequencies as they age," Dr Inselberg says. "This could be caused by stiffening of the membrane as part of the aging process that also makes the bones harder and more brittle. In theory—and so far only in theory—the changes in membrane stiffness could be compensated by changing the viscosity of the fluid around it."

Infrared sensors for firefighting helicopters

A new infrared sensor and imaging system that will enable helicopter crews to "see" through darkness, haze and smoke is undergoing flight tests with the Los Angeles County Fire Department, in cooperation with the US Forest Service.

The new infrared system was designed and built by Aeronutronic Ford Corporation, Newport Beach, California, and contracted through the Aerospace Corporation, Los Angeles, for the US Forest Service. It is intended to expand the useful role of helicopters in bushland fire suppression to both night and day operations.

The new thermal imaging system will be evaluated as a surveillance and navigation aid, and will provide the Los Angeles County helicopter crews with information on terrain features and other obstacles which may otherwise be invisible because of darkness or poor visibility.

The complete system consists of an infrared sensor/scanner, a cooling unit, gimbals to provide pointing of the sensor, associated electronics and television display units.

The sensor system will be installed in the nose bay of Los Angeles County's Bell 204-B helicopter, with the control panel and two eight inch television display units mounted in the cockpit.

In operation, terrain information from the scanning infrared sensor will be sent to a detector/electronics module, immediately processed, and visually displayed on the television screens in the cockpit for "real time" instantaneous viewing by the helicopter crew. This information can also be recorded on video tape.

Miniature TV camera for advanced space missions

RCA is developing a tubeless television camera—potentially no larger than a pack of cigarettes—for possible use in NASA's advanced space missions.

The prototype black-and-white camera will employ a charge-coupled device (CCD) as the image sensor and will be designed under a SUS90,000 contract from the NASA Lyndon B. Johnson Space Center, Houston, Texas.

The CCD will make possible an ultra-small, lightweight camera capable of operating in space on very low power, according to Bert Soltoff, Program Manager for RCA's Astro-Electronics Division, Princeton, New Jersey, where the work is being done. The one planned for use in the space camera is a 512 x 320 element device.

In describing the space camera design, Mr Soltoff noted that conventional TV equipment at times cannot be used for certain space mission applications because of size, weight and power consumption limitations of the spacecraft.

Mr Soltoff said a scanning technique will be developed for the space camera that will assure its compatibility with the 525-line standard of broadcast television. This will make it possible to operate the camera with current US TV equipment.
The computer revolution has begun, and before long "workshop" computers will extend their domain beyond the realm of the present day computer specialist and into the offices of executives and other professional workers. Coupled with this revolution will be increased business efficiency and profound technological and social change.

For 12 years, Douglas Engelbart, Director of the Stanford Research Institute (SRI) Augmentation Research Center, and his colleagues have been developing a prototype coordinated "workshop" of computer tools to augment the capabilities of professional workers in the same way that drills, lathes, grinders and milling machines augment the capabilities of machinists.

The professionals whose capabilities Engelbart seeks to augment include all those whom Peter Drucker refers to as "knowledge workers"—that is, executives, planners, researchers, designers, writers and others who create and apply knowledge to productive ends. In fact, Engelbart intends his system to serve the secretary as well as the boss and all his colleagues and assistants.

The visible tools include an electronic screen and a typewriter keyboard, plus two additional hand controls. One is a tracking instrument, which he calls a "mouse," used to point to a spot on the screen and make simple commands to the computer. The other is a 5-finger keyset to supplement the typewriter-like keyboard for high speed execution of detailed operations.

The invisible tools of the workshop include all the computer hardware, software and communication networks needed to serve the daily handling of the users' working information—their notes, memos, letters, designs, plans, budgets, announcements, commentary, proposals, reports, documentary, item-control catalogues, etc.

These tools are linked together in a flexible modular format that makes it easy to add new tools as they become available or needed, and to link the sys-
tem with other computer research centres in the ARPANET. This is a computer network that was built under the sponsorship of the Advanced Research Projects Agency (ARPA) of the Department of Defence, and interconnects computers all over the world into a single network.

The individual worker can use the workshop to draft and send memos, letters, documents, etc. The system then gathers together such material from all the members of an entire project team (who may be distributed throughout the country or even the world and connected only by the ARPANET), and organises this material into a comprehensive data base or library. All the collaborative dialogue that takes place among the team members over a period of months or years may be included in this library.

By a simple command to his own desk-side terminal, each team member can call up any part of this dialogue on his screen, modify it, make notes in the margin, index it, send it to another team member, or cross reference it in a memo on his own.

When the recipient of the memo comes across that reference in the memo, he can command the computer to change the display quickly to show the item referenced in whole or in part, and then return to the memo. Or he can divide his display into separate windows so that he can view each simultaneously.

The system allows the user to scan through messages and reports in a variety of ways. For example, he can command it to display just the chapter titles or just the main paragraphs. He can then point at items in the middle of this list and make the computer show some sublist such as the first sentence or the first two sentences of each paragraph. Or if he instructs the computer to “jump to content,” he can then type in a phrase or a word and the computer will show him where that phrase appears in the report and what words appear immediately before and after it.

James C. Norton, Assistant Director of the Augmentation Research Center, points out that these sophisticated tools actually change the way users think.

Typically, he says, writers who have never used the system organise at most the main points of a document, letting their thoughts on each point flow freely and sending the result to the typist. Not surprisingly, they often continue to make changes up to and including costly final stages of production.

The workshop tools allow users to rearrange words and paragraphs easily, so they can organise the material as they go along, trying this paragraph up there, noting the effect and changing it back if need be. Often when they look at the structure of the draft in some of the new ways described above, areas of faulty organisation pop out at them.

When the report is completed to their satisfaction, they can have it printed out or even published in final form. Programs that control these operations are included in the workshop software.

In addition, the worker can use other programs not presently included in the workshop so long as they are available on the ARPANET and provided, of course, that he makes contractual arrangements with the owners on the programs. He might, for example, wish to work interactively with a program that would help him step by step in the preparation of drawings and other graphics for the report. Once he had the entry code, he could access such a
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°Celsius
decimal degrees
rectangular
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Workshop computers

remote program as easily as one included in the workshop.

Richard W. Watson, another assistant director of the Center, points out that for him and many other ARPANET users, their deskside computer terminals have largely replaced the US mails. To send a message to a colleague anywhere on the ARPANET, Watson types the recipient's name and organisation into the keyboard and follows with the message. This information is stored in his or the addressee's computer memory. The next time the addressee logs in at his terminal, he sees Watson's name and the subject of the memo displayed on his screen, along with all his other messages. If the message is urgent, Watson can instruct the computer to notify the recipient as soon as the message is delivered by putting a special flag on the recipient's screen.

Watson admits that he finds this system of communication preferable even to the telephone. "I don't have to wait while the operator places the call," he explains, "or worry about time differences. And I don't have to interrupt the recipient. I know he will be logging in 3 or 4 times a day, so I can probably count on a response the same day."

One of the programs developed by the Center sorts Watson's mail for him, so that instead of reading through all the messages on the screen, he can query the computer about the nature of the messages. For example, he can ask it how many messages he has received, who they are from, whether they are over or under a certain length, etc. Then he can scan through the messages selectively in the manner described above for documents generally.

The availability of these computer tools on the ARPANET (and SRI is making them available on an experimental basis to clients) encourages collaboration among workers in different branches of an organisation or in different organisations involved in the same project. Not only can they send messages to each other, but they can set up conferences in two or more locations so that groups can interact. This is of course a great saving in time and energy over physically travelling to a common conference room. Large display screens in each conference room (or smaller ones beside each attendee, or both) can be linked so that an operator in any of the rooms (or each attendee himself) can control the visual material that is viewed simultaneously on all screens. This capability can be combined with two-way voice contact.

The implications of these capabilities for the business world in the last years of this century are obviously profound—as profound Engelbart believes, as the effects of railroads on the cottage industries of the 19th century. At one time, he...
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notes, every town had its artisans who supplied it with products that today are made at centralised factories and shipped throughout the world.

Engelbart expects a new computerised "marketplace" to evolve that will represent "fantastic wealth in the commodities of knowledge, service, information, processing, storage, etc. In the number and range of transactions, and in the speed and flexibility with which they are negotiated," he says, "this new market will have a vitality and dynamism as much greater than today's as today's is greater than the village market."

This computerised marketplace will encourage specialisation, he believes. Some individuals or small groups will provide libraries of information, all arranged for convenient use. Others will offer interactive programs specially tailored for particular types of analyses or for doing the text-graphic document typography in a special area of technical portrayal.

"Let's look at a specific 'for instance'," says Engelbart. "Suppose that one person becomes extremely proficient in making small programs to generate a display or printout to show (particularly well) the status of a multi-task project. He is an independent agent in this multi-access computer network, working at a display console in his office at home. Perhaps he specialises in construction projects, and within this, perhaps, in steelwork erection.

"You are a management consultant working (from your home) on a short job helping to set up the production-control system for a construction project. When you realise that you might benefit from this kind of help, this is the sequence that takes place:

"Your man is easy enough to find because of computer help in searching for and evaluating special products and services. Suppose you need something he can do for you with about 45 minutes effort. You expect immediate accessibility for negotiation. For instance: It takes you one minute to locate several candidates, two minutes to examine their relative credentials, 20 seconds for interrogation of public records to select him as being available right now for your kind of problem, two minutes of personal dialogue to determine for both of you that his capabilities and your needs match, and 15 seconds to negotiate and legalise a contract. He does his job in 40 minutes, and spends five more minutes transferring the results to you (with dialogue).

"He switches back immediately to a task sequence whose contract arrangement had permitted him such interruptions. In working on this job, you have been 'time-shared' with several other jobs having higher priority, and several that were running 'background'. During the forty minutes he was off doing his thing for you, your higher-priority task sequences took you off on other pursuits. In fact, when he was done, you weren't ready to get back to him for twenty-three minutes, but the mutual-scheduling algorithm agreed upon in your contract took care of connecting you and him, when you were both ready for your final dialogue."

Obviously there will have to be brokers, wholesalers, middlemen, retailers and bankers to make this computerised marketplace a working reality. And there will be a need for procedures and systems to assure privacy.

But Stuart Mathison, Vice President of Planning for Telenet, which is constructing a commercial network similar to the ARPANET, points out that long before all the mechanics of a computer marketplace can be worked out, there will be many uses for a commercial net. He expects the Telenet to be particularly attractive for interactive modes of communication with the computer—such applications as timesharing and order entry, or credit checking at the point of sale. It will also be attractive, he believes, for batch processing—the transmission of continuous streams of information such as large files on tape or cards—but only for long distances. For distances under about 500 to 1000 miles, he says, the leased line will probably be more economic than the Telenet for the next few years.

"And to think people actually used to travel to work!"
Impressive advances in ultrasonic technology

Ultrasonic equipment ranging from straightforward industrial cleaning units to complex scanning machines for use in medical diagnosis went on show at the Ultrasonics International 75 conference held recently in London. Designed to demonstrate the practical applications of ultrasonic equipment, the show attracted contributions from some 15 different countries.

by LEN STARNES

In March 1973 the largest exhibition of ultrasonic equipment ever held in Europe was opened at Imperial College, London. During three days its 30 stands displayed equipment from Britain, America, Continental Europe, Asia and Japan and attracted over 1000 visitors. The exhibition formed part of a larger international conference—Ultrasonics International 75—devoted to the science and technology of ultrasonics and was the first of a series now to be held every two years.

It was against this background that the second conference—Ultrasonics International 75—was held recently in London. Again held at Imperial College, the conference program included some 64 papers from 15 countries and covered such topics on ultrasonics as high-power applications, non-destructive testing, visualization techniques, physical ultrasonics, signal processing, transducers and arrays, medical and biological applications, and underwater ultrasonics.

As before, the emphasis was on the practical applications of ultrasonics, the equipment displayed ranging from industrial cleaning units to complex scanning machines for use in medical diagnosis. Some of this new equipment is described in this article.

One of the fastest-growing applications of ultrasonics is medical diagnosis. Ultrasonic diagnostic techniques now offer many advantages over conventional X-ray examinations, besides being inherently safer. The market for machines capable of making routine hospital examinations, for example in gynaecology and obstetrics, is enormous.

Among the British companies now firmly established in the design and production of such machines is Nuclear Enterprises, which displayed the most recent improvement in its award winning NE 4102 Diasonograph ultrasonic scanner—the NE 4104 greyscale storage display.

The new greyscale display offers clinicians the benefits of conventional storage tubes and, at the same time, a picture with the full range of grey shading. This greatly simplifies the acquisition and interpretation of pictures of more complex structures.

Ten observable shades of grey can be displayed on the screen for optimum tissue discrimination, while dynamic range compression and contrast-enhance circuitry allow echo amplitudes of interest to be spread across the grey scale of the display. Additional facilities include a time-share, store/view facility which allows the operator to see the build-up of a picture during the scanning process. A magnification capability allows any area of interest to be selected and magnified to cover the screen.

Two new products using high-power ultrasonics were shown by Dawe Instruments, one of Britain's largest manufacturers of ultrasonic equipment. The first is the 7801A metal welder, designed for welding practically all metals but most effective with aluminium, copper and brass. Ultrasonic friction between the metal surfaces to be joined breaks up oxides and other contamination, and the exposed, clean surfaces are brought under pressure into intimate contact with each other. Solid-state bonding then takes place.

The process is characterised by low heat, low distortion and an inherent surface cleaning action due to the vibratory friction. As a rule, no surface preparation is required prior to welding.

Metal thickness ranging from 0.1 to 2.0mm, or 0.3 to 3.0mm in the case of wire, can be accommodated and typical welding times are short—in the order of a few seconds. All connections are lap welds and it is normally possible to weld through layers of insulation material.

The second new product displayed by Dawe Instruments was the Dawe 7700-series fluxless ultrasonic soldering system. This is capable of soldering and
tinning aluminium, tin, brass, copper, beryllium copper, nickel and other non-ferrous metals. Three models are available and a typical system consists of a power supply, converter and solder tank.

The power supply delivers 20kHz acoustic energy to the lead zirconate titanate transducer and alloy horn located in the solder tank where it produces cavitation in the molten solder. The cavitation action erodes oxides from the surface to be soldered and the solder metallurgically bonds the bare metal without use of flux or any other cleaning agent.

Plessey Marine Division, which produces a wide range of underwater sonar equipment, displayed a sonar beacon for use on ships, aircraft and offshore oil drilling rigs and production platforms. Originally developed for Royal Navy helicopters, the beacon activates on contact with water (at about 1 metre depth) thus making search and location easier and faster.

Range is about 9km over 360 degrees. The replaceable and encapsulated mercury battery lasts for approximately 16 days. Operating frequency is 9.5kHz, the same as that used by military and commercial sonar-sweep equipment, with a pulse width of 14 microseconds at a pulse-repetition-frequency from continuous to one every five seconds.

Non-destructive testing is one of the largest applications of ultrasonics. At least two companies, Terratest and Sonatest, are active in this field, and both companies showed their latest flaw detection equipment.

Terratest has produced an improved version of the BT-2 materials tester, designed for quality control of concrete, refractories, cast-iron and many other materials. The up-dated instrument, designated BT22, has a wider range of frequencies (10kHz to 1MHz) and features modular circuit construction. Transit times through specimens can be measured to within 0.1 microseconds, the time being displayed on five 7-digit light-emitting-diode windows.

Sonatest’s flaw detector is the UFD1, a sophisticated general-purpose instrument operated from either mains or 12V direct-current battery supply. Special facilities include a calibrated attenuator two-channel monitor, with calibrated delay, swept-gain, and interface trigger circuit. Operating frequency is 0.5 to 15MHz in six switched bands and range is from 5mm to 8 metres in steel. The display is on a 100 x 80mm high-brilliance screen with non-parellax graticule.

Although the foregoing has only briefly described just five examples of the equipment exhibited, it should provide the reader some insight into the impressive advances now being made with ultrasonic technology. In summary, it is apparent that ultrasonics has important contributions to offer in medicine, underwater communications, and a wide range of industrial processes.

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ELECTRONICS Australia, September, 1975
Experimental 10GHz link using PWM & a Gunn diode

Although mainly intended for doppler radar and ranging, the new Gunn diode microwave transceiver modules can also be used for radio communication. In this article the author describes a simple communication system using pulse-width modulation, and suggests how the idea could be developed further.

by JAMIESON ROWE

When we were processing Philip Tracy’s article on the Philips 10GHz Gunn diode modules, published in the May issue, it occurred to me that these modules could be of interest to radio amateurs. It seemed possible that they might be used to form the heart of a simple low-power telephony link, which would be practical and at the same time give worthwhile experience with both Gunn diodes and microwave aerials.

I mentioned the idea to Philip Tracy, and he agreed that it seemed worth following up. However, he warned that simple AM would probably not be practical, as Gunn diodes tend to operate properly and reliably only within a fairly narrow range in terminal voltage. At the same time he kindly arranged for Philips Elcoma to make available a sample module, to experiment with.

At the earliest opportunity after the arrival of the sample module, I looked through the Gunn diode literature in search of inspiration. The first thing that suggested itself was that although the characteristics of the device would not allow anything like 100% AM by simple modulation of the current, it might be possible to achieve low-depth AM by swinging the voltage by 10% or so on either side of the nominal 7V DC.

The simplest way to try this seemed to be by connecting the low impedance secondary of an audio transformer in series with one of the diode supply leads, with the transformer primary fed from an audio generator. However, when I tried this, the immediate result was that the Gunn diode promptly expired! Apparently Gunn diodes do not like voltage transients, and the transformer must have produced such a transient at the instant of switch-on.

I had learnt one thing from this initial foray into Gunn diode communication, then: simple transformer modulation was out. Unfortunately my Gunn diode was also "out", preventing further experiments at least for a while.

After the initial embarrassment had worn off, I contacted Philips Elcoma once more and let them know what had happened. They were quite happy to provide a replacement module, but suggested that before we went much further, it might be a good idea if they found out if the modules could be supplied pre-set to a frequency within the 10GHz amateur band: from 10.00 to 10.50GHz. We let the matter rest while they followed this up.

In the meantime, I learned that another similar 10GHz Gunn diode transceiver module had been made available, by Associated Controls Pty Ltd of 55 Fairford Road, Padstow, 2211. Selling for a similar price to the Elcoma module, it appeared to be equally suitable for amateur radio work; in fact they had already done some work along these lines. I spoke to George Hodgson, VK2OH, who was happy to co-operate by offering a couple of sample modules, technical data and advice regarding the results they had already obtained.

As a result of this I was able to press ahead once again, and decided to follow up another idea: pulse-width modulation (PWM). This seemed likely to give good results with the Gunn diode, as it would only involve the diode being switched on and off—for varying proportions of the time. At the same time it would be straightforward as far as reception was concerned, because it could be detected in virtually the same way as for normal AM.

The idea is rather like the "class D" audio amplifiers which claim attention from time to time. The main microwave carrier is modulated by a supersonic sub-carrier, which in the absence of audio has a square waveform; the carrier is chopped into a string of short bursts, separated by gaps of the same duration. The desired audio modulation is used to vary the mark-space ratio, or the "duty cycle" of the supersonic subcarrier. During the positive audio half-cycles, the carrier bursts increase in length, while the gaps between them shorten. The opposite occurs during negative audio half-cycles. As a result, the audio has the desired effect of varying the effective amplitude of the main carrier.

Of course the supersonic subcarrier effectively "samples" the audio, so that from sampling theory it must have a frequency of more than double the desired audio bandwidth. And as it is in the form of a rectangular wave, with rapid transitions, the actual bandwidth of the modulated 10GHz carrier will be quite wide—between 200 and 300kHz if the subcarrier is at 20kHz.

This would make the PWM system quite unacceptable at lower frequencies, of course. But as the 10GHz amateur band is 500MHz wide, and we’re only talking about a radiated power of about 10 milliwatts, it is quite practical for the present purpose.

Well, to cut a long story short, I have been able to develop a simple PWM system which appears to work quite well with the Gunn modules. In tests with two of the Associated Controls modules, using only the integral 12dB horns, I was able to establish contact over a range of about 300 metres quite easily—a figure set mainly by operating convenience.

With supplementary horns or parabolic dishes to give considerably...
greater aerial gain, it should be possible to extend the range to much more than this modest result. There’s plenty of room for further experimenting, in other words.

At this stage I haven’t been able to verify that the system will also work satisfactorily with the Philips modules, as these have not yet turned up. However, Philips have advised that they will be making available modules accurately pre-tuned to 10.450GHz, for amateur use. From the technical data it seems likely that these units will be electrically almost identical to the Associated Controls modules, so that they should be equally suitable. The modules will be available on order through your usual supplier, as also will be the Associated Controls module. The type number for ordering will be C18966.

The main difference between the two types is that the aerial horn supplied with the Philips module has a gain of 5dB, somewhat lower than that of the horns integral with the Associated Controls module. It also has a slightly lower output power, typically 8mW compared with 13mW. On the other hand the Philips modules will be pre-tuned to a guaranteed frequency within the amateur band, whereas you will have to tune the Associated Controls modules yourself. More about this anon...

As you can see from the diagrams, the experimental PWM system uses quite straightforward circuitry. The heart of the transmitter circuit is a function generator IC, the Exar XR-2206, available from A. J. Ferguson Pty Ltd. This is connected to produce a triangular wave output from pin 2, at a frequency of around 20kHz (determined by the 10k resistor and .0033uF capacitor).

Pin 3 of the IC is an input controlling the DC level of the output triangular wave, and this is used to achieve the desired modulation. Transistors T1 and T2 are used as a simple mic preamp, driving pin 3 of the IC via emitter follower T3. This gives a low impedance source, and also serves to prevent supersonic signal from feeding back into the mic preamp.

A 50k pot across the 12V supply is used to adjust the DC level at pin 3, along with the audio. The output from pin 2 of the IC is thus a 20kHz triangular wave whose average level is set by the pot, but with the audio wobbling it up and down on an instantaneous basis.

This triangular wave is then fed to transistor T4, which with T5 forms a simple threshold sensing switch or comparator. In effect, the triangular waveform is compared with the fixed DC level at the base of T5, and transistor T4 is switched on and off depending on their relative levels. It is switched on when the triangular wave is the more negative, and switched off when the base of T5 is the more negative.

With no audio present, this on-off switching can be adjusted to a 1:1 ratio by means of the 50k pot, giving a symmetrical square wave at the collector of T4. Thus when the audio swings the triangular wave up and down, it is able to swing the mark-space ratio of the switching waveform symmetrically either way from this 1:1 level. Hence the reason for labelling the 50k pot “PWM symmetry”.

You can see from this, I hope, that the signal at the collector of T4 is our required PWM subcarrier. This is then squared up by transistor T6, and then fed to the Gunn diode via emitter follower T7. The emitter follower provides a low impedance driving source, which is needed both to supply the Gunn diode current (around 200mA) and to ensure that the diode operates in a stable fashion. The .047uF capacitor across the Gunn diode is also for stability, and it must be wired right at the diode terminals.

The 3.3V zener diode coupling T6 to T7 is used as a DC level shifter, to limit the Gunn diode voltage to within its ratings.

By the way, the positive supply grounding arrangement is used because the positive side of the Gunn diode is connected to the casting of the Associated Controls module. The opposite arrangement will be necessary with the Philips modules, however, as these have the negative side of the Gunn diode connected to the casting.

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COMPATIBLE SYSTEMS
will have to drive the Gunn diode via an NPN emitter follower, as well as reversing the supply grounding. This will involve an extra transistor, as shown in the small diagram.

The receiver side of the system is quite straightforward, being essentially an amplified "crystal set". The diode in the receiver cavity of the module is used as a straight detector, with the rest of the circuit used to amplify the resulting low-level audio. The amplified audio is used to drive a pair of 8-ohm phones via a small step-down transformer.

Transistor Q1 is used as a low-noise preamp, connected as a common-base stage. At the same time, it acts as a DC emitter-follower, providing bias current to the detector diode. This configuration is adapted from that used by Philip Tracy in the Doppler intruder alarm described in the May article.

The detector diode is supplied with DC bias as this improves its detection efficiency. As there is an optimum bias level, the bias is made adjustable. This is done by feeding the base of Q1 from a 10k preset pot connected across a couple of silicon diodes, which provide a stabilised source of around 1.2V.

The optimum bias current for the mixer diode will lie between about 10 and 100uA, and typically seems to be at about 40uA. If necessary, it can be monitored by means of a microammeter connected temporarily in series with the 100uA load of Q1. Note that the base of Q1 is bypassed directly back to the metal casting side of the detector diode, to avoid interference pickup. Thus the only input signal to Q1 should be the diode output, as far as AC is concerned.

The 390pF capacitor across the 100k load of Q1 is to provide integration of the detected PWM signal, to smooth it into fairly clean audio once more. The amplified output is then amplified by Q2 and Q3, connected as a low parts-count feedback amplifier with a gain of 50x. The amplified signal from Q3 is then fed to the output stage, which uses Q4 and Q5 in a similar feedback configuration.

As the receiver was designed to drive a pair of 8-ohm phones, which need only a few tens of milliwatts, the output stage uses a BC108 or similar transistor. It runs at around 5mA, and is more than adequate for the job. The DC operating point is firmly stabilised by the negative feedback effect produced by the 220-ohm feedback resistor.

Coupling to the phones is via a small transistor output transformer, reflecting an impedance of between 200 and 600 ohms. I used one from an old transistor radio, with a primary impedance of around 400 ohms.

The audio gain of the receiver is adjustable over a reasonable range by means of the 1k pot, which varies the degree of negative AC feedback in the output stage.

Note that like the transmitter section, the receiver circuit uses an earthed positive rail. Again this is to suit the Associated Controls module, which has the anode of the detector diode earthed.

As before the Philips modules have the opposite arrangement, so that for a Philips module the negative rail will have to be earthed instead. At the same time an NPN transistor will have to be used for Q1, as shown in the small diagram.

As you can see, both the transmitter and receiver circuits are designed to run from 12V DC, so that they can be operated from either a mains power supply or from a common dry battery. If desired they can easily be fitted into a small utility case, like that shown in the picture, to form a portable transceiver.

There are a few points to bear in mind if you build up the system. One is to never try operating the Gunn diode without the .047uF capacitor across it. This can cause spurious oscillations due to interaction with the connecting leads. Also do not run the Gunn diode at a voltage between 2 and 6 volts, as this can cause over-dissipation and diode damage. Never apply reverse bias, either. And avoid switching transients (!)

As far as the detector diode is concerned, the main point is never to allow diode current to exceed 1mA, even very briefly. Switching transients in the nanosecond region can cause damage, either completely destroying the diode or ruining its noise figure.

Incidentally, Associated Controls are able to supply replacement Gunn diodes and detector diodes, should you come to grief. Their module is also designed for user replacement of the two devices, whereas the Philips modules are not. A point to note is that the transmitter tuning depends upon the individual Gunn diode, so that it will alter if the diode is replaced.

The final point concerns frequency measurement, to ensure that you are operating legally inside the 10.00–10.50GHz amateur band. This won't be a problem if you use the Philips modules, because these come pre-tuned to 10.45GHz. However with the associated Controls modules the frequency will have to be set to within the band. For this you will obviously need to measure or at least check the frequency.

The situation is complicated somewhat because the tuning scheme used does not give constant oscillation efficiency at all frequencies. As a result the output tends to vary with tuning, going through a series of dips and peaks. The aim is therefore to set the tuning for one of the peaks within the amateur band, so that you are not only
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10GHz PWM link

legal but also putting out as much power as possible. The actual tuning is carried out by means of the 4BA screw which protrudes from the transmitter cavity, between the Gunn diode mounting grub screw and the end wall. When the locknut is loosened, the screw is capable of shifting the frequency between about 10.3 and 10.7GHz.

Note that the Philips modules are fitted with a similar tuning screw. But as these modules are accurately pre-tuned, in this case the screw should be left well alone.

One possibility for checking the frequency of one of the Associated Controls modules would be to find another amateur with one of the Philips modules, and adjust yours until a zero beat is heard in one or other of the receivers. However this may not be easy, as finding zero beat at 10GHz is rather like looking for a needle in a haystack. There is also the problem that you still won’t know if your unit is delivering its full output (10.450GHz may coincide with one of its dips, for example).

A better approach seems to be a simple wavemeter based on the principle of standing waves. The idea works rather like the “Lecher line” system used at UHF. If a metal plate is used to reflect the microwave energy back to the receiver cavity, a standing wave pattern is set up. The energy picked up by the receiver diode will depend upon the position of the metal plate, and if the plate is moved towards or away from the module, the detected current will vary cyclically, through a series of peaks and troughs.

In fact just as with a Lecher line, the distance the plate must be moved to vary the current through one peak-to-peak or trough-to-trough cycle is equal to one half wavelength. So that by connecting the detector diode temporarily to a microammeter, and measuring the distance the plate must be moved to vary the current between two adjacent troughs, you can determine the half-wavelength and hence the frequency and it is generally best to use the current troughs for the measurement, as they are more sharply defined.

The distance that the plate must be moved has to be measured quite accurately, as a half wavelength at 10GHz is only 15mm. The distance must be measured to considerably better than 1mm, which as an error corresponds to 333MHz. In fact you really have to achieve wavemeter accuracy, with resolution to either .01mm or .001in. These correspond to errors of 3.33MHz and 8.46MHz respectively.

The obvious way to achieve this is to modify a low cost micrometer. These are available in both metric and imperial versions, for around $10 at the larger hardware stores.

As you can see from the photographs, I modified one by cementing a flat disc of 22 gauge aluminium sheet to the end of the probe with epoxy cement, using the micrometer itself as a clamp to hold the disc square while the cement was setting. Then with the cement completely set, the anvil jaw was hacksawed off, and the resulting unit mounted on a wooden base.

The wooden base must be long enough for the transmitter assembly to be mounted at the other end, so that it and the wavemeter are rigidly fixed with respect to each other. Otherwise, the readings you will get will be wildly in error, and useless.

There you have it, then. A simple 10GHz communication system, using the latest Gunn effect device and a novel PWM modulation system. It will be interesting to see how far you can push its modest 10mW or so of output, using either auxiliary horns or parabolic dishes. Even if it’s only a few miles, I think you’ll find it a rewarding challenge.

Over to you!
SPECIAL OFFER:

Transistors, diodes—20 for $1

Here is an offer to gladden the hearts of experimenters, radio clubs, youth groups etc; PC208 (BC108) transistors and small signal germanium diodes for the equivalent of 5c each! To take advantage of this offer we have selected a number of past projects which used these devices extensively and we present them on these pages.

The offer comes from Dick Smith Wholesale Pty Ltd. Both the transistors and the diodes will be packaged in lots of 20 for $1.00. This offer is intended primarily for "Electronics Australia" readers and, by way of identification, we strongly recommend that the coupon, which appears elsewhere on these pages, be presented with each order.

This price applies to over-the-counter customers. Mail order customers should add 50c per order to cover postage and packing.

The offer will remain open while stocks last, which is not expected to extend beyond the end of October, 1975.

Dick Smith emphasises that these devices are in no sense factory rejects or "seconds". Both are standard quality items which would be expected to meet all their manufacturer's specifications. (The transistors are by Fairchild.) The offer is simply because Dick Smith was able to purchase the surplus stock of a local TV manufacturer at a very keen price.

Electrically, the PC208 is virtually identical to the older and better known BC108. Physically, it is slightly different, being housed in the TO-92 encapsulation, rather than the metal can of the BC108. This has the effect of slightly reducing the maximum dissipation rating but this should not be of any importance in the suggested applications.

Some readers may be able to work directly from the circuits. Others may have access to the original articles. Alternatively, reprints are available through our "Information Service".

HIGH IMPEDANCE FET PREAMPLIFIER. (January 1967, File No 1/PRE/16.) Although the key device in this circuit is a FET it also uses two BC108s. As shown, the circuit has an input impedance of 5M, a gain of 30, and a total harmonic distortion of 0.1% at 1V RMS out. Frequency response is from 20Hz to 35kHz at the -3dB points. By varying specified components it is possible to vary these specifications to suit particular applications. For example, the gain may be increased at the expense of reduced input impedance, or vice versa.

The high input impedance makes the unit particularly suitable for use with crystal microphones or ceramic pickups, which require loads of about 5M and 2M respectively. The output impedance is quite low, making it suitable for connection to low input impedance amplifiers as well as high impedance types.

Construction is simple, involving a short length of tag board, but a metal box is essential to prevent hum injection into the low level, high impedance input circuit. Current drain from a 9V battery is only about 3mA.

FUZZ-BOX FOR GUITARS. (August 1967, File No. 1/GA/10.) For the guitar enthusiast, this simple device will have a lot of appeal. Using 2BC108s and a few resistors and capacitators it can be built for a modest cost. It is designed to be interposed between the guitar and the main amplifier, thus confining the "fuzz" effect to the guitar signals only. It is fitted with a foot switch to allow selection of "fuzz" or "normal" as required; the level remains much the same in both modes, the degree of "fuzz" is variable, and the unit provides a small amount of gain.

The unit can provide a wide range of wave shapes, from simple half wave clipping to complex peaks. As well as the unit's own control, the guitar's volume control can be used to vary certain aspects of the wave form.

The unit is battery powered, thus making it completely self-contained. The prototype was built into a small metal box with a sloping front on which the foot switch was mounted, the whole unit being designed to sit on the floor near the player's foot. Most of the circuit can be built on a short length of tag board, or strung between it and the input and output sockets, controls etc.
**PROJECTS BOOK**

As well as the projects illustrated on these pages, there are a number of others, all making good use of the BC108, which space does not permit us to illustrate. Several of them were featured in our "Projects and Circuits" handbook, and we list them briefly below for our readers' guidance.

A SIMPLE MOISTURE ALARM. An easy-to-build device which will serve as a rain alarm on washdays or as a splash alarm to supervise a swimming pool. It uses four solid state devices, two of them BC108s.

MODEL TRAIN SIGNALS. An interlocked signalling system in which red and green signal lights are controlled by the movement of the train. Each signal requires 2 BC108s and two diodes, plus a reed switch and two lamps. Very simple to build and extremely reliable.

ELECTRONIC STEAM WHISTLE. Another sound effect device, this time for the model railway enthusiast. A little more complicated than the first two projects, but not unduly difficult if built and tested section by section. Uses seven solid state devices, five BC108s and two diodes.

ELECTRONIC BONGOS. Another musical sound effect device, this time simulating the bongo drums. It is "played" by tapping a touch plate with the fingers. A simple circuit using two BC108s. If any of these projects interest you we suggest you obtain a copy of our "Projects and Circuits" handbook without delay. The projects listed are only a few of the 30 odd which it contains. It is available from newsagents or our office for £2 00, or £2 60 posted to anywhere in Australia.

PHASE VIBRATO UNIT. (March 1969, File No 1/EM/21.) Some form of vibrato is desirable in most electronic organs, but provision of true vibrato (frequency shift) can present a number of problems, particularly where it is desired to add it to an existing instrument.

Shifting the phase instead of the frequency can produce much the same effect and has a number of practical advantages. The circuitry can be relatively simple and, more importantly, does not involve the tone generators directly. This means that it can be applied only to those sections of the system which will benefit from it.

The modulating frequency (around 8Hz) is generated by a phase shift oscillator (T4) and used to modulate a small lamp optically coupled to an LDR associated with T1. The LDR forms part of the phase shift network and signals fed to T1 appear at the output (T3) phase shifted at the oscillator rate.

The circuit uses six BC108s, plus a few other solid state devices and the usual resistor and capacitors. No unduly expensive components are required and the physical layout is not unduly critical. The main requirement is to provide a light tight housing for the lamp/LDR combination.

The power requirement is 9V at about 18mA. While it could be operated from a battery on an experimental basis, a small power supply or a dropping network from the main supply rail would be a more practical proposition.

THE AUTODRUM. (May 1970, File No 1/EM/24.) This simple unit generates a drum-like damped oscillation which sounds most impressive when fed into a higher power amplifier. It uses only two solid state devices, one of which is a BC108.

The beat rate may be determined in two ways; directly by the musician operating a foot pedal in much the same manner as for a real drum, or by means of an internal oscillator, the speed of which may be pre-set by the musician.

The whole unit can be accommodated in a small diecast box and powered from an internal battery. At 9V, current drain is approximately 0.5mA. Construction is on a length of tag board, and is not critical. The tone of the drum can be varied over a wide range, from a bass drum to a kettle drum, or even imitate a set of tom-toms.
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Display Modes: Single Trace Y1 and Y2. Dual Trace chopped or alternate modes, automatically selected on timebase switch. Chop rate approx. 250kHz. X-Y mode with Y1 input giving X deflection and Y2 input giving Y deflection. Bandwidth DC to 500 kHz < 3° phase shift at 200 kHz.

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Trigger: Variable level control with option of bright line in absence of signal. Source Internal Y1 or Y2 or External AC. AC fast TV Frame. Sensitivity Internal 2mm approx. 40Hz—2MHz. External Y1 approx. 40Hz—2MHz. Internal 1cm approx. 8Hz—10MHz. External 5V approx. 8Hz—10MHz.

Additional Facilities: Calibrator 1V ± 2% square wave at supply frequency. Dimensions 18cm(7") x 29cm(11") x 42cm(16"). Approx. 7 kg (15 lb).

Specifications quoted are for general guidance only, are subject to verification and change without notice.

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ELECTRONICS Australia, September, 1975
**MONOPHONIC PLAYER** (January, 1968, File No. 1/EM/18.) This is a development from a single monophonic organ described the previous month, with the aim of converting it from a mere toy to a serious instrument which could take its place in a musical group.

Two main refinements are the addition of an extra octave and a vibrato facility. There are also suggestions as to how these ideas might be expanded further.

The extra octave is provided by two-to-one division of the basic oscillator frequency, using a gated R-S flip-flop. Either octave may be selected by means of key switches, or both may be presented simultaneously, providing a richer sound.

The vibrato facility uses the now well established technique employing an LDR optically coupled to a small lamp. The lamp is energised from a low frequency oscillator and the LDR acts as a variable resistor in the signal circuit.

The circuit uses eight solid state devices, including 3 BC108s and two diodes.

**POKER MACHINE**

This special offer would be an ideal source of components for one of our most intriguing circuits, the Electronic Poker Machine, another of our Projects and Circuits handbook features.

The circuit calls for 37 transistors, originally specified as 083s (ex computer boards) but which can be replaced without circuit changes by BC108s or their equivalent. It also uses 91 diodes, small signal variety (ex computer boards) but which, again, can be replaced by the units in this offer. Without circuit changes it is not an unduly complex device to build, although a fair amount of repetitive wiring is involved. It can be built in two stages, the first, and simpler one, displaying the combination but giving no indication as to whether it is a paying one. This must be determined from a paying combination chart.

Addition of the second stage allows the winning combinations to be recognised by appropriate circuitry, and the value of the combination indicated.

To cater for this project Dick Smith has organised a package of BC108s and 100 diodes, price $7.00, plus 50c for post and packing.

"**VOX** CONTROL" (August 1966, File No. 1/RA/27.) Originally developed as a vox control for an SSB transmitter, it was presented in this article as suitable for tape recorder control. One of its main features is a very fast attack time, aimed at minimising loss of the first syllable of the first word.

The control actuates a relay which may be connected in the motor circuit or other control circuit of the recorder, so that the recorder functions only when there is signal to be recorded.

A typical use would be to monitor a mobile radio channel, either to provide a record of messages for subsequent checking, or to assess the traffic density on a particular channel over a given period. Use of the vox avoids unnecessary running and waste of tape and, on replay, avoids waste of time listening to long periods of silence.

The circuit uses four BC108s and two small signal diodes, plus three larger diodes and a zener.
Plessey Miniature Reed Relays

These professional printed circuit Reed relays are now available in a Low, Low Price. One, two or three single make Reed inserts are housed within a coil and encapsulated in polyester, with base pins mounted on 0.1 centres. The gold-plated contacts will switch 150V AC or 250V DC to 10VA resistive load. Life at full load 10 operations minimum. 2.5m Secs operating time.

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<th>Type</th>
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<tr>
<td>SPDT Push-on push-off, 3/8&quot; bush mlg</td>
<td>$3.50</td>
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<tr>
<td>Matching indicator lamp only, 3/8&quot; bush</td>
<td>$1.50</td>
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<tr>
<td>SPDT Push-on push-off, snap-in</td>
<td>$3.75</td>
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Micro-Miniature Connectors

When space is at a premium, and quality and price are important. These amazing "Micro-Miniature" Plessey Connectors. Socket suits panel mounting, plug mates firmly with socket due to screw-down action of plug and the cable is secured by a clamp. Each set includes 1 plug, 1 socket, 1 cable clamp.

Reed Relays

These bargained-priced heavy-duty reed relays are available for printet circuit or direct wiring and are of small dimensions in a modern plastic package.

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P.L.S. Emerson 21-pin T.V. Rectifiers

International Rectifier type 21PT10. These transistorized devices are available for DC to 100VA, life to 20° mechanical cycles. 750K different colours, button switches, available with various lens covers and in different finishes. These reed relays are now available in a Low, Low Price. One, two or three single make Reed inserts are housed within a coil and encapsulated in polyester, with base pins mounted on 0.1 centres. The gold-plated contacts will switch 150V AC or 250V DC to 10VA resistive load. Life at full load 10 operations minimum. 2.5m Secs operating time.

600V 25 AMP Silicon Rectifiers

International Rectifier type 21PT10. These bargained-priced heavy-duty reed relays are available for printed circuit or direct wiring and are of small dimensions in a modern plastic package.

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Extra Powerful Mini-Magnets

Extra-powerful Mini-Magnets. Size only 3/8" dia x 3 4" long. Intended primarily for burglar alarm installations, since only a 3/8" dia hole need be drilled in door/window, these extra powerful magnets will find a host of useful applications for the hobbyist experimenter.

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$3.50

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OTHER REFERENCES

A number of other projects, which space prevents our displaying in greater detail, are listed below. All make good use of the BC108.


KEYLESS ORGAN. (January 1969. File No. 1/EM/19.) Development from the Monophonic Organ described elsewhere on these pages. Uses a stylus and pattern of contacts to replace the keyboard, thus minimising the mechanical problems.

HIGH IMPEDANCE 4-CHANNEL MIXER. (February 1967. File No. 1/MX/7.) Uses five BC108s, four FETs, and minor components. Has four inputs, two for microphones, two for pickups. All are capable of an input impedance of up to 5M.


MULTIVIBRATOR SERIES. (October-November 1972, January, February 1973. File Nos. 8/DT/60, 61, 63, 64.) This was a tutorial series commencing with a theoretical description of the basic multivibrator circuits, followed by a number of simple practical experiments aimed at demonstrating the theory.

The series also demonstrated the basic principles of binary coding and decoding including construction of a simple counter and binary decoder. Almost all the circuits could be built using BC108s and small signal diodes, plus a few resistors and capacitors.

It would be an excellent series of experiments to include in a club syllabus, particularly now that the components are available at such an attractive price. Also ideal for the individual who wishes to catch up on this phase of electronics.

Most of the circuits drive indicator lights which makes the purpose of the exercise readily apparent, even to non-technical onlookers.

THE "CHUFFER". (February 1973, File No. 3/MS/38.) For the model railway enthusiast. A sound effect simulator designed to imitate the traditional "chuff chuff" of a steam train. A useful companion unit to Steam Whistle mentioned elsewhere in these pages and, in fact, it uses the white noise output from the latter. It necessary it could be made self contained by duplicating this part of the Whistle circuit.

There is provision to vary both the rate of "chuff" and the duration or "width" of the chuff. With a little practice it can be made to imitate anything from the slow pulsing of the Westinghouse brake compressor to the rapid panting of a loco at full throttle.

The circuit uses three BC108s and one small signal diode, plus resistors and capacitors. It is a simple circuit, may be constructed on tag board, and is not critical as to layout. It operates from an 18V supply and the drain is low enough to suit battery operation. Alternatively, it can be fed from any convenient power supply.

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Here is a dual selectivity AM tuner and power supply designed to go with the FM tuner IF strip and front end described in recent issues. Together the two tuners form a high performance AM-FM program source which would make a worthy addition to any hi-fi system.

**by IAN POGSON**

In July last, we described an IF strip with decoder and filters for an FM tuner. Then last month we described a matching tunable front end. Together, they go to make up the nucleus of a complete AM tuner. This month, we will describe an AM tuner which has been designed to be integrated with the FM tuner in a single cabinet. We are confident that the finished article will be worthy of any hi-fi system.

A considerable amount of thought was given to the question of what would be an appropriate AM tuner design to go with the FM counterpart. Should we cut it to a bare minimum—a straight AM tuner with normal sharp selectivity—leaving the FM side to give the only choice of high quality audio? This is what is almost universally done in commercial tuners.

It seemed reasonable to suppose that listeners to the FM high quality transmissions would welcome at least the choice of being able to listen to the AM service with a measure of high quality under favourable circumstances. "Under favourable circumstances" is the key to the argument. There are times when the wide band mode of AM reception would result in various forms of interference in many localities, particularly at night. This means that the idea of providing only wide band selectivity would be unsatisfactory in many instances. In contrast with the Playmaster 138, we have made considerable changes to the RF stage. For the first time in a tuner of this type, we have used a ferrite rod aerial. Due to the exceptionally high Q of this aerial circuit, it has been necessary to dampen it down somewhat with a 120k resistor. Also, coupling between the tuned circuit and the gate of the RF amplifier has been kept very light—via a 4.7uF coupling capacitor. A second tuned circuit is included in the drain of the RF amplifier, the output of which is fed to the base of the following self-oscillating mixer.

The self-oscillating mixer is the same as we have used before. It is important to note that with this circuit, the 0.01uF capacitor shunting the 470 ohm emitter resistor is fairly critical and should not be increased above this value.

The three tuned circuits are tuned by means of the new special Roblan composite 3-gang capacitor. The AM section has a maximum capacitance of 240pF per section and as no provision has been made to make this design paddless, it is necessary to fit a pad of 200pF in series with the oscillator section. This is made up by connecting two 100pF capacitors in parallel.

Following the mixer is a 455kHz IF strip, with switchable sharp and broad selectivity. This is done in the same way as previously. Prior to the first IF amplifier we have a sharp selectivity circuit consisting of two single tuned IF transformers coupled via an impedance matching network and a double ceramic filter. The broad selectivity is obtained by overcoupling a double tuned IF transformer. Selection of either circuit is by means of four germanium diodes, DC switched from the front panel.

As the main part of the selectivity characteristic is determined in the stage just mentioned, coupling between the first and second IF amplifiers is by means of a permanently overcoupled double tuned IF transformer. The detector is a germanium diode voltage doubler type, which gives quite a high level of audio output. Also, the DC developed is higher than from a single diode detector and this is an advantage when the DC voltage is used for AGC purposes. AGC is picked off via the 1M filter resistor and fed to the RF amplifier and the first IF amplifier.

Audio from the detector is fed into a Darlington pair, in order to transform from a high impedance for the detector, to the low impedance necessary for the bridged-T whistle filter. The purpose of the whistle filter is to notch out the 10kHz component resulting from heterodynes between the wanted station carrier and those on adjacent channels, under wide band conditions.

Following the whistle filter is an audio frequency treble boost network combined with the audio output level trimpot. The purpose of the treble boost is to make up for the slight treble cut which results from the restricted bandwidth of the aerial and RF tuned circuits.

The signal strength meter performs the dual function of signal strength for both AM and FM tuners. To achieve this, it has been necessary to combine the two circuits to some extent and this has necessitated the use of an isolating germanium diode to make for a completely satisfactory arrangement. The AM meter zero adjustment is done with a 1k trimpot, in series with a 4.7k resistor.
In our prototype, we have used a 5.6k resistor to zero the meter for FM. This may not be satisfactory in all cases and it may be necessary to use a different value, or a 10k trimpot may be used instead.

Full scale meter reading for the strongest AM signals is set by the 820 ohm resistor, while full scale for the strongest FM signals is set by the 15k resistor on the FM PC board.

The power supply is regulated to a nominal 12V. A 2N3055 is used as a series regulator, with a 12V zener diode as a reference in the base of the 2N3055. At first sight, it may appear that the use of a large transistor is quite unnecessary. However, the philosophy is that this transistor is quite adequate for the job, will withstand any likely overload, is readily available and low priced. In addition to supplying the tuner in operation the regulated supply also has the two small 6V/80mA dial lamps connected in series across it.

So much for the circuit. As for components, it would be wise to stick to those specified on the parts list as far as possible. However, unless a tuned circuit is involved, polyester capacitors could be replaced with low voltage ceramic types. Polystyrene types may generally be replaced with polyester or NPO ceramics.

The circuit and parts list show alternatives for transistors but it is quite likely that other alternatives could also be used. Although we have not tried other bipolar transistor types, it is quite possible that a number of other equivalent types would be satisfactory. Diodes should present no problems and where type OA91 is specified, any general purpose germanium type should be in order. Any silicon power diodes of sufficient ratings may be used for the rectifier, although we used a type WO2 bridge assembly, which is imported by A & R Soanar.

While we are on the subject of diodes, we used three light emitting diodes (LEDs) as indicators for FM tuner, FM stereo and AM tuner. These are colour green, red and yellow, respectively, and we used types made by Hewlett Packard. It would be wise to stick to these if possible, as they will just fit into the small holes in the metal front panel. However, other types may be used if desired.

The ferrite rod aerial, RF and oscillator coils and the IF transformers which we used are made by Transcap Pty Ltd and distributed by Watkin Wynne Pty Ltd, 32 Falcon Street, Crows Nest, NSW. A similar range of coils is made by Aegis and these may be used with equivalent results. Closely associated with the IF transformers is the ceramic filter and the one specified must be used.

A new whistle filter coil has been made available by Transcap, through the above source. The PC board has been made to take this coil and so it would be wise to use it.
PLAYMASTER 146

However, providing the necessary mechanical differences can be accommodated, an equivalent type could be substituted.

The PC board should be available from the usual outlets. The board for the AM tuner was made by RCS Radio who also can supply the other two boards for the complete project.

There are two push-button switch assemblies used, both available under the name of Isostat from McMurdo. One switch consists only of one DPDT unit and the type number without button is 3828-1. The other assembly consists of a bank of six DPDT units and the type number without buttons is 3829-6.

The component layout shows the PC board from the component side. External connections are via PC stakes. Take care to ensure correct orientation of polarised components.

The aerial loopstick is mounted on the back panel with two L shaped brackets. These may be readily made up using scraps of about 20 mm x 16mm x 1.5mm, cut to size and screwed together. The metalwork is quite simple and as such, should be less expensive than some more demanding designs. There are three plates, one each for the front and back panels and a bottom panel. The whole is held together with a framework of aluminium angle (16mm x 16mm x 1.5mm), cut to size and screwed together. The metalwork is simple enough for the average handyman to cope with himself but it should also be available ready for assembly through the usual channels.

The wooden cabinet is very simple, but effective. It consists of a four sided sleeve and would be within the capability of the average handyman to make himself. We made ours from 3/4" thick particle board and veneered it with the readily available pre-glued iron-on veneer.

We will assume that you have already made up the items already described for the FM part of the project. It now remains to make up the board for the AM section and then fit the lot into the final assembly and then into a cabinet. While the amount of work involved is not inconsiderable, the finished article is well worth the effort.

A logical place to start construction would be the printed board. This task is made easy as all components are clearly shown on the diagram. Fit all the small components first, followed by components of increasing size, finally finishing up with the power transformer and gang. There are a number of connections on the PC board and these are shown dotted on the diagram.

Points to watch when doing this job are to make sure that diodes and electrolytics are polarised correctly. Care should be taken with transistor connections. Coil cans should be seating properly before the connections are soldered. Care should also be exercised to make sure that the whistle filter coil is connected the right way round. The ceramic filter calls for special care in soldering, as the connections are small and close together.

Having finished fixing the AM tuner and power supply components to the board, the FM front end may be added as well. Before doing so, some tinned copper wire leads should be added to the main board some component sections such that when soldering the lead later on to the copper of the board, the lead will not fall off the gang if the soldered joint should melt. The three trimmers for the AM sections may also be fitted to the gang. Now screw the front end assembly to the main board, cut and bend the TC leads just referred to and solder to the appropriate points on the main board.

If you have already mounted the front end on a special board of its own, as described last month, then it would have been necessary to remove it from that board and then fix it to the new board as just described. The corresponding edge of the new board will have to be fixed to the FM IF board assembly, in the same manner as already described last month. Thus assembled, the whole unit may have six 1/8" thin spacers screwed to the holes provided.

Using the five separate pieces of aluminium angle, the framework may be assembled. This is quite a simple operation and the complete board assembly may be incorporated into the angle frame.

The aerial loopstick is mounted on the back panel with two L shaped brackets. These may be readily made up using scraps of about 20
PLAYMASTER 146 AM-FM STEREO TUNER

gauge aluminium. The brackets are 24mm wide, 32mm high, with a 12mm foot. The grommet which we used required a 3½in slot, first made by drilling a 3½in diameter hole and opening it into a slot with a hacksaw and finishing with a file.

The components, including the loopstick, terminals, sockets and balun transformer may now be assembled on to the back panel, which in turn, may be screwed to the angle frame. Compared with the back panel, the inside front panel has rather more components associated with it. Before starting this assembly, if you have not been able to obtain a suitable dial pointer, then now is the time to make one. The slider is made up from a piece of flat tin plate; a piece from a jam tin would do. Cut one. The slider is made up from a piece of flat tin plate; a piece from a jam tin would do. Cut a flat rectangular piece, 38mm long and 16mm wide. This has to be bent up longitudinally in the form of a thin U. The aid of a vice, hammer, and a small piece of flat metal, a little thicker than the front panel on which it will slide, will be required for this operation. I will leave it to your ingenuity, rather than attempt a lengthy description of how it may be done.

Having made the slider, a pointer is also required. We made ours from a piece of 16 gauge tinned copper wire, about 90mm long to start with. Place the slider on the top of the panel on which it will slide, with the wire at the centre of the slider and at right angles to it, and solder the two together. Leave about 22mm hanging over the back, and the rest towards the front. About 8mm of the shorter piece is now folded back on itself, to the underside, leaving a gap of about 5mm. At 10mm from the centre of the panel and slider, bend the front piece of the wire down at right angles and parallel with the panel. The long piece should now be cut off, 50mm from the bend.

We gave our pointer a coat of red enamel, leaving the double bent piece at the back unpainted. Incidentally, the bent piece will actually clamp the dial drive cord later on.

Now fit the 6-bank push-button switch to the front panel. Make sure that it is the right way around, and fasten it to the front panel with the screws provided. The single push-button switch and the dial drive bush assembly are next. The two meters may luckily be just a neat push fit into the holes and this will be enough to hold them. However, we are not always this lucky and a good way of fixing is to use a small quantity of PVA or other suitable glue applied to each of the mounting lugs. Make sure that they are held properly in place while the glue sets. At this point, the panel may now be fixed to the angle frame.

The major part of assembly is now finished and the interwiring may be done now. Wiring between the push-button switches and other points calls for care, but may be carried out by running wires in any reasonably short route. Audio output leads from both tuners to the switch and the two output sockets are run in thin shielded cable. The braids are earthed at one end only, the braid being cut off short at the switch ends. The .01uF capacitor across the tuning meter is connected across the meter terminals. The dial and the 5.6k resistor are connected right at the terminals of the signal meter strength.

The leads from the aerial loopstick coil are passed through the grommet on the back panel and the surplus length cut off. The tap, a little, the common leads of the green and blue leads, the lead from the front end input to the AM aerial terminal. While we are on aerials, we gave our pointer a coat of red enamel, leaving the double bent piece at the back unpainted. Incidentally, the bent piece will actually clamp the dial drive cord later on.

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When wiring the single push-button switch for the mains ON-Off, make sure that all contacts are well clear of other metal parts. We covered all lugs with short pieces of sleeving, including those which were wired to the transformer and terminal strip on the back panel. When terminating the mains cord to the terminal strip, clamp it to the back panel just above the grommet and next to the mains terminal block.

In the prototype, we made the holes for the three LEDs so that they were a fairly neat fit. After wiring each one in place, we fixed each one with a drop of PVA glue. We found it convenient to shorten the leads of the LEDs just a little, the common leads of the green and yellow being connected together and a lead run to a nearby earth terminal on the PCB. Each of the two LEDs just mentioned has a 680 ohm resistor connected to each respective lead, right at the LED. Hookup wire completes the leads, which are terminated conveniently at the AM/FM socket.

Part of the dial stringing includes a small l-shaped bracket. This is made from a piece of 16 or 18 gauge aluminium, 12mm wide with a 9mm foot and the main arm 32mm long. A hole is drilled in the foot for mounting on the front panel and two more holes are drilled 15mm apart and one 9mm from the bend. We tapped the two holes on the main arm to 3½in Whitworth but if you are unable to do this, we suggest that you stick screws with epoxy resin on the underside. They were fixed with 3½in Whitworth screws, so that they run freely. Then the screws may be permanently set with two lock nuts.

Towards the other end of the front panel, two pulleys are mounted on a ½in x 3½in Whitworth RH screw. The screw is first fixed to the panel with one nut. A pulley is slipped on and AM aerial terminal. While we are on aerial leads, the lead from the front end input to the balun and coax socket is run in thin shielded coax lead as was used for the audio circuits.

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another nut follows, set so that the pulley keeps the cord parallel with the panel. Run another nut on to lock the one adjacent. Then run two more nuts on the screws, with a solder lug between them. Lock the nuts, with the lug looking towards the meter and leaving enough room for the second pulley.

To do the dial stringing you will need a piece of nylon dial cord just under 1m long. This gives enough to handle and tie the ends, any surplus being cut off later on. Fitting a dial cord is never a particularly easy job but to help in the operation, we have supplied a simple sketch. Follow this carefully, loop the cord 2½ times around the drive spindle and adjust the tension by stretching the spring as much as possible within the limited space. The spring will be extended by about 8mm or so.

A “lilliput” lamp has to be fitted adjacent to each of the meters. Slide each socket into a neat fitting rubber grommet. Make a loop of 16 or 18 gauge TC wire to fit neatly and firmly around each grommet and bend the wire at right angles for about 25mm. Fit a solder lug under one of the lock nuts of the L bracket near the tuning meter. The wire of the lamp socket assembly is soldered to its respective solder lug, so that the lamp is over the centre of the meter—the lamp should clear the body of the meter and the front panel by about 1mm. The sockets are wired in series, picking up the 12V supply and earth from points on the switches.

This virtually completes construction, with the exception of a cabinet. The next job is to adjust and align the AM tuner, the FM part having already been covered previously.

As the dial scale proper is on the outside front panel and mounted in the cabinet, we have reproduced it full size so that this may be cut out and used as a temporary measure, to facilitate alignment. To do this, cut out the scale, with as much overhang at each end as possible. Using some cellulose tape, string the scale midway between the two meters, so that the distances from each extreme of the scale to each meter are equal. Close the gang and fit the dial pointer so that it is a line thickness to the left of the “88” line on the scale. The clamp of the pointer is fitted to the cord at this point.

Before starting adjustment and alignment, set the switches to “AM” and “Sharp”. Set the three trim pots to about mid travel and set the three AM gang trimmers to about one quarter in mesh. Switch on and check the supply voltage. Ours came to 11.4V and yours should be within about 0.5V of this.

Before tuning in a station, adjust the 1k trim pot so that the signal meter reads zero. Lift one side of the 18pF capacitor under the second IF transformer and tune in a station. It may not be very strong but it will more than likely give some reading on the signal meter. Adjust the slugs in the last IF transformer and each one in the first IF transformer pair for maximum response. It is essential to get all these tuned circuits on the same frequency as the ceramic filter. While making these adjustments, rock the tuning to make sure that you are getting the maximum possible.

Under no circumstances must the tuning be altered from the present setting for the rest of the IF adjustments. Solder the 18pF capacitor back on the second IF transformer. Connect a resistor with conveniently short leads across the secondary of the second IF transformer. The resistor may be any value between 4.7k and 10k. Adjust the slug of the transformer corresponding to the primary winding for maximum response. Change the resistor over to the primary of the transformer and...
peak the slug in the secondary winding. Then remove the resistor.

Now switch to the "Broad" selectivity position. Contact the same resistor across the secondary of the first IF transformer, which is the same as the second IF transformer just aligned, and adjust the slug of the primary winding for maximum response. Repeat the operation, contact the resistor across the primary and adjusting the secondary slug for maximum response. Remove the resistor, and this completes the alignment of both IF channels.

Switch to the "Sharp" selectivity position again. Tune to a station as near as possible to 600kHz and if it does not fall on the correct place according to the calibration, the slug in the oscillator coil must be adjusted until this is achieved. Adjust the RF coil slug for maximum. To adjust the aerial loopstick, the coil must be moved along the rod. Avoid touching the top, or gate end of the coil, as this will cause detuning. With a non-metallic tool, or fingers at the earthy end of the coil, move the coil for maximum.

Now tune to a station around 1300kHz and check for its correct place on the dial. This may be adjusted with the trimmer corresponding to the AM oscillator section of the gang. The other two AM trimmers are now adjusted for maximum response. Return to the low frequency station and adjust the slug again in the oscillator coil, followed by the RF coil and aerial rod. The high frequency station is checked in the same way and this procedure is continued until adjustment is complete.

Adjustment of the whistle filter coil is best done with the help of an audio generator, a frequency counter and a CRO or audio millivoltmeter. There are two small white dots, one each on the two halves of the pot-core. Adjustment is effected by grasping the top half with the fingers and rotating it slowly. It should not be necessary to make more than one quarter of a turn either way, to adjust for a null. Maximum attenuation is achieved by adjustment conjointly with the 47k trimpot.

If you have the equipment, a precise 10kHz sawtooth is fed into the Darlington pair, by lifting the .01uF input capacitor and then adjusting the whistle filter for maximum attenuation.

For readers who are less fortunate and do not have such elaborate equipment at their disposal, the other method is to do it by listening. This will be done at night and with the selectivity switch set to "Broad" and tuned to a station on which there is a high level of 10kHz whistle. The coil and 47k trimpot are adjusted as described, for maximum attenuation.

Although the circuit values given should make the correct adjustment possible, due to some component value spreads, it may not be possible to get the required adjustment. If this is the case, we ran into this problem on one occasion and a cure was effected by adding a 330pF capacitor directly across the whistle filter coil. This value may vary from one case to another and is mentioned as a guide only.

The 820 ohm resistor determines the full scale reading of the signal meter for the AM tuner. This value may be varied if the needle travel either falls short, or hits the stop, under very strong signal conditions.

The audio output trimpot may need adjustment to avoid overloading the input of the amplifier or control unit. A desirable setting would be such that the audio level from the FM tuner is the same as that from the FM tuner.

Details for the alignment of the FM tuner have already been given. However, there are some finishing touches which may be done now, which could not have been done earlier. There has been a modification to the use of the signal meter on the FM tuner. We found that a 5.6k resistor was just right to give a zero reading on the meter, with no signal being received. This may need some slight change and must be dealt with in each individual case.

Now that we have the scale for the FM tuner, it is possible to touch up the alignment so that the frequency of the stations received will fall at the correct place on the dial. If you do not have an accurately calibrated VHF signal generator, a signal of known frequency may be used for the low frequency end of the band. If you are fortunate enough to be able to tune the sound of TV Channel 5A, then this will give you an accurate 107.75MHz. Failing this, the next available frequency should be used.

For readers who wish to duplicate the wooden cabinet, a few guidelines may be helpful. The woodwork consists simply of a sleeve consisting of four pieces. The basic wood is 'Thermo' veneer. This veneer is obtainable at most hardware and timber merchants. It is pre-glued and it is fixed simply by ironing it on with a domestic iron. Details are given with each sheet of veneer.

So that the front panel may be fixed to the cabinet, a step is required around the four front edges. This step is about 8mm wide and about 2mm thick. It must be covered with the veneer, which is much thinner than the required 2mm. We solved this by using strips of cardboard, covered with the veneer, the combination then being glued in place with PVA glue. Make sure that the inside edges which will later take the front panel, are quite straight, otherwise cracks will spoil the final appearance.

The front edges are also veneered and in order to give that professional appearance, the corner joints should be chamfered at 45 degrees. All this may seem rather tricky, but with care and patience it is possible to come up with a cabinet which rivals the commercial ones.

Finish is a matter of personal choice. Some may prefer French polish but for the novice, this could cause some problems. A finish which is easy to do and which gives pleasing results is the Scandinavian oil finish. The materials for this are available at hardware and paint stores.

Only after the cabinet has been finished can the front panel be fitted. This is offered in through the back of the cabinet, carefully set in place and fixed with a fillet of PVA glue right around the edges. The cabinet is best left face down for this operation and until it is dry.

The complete tuner assembly slides in through the back and butts up against the front panel at two points. The tuner is held in by four screws, with rubber feet attached. Four holes must be drilled in the bottom of the cabinet, corresponding with the holes in the runners of the tuner assembly. This operation calls for care and accuracy and it is a good idea to drill oversize holes in the cabinet. We made ours 1/8in diameter.

With all this done, you will now have a tuner system which you should continue to derive much pleasure from for many years. At the time of writing, all we need now is a good FM broadcasting service! By the time this appears in print, let us hope that the ABC and some others will have made an appearance, or are well on the way.
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Sustain unit for guitar amplifiers

Circuits which produce special effects or deliberate—but legitimate—distortion of signals from guitars or similar musical instruments are always popular with modern musicians. The sustain effect, plus some ‘colouration’, is one of the more popular ones and this article describes a simple circuit to provide it.

by G. T. Ryan

This is a device used to effectively lengthen or ‘sustain’ the duration of a musical note. It is used by guitarists wishing to add emphasis to particular notes or chords.

Fig. 1 shows the decaying waveform (damped oscillation) obtained from a guitar string. Once having been plucked, a string will theoretically maintain oscillation indefinitely but, in practice, it is damped and the amplitude decreases with increasing time.

The rate of decay of the damped oscillation depends upon the loading of the string. Generally, higher quality strings will decay at a slower rate but this is also dependent upon the type and quality of guitar being used.

Sustain units consist of a high gain amplifier followed by a clipper to limit the maximum output voltage. In this way the amplitude at ‘t’ (Fig. 1) is raised to the required output level while the amplitude at time ‘t’ will be limited to the same output level. (Fig. 2)

Clipping the waveform distorts the original note and, if applied to speech or complex musical chords, would produce intolerable distortion. But, used with a guitar, the added ‘colouration’ of the musical notes is sometimes just what the guitarist wants. To produce a sustain unit

The entire unit is housed in a die-cast box which is robust enough to carry the foot switch and withstand the kind of treatment which this implies. The unit carries its own battery and is switched on by inserting the input jack.

Basically the circuit is that of a high gain amplifier, followed by a clipping circuit. Transistors TR1 and TR2 provide most of the gain, which is controlled by R8. TR3 provides additional gain, and D1 and D2 provide the clipping.
that did not distort would require a much more complicated and expensive approach.

Fig. 3 shows a practical circuit. Transistors TR1 and TR2 are used in a pre-amplifier circuit that provides most of the unit’s total amplification. R8 controls the total gain and so controls the amount of sustain. Maximum gain will produce maximum sustain. Transistor TR3 further amplifies the signal which is then applied to a diode clipper circuit, D1, D2. Inserting the guitar plug into the input jack provides the chassis return for the 9 volt battery, and no other switch is used or required.

**PLEASE NOTE**

This project is one contributed to our Kitsets-EA Competition. As such, it has not been through our laboratory and should not be regarded as a regular “Electronics Australia” project. We will therefore not be in a position to answer postal queries about its operation, or supply back-up information, diagrams, etc., beyond what is published. And while we may quote the contributor’s name and address, to authenticate the article, the contributor is under no obligation to answer letters about his project. That is entirely a matter of his own inclination and convenience.

A die-cast box (6in x 4in x 2in) was used as a case for the unit. The lid was used as the bottom with four small rubber feet attached. The two controls are at the front, the input jack on the left, and the output on the right. The foot switch is in the middle towards the front, to provide a rest area for the foot. The case can be spray painted any desired colour. The components may be mounted on matrix board or a printed board which can be positioned between the ledges inside the box.

Adjustment involves three steps. First, set the guitar amplifier level and the guitar volume with the sustain unit bypassed. Then, operate the foot switch, set the sustain level about half way, and adjust the output volume control for the same loudness as in the first instance. Finally, adjust the amount of sustain required by striking a note or chord. After some practice with adjustment and musical arrangements, the guitarist will find conditions that suit his taste.
New kit teaches
digital concepts to tyros

When the staff at Virginia Polytechnic Institute in the USA were faced with the problem of teaching digital systems concepts to chemistry and chemical engineering students, who lacked any background in electronics, they developed a rather unique teaching kit.

by JAMIESON ROWE

Electronic measurement and control techniques are now an integral part of chemistry and chemical engineering, as they are in many other disciplines, and students in these fields need to have a good grasp of the concepts involved. This can pose a problem, because such students often have no background in basic electronics.

The traditional approach has been to try and provide a basic electronics background, but this is time consuming and hard to justify for people who want to become chemists or chemical engineers, not electronics experts.

Virginia Tech faculty members Peter Rony and David Larsen were faced with this problem, but saw an answer in the trend towards digital technology. They reasoned that it should be possible to leapfrog the traditional approach, and teach digital systems concepts without worrying the students with detailed electronics theory. In short, they decided to present digital concepts in functional terms, divorced from circuit operation.

The system they developed to do this was a kit of small PC-board modules, designed to plug into the well-known SK-10 breadboard socket made by E-L Instruments Inc., of Derby, Connecticut. Known as "LR outboards", the modules are now being manufactured by E-L instruments, and sold together with a power pack and breadboard base as a complete teaching system.

To accompany the system, Larsen and Rony have written student laboratory manuals, which they have dubbed "Bugbooks". Bugbooks I and II are currently available to cover the modules released to date; further volumes will follow to cover the microcomputer and later outboards.

The books are very detailed, and take the student very thoroughly through the concepts of digital element and system operation. They have been published by E-L Instruments, and are being marketed as an integral part of the LR system.

Since the LR system has been produced and marketed by E-L instruments, it has become quite widely adopted by US colleges and schools, and also by firms such as IBM for staff training.

In Australia, the system is handled by General Electronic Services Pty. Ltd., of 99 Alexander Street, Crows Nest, NSW 2065, who report that they have already found a very favourable response from local educators. Quite a number of kits have been sold to date, to both colleges and manufacturing firms. GES marketing manager Erle Goodwin says that lecturers, tutors and staff training officers have been quick to see the benefits of the LR system's integrated hardware-software approach.

Price of the complete kit, including power pack unit, SK-10 socket, a full set of outboards with ICs, passive components and connecting wires, and the Bugbooks I and II, is $315.00 plus tax if applicable.

For further details, readers are referred to GES at the address given above.

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Dawn of the microprocessor era

Although microprocessors or "computers on a chip" have been around for about three years now, it is only in the last 12 months or so that they have really started to blossom. Almost all of the major semiconductor makers have now made an entry into the field, and there seems to be an accelerating stream of new and more powerful devices.

Not only this, but there is obviously a great deal of money and effort going into promoting the devices. Weighty tomes of systems planning and applications data are beginning to appear, and each maker is running seminars and lecture courses for designers and engineers of prospective customers.

If we at EA seem to have ignored microprocessors ("uP" for short) until now, it is not because we didn't think them important, nor because we weren't aware of the developments. Rather, it has been because we have quite frankly been bewildered by the sheer bulk of information. Where does one start?

After attending a few of the seminars run in Sydney recently, I still don't feel able to put the topic of the uPs into full perspective. However it does seem about time we said something about this important topic, so I'll try to pass on here some of the broad perspectives I've been able to form to date.

Perhaps the most obvious thing about uPs at present is that they're still quite a long way from being a complete computer on a chip. Most of them still need quite an array of associated devices, to provide such things as external ROM and RAM memory, data and address multiplexers, address latches, status registers, clock generators, bus drivers and so on.

In general it is probably true to say that current uP chips provide most of the "central processor" or CPU hardware of a computer, apart from the memory: the micro working registers, the arithmetic and logic unit ALU, and the timing and control circuitry. They also tend to include items like interrupt flags, and either a stack or a stack pointer register for handling interrupt and subroutine servicing.

Most of the makers have come up or are coming up with companion devices for their uP chips, to form complete system families. The companion devices include especially compatible ROMs and RAMs, addressable latches and bidirectional bus drivers, along with functionally more complex things like a "peripheral interface adapter" (PIA) and an "asynchronous communications adapter" (ACIA).

Some of these devices are not very far behind the uP chips themselves in terms of chip complexity.

Perhaps surprisingly, many uP chips don't seem to lend themselves for easy use in general-purpose computing. With some chips it could well be a major job to produce an equivalent of the familiar general-purpose minicomputer, let alone a full-scale "number cruncher".

Basic architecture of the National Semiconductor PACE uP chip, a very powerful microprogrammed 16-bit device.

Already a few uP-based "intelligent" video terminals have begun to appear, and the latest generation of complex automatic test instruments is based on uP controllers. And it seems very likely that before long our cars will have one or more uP systems on board, controlling such functions as fuel mixture, brake application, and perhaps maximum speed limiting.

In passing it is interesting to note that the first uP chips were organised for a single-bus system, with all data and address words shuffled back and forth along a single "highway". This called for fairly clumsy multiplexing, and also slowed down operation. Presumably it was done this way in an effort to reduce the number of device pins required.

Some new uP chips have gone for a multi-bus approach instead, with various bus lines used for addresses, data and control signals. This is in contrast with the trend in minicomputers, which started off with a multi-bus architecture but made a virtue of progressing to the single bus approach!

The very latest generation of uP chips feature a facility known as microprogramming. Here in place of the usual fixed logic circuits for decoding and carrying out instructions, they have an internal ROM-driven logic controller.

Perhaps the most obvious advantage of this approach is that the instruction set may be changed easily, without having to alter the basic chip design or layout: all that is necessary is to alter the instruction "recipes" in the microprogramming ROM. One uP chip can thus be made to respond to the instruction set used by another device, so that it can "emulate" that device.

Microprogramming is also very worthwhile for specialised applications, as it allows the uP chip to be provided with the most efficient set of instructions for the task concerned. Thus a single basic design can be effectively turned into a "word processor" or a "display controller", each with its own quite different instruction set, simply by the use of differently programmed microinstruction ROMs.

Perhaps the last comment on the uPs for the moment concerns price. At the moment, they're not cheap—from about $80 to $350 each in 1-off quantities. This seems mainly due to limited consumption. As products, they're no more complex to make than calculator chips—some of which are down as low as $5 each in large quantities.

As the application of uPs grow, then, the prices seem destined to fall quite markedly. The microprocessor era is just dawning, in other words! (J.R.)
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by A. J. LOWE

FIG. 2

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R2 10000 OHMS

LAMP

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FIG. 1

R1 66 OHMS

R2 470 OHMS

ELECTRONICS Australia, September, 1975
WHAT A TRANSISTOR DOES

The model on the left is wired as in the circuit diagram below it. A fairly large current can flow from the battery positive terminal, through the lamp, into the transistor collector terminal C, out of the transistor emitter terminal E, and back to the battery negative. This path is shown by the dotted line in the circuit diagram.

Another circuit is shown by the dashed line. Current flows from the battery positive terminal, through the 5600 ohms resistor R1, through the variable resistor R2, into the base B of the transistor, and out of the transistor emitter terminal E, and back to the battery.

Put the clip on terminal E, and turn the knob. Notice that when you vary the variable resistor R2 the lamp can be made dim or bright. This shows that the current flowing into the base of the transistor can vary the current flowing through the collector-emitter circuit of the transistor.

The current flowing into the base of the transistor is always relatively small; in this case the maximum is about 0.001 amperes, and the minimum about 0.0002 amperes. So, you can see that a small variation of current in the base can cause a big variation of current in the collector—it can turn the lamp from full on—about 0.05 amperes—down to very dim—about 0.02 amperes. This is how a transistor amplifies—a small variation of current in the base can cause a large variation of current in the collector.

Please put the clip back in the 'PARK' position.

This is the second in our series of "Teach Yourself Boards" designed to help beginners learn the basics of what common semiconductors and circuits do. A general account of the aims and construction of the boards was given in the first lesson.

This month's board, built on the standard 13mm chip boards "chassis" measuring 450mm x 300mm x 65mm, tells the rudiments of "What A Transistor Does".

It was designed simply to get across the fundamental concept that the current through a transistor may be controlled by the current flowing through the base.

Nothing more.

The layout of the board is shown in Fig 1, and the circuit in Fig 2. Note that in the circuit diagram on the board, broken lines are used to indicate current flowing through the collector-emitter circuit and through the base-emitter circuit. Also, the values of the resistor and the potentiometer are spelled out in full—not abbreviated to 5k and 10k.

Construction needs hardly any explanation. The pot was mounted on a "bridge" made of aluminium; the lamp holder was an ex-junk box. The battery comprised 4 AA cells in a suitable case, held in position by an aluminium clip.

The value of resistor R1 was found by test, so that the pot was fully effective—that is, it varied the brightness of the lamp over its full range. Thus when the pot R2 is set to zero ohms, the value of R1 should be selected so that the transistor will just saturate. Then any increase in base resistance, by turning the pot, will dim the lamp.

In our next lesson we will be looking at a board which demonstrates that most fundamental law of all electronics—Ohm's law. We have called it "Know Ohm's Law".
Radio problem for small private boats

Much to our surprise, two full pages in the May issue on the subject of the Citizens Band hardly stirred a ripple indicating, surely, that much of the one-time emotion has been dissipated. But it did invoke one response which is important enough to warrant special mention: it involves a possible link between CB equipment and safety at sea.

The matter is raised in a letter from a Tasmanian reader, but his concern is by no means unique. Only a few weeks ago, the same series of questions were posed to me by a business acquaintance in Sydney facing what is, in fact, a very common situation. Here’s the letter:

Dear Sir,

I read with interest your article about the Citizens Band, in the May issue of “Electronics Australia”. The article encouraged me to come forward with the following problem:

I am not a radio man, but I would like to use a CB radio once a year during my summer holidays, on a small day-sailer, for the sole purpose of communicating with my family, as there are only a few telephones in southern Tasmania. It makes an otherwise enjoyable holiday a race with the time to reach a telephone, despite the weather, because I have agreed to ring home twice a week!

It would also add to safety.

When I approached a local specialist on radio communication, I was presented with so many “difficulties” and legal aspects, licences and what not to do, that I had to give up the idea.

My question is: Is that really so? Could I use such a CB transmitter with the knowledge that I can reach my family, say 60 or 70 miles… I beg your pardon: 100 km away, without having to use the bulky and expensive radio transmitters used by yachts or fishing boats? The trouble is, my home is 3 miles from the sea, in a gully between mountains, which I understand, will make the contact difficult.

How dependable is the claim by the salesman: “…50 miles over water?” If such a range is possible, what sort of CB radio would you suggest? The point is also, that intending to use it only for about 3 weeks a year, I would not like to spend a fortune on it. Am I asking too much?

(G.A.W. Hobart, Tas.)

Well...
The isolation—and more particularly the safety—of small boats at sea has been a matter for increasing concern over the past decade, with the emerging fashion to have one’s own boat, with trailer, sails, or outboard motor. While intended mainly for rivers, lakes and estuaries, a good many of these boats do head out to sea, on the assumption that the weather will hold and that nothing unexpected will happen.

But the unexpected can happen, and does happen, often enough to invite restrictive legislation and to make at least the more cautious boat owners wary of venturing “outside” without some kind of radio gear aboard. But now comes the problem, as set out in the letter—and it isn’t unique to Australia.

U.S. authorities, for example, have been concerned for quite a while about what some U.S. writers have dubbed the problem of “rowboat radio”!

Though obviously a cut above simple skills, the boats concerned may still be relatively small and relatively inexpensive: $1000, give or take a few hundred. Compared with such a figure, it would seem reasonable to spend another hundred dollars or so on portable 2-way radio—roughly the price of a couple of CB units, off the shelf and ready to use.

The inquiry follows naturally: will these conveniently priced units meet the need and, if not, why not?

The short answer is: no and no again—relating to both practical and legal aspects.

In practical terms, the effective working range of hand-held CB units is both limited and variable because of their low power output, inefficient aerials and the dependence of the signal on environment at the usual 27MHz operating frequency.

The signals can be decimated by ignition or other electrical interference and I have seen hand-held CB units, in these circumstances, hard put to it to maintain a link beyond a few hundred yards.

Even in some quiet locations, say low bush scrub on relatively flat and dry sandy soil, they may be flat out to work over more than half a mile. But pick a path nearby, over water, and the signals may romp in from four or five miles away—provided neither party retreats from the water’s edge!

Fifty miles over water? It might just be possible, given the most favourable possible propagation conditions, but for it to happen on cue is quite another matter!

If it doesn’t, and if you can’t rely on a 2-way radio circuit when you need it, there isn’t much point in having it! As far as the present correspondent is concerned, my impression is that his local adviser has simply been honest and factual in discouraging him from relying on CB gear, either for personal communication or for safety at sea.

It might be argued that CB equipment would have to be better than nothing in an emergency and this may be true, provided absolutely no other reliance is placed on it. But, in the present case, absence of a radio signal would place Mrs G.A.W. in a real dilemma: the choice between initiating a possible false alarm or failing to react to a real emergency!

That the doubt surrounds a person on holidays, in a small boat, is not really relevant to the situation. The person concerned will not be any the less isolated on that account and, indeed, he may be in significantly greater danger from exposure and the difficulty of being spotted in any search.

In fact, contrary to the normal preamble to such inquiries, it could logically be maintained that, the less adequate the boat, the more reliable the radio needs to be.

What about higher powered CB equipment, with a whip aerial on the boat and something more pretentious again on shore? It would obviously be better than hand-held equipment but it
would cost a lot more and would still be subject to the propagation variables of the particular frequency. And, anywhere but in remote locations, the channel could be jammed at the shore end by local 27MHz "rag chews". In fact, this is far for the course on the U.S. waterfront.

What about some other frequency typically in the 2.6MHz region? Here we run into more of the "difficulties" which G.A.W. has already encountered:

Firstly, CB equipment is only plentiful and relatively cheap because it has been mass produced for the 27MHz band. Equivalent gear for other frequency bands is simply not available at present.

But, even if it was, the HF spectrum is so crowded that there would be no hope of a private individual being granted an exclusive or even moderately shared frequency. Indeed, such is the crowding that, in Australia and elsewhere, all projected HF marine installations must be capable of operating in single-sideband mode, involving equipment which is inherently costly and expensive.

And that is not all:

As a matter of long-standing policy, the Australian Government has assumed the responsibility for operating the nation's on-shore and off-shore communications facilities, respectively through ATC (Australian Telecommunications Commission) and OTC (Overseas Telecommunications Commission). Individuals are expected to use these facilities (at prevailing charges) wherever possible.

For its part, the OTC maintains permanently manned shore stations to handle emergency and regular traffic, with facilities to extend the communications net via telephone or telegram. Thus, while boats (small ships) may conceivably use certain HF channels or even CB gear for purely ship-to-ship messages, all ship-to-shore messages should legally pass through the OTC/ATC facilities.

The main exceptions to this are fishing cooperatives, boating clubs, volunteer coastal patrols, etc, which may be licensed to operate a base station in addition to the mobile marine installations. They can handle ship-to-ship traffic relevant to their own operations but this is of little consolation to the private boat owner who is not a member of such a group. He thus faces a double frustration:

Equipment which seems appropriate in terms of cost and size is neither technically adequate nor legal.

Equipment which can perform as required is too costly, often too bulky, and is legal only if operated in conjunction with the OTC/ATC system.

What about emergency equipment? A few years ago, there was talk of self-contained distress beacons which could be activated to provide both an initial distress call and a signal for subsequent radio location but I gather that none of these have been judged in Australia, to be appropriate for use in small, private boats.

So, while the authorities accept that a person in distress can use any means at their disposal to summon aid, the "at their disposal" bit is a problem indeed.

Seeking some enlightenment on the whole matter, I talked it over with Mr. R. Clark, Supl of the PMG Radio Branch for NSW. Mr Clark agreed completely that the operator of a small boat had real problems, in terms both of communication and safety, and he was as concerned as we were that there seemed to be no easy answer, for the various reasons already set out.

After talking with Mr. Clark, it seemed clear that the best hope for private boat owners would be for the Government to authorise equipment to operate in the International VHF Mobile Band in the vicinity of 156MHz, much as is being done in the United States. Shore stations might conceivably be privately operated in special cases but would more likely be part of a network of remotely controlled transceivers linked back to a central control point by landline.

The attraction of this scheme is that VHF radiotelephone equipment is already manufactured on a large scale for use in land vehicles and is compact and convenient, reliable, not prohibitively expensive, and economical in terms of battery drain in the receive mode. Adaptation for marine use would be relatively simple.

A further advantage is that fully resonant aerials can be used and, assuming suitable on-land receiving sites, range should be reliable and predictable.

In the USA 2-way radio communications for small boats is moving into the VHF Mobile Marine Band, not as a concession, but as a legal requirement. A variety of equipment is coming to light, ranging from the storage battery powered type already mentioned, to hand-held units, the more elaborate equipment being switchable for certain nominated channels. The move will take the pressure off the over-worked small-ships frequencies around 2.6MHz, avoid the inadequacies of the CB approach and provide a much more predictable service.

In Australia the PMG's Radio Branch is looking in this direction but I gather that the authority to proceed is held up somewhere along the Government pipeline. In the meantime, small boat owners presumably enjoy their extra hours fishing over the off-shore reef, hoping all the while that their family won't misinterpret their non-return. Or maybe that the motor will start when they do decide to head home!

Or have we missed something?

How would you advise G.A.W. in his problem, apart from not sailing off-shore at all?

Maybe the smart thing would be for both him and his wife to do a bit of study and get themselves an Amateur Novice Licence!
Pathfinder and visitor alert unit

How easily can a stranger find his way from your front gate to your front door on a dark night? While your path may not be as circuitous as the one which inspired this project, the idea of illuminating it as a visitor approaches has much to recommend it.

by K. F. FORD

A visitor to our home has to walk up two steps from the footpath to the front gate, go through the gateway, up one more step, turn right and mount seven more steps, turn left and walk along a path for some 25ft, turn left again, and mount a further seven steps to the verandah and front door.

Nothing to it? On a dark night, and particularly for the elderly or infirm, it can be a somewhat hazardous undertaking. Only if visitors are expected would one normally turn on an outside light in anticipation.

Hence the unit to be described. It automatically switches on the outside light and sounds a warning buzzer in the house whenever the gate is opened. The outside light remains on for 40-45 seconds, which is ample time for the slowest person to reach the verandah. The buzzer operates for two to three seconds.

As an “early warning—visitor approaching” signal it is invaluable.

A reed switch is mounted in the gate post with the operating magnet mounted in the gate. Since the reed is normally open a second (bias) magnet is set into the gate post behind the reed. The magnet in the gate is orientated so as to oppose the field of the bias magnet. Thus the reed is open when the gate is shut and closes when the gate is opened.

Also at the gate is a spherical lamp shade with the house number painted on its interior. It is illuminated by a 12V 6W car globe and is mounted above the gate. This runs continuously and shows up very well at night.

The control unit is located centrally in the house. It is mains operated via a step down transformer delivering approximately 7.5V. A half-wave rectifier and a 1000uF capacitor delivers about 10V DC. A three-core cable runs to the gate. The black lead is treated as a common and connects to one side of the 7.5V winding at the control unit and to one side of both the reed switch and the globe at the gate. The red lead connects to the other side of the reed and returns to one side of relay 1 in the control unit.

The green lead completes the circuit from the globe to the 7.5V winding.

When the gate is opened relay 1 is energised. Its contact connects the +10V positive rail to one side of both relay 2 and relay 3. The other side of each winding goes to the collector of TR1 and TR2 respectively.

Forward bias is applied to the base of TR1 due to the charging current through C1 via R1. TR1 conducts and relay 2 pulls in. When this happens its upper contacts provide a latching function by effectively shunting the relay 1 contacts. Thus relay 2 holds in regardless of the condition of the reed switch or relay 1.

A second set of contacts on relay 2 connects the +10V rail to the buzzer. At the end of a period determined by C1, when C1 has charged sufficiently, forward bias is removed from TR1, relay 2 drops out and switches off the buzzer.

At the same time the normally closed contact opposite the latching contact connects a 47k resistor across C1 (5.6k for C2) to discharge it in anticipation of the next operation. This assumes that, by this time, the gate has been closed and relay 1 has dropped out.

At the same time as relay 2 is energised the +10V line is connected to relay 3 and associated circuitry via diode D2. The functions of this section are essentially similar to those associated with

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*58 The Point Road, Woolwich, NSW 2110.

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The circuit is relatively simple and the component values not unduly critical. The unit may be built in any convenient form, but care must be taken in any part of the circuit where mains voltage is involved.
relay 2, except that C2 is larger than C1 (1000μF). The relay 3 contacts marked x and y are connected in parallel with the outside light switch, so that the outside comes on as soon as the gate is opened and remains on for about 45 seconds while C2 is charging.

The diode D2 prevents any possible second operation of the buzzer while relay 3 is still energised.

CAUTION: The wiring from the outside light switch must conform to the appropriate wiring standards, since the 240V mains are involved. Such wiring should be performed only by a qualified electrician.

For the same reason the relay contacts involved must be capable of carrying the current involved and, more importantly, be adequately insulated for 240V operation.

(Editorial Note: A simpler approach might be to use a low voltage lamp for the outside light, operated from a suitable transformer.)

PARTS LIST

1 Power transformer, 240V primary, 7.5V 2.5A secondary, (Ferguson PL15/20VA or similar.)
3 Relays, double changeover, V23027-B0002-A101 or similar
2 Diodes, 1N4004
3 Transistors, BC108

CAPACITORS
1 47μF, 25V
1 1000μF, 25V
1 2000μF, 25V

RESISTORS (all ½W)
3 5.5k
1 25k
2 30k
2 47k
1 100k
1 reed switch
2 magnets
2 switches, type 42
1 Bezel with 12V globe, type B6/B11
1 resistor mounting panel
2 Mains terminal strips

The control unit is fitted with two switches and an indicator bezel. One switch is in series with one of the outside light leads and, in its off position, is used to inhibit the outside light in daylight. The other switch is used to turn the whole unit off if not required. The globe in the bezel is in parallel with the relay 1 winding and is an indicator that the gate is open. The resistor in series with this globe is chosen to suit the globe and the amount of illumination required.

The switch controlling the outside light could be a double pole type with its second pair of contacts turning off the house number light during the day.

Layout of the unit is not critical. The original unit was housed in a wooden box measuring approximately 12in (H) x 5in (W) x 3½in (D). It is suspended from the picture rail above a convenient power point. The buzzer is mounted on the lower outside end of the case.

The mains lead terminates in the box in a six section mains connector strip which connects it to the on/off switch and the transformer leads. This connector also accommodates the leads from the outside light switch, the x and y contacts of relay 3, and the panel switch controlling the outside light.

On the outside of the case near the top is another section of mains connector strip. The three core lead from the gate terminates here, along with a pair of bell wires running to the bell push on the front door. The latter are wired in parallel with the relay 2 buzzer contacts.

The 3-core lead between the house and gate should be run through ½in water pipe or garden hose for protection, particularly if buried. Where the lead emerges at the gate it is terminated in a three section mains connector strip, together with the leads from the car globe and the reed switch. The whole assembly is sealed against the rain and garden sprinkler with a stout plastic bag tied open end down.

The buzzer could be replaced by a bell or set of door chimes, if available. Check the voltage requirements and fit a series resistor if necessary.

The unit as described was built some 12 months ago (at the time of writing) and has been completely reliable since its installation.

PLEASE NOTE

This project is one contributed to our Kitsets-EA Competition. As such, it has not been through our laboratory and should not be regarded as a regular 'Electronics Australia' project. We will therefore not be in a position to answer postal queries about its operation, or supply back-up information, diagrams, etc, beyond what is published. And while we may quote the contributors name and address, to authenticate the article, the contributor is under no obligation to answer letters about his project. That is entirely a matter of his own inclination and convenience.

In the event that the visitor is slow in closing the gate, or has left it open, voltage will continue to be applied to both transistors after they have been biased off due to C1 or C2 being fully charged. Without some protective arrangement the circuit which discharges the capacitor could also turn on the transistor again, with the risk of relay chatter.

To guard against this another pair of normally closed contacts is used to connect 5.6k resistors between base and emitter of each transistor, thus ensuring insufficient bias to allow either relay to pull in again while either C1 or C2 are discharging. Neither the buzzer nor the outside light will operate again until the gate has been closed for some 3 to 10 seconds.
HOT TIPS

Until recently, if you wanted a first-class hi-fi system, you had two ways to get it. You could buy a kit and build a system from scratch, if you were technically inclined, or you could buy ready-made units which were expensive and dull. In fact the only pleasure you'd get would be the matching of your amp, speakers and turntable.

Now, for the first time, KITSETS makes possible a top quality system you build yourself without tears! It's the new MOD AMP range—a comprehensive array of professional modules, fully wired and tested, designed and manufactured here in Australia.

Choose from MOD-AMP's selection of amps, preamps, tuners, tape controls, mixers and light displays to build the system you want, with the features you need. These are ideal for Hi-Fi, Public Address and Rock Groups.

Simply decide which modules you want, house them, and connect up. No need to buy everything at once. To update or expand your system, simply purchase modules to suit perhaps a filter, tuner, decoder... Whatever you need. These are ideal for Hi-Fi.

For all those KITSETS customers who have been waiting patiently—here it is! For all those KITSETS customers who have been waiting patiently—here it is! For all those KITSETS customers who have been waiting patiently—here it is! For all those KITSETS customers who have been waiting patiently—here it is!

RADAR INTRUDER ALARM BEAT THE BURGLAR!!!!

This alarm was featured in Electronics Today, May 1975. Using the latest economy radar unit, this alarm detects movement in the area covered by the alarm, up to ten metres. The kit includes the CLR896 device (which is specified for Australian standards), and can save you hundreds of dollars.

$59.00 P&P $2.50

LOW COST, HIGH PERFORMANCE, MAGNETIC CARTRIDGES.

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GETCHA GIZMO BOXES 80c EA.

Beautiful hard plastic, pin hinge things with clear lid, black base. Lid recess allows nesting (Hoho). P&P 40c. 60c for 2. $1 up to 10
5½" x 3½" x 1½"

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Not low quality—just low price. 5 of the most used TV receiver valves at prices that make it worth stocking up big. They’re Matsushita (‘National’) so you know they’re good.

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SPECIAL KIT OF THE MONTH
Electronics Today. 50 Watt stereo amplifier. This high power, high quality, economical kit gives a genuine 50 Watt per channel into 8 ohms at typically less than 0.2% distortion. Complete with teak cabinet.
$109.00
P&P $5.00

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DTI 301: Compact multimeter with fan-type scale. 13 range.
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DTI 305: 36 range. 25K & 50K ohm/volt. (Has range doubler.) Size 160 x 120 x 60 mm. Priced at
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Detects drop in battery voltage. No need for complicated switches. Relay output to drive car horn intermitently to save battery. 12V system only.

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PM143 featured in E.A. Sept 74. 165 Watt R.M.S. per one channel driven into eight ohms. Response within two decibels from 20Hz to 25kHz. Signal to noise better than 60dB
PM144 featured in E.A. Aug. 74. 80Hz to 10kHz. Signal to noise better than 42dB. Separation 30dB from 100Hz to 10kHz.

ELECTRONICS Australia, September, 1975
Quartz crystal drive for fluorescent readout clock

If you built the Fluorescent Readout LSI Digital Clock featured in our April 1975 issue, here is an interesting accessory: a crystal-controlled 50Hz drive source which uses just one integrated circuit. Build it and adapt your clock for battery operation in cars, boats and caravans.

Latest reports on the “Fluorescent Readout LSI Digital Clock” as featured in April, 1975, indicate that over 1500 have now been successfully completed—which must make it the most popular clock yet described. We are sure that many of those readers who have built the clock would be interested in this modification, as would many other readers who have yet to “have a go” at building a clock.

A small PC board measuring just 50 x 38mm accommodates this “simple” circuit, which derives a 50Hz square wave from a crystal operating at 3276.8kHz. The compact PC board is arranged to sit above the original clock board which accommodates the MM5314N clock IC plus its associated circuitry and fluorescent readout tubes.

Heart of the 50Hz clock driver circuit is a “queer looking” five-legged integrated circuit. It is in a TO-5 can and is made by Solid State Scientific with type number SCL5411. It is described as a CMOS oscillator/16-stage divider/buffer by the manufacturers. This means that quite a lot happens inside that little can.

Actually, the SCL5411T contains an oscillator inverter, 16 flip-flops connected in series, and a low impedance buffer output stage. The inverter is wired into a circuit which includes two resistors, two fixed capacitors, one trimmer capacitor and the crystal mentioned above. The crystal frequency when divided by two sixteen times gives a resultant output of 50Hz (ie, 3276.8kHz is the product of 50Hz multiplied by two raised to the power of 16).

The crystal required is a parallel-mode type coded IEE and made by Hy-Q International (Australia) Pty Ltd.

Two versions of the combined clock plus 50Hz driver circuit can be built. The first is mains-powered and has a 15V standby battery to keep the 50Hz driver and the clock chips operating in the event of a mains interruption. Here the aim is to ensure that no time error occurs. The low voltage readout filaments are of course not energised during mains interruptions.

The second version is powered from a 12V battery and has the virtue of being completely independent of mains supplies. It may be used in cars, caravans and boats. We shall describe operation and construction of the mains-powered version first.

As the first step in building the mains-powered version, you should build up the clock PC board exactly as described in the April 1975 issue of “Electronics Australia” (File No 7/CL/17). When you have the clock operating from the mains, you can then assemble the small PC board for the 50Hz clock driver. The circuit is shown in Fig. 1 with the components on the small PC board enclosed within the dotted border.

A 15V supply rail is derived from the clock DC supply (which is a nominal 18 to 22 volts) by the 100 ohm resistor and 15V zener diode. Electrical hash is removed from the supply by the .047µF/25VW bypass capacitor. This 15V rail is also used to run the clock circuitry on the main PC board. This is necessary because the clock pulses fed to pin 16 of the MM5314 need to have an amplitude almost equal to the chip’s supply rail. This is assured by running both IC’s from the same 15V supply rail.

Having the facility of crystal-controlled...
timekeeping in a mains-powered clock is futile unless there is a standby battery to power both chips in case of a power interruption. Accordingly, an EM401 silicon diode connects a 15V battery when the mains power is removed, and isolates the battery when mains power is available.

The 10 to 40pF trimmer is made by Stetna and suits the board pattern. Incidentally, all the component parts for this driver circuit, including the PC board, IC and 3276.8kHz crystal, are available from Dick Smith Electronics.

Assemble all the components onto the board leaving the SCL5411 until last. This IC is supplied with its leads pushed into a piece of black conductive foam, which protects the device from the build-up of damaging static charges. Leave the IC in the foam while soldering it to the PC board, ie, with the foam sandwiched between the IC and board. Leave the foam there until the board is connected to the rest of the clock circuitry and you are ready to switch on.

**PARTS LIST**

1 PC board, 50 x 38mm, code 75c19
1 SCL 5411 integrated circuit
(Distributed by Cema (Distributors) Pty Ltd, 21 Chandos Street, St Leonards, NSW 2065)
1 Stetna 10-40pF trimmer
1 BZX79/C15 zener diode
1 EM401 silicon diode
1 82pF NPO ceramic capacitor
1 39pF NPO ceramic capacitor
1 0.047/25VW ceramic capacitor
Half or Y4W resistors:
1 x 10M, 1 x 33k, 1 x 100 ohm
1 parallel-mode crystal, 3276.8kHz, HY-Q Code IEE
1 crystal socket to suit
Extra Parts for Battery Version
2 82 ohm 5 watt wirewound resistors
2 EM401 silicon power diodes or equivalent.

Now that when the 50Hz driver board is complete, some modifications to the clock board are required before the two PC boards can be interconnected. First, remove the 100k resistor and 0.01uF capacitor associated with pin 16 of the MM5314. The junction of these two components becomes the feed-point for the output of the 50Hz driver board.

Next, cut the copper pattern so that the positive connection of the 470uF/16VW reservoir capacitor is isolated from the rest of the circuit. Only one cut, close to the capacitor, is necessary. Similarly, make one cut to disconnect the positive output of the bridge rectifier from the circuit. Now connect the positive output of the bridge rectifier to the positive connection of the 470uF capacitor with a short length of hook-up wire soldered to the underside of the board.

The 50Hz driver board can now be connected to the clock board. It is supported on two stout sections of tinned
CLASSIC RADIO & HI-FI

24 WATTS R.M.S. HI-FI SYSTEM $229.00

Pioneer SA 500A Expo 1212 amplifier 24 watts R.M.S. or (12 watts R.M.S. per channel) in walnut finished cabinet with high filter. Loudness control & tape monitor. Frequency response 20 to 25,000 cycles. Distortion better than 0.5% as full rated output. Garrard 6-300 changer with Shure mag. cart with base and cover. Two four way speaker systems: two Philips 8" & two Philips tweeters in each system. Walnut finish. (Regret no mail orders.)

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Six transistor A.M. tuner with a variable output suitable for use with any amplifier or tape recorder. Imbuit audio amplifier & speaker enable this unit to be converted to a mantel radio at a flick of a switch. Supplied in attractive wood grain finished cabinet. 240v A.C. operation. Suitable for local stations only.

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$140.00

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MODEL C.700 — Cabinet available in teak or oiled walnut finish with matching metal trim. $12.00 extra.

SPECIFICATIONS

POWER OUTPUT: 25 watts per channel R.M.S. Total output 50 watts R.M.S. @ 8 Ohms.

FREQUENCY RESPONSE: 20 cycles to 15,000 cycles.

HUM & NOISE: Less than 50 dB.

INPUT SENSITIVITY: 1 mV at 1 kHz.

EQUALISED: Mag. R.M.S.

TONE CONTROLS: Bass 50 Hz — Treble 15 kHz.

HARMONIC DISTORTION: Less than 0.5%.

LOUDNESS CONTROL: 0 dB.

LOUDNESS FILTER: High filter at 10 kHz. 0 dB.

RUMBLE FILTER: 50 Hz & 50 Hz.

PROVISION FOR TAPE RECORDER: Record or playback with plug connector.

SPEAKER SWITCHING: Two sets of speakers can be connected and selected by switch on front panel. They can also be driven together.

HEADPHONES: Headphone jack is situated on front panel.

DIMENSIONS: 15" x 9" x 5" high. Weight 16 lbs.

POWER SUPPLY: Regulated power supply with switching protection for output transistors.

SEMICONDUCTORS: 30 Silicon transistors plus 7 diodes.

PROVISION FOR 4 CHANNEL.

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Post & Packing 90c

(All spare parts available)

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DRIVE UNITS: Magnavox 8-30 High Performance 8 in. Bass Unit & Magnavox 6J-6 in. Mid Range Speaker Philips High Fidelity Dome Tweeter.

SPEAKER KIT: Less cabinet comprising 1. 8-30 speaker, 1. 6J speaker, 1 Philips dome tweeter, 1 inch induc- tance, 1. 8 mfd & 1. 4 mfd polyester condensers, 1/3" & V. 1/6" tube inaudible & speaker silk. plans for cabinet. $40.00. Reg. Post & Packing $3 Extra.

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Reg. Post $2.00 EXTRA

At last a breakthrough in the cost for high quality portable radio transceivers of the walkie-talkie hand-held type. We are introducing and offering for sale a fully PMG approved transceiver.
copper wire (16 SWG). One piece of tinned copper wire connects the 0V rail of the 50Hz driver board to the 0V rail on the clock board, ie, to the copper pad for the HOLD time-setting switch.

The other support wire connects the 15V rail of the 50Hz driver board to the emitter pad of one of the readout transistors. Once the support wires are soldered to the main board take care not to flex them unduly, otherwise they may lift the copper off the laminate. Needless to say, two holes have to be drilled in the main board to accept the support wires.

Having installed the support wires, the output of the driver board can be connected as noted previously. Then connect a wire from the positive side of the 470uF filter capacitor to the supply input of the driver board. Finally remove the foam sandwiched under the SCL5411 IC and you are ready to switch on.

The 15V battery we used was an Eveready type 411. It is possible also that you may be able to get the battery work-

Above is a general view of the completed battery powered version.

The 15V battery we used was an Eveready type 411. It is possible also that you may be able to get the circuit work-

The component layout shows the PC board from the component side. Pattern is shown actual size.

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A novel metronome

Readers who are studying a musical instrument and having difficulties with counting, may be interested in the circuit shown. The device is a metronome, but one having independent volume controls for counting crotchets and quavers. It also has a row of LEDs, used to show the timing within a bar. The prototype used an 8-position switch to adjust the count. However, a 3-position switch for 2/4, 3/4 and 4/4 times may be used, leaving out the intermediate positions.

Volume control is effected using a variable pulse width applied to the loudspeaker. The reverse voltage applied to the LEDs has no ill effects but separate 220 ohm resistors in series with each LED could be used if desired. Total cost of new parts is about $10 to $12. Four D size dry cells were used for power supply but three cells would be sufficient.

Salvaging automotive two-filament lamps

When you find yourself with an automotive two-filament stop/tail light bulb with one filament open circuit, it is worth keeping for future emergency use. Bridge the two contacts by soldering a short piece of tinned copper wire across them. The repaired lamp may then be used in an emergency or other suitable application, provided of course that wattage ratings and socket fittings are compatible. (By Mr Gary Kurzer, 8a Benelong Crescent, Bellevue Hill, NSW 2023.)

Cross modulators—a novel circuit technique

Here is a special form of double-balanced modulator with applications parallel to those of the double-balanced ring modulator/mixer. It stems from a recent paper by Dr. Zdenek Mack, of the Tesla Electronics Research Institute of Czechoslovakia; this presents a detailed comparison between the ring and cross modulator, suggesting that the latter has some useful advantages.

Mack lists three main factors which emerge from the comparison:

(a) From the point of view of transfer ratio and efficiency the modulators complement each other—the cross modulator is advantageous when the value of the load resistance is equal to or less than the modulating source resis-


Circuit & Design Ideas

(b) The cross modulator has always better diode operating conditions.

(c) From the point of view of the switching signal the cross modulator can save a substantial amount of power.

He thus suggests that the use of the cross modulator may provide either circuit simplification or parameter improvement.

A diagram of the basic transformerless ring and cross modulator is shown, while the diagram indicates how balance is achieved and is based on a proven arrangement. From the switching signal side, the modulator is balanced by pots RV1 and RV2 (real components) and by capacitances CT (imaginary components), including semiconductor diodes capacitances. From the modulating signal side, the modulator is balanced by pot RV3. At 30kHz (stereo decoder) the achieved suppression of carrier and its harmonic components was 60 to 80dB. The circuit is said to have been tested at frequencies from 10Hz to 1MHz.

(From "Radio Communication").

**Accurate current generator**

Most operational amplifier constant-current circuits suffer from the disadvantage that they require a load isolated from ground. The circuit shown uses a grounded load and, using the 741 op-amp, can achieve a Norton equivalent of an ideal current source in parallel with a resistor of greater than 100M when delivering one milliamp of current.

The output impedance of the current source is primarily decided by the common-mode rejection of the amplifier used. As current through R2 is also approximately constant it does not affect the output impedance.

In the diagram

\[ i = \frac{R_1 V_z}{R_2 + R_3} + \frac{V_z}{R_2} \]

 Normally \( R_L < R_1 = R_2 \) and \( i = \frac{V_z}{R_3} \)

(By R. Morcom, in “Wireless World”.)

**Simple volume expander**

I am interested in high quality broadcast reception but unfortunately all tuner designs for reception of AM transmissions seem to be lacking in one vital aspect—dynamic range. All available transmissions appear to be compressed to a greater or lesser degree.

In an attempt to overcome this problem, I tried a volume expander circuit described in “Popular Electronics” but this did not entirely meet my requirements. The accompanying circuit is the one which I have adapted and permanently wired to the output of my Homodyne tuner. The audio from some of the broadcast stations can be most satisfying.

Signal from a loudspeaker is taken via a 1k potentiometer. The tuner output and amplifier input are connected as shown. The LED and LDR must be enclosed in a light-tight compartment. The 1M resistor should be adjusted where necessary, to give approximately 5mA through the LED with no signal.

(Electronics Australia, September, 1975)
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Plessey offer an extensive selection of low-cost, long-life L.E.D.’s, L.E.D., numeric and alphanumeric displays and devices by Plessey, Okaya, OKI and NEC.

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32 Barcoo St, East Roseville,
N.S.W. 2069
The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

**EDUC-8 too small**

First of all, I would like to congratulate you on your series of articles on minicomputers. I agree entirely with your sentiments. There is plenty of information on individual devices, but none on the interconnection of same.

Now one criticism. On account of economy you have limited the word lengths to 8 bits and the total number of words to 256. This limits the usefulness of the device to the function of a teaching aid, ideal for teaching institutions, but not much use to anyone else.

I am an Accountant, and could justly purchasing a minicomputer if I can use it in my office. To do so it must have a reasonable storesize, preferably at least 1000 words of 16 bits. If the price were 3 or 4 times that mentioned by you, I could still justify this expense. Interfaced with an IO writer (say IBM or Facit) and a mass memory (Tape or preferably disc) it could be used daily in my office for comparing mailing lists, used as a word processor, etc.

I appreciate that not everyone would spend $1000 on a minicomputer. As storage is only dependent on the number of devices employed would it not be possible to design the mother board in such a way that the machine can be commissioned in its basic "teaching" mode, as is but with provision to add a further PC board to increase the memory and/or number of registers, as stated above. This would enable everybody to get the machine of his choice.

Trusting that you may be able to give me the above some consideration and wishing you all the best,

E. M. Zimmermann,
Wellstord, N.Z.

COMMENT: We presume you are using "lateral" here to mean "imaginative alternative", in which case there would surely be an infinite number of such definitions. Yet in a strict sense, time cannot ever be defined at all, as it is one of the basic parameters of existence. About all one can really do is say something like "Time is the difference between 'now' and '...now'!"

**Definition of time**

At school another student and myself have posed a question which as yet still hasn't been satisfactorily answered. The question is posed in a spirit of inquiry, not simply to pose a question which can't be answered.

The question is, can you give a lateral definition of time?

If you, your staff or any reader could answer this question, we and the school staff would be grateful.

Chris Jones
Bassendean, W.A.

**Solar panels**

You completely misunderstand the function of special coatings for solar panels! The correspondent who said "good absorbers are good radiators" was quite correct. The function of special coatings is that of selective transmission — being highly transparent to the wavelengths in which most of the Sun's energy lies, and highly opaque to the long infrared.

What happens is that the temperature of the panel metal rises until the amount of energy entering equals the amount leaving; this is the maximum temperature to which the panel can heat the water. As the panel temperature increases, the wavelength of radiation moves towards the visible spectrum, thus more of it is transmitted the higher the temperature becomes.

Your point about open ended systems does not explain why the new panel is any better than a simple black surface. Nor that what you are saying is wrong — it is just irrelevant.

David Brown
Northbridge, 2063.

**Ironic brand name**

Greetings from the UK!

I thought you and your readers might be amused to learn the name of a specialist hi-fi turntable manufacturer I came across recently in this country: C. H. RUMBLE. No, I'm not kidding!

Keep up the good work.

Stephen Frost
Bristol 6, Uk

**Not amused**

I am disappointed in the lack of "local content", in your recent issues of the magazine. It would appear that owing to the present economic climate your superiors are requiring you to cut costs, thus resulting in the present dull splurge of product reviews and reprints from your overseas associates.

J.E.
Cono, W.A.

COMMENT: When we publish material from overseas, it is because we believe it will be of interest to readers. The fact is that in the modern electronics industry the majority of new developments originate overseas. The balance of content in the magazine is determined almost wholly by reader appeal, as reflected by circulation and "feedback". Naturally our management are interested in magazine content, as it affects circulation, but they have never attempted to influence our content in the way you suggest.

**Hot chassis TV**

I have recently learned that a number of brands of colour TV sets sold in Australia have chassis which are "hot". I am quite dumbfounded as I thought that in this enlightened age such barbaric practices went out with 90 volt batteries in portable radios. What are the powers that be doing to allow these death traps into the country?

I am sure that after a few servicemen have been tried that this frivolity will swiftly realise the dangers involved and take the necessary steps to ensure that no more of their brothers get zotted.

But what of the handy man fiddler, the bloke who until now has been able to whiz the back off his set, find an unlit valve, replace it and become an electronic genius? Finding no valve to change your point about open ended systems does not explain why the new panel is any better than a simple black surface. Nor that what you are saying is wrong — it is just irrelevant.

Brian Robb
Lismore, NSW

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**Letters to the editor**

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Converting a foreign colour set

Colour TV sets brought in from other countries, usually by migrants, and designed for use in their country of origin can present a sticky problem for any one approached to convert them to local standards. While this can often be uneconomic, the approach by one reader to the problem may interest those who would like to try it on other than a strictly business basis.

The reader is Mr P.T. of Box Hill, Victoria, and he has several interesting comments about colour TV. First, he comments on my story in the April issue concerning a lack of colour in a new set which was only a few miles from the transmitters.

He refers to the "Mazda Book of PAL Servicing" and one explanation it gives for loss of colour. Any condition which causes standing waves on the aerial feeder can create this effect if the reflected signal arrives exactly one half-cycle at the subcarrier frequency—after the original signal (0.11uS approx.).

(This situation was described in more detail in the August issue.)

The only query about this suggestion is the likely cause of the standing waves. As one reader went to some trouble to point out (Forum, March 1975) a mismatch between aerial and feeder will not normally create standing waves, assuming that the receiver is correctly matched to the feeder.

But, as also pointed out in the July issue, amateurish attempts to provide multiple outlet points from a common aerial can easily create this condition.

But Mr. P.T.'s main story concerns the conversion problem; conversion of sets from overseas standards to our local standards.Personally, I treat such sets more kindly while they are still under guarantee, and if a reasonable standard of sound is being obtained it is hardly worth the trouble and cost of conversion. But when the sound deteriorates to the point where it is not acceptable, it seems to have been done a remarkably good job.

Here is his story:

You may be interested in a project I was asked to undertake recently. A "friend of a friend" returned to Australia this year after two years in the United Kingdom. His personal effects followed by ship, including a colour TV set. I was asked what could be done about making it work here.

I explained what I knew of the difficulties involving different intermediate frequencies, sound video separation and UHF versus VHF channel selectors but agreed to have a look at it to see what could be done. I also advised the owner to try to obtain a copy of the service manual from the British agents.

The set arrived through customs two weeks before C-day. It was an 18-inch Hitachi Model CEP-180. The local agents could offer the owner no assistance so it was brought to me and a request sent to Britain for the service manual.

The first thing, after making sure that it would function, seemed to be to obtain some sort of monochrome picture. I disconnected its own UHF tuner and connected an IF signal from a 'spare' TV set (i.e., the output from its tuner) taking care to keep both leads isolated via suitable capacitors as I suspected that I was working on a hot chassis. Actually, I later discovered that the set did have a mains isolating transformer.

A monochrome picture was easily obtained and the next step was to adjust the sound IF transformer(s) and discriminator (wherever they were) to 5.5MHz instead of 6.0MHz. Following the lead from the volume control lead me to the right part of the relevant board and an inspection of the numbers on the board relative to the various components enabled me to guess which two coils were involved. After noting their original position I turned the cores of each coil in about 1/4 to 1 turn each, a little at a time, and obtained quite reasonable sound. Although I realised there would probably be some tuneable sound traps elsewhere in the circuit I decided to leave these until the circuit was available.

The next step was to obtain colour but this was complicated by the fact that only a few hours a day were being transmitted, at that time. When a station eventually obliged colour was obtained, but it was sensitive to signal strength, fine-tuning, etc. (A set top antenna only was being used.)

Tests over the next two days on all channels and with another tuner showed that these two old valve tuners would produce the required 39.5MHz IF with suitable adjustment to the fine-tuning preset controls.

While I would have been prepared to remove a tuner from an old non-repairable set, even to the extent of buying one for this purpose, this was unnecessary as I could obtain an old 10 channel incremental AWA tuner, with valves, from a disposal source for $4.00. The hardest part was fitting this into a suitable box and making this acceptable, with suitable knobs, etc., to sit on top of the set in the living room. A small 230V power supply had to be fitted in too, together with suitable switching to enable the set's own UHF tuner to function if required in a few years' time.

Apart from physical construction, a major problem was adjusting the preset fine tuning so that colour was received at the centre of the fine-tuning range with a minimum of fiddling on all channels. In this regard a turret tuner would have been easier but it was made more difficult by the fact that there was hardly ever a time when more than one channel was transmitting colour at the same time and I was around to see it.

Eventually, the set was brought into my living room and set up next to our own colour receiver for comparison. The results obtained were quite good except that channel 0 was a bit 'touchy'. When the fine-tuning was set so that colour reception was good the sound was slightly distorted and vice-versa. I decided that this might be improved when the various sound traps were located and adjusted.

Since C-day was approaching, the set was returned to its owner who, on my advice, installed a loft antenna with a 75 ohm coaxial feeder. I understand that the set is still performing satisfactorily, with the previously mentioned trouble on channel 0. Since the time it was installed the service manual has arrived and, when I manage a free Saturday morning, I will attempt to adjust the sound traps. (The fault appears to be from information entering the chrominance channel.)

Well, that's Mr P.T.'s story and, as I said at the beginning, I think he did a particularly good job, considering what he had to work with. Others faced with the same problem should have learned a point or two.

Finally, Mr P.T. describes a fault which developed in his own colour set, and which he feels reflects adversely on the manufacturer. He says: Another matter which may interest you relates to a fault which I located in my own colour receiver (AWA Model 603.) This is an AWA-Thorn 4KA chassis.

After being in use for some weeks I noticed that the picture was subject to
"blooming" on bright scenes and/or when the brightness control was advanced. In the worst cases "motorboating" of the brightness occurred. The EHT SET control was ineffective and up at the "high" end of its range.

Voltage and resistance checks showed that the voltage at the junction of R352 and 039 was high. A 68k resistor, not shown on the circuit, was strung on the "wrong" side of the board between this point and earth. When removed and tested R352 was found to be about 650k instead of 1M. This is a special purpose resistor which has about 1000V across it and consequently dissipates about one watt.

A direct replacement could not be obtained from the makers and so it was replaced by four 1M one watt resistors in series/parallel and the 68k resistor removed. The EHT SET control could then be adjusted satisfactorily, at the other end of its range.

The point of this story is that it appears that a fault was discovered at some time during production testing and "cured" by adding the resistor to earth. In use, the faulty 1M resistor became lower in value and, eventually, had to be located and replaced. This is hardly a good manufacturing practice and I hope that there are not too many other examples of it around, both for the sake of users and servicemen. Come to think of it, I hope that there are not any other examples of it in my set.

Thank you for your many informative stories. The "Serviceman" pages are the ones I usually read first in each issue of Electronics Australia.

Well thank you, P. T., for your interesting stories and the kind remarks about the magazine. Regarding the AWA receiver we agree that, at first glance, it appears to have been a "bodgie" approach. On the other hand, I suspect a more subtle series of events which led to this situation, and which was outside the control of the manufacturer.

First, it is not unusual for manufacturers to "pad" certain components, in critical circuits, by mounting an additional component on the opposite side of the board. This may be necessary in only a small percentage of cases and the component padded may not necessarily be the one which is out of tolerance. This can still be a perfectly legitimate approach where the nature of the circuit allows one tolerance to be balanced against another and where, for reasons of cost, it is more logical to add a low cost component, rather than change—and possibly reject—a higher cost or more awkwardly placed one.

In this case I suspect that the 1M resistor was marginally low when it was fitted, and that the possibility of this was allowed for in production testing by fitting a 68k (or other suitable value) resistor. Subsequently, the 1M resistor dropped a lot further in value; something which could not necessarily have been foreseen during testing. If any criticism is justified it might concern the wisdom of choosing the particular type of resistor for this role, but this is something which a manufacturer often learns the hard way; from his sets in the field.

In the meantime other readers may learn from your experience; where this model set exhibits similar symptoms it would be worthwhile checking this resistor before launching into an extensive test routine.

And to finish off, here is a brief story from a reader which is worth keeping in mind.

"This family owns a portable receiver which is knocked around and frequently dropped. Inevitably, it suffered a broken ceramic aerial rod.

"The rod was replaced but, even with fresh batteries, the sound was weak and distorted.

"The speaker was removed and several pieces of the aerial rod, and other stray pieces of magnetic material, were found clinging to it."

A.B., North Mackay, Q.

Thank you A.B. and while I have not experienced this situation myself, it is easy to understand how it could happen.

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Mozart: Cosi Fan Tutti—complete opera

MOZART—Cosi Fan Tutti. Complete Opera. Montserrat Caballe (Fiordiligi); Janet Baker (Dorabella); Wladimiro Ganzarolli (Guglielmo); Nicolai Gedda (Ferrando); Ileana Cotrubas (Despina) and Richard Van Allen (Alfonso) with the Chorus and Orchestra of the Royal Opera House, Covent Garden conducted by Colin Davis. Philips Stereo 6707 025. (Four discs).

Colin Davis doesn't take long to make it clear that, unlike many musicians, to him Cosi Fan Tutte is not a frivolous opera. True, it has it light moments and its beginning is consistently in this light vein. Here Davis is possibly at his best in his excellent account of the opera. His tempos are lively, his orchestra clear and splendidly balanced and everywhere the accents are carefully observed and beautiful executed. There is no surprise that his grasp of Mozart's quicksilver emotional changes are handled with unerring perception. Consider the contrast, never caricatured, between the soulful, parodied parting of the two sisters, and their swains' self-confident smugness at its outcome. These are the sorts of situations that Mozart expresses so subtly—his orchestral comment is in itself a delight to the ear. It just never happens. Every note is struck dead centre without the slightest loss of quality. And she can push a phrase out effortlessly yet never aggressively in the most complex writing of the ensemble. If her interpretation of the role leaves something very slight to be desired, ample compensations can be found in the beauty of her singing.

Nicolai Gedda at times sounds a little tired of some of his customary lyricism occasionally missing. But his is a generous, manly Ferrando despite rare moments of tonal roughness. I am afraid I cannot say the same about Wladimiro Ganzarolli's Guglielmo. Compared to the others his style is altogether too coarse for a good Mozart performance. He is sometimes off pitch and his characterisation is no better than his singing. Such roughness is quite alien to this always extremely subtle opera. I liked better Richard Van Allen's Alfonso. The Italian buffo tradition can probably be blamed when he descends into overstressing some of the humorous aspects of his part, but on the whole his is a good musical performance.

The diction is consistently excellent, a point that gives unusual pleasure to the spriently recitative. But here again I cannot approve the continuo which, for some reason or other, confines itself too often to the higher register of the instrument. There is also too much apparent enjoyment of his own ornamentation. The use of the appoggiatura is often a question for debate in music of this period. It overdone it can sound niggling. If cut out altogether, as sometimes happens here, it brings a phrase to too abrupt a transition between notes.

The engineering is clear and never hags the lucidity of Mozart's wonderful scoring. The balance within the orchestra and between the players and singers is always sensitively preserved. If this set has its very minor faults I don't know of another which hasn't any. If I recommend this one enthusiastically it is simply because I am at a loss to recommend one better. It should satisfy all but the hypercritical.

Walton—The Bear: “good comic opera”

WALTON—The Bear. Complete one act Opera. Monica Sinclair (Popova); John Shaw (Smirnov); and Norman Lumsden (Luka) with the English Chamber Orchestra conducted by James Lockhart. World Record Club Stereo S 4525.

Good comic operas, and by this I mean those with wit in the orchestral part and no buttoonery on the stage—are indeed rare nowadays. Those that come to mind most readily are Verdi's immortal Falstaff, and at somewhat lower level Ravel's L'Heure Espagnole, Puccini's Gianni Schicchi, Wolf-Ferrari's Susannah's Secret, and Scheck's Fisherman and his Wife. I can't recall either of the last two being presented, at any rate professionally, in Australia. But Walton's delightful little work can easily take its place among all but the Falstaffian work. There is humour in some of the situations (adapted from a short story by Chekov) in the libretto all wittily commented on in the orchestral score. In the latter, most of the fun comes from a series of parodies of other composers' styles sneaked into the entertainment with all the deltness that Walton displayed so early in life in his Facade music.

Some of these parodies are immediately obvious, others more elusive, and some might perhaps be missed altogether even by the best informed lis-
teners. I must leave it to you to pick those you can identify and guess at those you can't. You will get no help, by the way, from the bare libretto provided with the single disc. It is important to point out that this wholly delightful excursion goes on without in any way disturbing the even running of the stage action. The orchestra is small, but it is surprising how rich Walton can make his limited number of musicians sound whenever he wants to. But the players are the English Chamber Orchestra so that I need add no more in the way of praise of that part of the entertainment.

The diction of the singers is generally so good that after having acquainted oneself with the story, the libretto can easily be put aside even the first time through. The vocal line is admirably singable, seeming to follow the almost conversational style used by Ravel in his L'Heure Espagnole. This, allied to the magnetism of the quality of the sung words, makes understanding of what is going on quite easy. It also has a tendency to magnify the always large presence—both physically and vocally—of baritone John Shaw, though this is never taken beyond the bounds of valid characterisation. The Bear—a local landowner in financial difficulties—somewhat along the lines of Baron Ochs in The Rosenkavalier. Shaw has achieved considerable refinement since he first sang in opera in Australia many years ago. Then his Scarpia in Tosca used to remind one of a member of the Darlinghurst Vice Squad rather than an aristocratic Italian police chief. But he still has a habit of seeming just a little larger than life size, though as I said above this is no very great fault here. Monica Sinclair is perfect vocally and dramatically as the young minx of the mould. As her old manservant, Norman Lumsden uses his fine bass with splendid discretion.

This little opera—it runs only about 50 minutes—is a real charmer. Walton uses a verismo style in a completely contemporary manner but, thank heavens, without any reliance on 12-tone abuses. The rhymes have quite a Gilbertian quality. Presented in the right spirit it should be a winner in the Opera Hall of the Sydney Opera House complex.

It would make an excellent double bill teamed with one of the other witty oneacters I noticed earlier. With Walton's tightness of expression, its small cast and orchestra and the composer's well controlled exuberance it never drags. Strongly recommend it for all its very great merits which will not only provide you with much enjoyable listening but will also set you the fascinating exercise of trying to identify the styles of the various composers parodied with such skill.

For information on World Record Club albums, contact the Club at 605 Camberwell Rd. Hartwell, Vic. 3124. Tel. 29 2636.

**TCHAIKOVSKY—Symphony No. 1 in G Minor. “Winter Dreams.”**

**LIADOV—Kikimora and Polonaise in C.**

**USSR Symphony Orchestra conducted by Yevgeny Svetlanov. World Record Club Stereo S/5029.**

It is hard to imagine why this alluring symphony should be so neglected in the concert hall, especially since the composer is coming back into favour amongst the highest of highbrow audiences, and even accepted in some 12-tone coteries. For many years since the war Tchaikovsky has been consistently written down by snob audiences. Toscanini was alleged, incorrectly, to have said that he would never conduct a Tchaikovsky symphony.

A curious incident happened a few years ago on which this might have some bearing. The American magazine, the New Yorker, published a review by its highly regarded music critic of that performance of Tchaikovsky's Fifth Symphony, a recording of which he was reviewing. It was not as good as the live performance he had heard Tchaikovsky give in New York some years earlier. Challenged with the fact that Toscanini had in fact never conducted the work in New York the critic replied neatly that this might well have been so, but that Toscanini would have played it better if he had played it! The symphony is delightfully melodic, though in form it does not comply with the highest symphonic tradition. This, however, does not prevent its always pleasant sound from consistently charming the ear. Moreover, on this disc, one is immediately struck by the excellence of the authority of the reading of it given by this fine Russian orchestra. They play it with sparkling energy and fervour, with the slow movement, one of Tchaikovsky's great cantilenas, flowing up to a superb climax. The sound is very good indeed, the balance excellent especially when the low basses add a pizzicato accompaniment. If a charge of vulgarity can be sustained against the big horn tone—well that currently much admired composer, Gustav Mahler, is often guilty of the same fault. In any case there is no trace of vulgarity in the graceful, delicate boned Scherzo with its subtle syncopations in its main part and a delicious waltz in the middle section.

The Finale is perhaps a bit on the brash side but, after all, this is an early work and the band plays it for all it's worth. On this disc, one is immediately struck by a Polonaise both by Liadov. This composer was first brought to the notice of Western musicians by the famous Russian Ballet entrepreneur Diaghilev who used Kikimora for one of its productions about 60 years ago. It is not great music but fine fun and is beautifully played. The Polonaise is just another polonaise.

**PHILIPS CASSETTE**

**ELGAR—Enigma Variations. London Philharmonic Orchestra.**

**STRAUSS—Don Juan. Symphonic Poem. Concertgebouw Orchestra of Amsterdam, both orchestras conducted by Bernard Haitink. Philips Dolby Stereo Cassette No. 7300 344. Philips Stereo disc No. 6500 622.**

This unusual coupling goes far to contradict those who claim that Elgar cannot be played satisfactorily by non-British conductors. Hollander Bernard Haitink interprets both these works impressively and shows no lack of understanding of the Elgar. By the way, this might be as good a place as any to recall that Richard Strauss was a great admirer of Elgar and did much to get his work performed in Germany and Austria. Haitink's is a big performance. He would never conduct a Tchaikovsky symphony. The symphony is delightfully melodic, though in form it does not comply with the highest symphonic tradition. This, however, does not prevent its always pleasant sound from consistently charming the ear. Moreover, on this disc, one is immediately struck by the excellence of the authority of the reading of it given by this fine Russian orchestra. They play it with sparkling energy and fervour, with the slow movement, one of Tchaikovsky's great cantilenas, flowing up to a superb climax. The sound is very good indeed, the balance excellent especially when the low basses add a pizzicato accompaniment. If a charge of vulgarity can be sustained against the big horn tone—well that currently much admired composer, Gustav Mahler, is often guilty of the same fault. In any case there is no trace of vulgarity in the graceful, delicate boned Scherzo with its subtle syncopations in its main part and a delicious waltz in the middle section.

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The sound generally is very good on the cassette—the coupling is also issued on disc which I haven't heard—and the slight intrusion by the timps can be overcome by a slight cut in the bass control.

Haitink uses his Amsterdam Concertgebouw Orchestra for Don Juan. There is a splendid solidity about the vigorous opening that suggests in a way I have never heard before mature impetuosity. Here is a Francis Drake rather than an elegant young Spaniard. Although this might sound fanciful I am sure Haitink had in mind no young rapscallion but a refined elegant young Spaniard. Although this might sound fanciful I am sure Haitink had in mind no young rapscallion but a fully fledged adventurer and I think the work gains from it. And this same characterisation extends even to the lyrical sections which refer to the Don. The women's sections are all intensely feminine. The cassette sound—and I must again mention that I have not heard the disc though I have no doubt it is magnificent—is all one could desire. And among the many fine first rate musicians you will hear some delicious oboe playing that treats you to a finely etched line of elegant proportions. The solo violin must also be mentioned though I find it strange that his name is featured on the label but not that of the oboist. The whole work is full of seemingly inexhaustible energy. Both orchestras sound at their noble best in these works.
Devotional Records

SINGIN' A NEW SONG. Cliff Barrows Presents The Young Church Singers. Stereo, Word WST-8572-LP (From Sacred Productions Aust, 181 Clarence Street, Sydney and other capitals).

For the most part recent compositions, the titles on this album will not be familiar to many, but don't let that deter you—they are very tuneful, well arranged and beautifully presented:

Jesus Walk Past Me; Here Comes Jesus—Until That Time—Make Us One Father God; Loves You And Me—Bring Back The Springtime—Will You Stay Where You Are; Fill Me, Jesus—My Tribute—A Mighty River, Goin' To Build My Life—A Common Love—To A Mountain—Softly And Tenderly; Someone Is Waiting.

While the singers maintain a steady flow of words and melody, mainly from centre channel, the instruments from either side produce a sound that will tickle the ears of any hi-fi fan—sparkling transients and a heavy throbbing bass.

In sharp contrast to the style of Rudy Atwood's "Wonderful Old Chestnuts", reviewed elsewhere, this one is right up to many, but don't let that deter you—they are very tuneful, well arranged and beautifully presented:

Take My Hand Precious Lord—Teach Me How To Pray—Whispering Hope—We Thank Thee—May The Good Lord Bless And Keep You—This World Is Not My Home—It Is No Secret—I'd Rather Have Jesus—In The Garden—He Will.

The critical listener may catch a few wisps of pressing texture noise on side 1 but otherwise the quality and total balance are well up to standard. (W.N.W.)

THE BEST OF JIM REEVES' SACRED SONGS. Stereo, RCA Victor APL1-0793.

"The best of" title is sometimes dubious but, in this case, listeners with a liking for devotional songs will almost certainly go along with it. Though apparently assembled from a variety of sources, the whole program is very smooth, gently rhythmic and with only sparse touches of C&W style. The songs are all well known in church circles:

Take My Hand Precious Lord—Teach Me How To Pray—Whispering Hope—We Thank Thee—May The Good Lord Bless And Keep You—This World Is Not My Home—It Is No Secret—I'd Rather Have Jesus—In The Garden—He Will.

The recording itself is as smooth as the program. If you like traditional devotional songs, sung in the traditional way, you'll enjoy this one. (W.N.W.)

WONDERFUL OLD CHESTNUTS. Rudy Atwood, Piano with String Orchestra Stereo, Word WST-8591-LP (From Sacred Productions Aust, 181 Clarence Street, Sydney and other capitals).

Faced with this completely honest title, it is almost automatic for a member of the older generations to slip back through the years, to the golden days of radio, when the Old Fashioned Revival Hour won so many listeners with its smooth, polished renditions of favourite hymns. At the piano, Rudy Atwood set a new style for Gospel pianists with his gentle embellishments of the old tunes.

By today's standards of involved improvisation, his familiar embellishments are as much "old chestnuts" as the hymns themselves. But they do have the advantage that the melody is always recognisable, even dominant!


Combine those tunes with Rudy Atwood's piano, add a small string orchestra and you have an album that will carry your grey hairs back through the years in a restful nostalgic journey! A fully imported album, the quality is excellent. (W.N.W.)

Instrumental, Vocal and Humour


All the songs on this album were written by American Gospel songwriter Bill Gaither, probably best known for his composition "He Touched Me". The number is featured on this album, along with; Let's Just Praise The Lord—My Faith Still Hoks—All God's Children—Because He Lives—Get All Excited—Something Beautiful— I Don't Know What You Came To Do—Come Holy Spirit—There's Something About A Mountain—Even So, Lord Jesus, Come.

With varied and generous instrumental backing, the Rick Powell Singers produce a very smooth, pleasant sound that should be eminently suitable for family listening. The fact that the songs may not be well known should not be a discouragement; they are tuneful and the themes are readily apparent.

The critical listener may catch a few wisps of pressing texture noise on side 1 but otherwise the quality and total balance are well up to standard. (W.N.W.)

SPECTACULAR MARCHES. The Philadelphia Orchestra conducted by Eugene Ormandy. Stereo, RCA Red Seal AR1-0450.

Branded "newly recorded", this would be a good album for anyone who is on the lookout for a big orchestral sound, to see it being adopted as a demonstration recording for big, symphonic sound, to groups which might show a mixed reaction to heavier—or lighter—fare. Well worth a hearing. (W.N.W.)

SNOWFLAKES ARE DANCING. The Newest Sound of Debussy. Performances by Tomita on Moog Synthesizer Stereo, RCA Red Seal AR1-0488.

If "Switched on Bach" caught the imagination with its scintillating Moog sound, this performance of Debussy's beautiful tone paintings may well do the same for an entirely different reason—gentle, ethereal sound that caresses the ear with its quaint merging of Debussy. 
with electronically generated tones, arranged and performed by an oriental artist.

To be sure, there are the characteristic Moog phrases and stanzas that are more suggestive of a suspense drama or a TV theme than classical Debussy, but Tomita is revealed as a very notable exponent of the electronic music he has specialised in for several years.

The tracks: Snowflakes Are Dancing—Reverie—Gardens In The Rain—Clair de Lune—Arabesque No 1—The Engulfed Cathedral—Passepied—The Girl With The Flaxen Hair—Golliwog’s Cakewalk—Footprints In The Snow.

Gentle, classically derived sound, with touches of the orient, electronic gimmickry and musical gaggles, it is interesting to the casual listener and worthy of closer study by the student or specialist. (W.N.W.)

THE ALAN HAVEN ORGAN SHOW. Quadraphonic, Astor QUAD 1028.

If the jacket quotes are to be believed, Alan Haven is “the greatest”. Without seeking to debate the point, he certainly has a generous share of digital dexterity. The organ itself is also a “Haven”, to his own design, apparently with an emphasis on percussive facilities, with piano and harpsichord voices too for good measure.

It’s actually a 3-man show with Alan Haven on organ and two percussionists. What each contributes would be hard to pick, so well is the sound integrated. You will listen in vain for a traditional organ solo, but you will hear skillful one and two-note melodies against a rhythm accompaniment, convincing piano, and a few effects that are quite Moog like.

The tracks: Close To You—The Odd Couple—Here’s That Rainy Day—Finding Words—Watch What Happens—Caravan—Aranjuez Mon Amour—South To The Sun—Scheherazade—Raindrops Keep Falling—Misty—Mozart’s Rondo Alla Turca.

The quality is very clean but, played in 4-channel, one has to get used to sounds from one organ coming from opposite ends of the room. The point is, of course, that they can do so in real life from a multi-channel instrument. Fine, as a record of combo style organ. (W.N.W.)

THE COLE PORTER STORY. Franck Pourcel and his Orchestra. EMI Studio 2 Stereo TWOX 1028.

Mix Cole Porter’s evergreen hits and the orchestral skills of Franck Pourcel and you are bound to come up with a winner.

The record has a very forward sounding rhythm, something like the sound on the Spanish ‘Hispavox’ discs.

The twelve tracks are: C’est Magnifique—I Love Paris—I’ve Got You Under My Skin—In The Still Of The Night—Easy To Love—True Love—Begin The Beguine—Night And Day—Just One Of Those Things—Ca C’est L’amour—So In Love—Don’t Fence Me In. The quality of the record is superb; if you’re a Porter fan, don’t miss it. (N.J.M.)

I’M MOVIN’ ON. Hank Snow. RCA Camden ACL1-0540. Stereo.

If you like Hank Snow’s style, then you’ll probably like this album. Be warned, however, it is a reissue, though at a budget price. Titles included are I’m Movin’ On—Green, Green Grass Of Home—There’s A Star Spangled Banner Waving Somewhere—With This Ring I Thee Wed—Let Me Go Love—My Rough Day—Rowdy Ways—Frankie And Johnny—Folsom Prison—I’m Movin’ In.

Personally, I find his nasal tones unpleasant. Record quality is good. (D.W.E.)

BACK TO THE COUNTRY. Loretta Lynn. Astor MAPS 7818.


While there are one or two exceptions, most of the songs on this album could be classified as sad love songs. I found that the Conway Twitty composition “Jimmy On My Mind” was the one I liked best. On this track, Loretta’s voice did not seem quite as rhapsodic as on some of the other tracks. Recording quality is excellent. (D.W.E.)

ALL-TIME ORCHESTRAL HITS. Geoff Love and his Concert Orchestra. EMI Studio 2 Stereo TWOX 1029.

If you are looking for a delightful record for quiet relaxing or for a dinner background, have a listen to this disc. For your money you get these titles; Theme from ‘La Ronde’—Love Is Blue—Intermezzo—Blue Tango—Stranger On The Shore—Canadian Sunset—Holiday For Strings—Eb Tides—Forgotten Dreams—A Man And A Woman—Romance—Lime.

The quality and siereno impression are first class. (N.J.M.)

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ELECTRONICS Australia, September, 1975 89
LIGHTER SIDE

GREATEST HITS OF THE 30s Vol 2.
Arthur Fiedler and The Boston Pops
RCA ARL-0506.

This is another in RCA's series of all-
time hits through the years, making
enjoyable listening especially for the
Wrinklies like me who can remember
back that far! The twelve tracks are: In
The Mood - Love Is Here To Stay - Yours
Is My Heart Alone - Tumbling Tumbleweeds - Easy To Love - Blue
Moon - All The Things You Are - Bidin' My Time - Wagon Wheels - Sunrise
Serenade - Someday I'll Find You - Whis-
tle While You Work. With the exception
of 'In The Mood' which sounds as if it
had been recorded in a barn, the sound
quality is superb. Peter Nero is the piano
soloist on two tracks, Love Is Here To
Stay and Bidin' My Time. (N.J.M.)

★ ★ ★ ★ ★

TOMMY TYCHO'S A NIGHT WITH
COLE PORTER. Live at the Sydney
Opera House Festival L45597/8
Stereo.

At the special two record price of
$7.95, this album is an excellent show-
case of local talent at their best.

Among those performing are Mary
Jane Boyd, Peter Brandon, the Claire
Poole Singers, Neville Marshall and
David Gray.

The titles are too numerous to list here
but most of Porter's best known music
is represented in instrumental or vocal
form. The quality leaves nothing to be
desired. In short a very enjoyable album.
(N.J.M.)

★ ★ ★ ★ ★

THE BEAUTIFUL MUSIC OF ROGERS
AND HAMMERSTEIN. Played on the
Sydney Town Hall Organ by Eric
Smith. Stereo, M7 label. ML-001.

The title of this recording will be cer-
tain to attract the attention of Sydney
organ enthusiasts in particular even if it
simultaneously produces some appre-
hension.

Perhaps I had better come right out and
say that any such apprehension
would not be misplaced on this occasion.

In its own way, the Town Hall organ is
a magnificent instrument and I have
heard sound from it beguiling and belitt-
ing. But, on this occasion, it is simply
bewildering.

I am prepared to accept that, in the
actual auditorium, it might have made
better sonic sense but, via the recording,
the melodic flow barely manages to be
heard through the reverberated residue
of what has gone before.

Blame the organist, if you like, for
over-registration, the hall for too much
echo, or the recording engineer for less
than optimum mic. placement, but the
end result is not a happy one.

"Happy Talk" - definitely not! "The
Sound Of Music" - hardly! "Whistle A
Happy Tune" - couldn't hear myself!
"Some Enchanted Evening" - fraid not!
Sorry Eric. (W.N.W.)

★ ★ ★ ★ ★

PUFFING BILLY IN STEREO. Steam
Action Productions 33 1/2 EP, stereo
SAP 101-S.

No doubt every steam train enthusiast
in Australia knows of the "Pennng Billy"
small gauge line, and those who have
visited Melbourne have probably had
many rides up through the beautiful
country-side from Belgrave to Emerald.

The line is justifiably famous, both
because of its unique story of a group of
amateurs rebuilding a closed-down line,
and because of its happy blend of nostal-
gia and scenic beauty.

Peter Nielson has made this recording
of the hard-working little 2-6-2 Prairie
engine which locos on the 2ft 6in gauge
Puffing Billy line as the latest addition to his series
capturing the remaining steam train surv-
ivors. In a cover note received with the
review disc he comments that the record-
ing was produced not only as an his-
torical item for steam enthusiasts, but
also as a souvenir for tourists. As one who
visited the line a couple of years back - and
thoroughly enjoyed myself - I have no doubt it will be successful in
both respects.

If you've taken a home movie of the
line, it would also be ideal to provide the
sound accompaniment. No prizes for
guessing what mine will be used for!

There are four tracks on the EP, each
capturing one of the salient aspects of the
lined, and explained by the sleeve notes.
The recording is of good quality, too.

As with previous Peter Nielson recor-
dings, it is distributed by Steam Action
Productions, P.O. Box 75, Ormond, Vic-
toria 3204. No price was given, however.
(J.R.)

★ ★ ★ ★ ★

FRANCES YIP. With The Nick Ingman
Orchestra, EMI EMC-3638 Stereo.

This young lady from the Orient has a
voice that belies her diminutive
appearance, a voice that should ensure
a sound future in the singing game. She
makes a splendid job of twelve tracks:
Stage Struck - Yesterday When I Was
Young - Someday - To Be The One You
Love - The Ballad Of The Sad Young
Men - Go - Send In The Clowns - One
More Ride On The Merry-Go-Round -
The Way We Were - He Did With Me
- She - For You.

The quality is superb, with an excellent
orchestral backing. If you are looking for
a new voice for your ballad collection,
rush out and buy this one. (N.J.M.)

★ ★ ★ ★ ★

MANIFIESTO. Victor Jara, Chile Sep-
tember, 1973. Transatlantic Records
Stereo. L-35415.

Victor Jara was a Chilean folksinger
who was murdered during the coup
government by President Allende on 11th of Sep-
tember, 1973. This record is a representa-
tive collection of his work, from 1968 up
to his death.

Although all the songs are in Spanish,
a sheet of translations and backgrounds
is provided. In addition, some tracks are
preceded by spoken translations. The
songs included are: Te Recuerdo
Amando - Canto Libre - Aqui Me
Quedo - Angelita Huemuman - Ni
Chicha Ni Limona - La Plegaria A Un
Labrador - Cuando Voy Al Trabajo - El
Derecho De Vivir En Paz - Vientos Del
Pueblo - Manifiesto - La Partida -
Chile Stadium.

The last track is a poem which Victor
wrote while imprisoned in the boxing
stadium at the Technical University at

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ELECTRONICS Australia, September, 1975
come To My World - This Is The 'Time
Jody And The Kid - Crying Time -
- Strings Are Broken - Shaney Boy -
Snowbird - I Walk The Line - Jambalaya
record store an' buy it?
Why don’t you git on down to your
good album an’ record quality is beaut!
kinda like the late Jim Reeves. I wonder
too. ’N fact in some songs he sounds
Yup! An’ he does a durn good job of it
words of the title track:
some of his
fellow prisoners, and later smuggled out
words were memorised by some of his
Santiago just prior to his death. The
improbable story on the album is
brilliant album of idiotic antics by the
GOON SHOW CLASSICS. BBC Records
The fourteen tracks are:
I Love Country Music. Val
Val Doonican singin’ country music? Yup! An’ he does a durn good job of it
Snowbird - I Walk The Line - Jambalaya -
Strings Are Broken - Shaney Boy -
Jody And The Kid - Crying Time
Haven Is My Woman’s Love - Welcome To My World - This Is The Time For Living - Oh Woman - You’re The Only Good Thing. (L.D.S.)

Reader’s Digest boxed set

GREAT ORIGINAL HITS OF THE 50’s and 60’s. Various artists and orchestras. Reader’s Digest 9-record boxed set. Stereo.

Invest in this boxed set and you’ll have a lot of listening ahead of you—far more than the single evening I allowed myself to sample the many tracks. There are nine records, with six titles per side, adding up to 108 numbers in all.

With the exception of 51/52 and 66/67 each year has a side to itself, beginning with 1950 and finishing with 1969. They are so arranged that they can be played in order by stacking on a changer, if you want to do it that way.

My phrase “various artists and orchestras” is in no sense an overstatement. Just reading down a few of the tracks, one encounters Teresa Brown, Andrews Sisters, Frankie Laine, The Weavers, Ames Brothers, Eddie Fisher, Hugo Winterhalter, Manfred Mann, Henry Mancini, The Four Aces, Georgia Gibbs, Tony Martin, Paul Mauriat, Irish Rivers, and so on. And, if that first list omitted names like Bill Haley, Perry Como, Louis Armstrong, Billy Vaughn and Horst Jankowski, it’s only because there’s a limit to what one can include in a neces-

sarily brief review.

The problem of summarising the track titles is even more formidable but here’s a random picking: Music, Music, Music—Kiss Of Fire—’Cest Si Bon—Three Coins In The Fountain—Unchained Melody—Hot Diggity—Fascination—Catch A Falling Star—Mack The Knife. That takes us up to ’59; it would need another 9 to quote one each through to ’60.

As distinct from many other Reader’s Digest sets reviewed in the past, this one is predominantly vocal. And, while sonic excesses are avoided, the music comes through in the appropriate style. So Bill Haley’s “Rock Around The Clock” is as animated as Oliver’s “Jean” is sentimental.

For the studious listener, there are notes on each separate track on the respective jackets. Brief titles on the disc make it easy to locate any particular disc or title.

Recorded in Dynagroove by RCA, the pressings are completely clean and right up to modern recording standards. And, if you want to play them through a 4-channel decoder, they work just fine. In short, a serving of pleasant, popular music that will keep your ears busy for quite a while! Recommended. (W.N.W.)

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Using op amps

110 OPERATIONAL AMPLIFIER PROJECTS, by R. M. Marston.
Published by Newnes-Butterworth, London, 1975. Soft covers, 213mm x 140mm, 123pp, numerous circuit diagrams. Recommended price in Australia, $4.50.

This book should have considerable appeal to the enthusiast who has not yet given serious attention to the operational amplifier. In fact, to anyone not yet familiar with this device, this book would seem to be as good a place as any to make its acquaintance.

The approach is essentially practical. The first chapter, Basic Principles and Applications, describes the operational amplifier in terms of what it does. There is no attempt to look inside the device, it is treated simply as a "black box" having certain electrical characteristics as seen looking into its various terminals. This chapter—and indeed the whole book—confines itself to the types 709 and 741; types which are readily available world wide.

The following chapters are devoted to practical circuits designed around these two devices. All the circuits are relatively simple and use only a few ancillary components, all of them quite commonplace, readily available devices, of a non-critical nature.

At the same time the circuits are representative of a wide range of completely practical applications for operational amplifiers, either as self-contained devices, or as part of larger circuits.

Whether you need to solve a particular problem, or just want to learn about operational amplifiers, this book will give you a good start—and a lot of fun into the bargain.

Our copy from Butterworths, 586 Pacific Highway, Chatswood, NSW, 2067.

(P.G.W.)

LIGHTNING, etc


The author of this text, Senior Lecturer at the School of Electrical Engineering, University of Sydney, was formerly system design engineer for the Snowy Mountains Hydro-Electric Authority, Australia. The present book, he explains, is virtually a re-write and an up-dating of material assembled over the years for lectures and symposia.

Chapter headings cover the following subjects: Overvoltage; Disruptive Discharge and Withstand Voltages; Lightning Overvoltages on Transmission Lines; The Lightning Performance of Transmission Lines; The Switching Surge Design of Transmission lines; The Insulation Coordination of High Voltage Stations; Bibliography; Appendices.

It would be inappropriate for an electronics-orientated writer to comment in detail on this specialised subject but readers interested in this field may like to know about the existence of the new book. (W. N. W.)
In summary, then, a very good book for the serious student, particularly one who likes things explained in a little more detail than is available in some textbooks. A good reference book for a technical library also. (P.G.W.)

But not this one


At first glance this appeals as a useful and commendable book, intended to provide the uninitiated reader with a background in the broad field of electronics.

It begins at the conventional place with electrons, conductors and insulators, moving on to alternating and direct current. Then follow chapters on components, circuit concepts, test instruments, computers, radar, medical electronics, space electronics, television, instruments, computers, radar, medical electronics, space electronics, television, industrial applications, the future, and training to be an electronics engineer.

Fair enough, as far as the broad intention is concerned, but scanning the text turns up phrases which suggest that the text would have benefited from an examination by experts in the various subjects.

For example (p16) the pars on matching are suspect, leading to a statement that the load presented to an audio amplifier must match its output impedance; in practice this situation is studiously avoided! On page 26 there is an inference that the radio spectrum starts with frequencies in which the cycle time is "less than one thousandth of a second". On page 30 is the statement that, in any electrical circuit, voltage is the cause and current is the effect. Pentode valves are credited with "many interesting characteristics" on page 67, one being its "ability to produce a constant current whatever the voltage on its grids (within limits)". On page 201 the reasons for an odd number of scanning lines in a TV picture is given as "the half-line being used as an indication to the receiver synchronisation circuits that one field has been completed".

If a quick sampling can turn up pars like these, it doesn't augur well for a detailed study of the text. Sorry, but we can't recommend this one. (W. N. W.)

Communications


One of a series of monographs being produced in collaboration with STC (Standard Telephones & Cables Ltd), this book is intended primarily to assist postgraduate students and younger engineers to a better understanding of the vasty involved communications network on which the world now substantially depends.

Each of the authors is a recognised expert in the subject on which he writes. If their contributions overlap or reflect somewhat different value judgments, this is seen by the editor as a factor which is likely to enhance the value of the text to a serious student. The scope of the book is best indicated by listing the chapters, along with their respective authors. Their multiple qualifications are omitted purely for the sake of brevity: History and Growth (K. G. Hodgson & G. C. Hartley); FDM Systems (K. G. Hodgson); PCM and Digital Networks (G. C. Hartley); Microwave Radio Systems (H. B. Wood); Communication Satellite Systems (O. G. Williams); Optical Communication (C. Kao).

The book appears to be well written and is an authoritative treatment of a subject which, considered as a whole, is nothing less than bewildering in scope and scale. It should be a valuable reference source for the postgraduate student while, at the same time being quite readable by anyone interested in concepts rather than detail.

Our copy came from the publishers who advise that stocks are currently available in Australia. (W. N. W.)

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Below, left to right: QUAD electrostatic loudspeaker, QUAD 303 power amplifier, QUAD 33 control unit, QUAD FM3 stereo tuner.
New Products

Two scientific calculators from Texas Instruments Inc

Scientific calculators continue to become cheaper and ever more powerful. Here we review two of the latest from Texas Instruments, the SR50A and SR-51, which feature scientific notation with a 10 digit mantissa and an exponent up to plus and minus 99.

Each calculator is supplied in an attractive cardboard carton together with a "plug-pack" power supply for recharging the batteries. Also a soft zippered vinyl carrying case, which has a loop for attaching to the proud owner's belt.

The SR-51 comes with two manuals: one is the owner's manual which has detailed instructions for all the possible calculations. The other is a brief operating guide for quick reference purposes. The SR-50A comes with a single comprehensive owner's manual.

The push-buttons are small but well-spaced and give a good tactile sensation, i.e., they give a positive click when pressed. Readout is via a multi-digit LED display in red.

A big feature of the two calculators is that they both employ scientific notation. They will compute and display numbers as large as $\pm 9.999999999 \times 10$ raised to the power 99 or as small as $1.00000000 \times 10$ to the power -99. Answers are automatically converted to scientific notation when the calculated result exceeds 10 to the power 10 or less than 10 to the power -10.

In addition, variables may be entered directly into the calculator in the scientific notation. On the SR-50A there are three data registers for data calculation and one memory register for data storage. The memory may be used to store a constant for iterative calculation or to store a calculated result for additional subsequent calculations. A feature is the sum and store key which algebraically sums any displayed number with that in the memory and then stores the result in the memory.

On the SR-51 there are three data registers and three memory registers for data storage.

Frankly, we cannot even begin to describe all the possible calculations which both units are capable of—there are supplied with comprehensive manuals for that reason. Both units can do such calculations as factorials, reciprocals, roots, powers, trigonometric and hyperbolic functions with just a few keystrokes.

Most calculations take place in less than a tenth of a second although factorials of large numbers do give them some pause. The largest factorial which can be performed is 69! which takes about 2½ seconds to perform before the dramatic result is displayed: 1.711224524 x 10 to the power 98. That is a mind-boggling number to say the least.

What sets the SR-51 apart from the SR-50A are its second function keys. For example, the "ln x" key is also used for log (to the base 10) calculations. Second functions are engaged by pushing the "2nd" key (logical enough).

One particular feature which caused a lot of amusement in our office was the random number generator, which will generate a random sequence of numbers from 0 to 99. Several members of the staff ran bets on the highest number.

Texas Instruments probably have not visualised the SR-51 being used in a betting shop. On a more serious note, the random number facility would be very useful for people performing problems in statistics or probability.

But definitely the biggest feature of the SR-51 is its direct conversion of quantities such as miles to kilometres, yards to metres, Fahrenheit to Celsius and so on. These are exact conversions, not approximations. A particularly convenient conversion is voltage ratio to decibels.

In all, there are nineteen direct conversions possible just by punching in a two-digit code. Combined with the reciprocal key just about every conversion ever needed is available. About the only conversion not directly applicable to the Australian scene is gallons to litres, because it refers to US gallons. But that is easily overcome.

Both the SR-50A and SR-51 have direct conversion available for degrees to and from radians, via a slide switch which matches the on-off slider.

Clearly, we can only present just a brief review of these powerful calculators. It takes quite some time to appreciate their full capabilities. They are almost a mandatory aid to today's engineering students, and design engineers without one are just not in the race.

Recommended retail prices are $173 plus 15% sales tax for the SR-51 and $109 plus 15% sales tax for the SR-50A. Retailer enquiries should be made to the Australian distributors for Texas Instruments calculators, A. J. Ferguson Pty Ltd, 44 Prospect Rd, Prospect, SA 5082. (L.D.S.)
Low cost sound level meter

Those needing to make general-purpose noise and sound level measurements should find this low cost meter of interest.

With so much current discussion on the need for, and the possibility of, legislation to curb noise pollution, interest is growing in the standards which will be set down by any such legislation. Similarly, there is considerable interest in the means by which the individual can make meaningful measurements, where it is suspected that such limits are being exceeded.

While highly precise and very expensive instruments might be needed to provide evidence at a legal level, there are currently available modest priced instruments which would be quite suitable for preliminary surveys and as a basis on which cooperating parties might reach an agreement.

One such is the model SVI-7 Sound Level Meter made by the Onsoku Electronic Corporation of Japan, and marketed by Dick Smith Pty Ltd. It is an extremely light and compact instrument, measuring only 106 x 66 x 36mm and weighing only 150grams, including the internal 9V battery.

The instrument is calibrated to read from 40 to 110dB, with a meter scale covering a range of 20dB and six ranges having 10dB steps. The meter scale also carries a battery check zone, used in conjunction with an appropriate switch position.

The instrument employs a weighting network according to the international "A" response, the most universally used "weighting" at the present time.

It is fitted with an electret capacitor microphone, and has a frequency response from 31.5Hz to 8kHz. The meter is a ribbon suspension type with a fast damping factor. There is also provision to plug in an earphone (supplied) which, on the lowest range, provides a high order of amplification. This is intended as an aid to identifying individual sounds as likely offenders.

As a matter of interest, a quick check produced the following readings:

- Typical office, 50-60dB
- Suburban train, 80-90dB
- Suburban dwelling, 40dB

(The level in the last named environment was below the minimum level of the meter most of the time.)

The sound level meter comes complete with battery, earphone, and instruction sheet, packed in a moulded plastic foam container. The price is $47.50. Further information from Dick Smith Pty Ltd. (P.G.W.).

Crystal controlled clock

Australian Time Equipment Pty Ltd are importers of the French Vedette clock movements. A popular line has been the transistorised balance wheel movement which is fitted to different types of case to suit various environments. The movement operates from a single 1.5V dry cell with a life of from 12 to 18 months. Reliable operation is assured by the use of a transistor in the role of a solid state switch, instead of some other mechanical arrangement which cannot match the former for reliability.

The accuracy of this type of movement is such that it is possible to attain time keeping to within 40 seconds per week. This compares more than favourably with mantel type pendulum clocks.

In spite of the accuracy possible with this type of movement, there are many modern applications where this is just not good enough. In view of this an interesting development by Vedette is the modification of this movement so that it is brought under the control of a quartz crystal. By doing this, the accuracy attainable is enhanced markedly. Instead of the figures just quoted, it is possible, the maker's claim, to reach an accuracy of better than 1 minute per year at ambient temperature.

The crystal controlled unit is substantially the same as the earlier one but the case containing the complete movement has been altered to take the extra electronics. This includes a crystal on 32768Hz, an IC and a 1.4V mercury cell.

The mercury cell has been substituted for the conventional 1.5V "C" cell presumably because the mercury cell maintains substantially a constant voltage throughout its useful life. This may be necessary to ensure correct operation of the IC with its division factor of 2^12. With this division, the crystal frequency is brought down to 5Hz, which is a suitable frequency for synchronising the balance wheel.

It is interesting to note that we at EA developed a method of synchronising transistor switched battery operated clock movements a couple of years ago. In fact, the movement which was used for the original work was a Vedette, the same as the one under review. While I have not delved right into the "works", the systems used appear to be the same.

We have had this unit under observation in our laboratory for several months and have found its time-keeping to be excellent. One second per month is not uncommon. There may be a variation of two or more seconds in some months. However, the maker's claim of 1 minute per year is conservative and something better than this is normal in practice.

Applications for this type of clock are almost endless, particularly where this sort of accuracy is required. Another particular advantage this unit has over synchronous clocks operated from the mains, is the fact that they do not require a power point for operation, making it quite independent of external leads.

While we are on the subject of crystal controlled timekeeping, Australian Time Equipment Pty Ltd also have a watch crystal on 32768Hz. This is an XY flexure bar in a metal case just under 17mm long x 5.2mm wide and 3.1mm thick. The crystal is designed for series operation. Further details of the crystal and clock movement may be had on application to Australian Time Equipment Pty Ltd, 192 Princes Highway, Arncliffe, NSW 2205. (I.L.P.)
## E.D.&E. (SALES) PTY. LTD.

### EDUC-8 COMPUTER—COMPLETE KIT
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  - 12, 24 and 48 Volt

- **Audio**
  - Crystal & B.C. Receivers

- **VHF Powermatch**
  - 100 Watt: 200, 300 and 500 Watts

- **Tuner Units**
  - 220, 135 and 120 Watts

### ELECTRONICS Australia, September, 1975

**PHONE**

662-3506

**E. D. E. & E. (SALES) PTY. LTD.**

118 LONSDALE STREET, MELBOURNE — 3000 — VIC.

**PHONE**

662-3506
Compact electronic thermometers

Convenience and reading accuracy are the features offered by "Mini-Z" electronic thermometers, made by Hokuto Electric of Japan. Both technical and medical versions are available, from Dick Smith Electronics.

The Mini-Z model 2N is intended for technical applications, such as measurement of transistor and heatsink operating temperatures. It has a range of from -10°C to +80°C, with the scale calibrated in degree divisions. The alternative model C instrument is intended for medical work, covering the range from 32°C to 42°C (90°F to 108°F) with 0.1°C scale divisions (0.2°F divisions).

Both instruments are housed in plastic cases measuring 145 x 92 x 42mm, the only difference being colour—that for the cases is white. The cases appear to be made from "Cycolac," or a similar impact resistant plastic.

The instruments employ thermistor probes, which connect to the meter cases via cables and 3.5mm plugs. Each instrument comes with an appropriate probe, although additional and specialised probes are available. The instruments are battery operated, the model 2N requiring a single "AA" penlight cell while the model C uses a miniature 9V battery. Both instruments have a calibration adjustment to allow for battery ageing.

Measurement accuracy of the model 2N instrument is claimed as ±1°C, while that of the model C is claimed as ±0.1°C (±0.2°F). Time of response of the model 2N with the probe normally supplied is 7 seconds, and the same figure applies to the model C.

Tested in our laboratory, the sample model 2N proved itself a handy instrument, easy to use and with an accuracy within that claimed.

We passed the sample model C instrument over to a general practitioner friend, to try it in a realistic clinical environment. His reaction was that while it appeared to have adequate accuracy, there were a number of negative features compared with a conventional clinical mercury thermometer. It wasn't any faster than the mercury type, for accurate readings, yet unlike the mercury type it doesn't hold its reading, so that readings must be taken very rapidly. There is no provision for interchangeable tips, either, so that sterilisation would pose a problem in a busy surgery.

Not only this, but there is the added problem of having to tweak the calibration adjustment periodically, to ensure accuracy, and of remembering to replace the battery. In short, the model C seems best suitable for relatively casual use, perhaps in the home.

Etch resist pen

Those who need to produce custom PC boards rapidly should know about the DALO type 33PC marking pen, specifically designed for this purpose. It incorporates a special value-controlled ink dispenser to control the etch-resist ink and prevent evaporation. Etching is possible 15 minutes after drying.

The pen, ink solvent and solvent dispenser are available from Royston Electronics Pty Ltd, 162 Pacific Highway, Gore Hill, NSW 2065. (J.R.)

Multi-tap 40VA transformer

As a result of the response to the 20VA multi-tap low profile transformer model PL1.5-18/20VA added to their range a few months ago, Ferguson Transformers have produced a similar unit rated at 40VA. Conforming to the requirements of AS C 126, the new transformer provides the same range of output voltages as its smaller brother: from 3V CT to 18V CT in 1.5V steps, at a current of 2.2A. It carries the type number PL1.5-18/40VA.

Both multi-tap transformers should be available via normal suppliers, or from Ferguson Transformers Pty Ltd.
One year from now you’ll be able to read this circuit as easily as the back of a cornflakes packet.

You don’t need to be an Albert Einstein to learn about electronics.
All you need is youth, enthusiasm, and someone who’ll give you the chance to learn at the right speed.
That’s what an electronics apprenticeship in the army will give you.
A year from now you’ll be able to read this circuit standing on your head. And you’ll be well on the way to gaining qualifications that will make you valuable to employers everywhere.

So if you’re between 15 and 17 in January and you want to get into electronics, this is probably the best opportunity you’ll ever get.
Fill out the coupon and we’ll send you more details. Or pick up the nearest phone and call the Army Careers Adviser in your city. (Closing date 13th August.)

To Army Careers Adviser
G.P.O. Box XYZ in your nearest State Capital City.
Please send me information about Apprenticeships in the Army.
Name
Address
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Brisbane 31 1031,
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Melbourne 61 3731,
Launceston 1005,
Hobart 34 7077,
Adelaide 223 2891,
Perth 22 4355,
Darwin 89 0911.

Authorised by the Director-General of Recruiting, Dept. of Defence and by the Dept. of the Media.
Future of amateur radio societies

What future is there for amateur radio societies? A question which must concern all amateurs if such organisations are to flourish and continue to provide services needed by members.

At the outset, it must be emphasised that any society, be it a voluntary or paid organisation, can only be as strong and effective as members make it.

With changing patterns of behaviour, outlook, attitudes and values, it is difficult to predict what the future of national amateur radio societies will be. Several are already finding that rising costs and world economic trends are causing problems.

Amateur radio, being a technical self-educational, self-policing, and international activity, fostered the formation of radio clubs and later national societies. In most cases the work has been done on a voluntary basis. This also applies to the smaller national societies, which are in the hands of a few large national societies employing staff on a part-time basis. The few large national societies employ staff to carry out routine management and clerical tasks.

At the outset, at a time when the strongest possible organisation was needed, we can only be as strong and effective as members make it.

The inevitable rise in subscription rates is too often followed by a fall in membership. The latter is more economical financially but only be as strong and effective as members make it. The situation in Australia is an interesting one. For more than 50 years the WIA, the oldest national radio society in the world, was operated with an absolute minimum of paid staff. In the 1960's the two largest divisions, NSW and Victoria, employed clerical assistance to carry out the everyday work. This was more on a part time basis. As far as federal executive was concerned, all duties were in the hands of the volunteers. In 1972 a manager was appointed, ostensibly to work on the Institute's monthly magazine (until then done voluntarily) and also as a part time assistant to federal executive.

Up to the beginning of the 1970's each division maintained independent membership and accounting systems. Only membership figures and per capita payments were passed to federal executive base station, mobile or portable operation is allowed during the contest, with all points claimed for contacts not registered as attending the convention.

Registration fees: Family -104.00 Single -$3.00

Rules for contest between amateurs attending the convention.

Duration: 9.00 am to 2.30 pm.
Frequency: 7095kHz or nearest clear channel.
Aim: For both mobile and base station operators. Even the smallest mobile operation has a place in the contest.
Number of stations to be entered on the same log sheet. All points are additive.

3. Base station, mobile or portable operation is allowed during the contest, with all points claimed being entered on the same log sheet. All points are additive.

4. Standard 59001 type scoring. Legible log sheet showing stations worked, times, points claimed, etc.
5. Operators may continue to score up to 2.30 pm provided operation takes place in excess of one mile from the convention site.

6. Scoring for working the convention base station

LOCAL AND OVERSEAS NEWS

ITU NEWS

The 2nd World Telecommunication Exhibition will be held in Geneva, Switzerland from 2nd to 8th October, 1975. The first exhibition was held in 1971. Both were sponsored by the International Telecommunication Union.

More than 300 exhibitors from about 40 countries will be participating. In conjunction with the exhibition there will be "Youth in the Electronic Age" competition and on 4th and 5th October, there will be a "World Radio Amateur Convention".
MONTHLY MEETINGS are held on the first Wednesday of each month at the Civil Defence Headquarters, Highgate Street, Bexley.

HIGHT FREQUENCY NETS: Two HF nets have been established in Sydney. They use CW, AM and SSB on 27.125MHz and 28.5kHz. The nets cater for mobile, portable and base station operation. A secondary frequency of 28.10MHz has also been proposed, for use when novice licensees obtain their full licence as it will require only minor modification to their existing novice band equipment. It is also hoped that DX contacts can be promoted through the use of these calling frequencies.

Plans are also in hand for a net on 1.825MHz in the 160 metre band. The Sydney group would like to see interstate as well as local amateurs keep a listening watch on these frequencies.

SAM Voron, VK2BVS, would like to have those interested in promoting the use of these net frequencies.

GOLD COAST RADIO CLUB: The GCRC continues to attract visitors and new members. One visitor was B. Sutherland, ZL2AQZ from Nelson, New Zealand.

At least six GCRC members were preparing for the novice licence examination and VK4FE has offered a prize of $10 to the first to receive a novice licence.

A lot of work has been done on the repeater installation at Mt Tamborine.

ILLAWARRA AMATEUR RADIO SOCIETY: From Noel Spratt, VK2SNR, publicity officer. The St George repeater is nearing completion inasmuch as it is undergoing on-air tests and final adjustments.

Gary Herden, VK5ZK, president of the South Australian Division, WIA, attended the July meeting. At the same meeting, Geoff Moss, VK2AHK, gave an interesting discourse on SSB transceivers. Geoff is the sole agent for Swan equipment in Sydney.

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in July. This examination was for radio and electronics stage 1.

The course is designed as an introduction to the hobby of radio and electronics. Examinations for stage 2 and stage 3 were planned for the end of July.

The president of the NSW division WIA, Tim Mills VK2ZTM, visited the YRCS during July. When expressing his pleasure in being able to see the club for the first time, Tim congratulated the members on their achievement.

The YRCS is located at 211'75" celled by the one post-mark "Bayswater West Aust.

HUTT RIVER PROVINCE: Below is the text of a letter received which may raise some queries. Some points which come to mind are - radio regulations applicable to the area, reciprocal licensing agreements and suffix visitors would be expected to use; DXCC country listing.

"It is with much pleasure that I advise you of the formation of the Hutt River Province Principality Radio Club.

"As the province grows rapidly and interest in amateur radio being high, the formation of an organisation to foster all interests in radio and its technology was essential.

"Although the organisation is in its infant stages amenities include electrically noise free location, 10 metre tower, TH6DXX antenna and some associated equipment.

"Any amateur contemplating a visit to the province, which is only 56km north of Perth, will be made most welcome and invited to "hook up" his gear and work the fantastic DX that is available".

The letter was written on printed letterhead with the insignia "Hutt River Province - 1970-Independent Sovereign State", dated 1st July, 1975 and signed A. McIntyre, president.

The envelope also carried the insignia, a colourful 25c provincial and 10c Australian stamp both cancelled by the one post-mark "Bayswater West Aust. 20725X".

The radio address given is - HRPPRC, PO, Northampon, via Western Australia.

Some of the background of the motive and aims of the province are known but the official situation should be clarified as far as amateur radio is concerned before it becomes too involved at an international level.

YRCS NEWS

NEW SOUTH WALES

The annual pennant, awarded to the most successful YRCS club by the Institution of Radio & Electronic Engineers, has been awarded to the St George YRCS Training Annex for their achievements in 1974. The annexe is run by Noel Ercik, VK2MF, at Brighton-le-Sands, a southern Sydney suburb.

In the school club section, the pennant was won by Parramatta Marist High School Radio Club under the guidance of Reverend Brother Cyril Quinlan, VK7ACQ. Congratulations to the club leaders and students in both clubs on their achievements.

Among the school clubs affiliated with the YRCS are: -- Whalan High School Radio Club, in the outer western suburbs of Sydney. Club leader is David Wilson of the school's science department. Two other teachers are associated with the club and several students are sitting for YRCS certificate examinations. It is planned to have a club station on the air during the latter part of 1975.

Marist Brothers Warrigul. 4 elementary and 1 junior certificate.

The winners of the 1974 IREE pennant awards in New South Wales were: in the school section, minor Mitchell High School Radio Club, -- for the second consecutive year. To be eligible for the award in consecutive years a club must improve on the previous year's performance.

In the non-school section the Black Forest Scouts were successful. All told sixteen clubs were listed in the points gained table.

WESTERN AUSTRALIA

Latest information to hand lists the following active clubs in Western Australia.

Hamilton Senior High School, call sign VK6HH, club leaders Norm Hyde, VK6NH and Tom Siter, VK6AS.

Bunbury Cathedral High School, club leader Keith Peterson, VK6PH.

Aquinas College, call sign VK6RA, club leader Rev Br John Marks, VK6RAP.


Both Hamilton and Bunbury clubs are on the air on 80 metres and 52.586MHz (6 metres).

VICTORIA

Examination results for YRCS certificates show that members of the following clubs were successful:

Central Gippsland Youth Radio Club. 3 elementary, 1 junior and 4 intermediate certificates.

Marist Brothers Warrigul. 4 elementary and 1 junior certificate.

Collingwood Technical College Radio Club. 2 elementary, 2 intermediate certificates.

Disabled Radio Amateurs Club. 1 elementary and 1 junior certificate.

St John's College Radio Club, 4 junior certificates.

Inquiries about the YRCS in Victoria should be sent to the secretary, Kevin Baker, VK3BKR, 12 Havelock Street, Maidston, Vic. 3012.

SO YOU WANT TO BE A RADIO AMATEUR?

To achieve this aim, why not undertake one of the Courses conducted by the Wireless Institute of Australia? Established in 1910 to further the interests of Amateur Radio, the Institute is well qualified to assist you to your goal. Correspondence Courses are available at any time. Personal classes commence in February each year.

For further information write to:

THE COURSE SUPERVISOR, W.I.A.

14 ATCHISON STREET, CROWS NEST, N.S.W. 2065.
A new station operating on 6185kHz and announcing as Radio Swan is understood to be broadcasting from Swan Island in the Caribbean. Programming is in Spanish, with reception best heard around 0700GMT.

Swan Island is a former American possession off the coast of Cuba. In the mid-1960s it was the site of a powerful radio station with the slogan "Radio America", and beamed programs around the clock to Cuba. The actual operation of the company which owned the station was never disclosed, but it was thought to be a CIA operation. Verifications from the station on that theory depended on 1161kHz with the power of 50kW, and had a shortwave transmitter of 7.5kW on 6000kHz.

The new Radio Swan broadcasts in Spanish on 6185kHz, and is best received around 0700GMT. The program consists of popular Spanish music with announcements after each recording that indicate the station operates on both medium wave and shortwave. Transmitters are beamed to Cuba.

The Island of Swan was recently handed to Honduras by the American Government, and it is presumed that the old Radio American transmitters have been reactivated.

The announcement in Spanish does not give an address or location of the station, but simply identifies as Radio Swan. According to our reception the station appears to operate 24 hours a day as it still can be received past 0900GMT. The time announcements indicate that they are using Central American time.

ENGLISH FROM RADIO CAPITAL

A new program about Costa Rica is now broadcast by Radio Capital in San Jose on 4832kHz from 0700-0730GMT. Though this program is in Spanish, an English announcement has been heard by Chris Davis of Featherston NZ which indicates the station is using a new address. The program called Aqia Costa Rica includes an appeal for reports. Listeners should write to PO Box 2936, San Jose, Costa Rica.

According to the announcement the same program is carried on 6000kHz by Radio Reloj, which is owned by the same company. Signals in New Zealand are good during the period of reception. The English announcement is heard around 0720GMT.

VOICE OF TURKEY

The Voice of Turkey is now using a new frequency for its English transmission from 2200-0115GMT. Broadcasts are now heard on 15165kHz, which replaces 11220kHz, and on the old channel of 9515kHz.

The new channel provides good reception. The program includes news on the hour, with the balance made up of Turkish music, popular music and a jazz program. There is slight sideband on 15165kHz from 2200-0115GMT. Broadcasts are now heard on 15165kHz, which replaces 11220kHz, and on the old channel of 9515kHz.

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### CASSETTES

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### APAN TURNTABLES

#### BMU 121
- **$115.00**

#### BRU 121
- The new Apan BRU 121 series 4000. Semi-automatic. Integrated hydraulic cue device.
- **$130.00**

#### BFU 121
- The new Apan BFU 121 series 4000. Fully automatic. Fully manual for the enthusiast. 4 channel ready. Separate cueing hydraulic device.
- **$150.00**

#### BRA 121
- Integrated hydraulic cue device. Semi-automatic. 4 channel ready. Servo assisted.
- **$178.00**

---

*These prices include Base and Cover and Jelco MC14D Cartridge.*

#### Pioneer KP212
- Car stereo cassette 8 watts RMS auto eject
- **$109.00 + speakers**

#### Pioneer KP4000
- AM/FM-MPX car stereo radio 8 watts RMS
- **$185.00 + speakers**

#### Hitachi CS2000
- Auto reverse car stereo
- **$115.00 with speakers**

#### Magnavox 8.30
- 5" round speaker
- 4 and 8 ohms
- **$3.95 + speakers**

- 7" x 5" elliptical speaker
- 4 and 8 ohms
- **$4.50 + speakers**

---

Here is a summary of the products and prices mentioned:

**Cassettes**
- Hitachi: C60 LN, C90 LN, C120 LN, CDC 60, CDC 90, CDC 120
- Memorex MRX2: C45, C60, C90
- TDK: C45 LN, C60 LN, C90 LN, C180 LN, C90 SD
- Concorde: C60, C90
- Sony: C90 LN

**Turntables**
- BMU 121: The new Apan BMU 121 series 4000. Fully manual. Separate cue device. **$115.00**
- BRU 121: The new Apan BRU 121 series 4000. Semi-automatic. *Integrated hydraulic cue device.* **$130.00**
- BFU 121: The new Apan BFU 121 series 4000. Fully automatic. Fully manual for the enthusiast. 4 channel ready. Separate cueing hydraulic device. **$150.00**
- BRA 121: Integrated hydraulic cue device. Semi-automatic. 4 channel ready. Servo assisted. **$178.00**

**Additional Products**
- Pioneer KP212: Car stereo cassette 8 watts RMS auto eject. **$109.00 + speakers**
- Pioneer KP4000: AM/FM-MPX car stereo radio 8 watts RMS. **$185.00 + speakers**
- Hitachi CS2000: Auto reverse car stereo. **$115.00 with speakers**
- Magnavox 8.30: 5" round speaker. 4 and 8 ohms. **$3.95 + speakers**
- Magnavox 8.30: 7" x 5" elliptical speaker. 4 and 8 ohms. **$4.50 + speakers**

---

*These prices include Base and Cover and Jelco MC14D Cartridge.*

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**Notes:**
- The prices listed are as of the publication date of this document.
- For more details and updates, please visit the store or contact them directly.
1. Central Processing Unit (CPU) Board. This double-sided board is the heart of the Altair. It was designed around the powerful Intel 8080 microprocessor—a complete central processing unit on a single LSI chip using n-channel silicon gate MOS technology. The CPU Board also contains the Altair System Clock—a standard TTL oscillator with a 2.000 MHz crystal as the feedback element.

2. Power Supply. The Altair Power Supply provides two +8, a +16 and a -16 volts. These voltages are unregulated until they reach the individual boards (CPU, Front Panel, Memory, I/O, etc.). Each board has all the necessary regulation for its own operation. The Altair Power Supply allows you to expand your computer by adding up to 16 boards inside the main case. Provisions for the addition of a cooling fan are part of the Altair design.

3. Expandability and custom designing. The Altair has been designed to be easily expanded and easily adapted to thousands of applications. The basic Altair comes with one expander board capable of holding four vertical boards. Three additional expander boards can be added inside the main case.

4. Altair Options. Memory boards now available include a 256 word memory board (expandable to 1024 words), a complete 1024 word memory board, and a 4,096 word memory board. Interface boards include a parallel board and 3 serial boards (RS232, TTL and teletype). Interface boards allow you to connect the Altair Computer to computer terminals, teletypes, line printers, plotters, and other devices.

Other Altair Options include additional expander boards, computer terminals, audio-cassette interface board, line printers, ASCII keyboards, floppy disc system, alpha-numeric display and more.

5. All aluminum case and dress panel. The Altair Computer has been designed both for the hobbyist and for industrial use. It comes in an all aluminum case complete with sub-panel and dress panel.

6. It all adds up to one fantastic computer. The Altair is comparable to mini-computers costing 10-20 thousand dollars. It can be connected to 256 input/output devices and can directly address up to 65,000 words of memory. It has over 200 machine instructions and a cycle time of 2 microseconds.

Available as kit & assembled.

**CALCULATORS**

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plus sales tax if applicable

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CALCULATOR CATALOGUE listing all new LLOYD'S & COMMODORE SCIENTIFIC CALCULATORS at rock bottom prices.

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W.H.K. ELECTRONIC & SCIENTIFIC INSTRUMENTATION
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Please forward E A 9

☐ Computer Catalogue
☐ Calculator Catalogue
☐ Technical Catalogue

Name__________________
Address__________________
Postcode__________________
RC BRIDGE: I have enclosed a crude diagram of the front panel of an RC bridge that I have acquired. It has a few components missing, and I hope to fix it and use it for finding the values of unmarked components. It looks homemade, and I thought it might be something of interest to you in Electronics Australia.

It runs off 24V AC, and has two nine-pin valves. If it is one of your projects, could you publish the date of the edition in which it appears, and the price of any reprints available? (K.S., Tukely, NSW.)

Your diagram was not too crude for us to be able to recognise the Resistance-Capacitance Bridge, featured in the September 1963 edition of "Radio, TV and Hobbies". The file No is 5/7/87, and a reprint is available for $2.00, including postage.

GUITAR PREAMPLIFIER: I am designing a preamp for a guitar amplifier which will have inputs for lead, guitars and also need to know the impedances of the output voltage of the pickup heads in these guitars, and also need to know the impedances of the heads. (S.G., Tauranga, NZ.)

Guitar pickups can have an output signal of less than 10 millivolts for a lead guitar to substantially more than 100 millivolts for a bass guitar, depending on how hard the strings are struck. We cannot quote figures for the impedance of guitar pickups but most guitar amplifier designs provide load impedances of about 50k to 100k. We have published several solid-state guitar amplifiers and preamplifiers in the past which may be useful references for you. "Preamplifier for electric guitars", October 1968, File 1/ GA/13 and "Playmaster 138 Guitar Amplifier", May 1973, File 1/ GA/20 are representative of these.

TRAIN CONTROLLER: I would like to thank you for the Model Train Controller article of May 1974. I have just built it and it works extremely well. The inertia is so realistic that there is no point making trains with fingers, the built-in "kick" is very satisfactory. I am so pleased with the result that I am going to build two more and scrap the old controllers I have been using.

What happens if, through points switching the output of one controller presents itself at the emitter of the 2N2955? Would I need to isolate each controller in turn by the switches as the points change, or do I use diodes to isolate the controllers from each other? I made my unit from components on hand, except the two transistors, and when complete I could get only 2V at the track. After much checking I found that diodes were missing. Others, with limited knowledge like myself, might spend as much time as I did looking for such a fault. My experience might save them a couple of hours fruitless searching. Thank you for a brilliant and uncomplicated circuit.

(D.H., Christchurch, NZ.)

Thank you for your kind remarks D.H., and we are glad to learn that you have found the controller to be such a good performer. Having played with it ourselves, we think your comments are valid. Your question about controllers being connected together raises a number of points. First, there is the matter of polarity. In the event (happily rare) that two controllers are connected with opposing polarity it is probable that each will behave as if looking into a short circuit, and the circuit protection should prevent any damage. But if the polarities are the same there is the possibility that the maximum permissible base/emitter voltage will be exceeded for both 2N2955s. Your suggestion of a diode appears to be a good one, although we haven't tried it. A heavy duty diode, such as a 1N4148, might be connected directly in series with the emitter, prior to the reversing switch. Were we not to have a chance to try this, we cannot comment on any subtle side effects which might arise. Perhaps you could let us—and other readers—know how it works out.

Thank you for the comment about the shorted diode. It emphasises the desirability of being able to test all components—even new ones—before fitting them.

CASSETTE DECK: I have a rather small but frustrating problem and would appreciate it if you could give me a suggestion. I have a stereo cassette deck and just recently purchased the Playmaster 136 amplifier.

I have read in many magazines that a cassette deck should not be kitted when near a magnetic field because time the heads become magnetized and this affects volume or tone reproduction. The problem is whether or not it would be safe to keep the deck on top of the amplifier which has a transformer which produces a magnetic field around it. If I do keep the deck on top of the amplifier, is the magnetic field around the transformer strong enough to harm the heads in any way? (G.B., Holdem Gardens, SA.)

It is unlikely that the magnetic field around your amplifier's transformer could even partially magnetise your deck head. However, it is much more likely that the field will react with the head to induce hum into the playback circuitry and thus worsen the signal-to-noise ratio. If you do not like hum, keep the deck off the amplifier.

ORGAN KITS: I have been reading your magazine for many years and I find it very interesting. Perhaps I am not able to help some of your organ enthusiasts. Many enthusiasts spend a lot of time, money, and effort to build an organ, which often costs more than a large house. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous.

Construction is simple and the completed organ is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamorous. I have just completed an organ and I am preparing to put it on the market. It is quite glamour...
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INFORMATION CENTRE
(Continued from p. 105)

there is less likelihood of variations between units and so they are more likely to fit in with the published dial calibrations. As for the choice of a square wave generator, this is a matter of individual choice. In short, readers may build either our design or the one given in May 1972.

STATION LISTS: I occasionally buy "Electronics Australia" and one thing I found useful was the list of Australian Broadcast stations which you published in each January issue. It seems the last time you published the list was in January 1973. Have you stopped publishing these lists or have you changed them to a different month? I would appreciate it if you would publish a new list as that for January 1973 is now out of date, especially with the addition of radio station 21I (R.M., Colac, Vic.)

- If we were to accept the opinions of some readers, R.M., radio 21I is the "only" station! Seriously though, we omitted the station lists to conserve space. Very few readers have reacted, either way. If there are more readers who wish to see the lists published, we shall certainly give it consideration.

CASSETTE PREAMPLIFIER: I wish to use the November 1973 Cassette Playback Preamplifier (File 1/Pre/28) with an Ultrasonic 15 full track head which requires an impedance of 0.5 to 1 megohm. I would be grateful if you would let me know what alterations will be necessary in the circuit. (G.B., Glen Waverley, Vic.)

- As it stands, the cassette preamplifier circuit you refer to is not suitable for high impedance tape heads, because it cannot provide the necessary load impedance. Unfortunately, there is no easy way of modifying it to suit the purpose nor can we suggest a suitable solid-state alternative.

Information Centre (Continued from p. 105)
PLAYMASTER 136: I have a problem with a Playmaster 136 which I have assembled with success. I am using a BSR C1 ceramic cartridge into one of the high-level inputs and find that bass response is just about non-existent. I tried the ceramic preamplifier you suggested in the second article on Playmaster 136, not aware that the BSR C1 has an output of the order of 250mV.

As the cartridge is new, I would be thankful if you could suggest how to increase bass boost, without the added expense of a new cartridge.

What modifications would be necessary to fit a loudness control, for low level listening? For the Playmaster 136, what would be a suitable magnetic and ceramic cartridge? Congratulations on a fine magazine. Best in the business (R. T., Highton, Vic.)

- Thank you for the kudos, R.T. The reason why you are not obtaining a satisfactory bass response when the cartridge is plugged into the high level inputs is that these do not have a suitably high load impedance. The ceramic preamplifier you mention should be suitable for your cartridge. If there is any tendency for overloading of the preamplifier to occur, the cartridge should be shunted with small capacitors, as suggested on page 53 of the January 1973 article on the Playmaster 136

We have not and are not likely to publish information on how to add a loudness control to your amplifier, because we regard such controls as gimmicks. See the article "Loudness Controls … Light" in the full-sized, newspaper issue. We cannot make specific recommendations of cartridge brands. However, for best results from your amplifier, use a magnetic cartridge.

BONGOS: I have just completed the electronic bongos but cannot get them to work. All I can get is a click when I switch the plate. This click is very slightly intermittent. I take it the dotted lines shown in the diagram are hook-up connections underneath the tab board. I have used a mixture of 3/4, 1/2 and 1/4 watt resistors and had to settle for capacitors 10% up on the specified value and some of 400V. Transistors used were BC548 which were supplied as BC108s. P.S.: I have just checked the resistors and find that both the 2.1M and three of the 56k are 0.1% less than half their indicated value. (R.M., Ashburton, Vic.)

- Frankly, we would be rather surprised if it did work, wrong capacitor values and resistors so far off the mark. In fact, it sounds like a poorly collection of components and we wonder about their age. The 400V capacitor rating would not matter but, if the capacitors are old, as well as having the wrong values, they could be leaky into the bargain. Resistor wattage rating is unimportant in this circuit, but resistance value is. Get all this right and your troubles may vanish. The BC548 transistors should be okay. Yes, the dotted lines are links under the tagboard.

Notes and Errata.

PLAYMASTER J-45L SPEAKER SYSTEM (April 1975, File No. 1/5E/38). In the dimensioned drawing on page 55, the asterisk specifying an internal dimension should be deleted from the outside depth dimension of 300mm, and instead placed on the internal depth dimension of 260mm.

AM SYNCHRODYNE RECEIVER (June 1975). Unfortunately, a number of errors have come to light on the circuit and PC board. On the circuit: R9 and D6 should be returned to the emitter of Tr1 rather than OV; external aerial should connect to primary of L1; there should be no connection between drain and source of F3; negative leg of P2 should go to OV; D8 is TN41J instead of TN44J; IC7 non-inverting input pin 2 should be pin 1 and IC6 connects to 1/2 bacon rather than after R32.

On the PC board: R1 near C9 should be R2; D3 has wrong end marked as cathode; C7 near F3 should be C8; C10 near Tr4 should be C18; C20 near V1 should be C24; R16 should be R17 and R19 next to it should be R16; R25 between C26 and R32 should be R25; D9 and D10 cathodes connect to their common point. Also, the inputs to IC2 have been swapped between 1/2 and 1/4 although this makes no difference to circuit operation.

Readers unable to obtain 0A85 diodes may omit them. The value of R2 is 1.5k, not 2.1k. The resistor values are not critical.

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EDUC-8 COMPUTER (December 1974, File No. 2/CC/5); also EDUC-8 HANDBOOK. In the description of simple tests for the conditional skip instructions given on page 79 (handbook, page 35) the text overlooks the fact that the PC register normally increments once whenever any instruction is fetched and executed. Hence in each of the tests, the PC register should always increment, but either ONCE or TWICE depending upon the condition being sensed. In other words, where the text states "should not increment", please read "should only increment once", and where it states "should increment", please read "should increment twice".

200MHz digital counter—addendum

In response to requests from readers for assistance in adding the overflow option to our December 1973 DF41 project, we publish this diagram. It shows wiring of the additional IC, as viewed from the top.

CAPACITANCE TESTER: I am interested in building the capacitance section of your latest RC bridge (March 1974, File 7/8/10) but I want to use a 1kHz instead of a 50Hz AC. Have you published a circuit for a 1kHz sine wave oscillator capable of performing this duty? Would there be any other circuit changes required? Is the full size printed scale still available for the RC bridge? If so, what is the price? (C. V. Campbelltown, NSW)

- An article in the November 1972 issue of "Electronics Australia" entitled, "Convert your RC bridge to measure inductance" (File 7/8/10) has details of a 1kHz oscillator to suit the RC bridge. No further modifications are required. The printed scale of the front panel is no longer available.

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- Aluminium diecast base.  
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