ELECTRONICS Australia

HIFI NEWS

JANUARY, 1976
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The case for cassettes...

Who better than Sony to develop a cassette deck that genuinely rivals open reel in performance. After all, Sony made its name by leading the way in open reel technology. That same brilliant Sony engineering now brings you the TC-177SD, a superb instrument for cassette fans.

Consider: Wow and flutter less than 0.07%; Frequency response 20Hz to 20kHz; Signal to noise of 55dB (and even better with Dolby on). All that and cassette convenience!

Sony did it by combining its proven closed-loop dual capstan drive with a number of remarkable new cassette deck developments. First, the TC-177SD has three heads for separate erase, record and replay. This ingenious design avoids the compromise between record/playback head design and permits A/B monitoring of sources and just recorded signals for instant checking.

Second, the TC-177SD is unique in providing Bias/Equalisation switching so that Sony's fantastic new Ferri-Chrome and the normal chrome dioxide tapes can be "tuned" for ideal balance in recording. Naturally Dolby noise reduction is inbuilt. But with a typically Sony difference; four Dolby circuits provide such super features as Dolby monitoring, there's a Dolby oscillator for optimising the particular tape in use, and for Dolby-encoded broadcast FM.

Functions, too, are up to the highest reel standard: feather touch control buttons; FM multiplex filter; full mixing for microphone and line inputs; peak level indicators are LED to complement the Limiter and 2 large VU meters; a memory counter for auto location of desired part, and there's an auto shut-off.

Everything you've wanted for easy, professional-quality cassette recording is now together in the fabulous Sony TC-177SD.

See it and hear it, soon.

Sony TC-177SD puts 3 heads together

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Australia's largest-selling electronics & hi-fi magazine

VOLUME 37 No 10

Based on a single integrated circuit, our new Autodim provides both automatic and manual light dimming control. The unit is ideal for parties, for watching television, and for young children who require the light on while falling asleep. Full details on page 30.

For those who cannot afford Dolby, this stereo dynamic noise filter may be the next best thing. The unit provides a useful reduction in tape hiss during quiet passages, while not affecting the bandwidth of high signal levels. See page 36.

On the cover

A technician demonstrates how easy it is to remove one of the printed circuit logic cards from the central control unit of the Philips PRX processor controlled reed exchange. Computerised systems of this type will form the next generation of Australian telephone exchange equipment, and Philips is among those companies that have submitted tenders to the Australian Telecommunications Commission. (Picture courtesy Philips Industries Ltd.)

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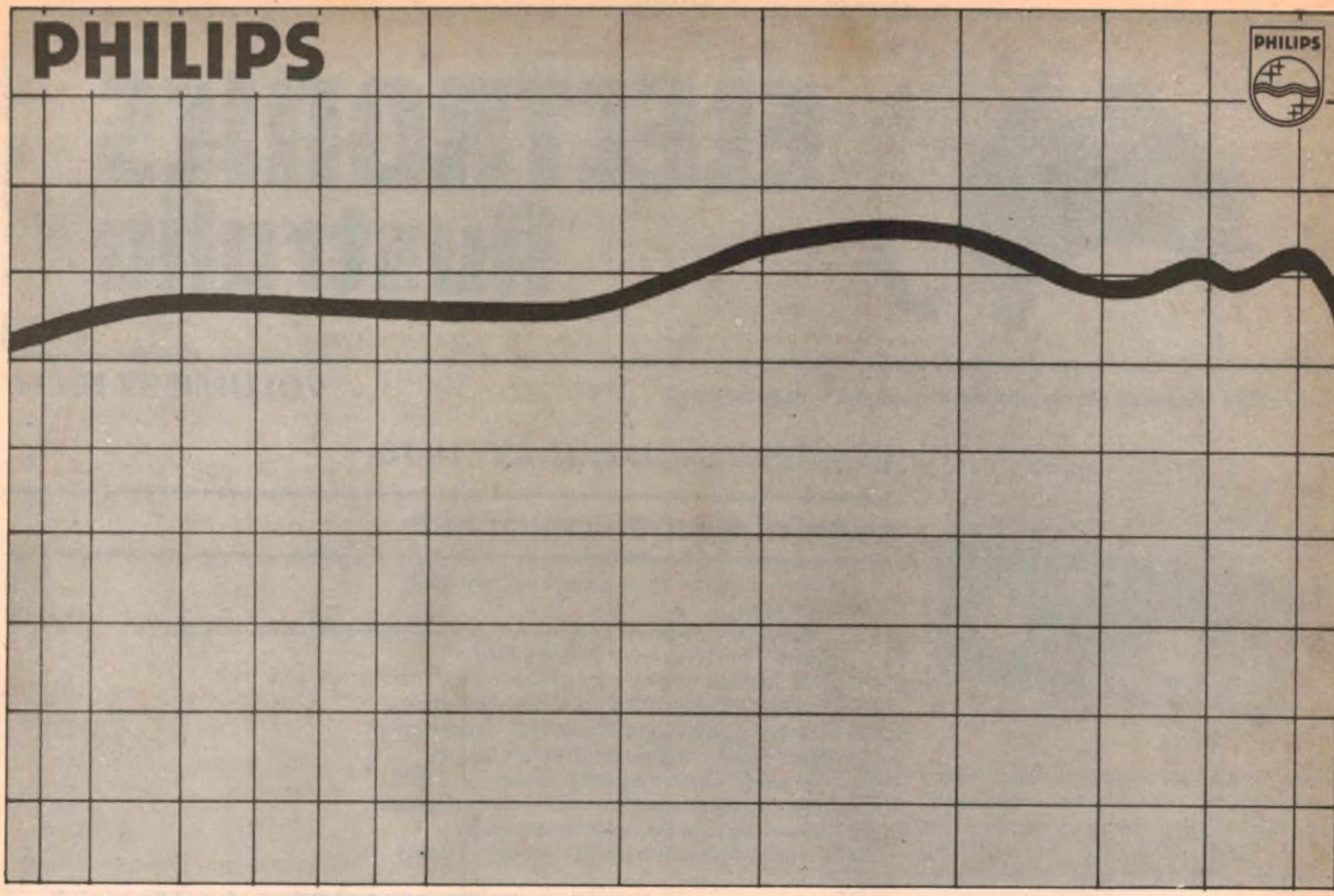
world of electronics and hi-fi

projects and technical

regular features



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

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Editorial Viewpoint

Some serious rethinking needed

Back in June 1974, I commented here on the way in which the November 1973 decision to implement a sudden cut in tariffs had triggered a partial collapse of the local electronic component manufacturing sector. I also reported on a growing spirit of defeatism in the equipment manufacturing sector, and suggested that both these ill-effects could grow worse unless urgent remedial action was taken.

It has now become sadly clear that this prediction was all too true. As I write in early December, the components manufacturing sector is almost completely dead, and the technological expertise which had been acquired in many important areas has been dissipated—quite possibly to an extent where reorganisation would be impracticable.

Not only this, but those firms involved in equipment manufacture have scaled down their activities quite markedly, with an estimated total of 30% employee retrenchment. Things have now reached the state where even some of the largest firms appear to be working with almost "skeleton" staffing and facilities. In fact it has been seriously suggested that it would now be impractical to attempt assisting local industry by enforcing offset requirements upon overseas contractors, because the industry no longer has the capacity to carry out or even make realistic tenders for offset business.

While the Australian electronics industry was undeniably languishing in a rather unrealistic hothouse of tariff protection, the effects of dismantling most of the hothouse in one fell swoop have surely been drastic—most of the plants have died, and the remainder are looking decidedly sick.

I find it reassuring that these broad facts are acknowledged in the Green Paper recently released by the Jackson Committee of enquiry into manufacturing industry. The paper notes that early attempts to restructure manufacturing industry were hasty and improperly planned, and recommends a more thorough and detailed approach to planning—coupled with carefully graduated changes in tariffs and other incentives.

It would surely be a great pity if the paper and its recommendations were not given the consideration they deserve, merely because it was released in the midst of the current political turmoil. I hope that by the time you read this, the question of who is to govern Australia will have been settled for a while, and perhaps some serious thought can be given to the future of our electronics industry—while there is still some industry left to have any future.

—Jamieson Rowe

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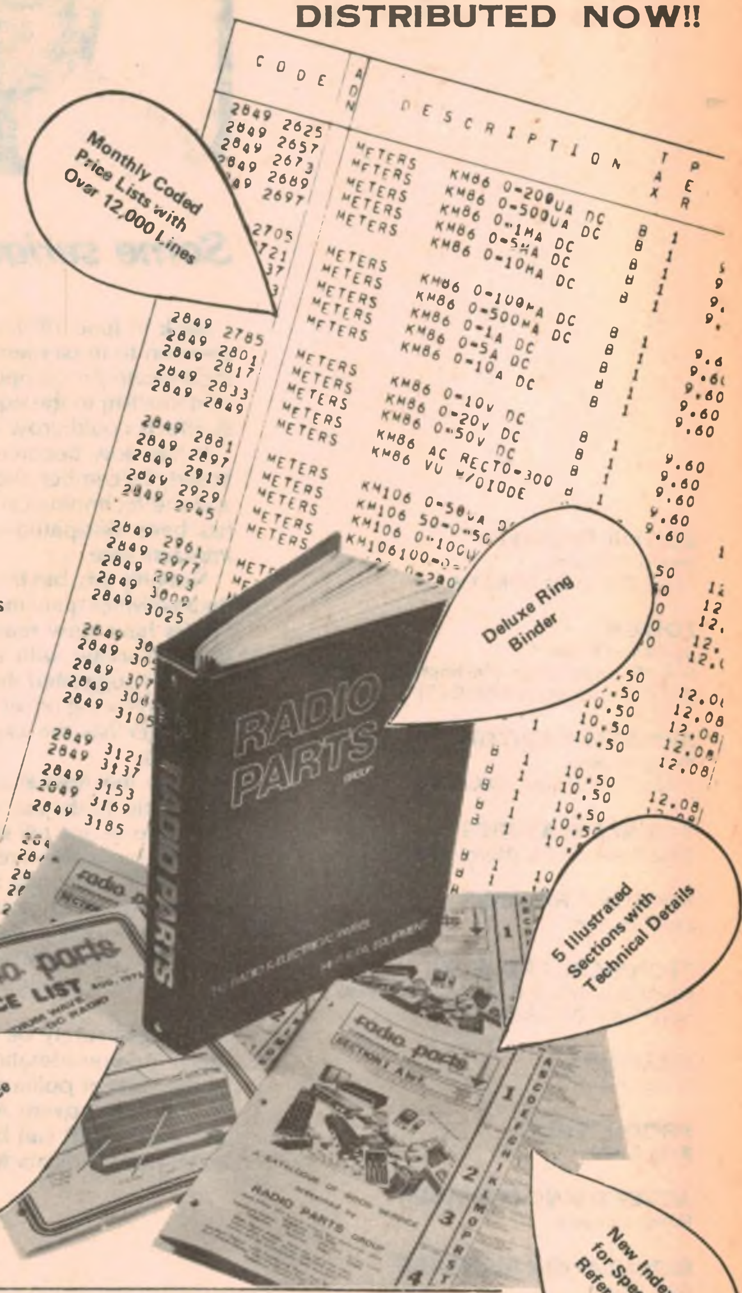

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Hi Fi News

"Modulus"—Heathkit's add-on hifi system

Although they have long been active in the field of build-it-yourself hifi receivers and amplifiers, Heath/Schlumberger, the originators of Heathkit, have something really new for 1976. Under the trade name "Modulus", they will be offering a build-it-yourself add-on hifi system that promises to out-perform and out-look much of the built-up commercial equipment currently on the market.

by NEVILLE WILLIAMS

The main unit with knobs, push buttons and meters is the basic Module 1. Alongside it, on the left, is a power amplifier module.

The thinking behind the new Heathkit "Modulus" is that it is very difficult for an enthusiast, at any point in time, to decide exactly what equipment he should settle for. He may spend money for facilities that, in practice, he will never use. Alternatively, and more likely, he may buy something fairly unpretentious because it is so much better than anything he has previously owned; later, he may discover that he needs more facilities, greater power or a higher all-round standard of performance. The only way out may be to repeat the whole performance—trading in and buying up, until next time!

In offering the Modulus concept, the Heath Company makes it possible for the enthusiast to start from a couple of basic pieces of equipment which may meet his listening needs for an indefinite period. but, at any time, he can buy and build up additional equipment to meet future needs.

The central and basic unit for the Modulus system—Heath call it Module I—is a tuner/control centre, as pictured.

It contains an AM tuner and a high performance FM tuner, with signal and tuning meters. There is no dial, as such, the selected frequency being displayed in digital readout form in figures ½-inch high.

Also in-built is what Heath refer to as a 2/4 preamp which can accept low level (e.g. phono) signals and amplify them as necessary with a claimed dynamic range of 94dB, a distortion content of 0.5% at full output and noise level 80dB below the full output figure. The preamplifier has full 4-channel capabilities against possible future requirements but, in the meantime, it can drive directly either 2-channel or 4-channel headphones, as well as the external power amplifiers.

Tape-in and tape-out facilities are provided on the front panel, with illuminated meters to indicate signal levels in up to 4 channels.

Control facilities are sufficient to gladden the heart of any enthusiast, with a row of no less than 21 push-buttons dominating the upper section of the panel. Apart from normal calibration, they all light up, when pushed, to indicate that they have been actuated. The push-buttons control mains power, select the desired input, actuate the tuners, select the playing mode (mono, stereo, 4-channel, etc), select decoding, invoke hi and low filters, loudness, Dolby circuitry, etc.

Controls include separate volume knobs for each of the four possible channels, separate bass and treble controls for front and rear and a provision for relay protection for the loudspeaker. With a diecast panel, black textured metal cover, and simulated wood grain end panels, the Modulus control centre is indeed an ambitious and attractively styled piece of equipment.

All told, it contains 28 ICs, 134 transistors, 55 diodes and the peripheral components, assembled on 14 circuit boards and interconnected by 4 wiring harnesses. Most of the boards flip up for easy access and inspection and a built-in test meter aids in tracing errors.

The control centre is intended to be used with a power amplifier module and here the purchaser can exercise his first option. For most purposes, Module II will be more than adequate, offering a minimum of 35W RMS per channel into a pair of 8-ohm loudspeakers. Rated distortion level is 0.1% at full output and response is flat to within 0.5dB from 8Hz to 45kHz.

If a higher power rating is required, Module III offers 60W RMS per channel into 8 ohms at the same low rated distortion.

What of quadraphonic? A pair of power amplifiers as above will provide 4 x 30W or 4 x 60W as required.

Modules IV, V and VI are illustrated as PCB assemblies and one would assume that they are intended to be installed as options inside the Module I control centre.

Module IV contains the circuitry necessary to accurately decode FM/stereo broadcasts which have been processed in accordance with the Dolby-B system. With such transmissions, it offers a possible reduction in signal/noise ratio of up to 10dB.

Module V provides for a CD4 4-channel decode facility—the works behind the CD4 push-button on the front panel. Rated separation is greater than 20dB in any direction and total harmonic distortion less than 1.0%.

The corresponding processing for SQ encoded discs is available as module VI, with a rated distortion of 0.5% and separations of 40dB L-F front, 12dB L-R rear, 18dB F-B, 20dB diagonal.

As indicated earlier, the Modulus system is being made available in a kit form, complete in every detail and accompanied by an appropriate instruction book. While the Heath Company sees a project of this size as most suitable for constructors with some previous experience, it could nevertheless be tackled by a novice prepared to exercise the necessary care in working exactly to instructions.

Released in America in November, the Modulus kit is scheduled for Australian release early this year through Messrs Warburton Franki, who advertises in most issues of this magazine.

AMPLIFIER POWER

Many er . . . less young . . . readers will be able to remember the Goodmans Axiom and Audiom series of loudspeakers and the corresponding Wharfedales, which were notable for their input/output efficiency, at least as far as loudspeakers go. Pump them with 15 or 20 watts of audio and they really made a noise.

Curiously, it was probably Goodmans as much as anybody who started the industry on the opposite tack with their tiny hifi "Maxim" units that would pump out very acceptable sound (including bass) from a box not much bigger than a handful of books. They were acoustically inefficient but it was an acceptable price to pay for big sound from a very small unit.

Initial reaction was that the reduction in sensitivity was simply the end result of having to use a long travel voice coil in a generous air gap; that it could be offset by tighter tolerances, the use of a bigger magnet, etc.

In fact, it has become evident that these mechanical considerations are simply ingredients in the total system design—driver plus enclosure—and are subject to quite precise mathematical quantification. It turns out that, for enclosures of a given size, there is a definite trade-off situation: efficiency for bandwith. The smaller the size, the harder one has to trade to retain that vital response below 50Hz.

It is largely for this basic reason that modern hifi loudspeaker systems have tended to be less sensitive than their earlier counterparts—their designers have deliberately sacrificed efficiency to achieve smoother and more fundamental bass from enclosures of, usually, limited size.

The compromise has been accepted largely because solid-state amplifiers have been able to offer higher orders of power output than were previously convenient with valves. A figure of 15W RMS, once a very respected rating for a valve amplifier, is about where solid-state amplifier ratings begin!

In fact, it might now be contended that designers have tended to become too casual about sensitivity and some of the systems which have emerged—even quite large ones physically—need very substantial drive to get them to speak up. Not surprisingly it has produced a definite reaction, in some quarters, towards calling a halt and conserving efficiency rather than treating it as the last

Luxman hifi from International Dynamics

While not the Luxman M6000 mentioned in the text, this new Luxman L1000 is not exactly a weakling either. Completely self-contained, it provides all normal input and taping facilities, plus tone controls with selectable turnover, hi and lo filters, speaker system select and a touch actuated mute provision. Power output is 110W continuous per channel into 8 ohms with an IM distortion of 0.05%.

For those who prefer a receiver, the Luxman R1500 provides AM facilities and a high performance FM tuner with switchable de-emphasis. Facilities include separate L-R tone controls with switchable turnover, filters, muting, stereo microphone input and mixing, loudness, and switching for three sets of loudspeakers. Power output is 75W RMS per channel into 8 ohms at a THD of .05%.

The new Luxman 310 tuner provides AM facilities with a high performance FM section and inbuilt circuitry for decoding Dolby-B encoded transmissions. Provision is also made for a future 4CH facility. The T300 tuner is similar in appearance, providing AM and FM facilities, but without the inbuilt Dolby decoder. Further information on all these items is available from International Dynamics (Agencies) Pty Ltd, 23 Elma Rd, North Cheltenham, Vic 3192.

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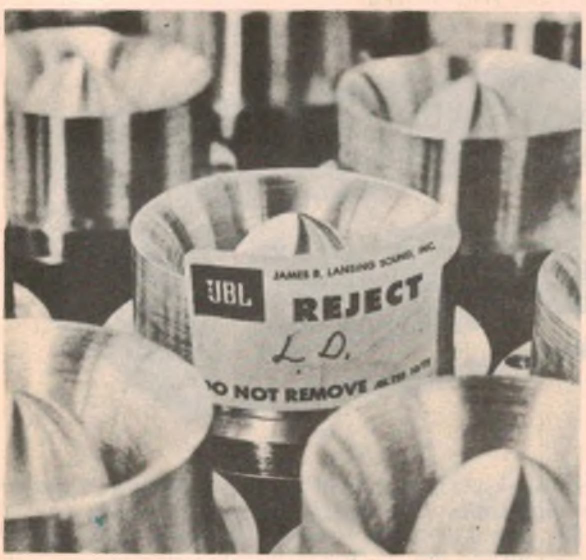
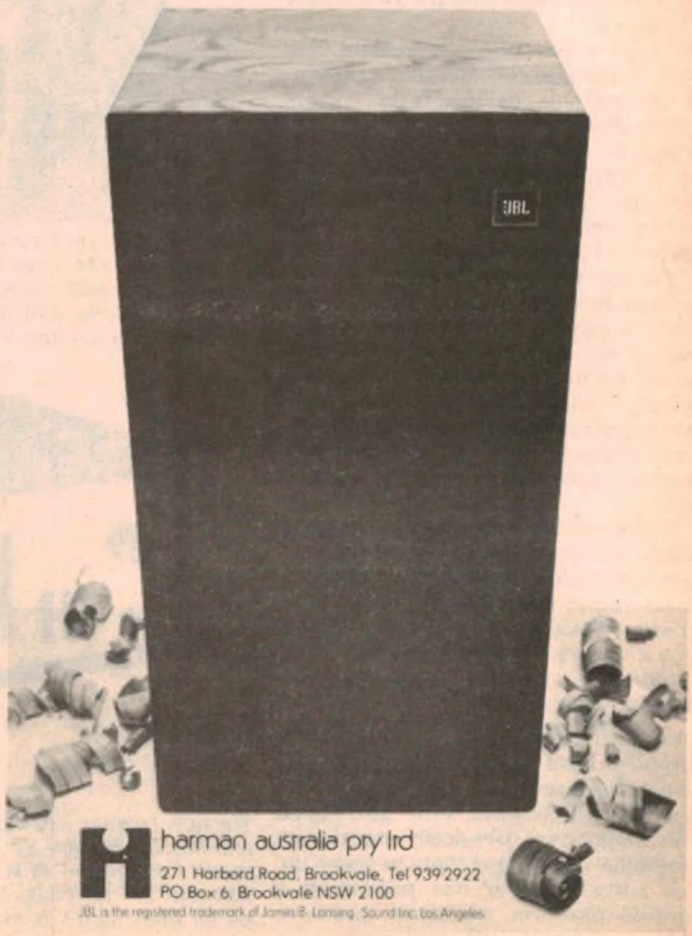


Near enough is just not good enough.

Until we developed them just recently, most JBL's were out of the normal person's reach. Now you can own a pair of JBL's for around $500.

They're still more expensive than ordinary speakers, but then they're JBL's aren't they.



thing to worry about.

Amplifier drive power may be available but it still has to be paid for in terms of more expensive and more bulky equipment, and greater power consumption from the mains.

Bearing some resemblance to the now-waning automotive power race, super-power amplifiers have become quite a feature of overseas hifi shows. Seemingly no matter how insensitive the speakers, nor how loud the sound required in the listening room, there is going to be an amplifier to drive the darned things!

Take the Luxman M6000, for example. A power amplifier module, intended to be used with separate preamplifier/control unit, it can deliver something like 300 watts of continuous power into 8-ohm loads, within the frequency range 20Hz to 20kHz. If you're worried about distortion, forget it. Harmonic and intermodulation distortion are both down around the .05% mark and the signal/noise ratio about 100dB referred to the 300W level.

There are 12 transistors in each of the stereo output stages: 6 pairs arranged in complementary symmetry, with each output transistor separately fused and protected. When they are all sitting there quietly doing nothing, they pull about 150VA from the mains. Drive them to full output and the consumption shoots up to 1.3kVA!

The manufacturers are obviously convinced that enough people will want an M6000 to justify the design effort. But, if you have such an ambition, don't expect to pick one up and carry it away under your arm. The M6000 weighs 115lb (52kg) and is fitted with castors so that it can be moved into its allocated spot on the floor!

Another new product from International Dynamics (Agencies) Pty Ltd—a magnetic phono cartridge manufactured in Japan by the Supex Corporation.

A NEW RANGE OF GOLDRING STYLI

Under a financial cloud for much of 1975, Goldring is poised to make a strong comeback during the current year, concentrating primarily on the lines for which they were originally best known—replacement styli and other hifi accessories. The following circular defines the company's new thrust:

Twenty-year old Australia-wide audio accessories supplier, Goldring, has launched it's new range of turnover styli, magnetic styli and audio accessories. A national promotional campaign over the next twelve months will be aimed at impressing consumers with the importance of protecting their valuable record collections by replacing worn out styli.

Market research has shown that the majority of stereo owners are not aware of the irrepairable damage caused to records by worn needles, and that more than 60 percent of people who have bought stereo record players in the last two years cannot remember replacing the stylus.

There are two types of turnover styli—sapphire and diamond—the main difference being that sapphire needles will last 50 to 80 hours of playing time, while a diamond will last up to 500 hours. Each model is available in stereo, mono or 78rpm versions.

On an average playing time of five to ten hours a week, a sapphire should be replaced every two months and a diamond every five to six months. The extra cost of the diamond stylus offers better value for money with the added advantage of not having to be changed so frequently.

Goldring has over 450 different types of replacement turnover styli available, all of which are Swiss made using jewel chips, not paste compounds.

Currently the demand for styli is moving away from the turnover type used in ceramic and crystal cartridges towards the magnetic type featured in the increasingly popular hi-fi equipment being imported from overseas.

Due to the high technical specifications hi-fi now demands, the stylus has become the focal point of reproduction quality.

Goldring magnetic styli are available in three categories: (1) The conical tip stylus is used for normal hi-fi reproduction. (2) The eliptical tip styli is designed for higher frequency, more accurate reproduction and better trackability. (3) The shibata or parabolic tip specifically engineered for CD4 (or quadraphonic discrete) reproduction and allowing a very high frequency response in excess of 50kHz.

Goldring has just added over 40 new types of magnetic replacement styli to its existing magnetic range in order to meet the requirements of the newer, more sophisticated sound equipment coming onto the market.

Each Goldring stylus packet will contain complete instructions for removal and replacement as well as a peel-off sticker which may be attached to the equipment to remind customers of their stylus replacement number.

A wide range of record and tape accessories are also sold by Goldring, including record cloths, anti-static fluid and needle cleaners.

For further information please contact: Mr. Mike Dean (02) 669-6088 or at 26-28 Ricketty St, Mascot NSW 2020.

BETTER TV SOUND

In general, television viewers have been notably uncritical of the sound which has issued from their TV sets. The picture was the thing. As long as the sound was clear and reasonably free from extraneous hum and noise, that was all they expected—and all they got!

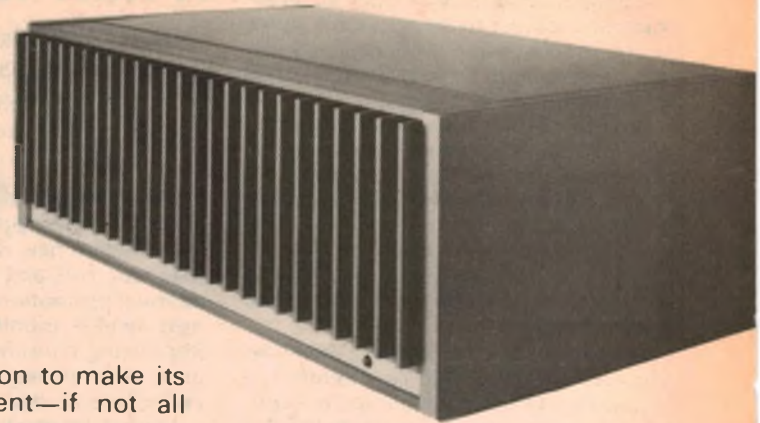
Those persevering souls who were sufficiently motivated to connect the TV set to a hifi system sometimes got better sound. But sometimes they also got better TV frame buzz!

Now, at long last, it seems that pressure may be building up in the U.K. and Germany for sound quality more in keeping with the excellence of PAL colour pictures. There is talk of fitting TV receivers with larger loudspeakers and with separate bass and treble controls.

And what of the frame buzz which better bass response might show up? The answer is more attention to IF channel design and, if need be, the provision of a completely separate sound IF channel, presumably not using the intercarrier facility.

A new approach to high power output stage design—

THE QUAD CURRENT DUMPING POWER AMPLIFIER



The QUAD 405 current dumping power amplifier measures 115 x 340 x 195 mm and weighs 9 kg—not by any means massive when it is considered that it offers 100W continuous per channel.

A new high-powered, high fidelity QUAD amplifier, soon to make its appearance on the Australian market, breaks different—if not all new—ground in its design approach. Using a "current dumping" output stage, it seeks to offer the economies of class-B operation, without its troublesome disadvantages.

by NEVILLE WILLIAMS

To date, the vast majority of solid-state power amplifiers have made use of a class-B* output stage, with the output transistors drawing a relatively small quiescent current. The approach minimises demands on the power supply, minimises temperature rise and therefore heatsink demands for the output stage and, generally, offers more output power on program material for a given expenditure than other approaches.

At the same time, class-B operation has its own problems, arising mainly from the fact that the task of delivering output power has to "transfer" from one output transistor to the other for each successive half-cycle of signal. The output transistors have to be matched and critically biased to ensure a reasonably smooth transition from one to the other.

If the transistors are operated too close to cut-off, in the interests of low power consumption and cooler operation, there will be a marked discontinuity in the transfer characteristic—leading to what is commonly referred to as "crossover" distortion. It is a particularly serious problem because, with the output transistors passing simultaneously through the near-cutoff, low transconductance zone, feedback loop gain is at its lowest and therefore least able to deal with a quite high level of intrinsic distortion.

Conversely, if the output stage is biased to too high a quiescent current, the feedback has to cope with a transconductance overlap condition, while the output transistors may also nudge up towards the thermal runaway condition.

*We use the term class-B in its usual audio sense to indicate that the output devices operate from a bias point close to cut-off but giving sufficient quiescent current to ensure continuity of output in the crossover region.

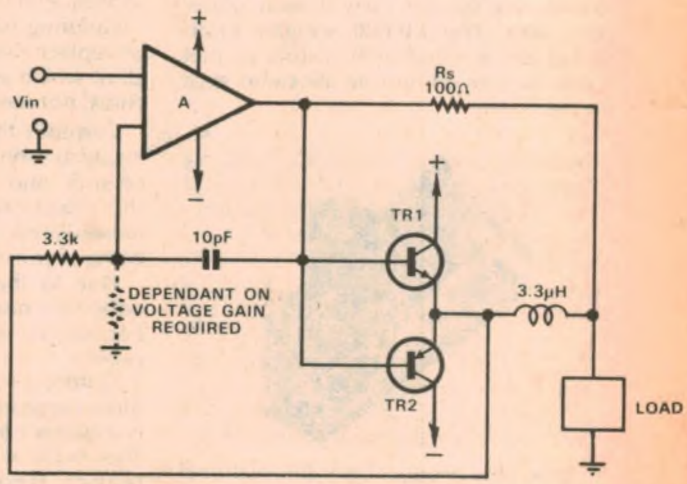
Designers obviously try to achieve the median position but, in practical amplifiers, there is no ideal setting where the transfer characteristic is completely free from non linearity.

Given matched transistors, carefully adjusted bias and effective overall negative feedback, amplifiers using class-B output stages can achieve a very commendable performance level but designers find the foregoing problems irksome, particularly in the high performance, high power area. More than that, discerning enthusiast/customers have distinct reservations about the class-B mode, and a recollection of the valve area when class-B was scorned for high quality applications.

One minority reaction to this situation has been for some designers to produce amplifiers using bipolar transistors operating under class-A conditions. Because they draw full current, irrespective of signal level, these necessitate large power supplies, large output transistors, large heatsinks and elaborate electronic and thermal feedback to prevent thermal runaway. Not surprisingly, the appeal of such high power class-A solid-state amplifiers is limited largely to the well-heeled purist market. And in the market, curiously enough, such amplifiers are in competition with valve amplifiers designed along traditional high fidelity lines!

A new and promising way around these problems emerged with the development of power FET (power field effect transistors) as featured in our April issue, and identified mainly with Yamaha and Sony. Because power FETs tend to reduce their current with rising temperature, they can be used in class-A or class-AB conditions, without elaborate precautions against thermal runaway. In fact, they tend to find their own thermal equilibrium and hold promise of designs which combine the merits of class-A with the convenience of solid-state devices.

However, while Yamaha, Sony and others have launched amplifiers using power FETs, their broad attraction in terms of cost and availability has yet to be demonstrated. Certainly, engineers at the Acoustical Manufacturing Co Ltd, makers of QUAD brand amplifiers, have



The basic configuration of the current dumping amplifier. A low power, high quality amplifier "A" feeds power to the load through a series resistor, taking care of the crossover region. Virtually all of the load current outside this region flows via TR1 and TR2. QUAD engineers claim that, by regarding the feedback circuitry as a bridge and by critically proportioning values on this basis, distortion characteristics become substantially independent of TR1 and TR2.

sought out an alternative answer. Their "current dumping" circuit behaves like a class-B system, in terms of efficiency and economy, while being something else again!

The concept was described by P. J. Walker and M. P. Albinson in a paper presented before the 50th Convention of the Audio Engineering Society and, in that form, made very heavy reading. If we manage merely to communicate the concept here, we will have achieved what we set out to do!

BASIC IDEA

In the accompanying diagram "A" represents a low power amplifier (e.g., 1 to 2 watt variety) typically using a class-A output stage and designed to have the lowest possible intrinsic distortion.

A further design requirement is that the amplifier be capable of delivering an output voltage of such an order that, if applied across the ultimate load, the desired power output would be achieved. To pluck a couple of figures out of the air, the designer's objective might be 100W RMS across 4 ohms. In this case, amplifier A must be capable of producing an output voltage somewhat in excess of 20V RMS or about 60V P-P.

Fairly obviously, the amplifier cannot be coupled directly to the load, because it could not produce anything like the current or power which would be assumed by applying 20V RMS to the load. It therefore feeds the load through a series resistor, at least large enough to allow the amplifier to develop the designated voltage.

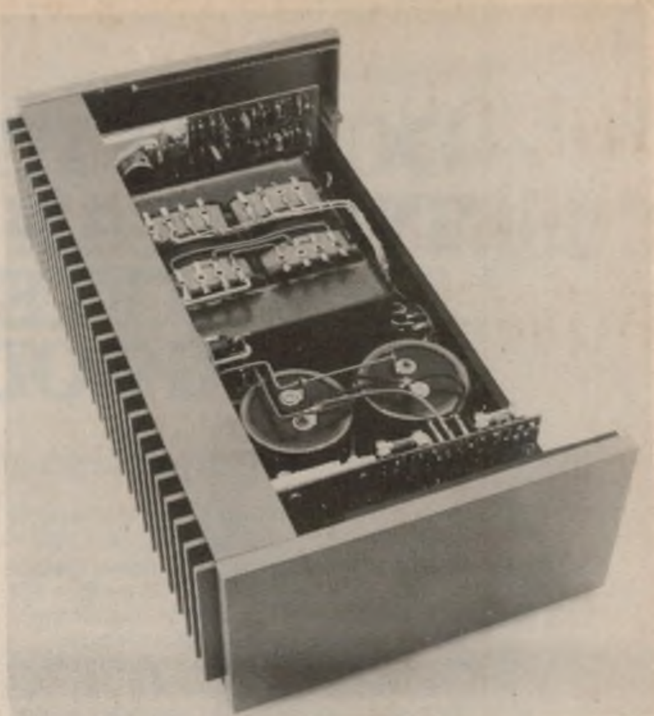
Because of the presence of the series resistor, amplifier A by itself can only deliver a small amount of power into the load. Again, to pluck figures out of the air, if Rs is 100 ohms, amplifier A might be able to deliver about 0.8V RMS to the load, representing a power level of just over 100mW. Negative feedback derived across the load ensures that it is a very clean 100mW and that it appears to come from a low impedance source, despite the series resistor.

To this point, it might seem like a particularly futile exercise but, of course, there is more to come.

Output from amplifier A is taken to the bases of two high power transistors, each operating as an emitter follower, and with collectors fed from a split power supply. The transistors have no static forward bias, and therefore draw no current and generate no heat under quiescent conditions.

However, as soon as the amplifier A generates an output signal larger than about 0.7V plus and minus, the respective emitter followers begin to conduct. Being emitter followers, and on the assumption that they are high-power devices working from an adequate supply, they produce at their emitters (and therefore across the load) a voltage which is only slightly less than that applied to the respective bases.

200W OF AUDIO



Inside the QUAD 405 power amplifier with the top cover removed. It is intended to mate with other existing units in the QUAD range, but providing as much power as most people would ever be likely to need, even with insensitive loudspeaker systems. QUAD claim that if the amplifier is used under optimum conditions the distortion level on program will not exceed 0.01%.

In short, as amplifier A applies a large voltage swing to the bases, the emitter followers transfer that voltage swing to the load, drawing the related current from the major power supply source. Walker and Albinson describe the action as "current dumping".

Fairly obviously, at milliwatt levels and in the transfer region of larger signals, all the power into the load must come from the drive amplifier A via Rs. At high levels, virtually all the power will come from the emitter followers, so that the current dumping stage involves its own transfer mechanism. However, it operates in a way that secures two important advantages.

The first is to obviate problems of matching and critical biasing. Because the "current dumpers" operate as emitter followers, batch differences in their characteristics will be largely swamped. Similarly, there is no question of having to bias them to a critical low current figure related both to transconductance and to thermal considerations; they simply operate from cut-off!

But despite this—and here the second point emerges—the feedback loop from amplifier A, through Rs, across the load and back to input, is always valid. When the current dumpers add their contribution, the feedback carries right on through the cycle, in the interests of overall linearity. In fact, the Authors point out that the circuit applies the "feed forward error" concept: distortion components from the current dumpers are fed back to the drive amplifier, which then feeds an exact out-of-phase component to the load via its own direct path, Rs.

In short, the new amplifier design offers the theoretical economy, and simplicity of a class-B amplifier working from actual cut-off, while eliminating the hazard of excessive crossover distortion during the transition period when the negative feedback normally drops out.

In their paper, Walker and Albinson detail a number of special design considerations as, for example, the rise time and frequency response of the basic amplifier and the current dumping circuits. Thus amplifier A must not present to the current dumpers any transient which they cannot follow, otherwise the transient will be clipped or distorted or may set up a condition which may have an audible effect upon adjacent signals.

ARGUMENTS?

The authors also attach strong significance to the configuration of the feedback circuitry around the driver and current dumping stages. By analysing it mathematically as a bridge, they come up with the surprising answer that the distortion can be independent of the characteristics of the current dumpers, being essentially that of the high quality class-A driver amplifier.

The maths seem to work out as an exercise, although it is surprising to find that one of the arms of the bridge, in the basic diagram at least, is a 10pF capacitor —a most unlikely value, having a reactance of 300 megohms at 50Hz! How it all relates to the final circuit of the complete amplifier will doubtless be thrashed out in the course of time.

However, possible arguments aside, QUAD have a rather powerful one themselves in the form of an amplifier which can deliver 100 watts per channel over the full frequency range at a "maximum power" distortion level of 0.1%.

This, then, is the background to QUAD's new high power amplifier, due for local release in the new year through British Merchandising Pty Ltd (49 York Street, Sydney).

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.

SONY®

Research makes the difference

GAC S.7533

Peerless 20-3 Loudspeaker System

Compared with the diverse range of loudspeaker systems sold on the Australian market, there is a relative dearth of loudspeaker systems which can be assembled by the do-it-yourself hifi enthusiast. One of those few systems is the Peerless 20-3 which is a three-way system for use in a sealed cabinet.

As may be inferred from the system designation, the volume of the cabinet is 20 litres. Cabinet dimensions of the sample systems submitted for review were 250 x 502 x 250mm (W x H x D). Loudspeaker types used in the system are the L 825WG woofer, G 50MRC midrange and MT 225HC tweeter. Crossover frequencies are 6kHz and 1.5kHz.

Frequency response is quoted from 40Hz to 20kHz, albeit with no limits, and power handling is quoted at 50 watts. An additional rating which Peerless call the "working power" is quoted at 6 watts.

Both the tweeter and midrange units are close backed cone loudspeakers with generous Alnico magnets. The woofer appeared to have a relatively light magnet structure but we cannot state whether it was alnico or ceramic because it was encased in a metal cover which appeared to be secured with an epoxy adhesive.

The tweeter is one of the smallest we have seen, with an effective cone diameter of only 40mm. The midrange unit is of more conventional size with an effective cone diameter of 90mm. It has a viscous treated cone surround to damp resonances.

The woofer has a large syntheitc rubber roll surround and a very large spider assembly which would enable long voice coil excursions. An unusual though neat feature is that the woofer is not mounted by means of screws or bolts through its flange rim, but by simple clamps as can be seen in the photograph. This means there is less likelihood of cabinet leaks via the mounting holes or the inevitable breaks in the mounting gasket, if used.

The crossover network is assembled on a PC board which accommodates two air-cored inductors and four non-polarised electrolytic capacitors.

The cabinet was well-filled with what we gather is an Orlon flock material. It appears to have the right effect because the main system resonance at around 60Hz is reasonably well damped.

Nominal impedance of the complete system is 8 ohms. We checked this over the whole audio range to see that there were no undue dips or peaks, and we found that the minimum value was 6.7 ohms. This should cause no problems with any amplifier it is likely to be used with.

Sine wave testing revealed no major faults in the steady state response. There are peaks in the treble response at around 4kHz and 8kHz and these are due to the midrange and tweeter respectively. On music signals these peaks are not over obtrusive.

The bass response is well maintained down to about 100Hz, below which it tapers to 70Hz and then rises again to a fairly solid peak at the system resonance of 50Hz. Driving the system hard reveals little sign of doubling.

On music signals, the Peerless 20-3 gives a good account of itself. Overall sound quality is well balanced and transient response is good, although with some traces of hangover. There is little need to apply bass boost. In fact, with some records bass cut would produce a more natural effect.

Overall efficiency is certainly less than many comparable bass reflex systems and we would suggest that the minimum amplifier power would be about 15 watts per channel. The system can comfortably handle the output of amplifiers up to 50 watts per channel provided the bass boost control is used with respect.

Summing up, the Peerless 20-3 is a pleasant sounding system well worth consideration by the do-it-yourself enthusiast—especially if they are partial to a prominent bass response.

The Peerless 20-3 system is available in kit form which comprises loudspeakers, crossover network and connecting cables but not timber for $124 per pair. Hifi dealers presently handling Peerless loudspeaker kits are: Brisbane Agencies Audio Centre, 72 Wickham St, Fortitude Valley, Queensland; Convoy International Pty Ltd, 4 Dowling St, Woolloomooloo, NSW and Danish Hi-Fi Pty Ltd, of 698 Burke Rd, Camberwell, shop 9, Southern Cross Hotel, Melbourne and 308 Walcott St, Mt Lawley, WA.

Interested readers can contact the above mentioned hifi dealers while trade enquiries should be directed to the Australian distributors for Peerless loudspeakers, G.R.D. Group Pty Ltd, 698 Burke Rd, Camberwell, Victoria 3124. (L.D.S.)

Audiosound Motet 750 stereo system

While most hifi components of different brands are compatible with each other there are a number of advantages in having all the components of the one brand particularly when sold as a package deal. Here we review one such package, the Audiosound Motet 750.

One advantage of having all the components in a hifi system made by the same manufacturer is that there is a reasonable chance that they will be well-matched to each other. And if the system is a package-deal from the manufacturer the price is likely to be a considerable saving compared with the total if the components were purchased separately. With this thinking in mind, Audiosound have four complete systems and that reviewed here is the lowest in price.

Basis of the system is the new Audiosound A750D stereo amplifier which is a domestic version of an amplifier developed for monitoring use by the Australian Broadcasting Commission. Power rating is 20 watts RMS per channel into 4 or 8 ohm loads.

The turntable is an automatic single-play unit made by BSR and modified by Audiosound. It has an aluminium platter and idler drive. The tone arm is balanced by an adjustable counterweight and tracking and antiskating forces are applied by spring-loaded dials. A damped cueing device is fitted for manual operation. If manual set-down is employed the arm returns to stop at the end of play and the turntable stops, as it does in the automatic mode.

An ADC K5E magnetic cartridge is fitted to the turntable. The cartridge is an induced magnet type with a user-changeable elliptical stylus. Tracking force range is 1½ to 2½ grams and the force recommended by Audiosound is between 2 and 2½ grams.

Two Motet 2 loudspeaker systems are included. These are compact systems measuring 220 x 370 x 200mm (W x D x H) with a 25mm dome tweeter and 70mm cone woofer and a complex cross-over network. These were reviewed in more detail in the June 1975 issue of "Electronics Australia".

Rather than extensively test each component of the system which would take a great deal of time and a lot of space, we decided to put the amplifier through a few tests and then listen to the whole system.

The A750D stereo amplifier is a relatively compact unit measuring 350 x 105 x 266mm (W x D x H). Comprehensive control facilities are provided. To list a few: push-button selection of either of two pairs of loudspeakers; ambience control for a pair of rear loudspeakers in a "simulated quadraphonic" system; tape-monitor switch. Other features include a switched three-pin mains outlet on the rear panel; DIN loudspeaker sockets; short-circuit protection and loudspeaker protection in case of transistor damage.

All the amplifier circuitry is assembled on one large PC board. This includes the four output transistors which are 60W plastic encapsulated Darlington types. Each Darlington has a large aluminium extruded heatsink which is also mounted on the board. The case is ventilated at top and bottom to allow heat convection.

We have only one major complaint regarding the presentation of the amplifier and this concerns the various knobs and their layout on the front panel. The differing knobs, pushbuttons, type fonts and lack of alignment of the controls all add up to a rather disorganised layout which prompted one staff member to say that it looked like a "mad-woman's breakfast". While we agree that styling is largely a matter of personal preference it does seem as though this particular amplifier could be made more attractive with a better arrangement of knobs and control labelling.

We were able to confirm all the amplifier's specifications without any trouble and are able to state that the performance is satisfactory except for two points. The first concerns the residual noise output when used in the phono mode. Audiosound quote the signal-to-

Below is the complete Audiosound Motet 750 stereo system which includes the turntable, timber plinth and tinted perspex cover all for less than $400.

noise ratio as 62dB with respect to 20 watts and a 10mV input at 1kHz. We were able to achieve a little better than this but are of the opinion that it is still only a fair result for a modern amplifier. A reasonable improvement could be gained by reducing the hum.

Under normal listening conditions the amplifier is satisfactorily quiet.

The other reservation concerns the overload protection system which protects the output transistors against short circuits and excessively low load impedances. The system employs two transistors to monitor the output stage current and if this becomes excessive the input signal to the Darlington output transistors is removed. Now this is a commendable feature in an amplifier of this price range.

The problem concerns the way in which the protection circuit operates when the amplifier is driving a reactive load, such as any loudspeaker. With a resistive load the protection transistors merely remove enough of the base drive to the output transistors to prevent excessive output current. But with a reactive load the protection transistors switch on and off very rapidly so that the output signal is chopped. In fact, depending on the load and signal frequency, the resultant output waveform has high frequency "bursts" superimposed upon it. This in itself is not a problem in the high power amplifiers where it is commonly used because there is generally a large margin between normal use and overload. However, with the Audiosound A750D amplifier the overload protection comes into effect shortly after the onset of clipping of the output signal.

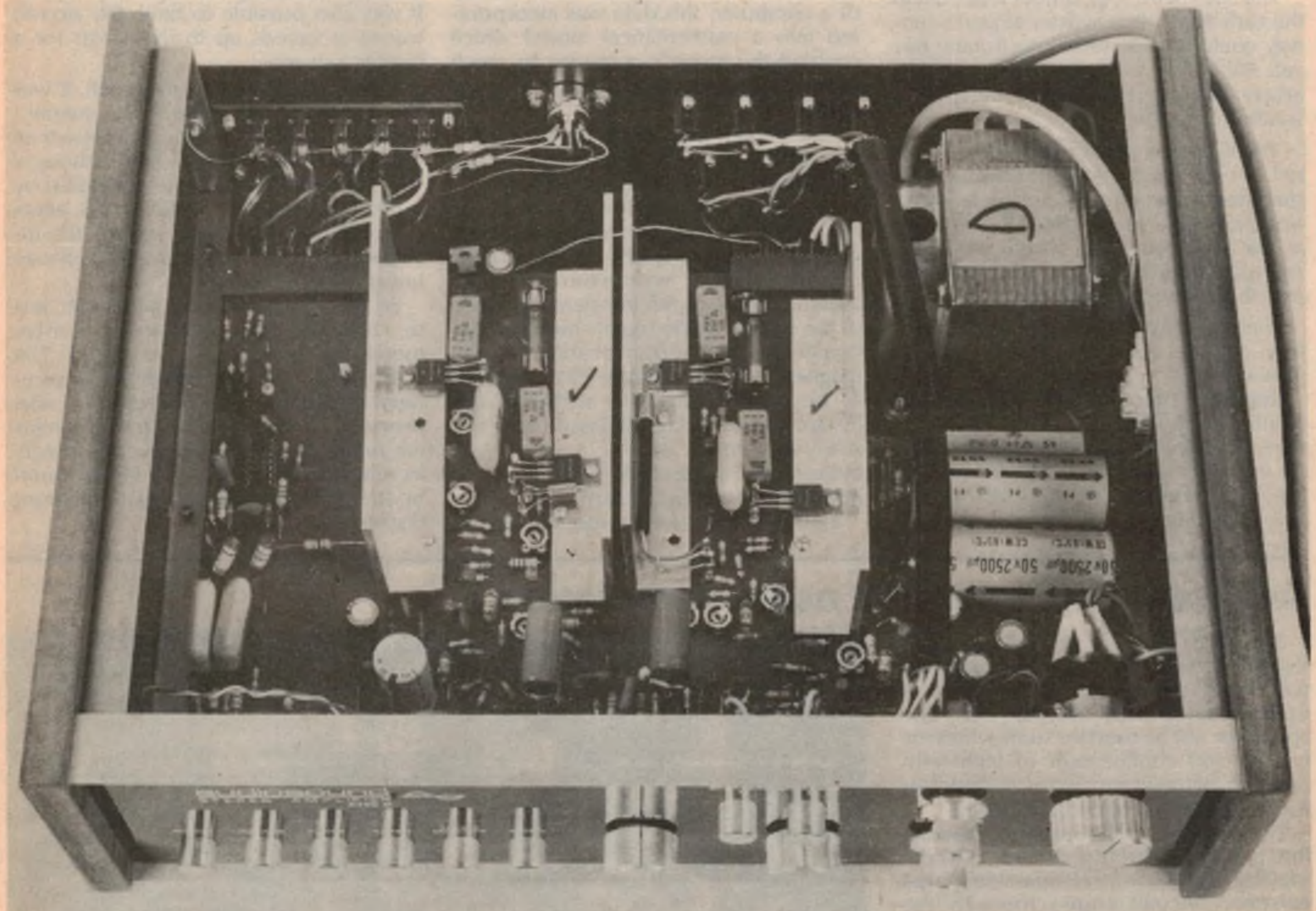
When driving loudspeakers of modest efficiency such as the Motets it is relatively easy for the amplifier to be driven to clipping when listening at a loud level and with bass boost. Provided an amplifier is not grossly overdriven the resulting distortion is not obtrusive but with the Audiosound A750D the overload protection circuit really lets you know that clipping has occurred as it delivers an ear-piercing screech from the loudspeakers. As well as jarring the equanimity of the listener, the spurious signal would not be healthy for tweeters, especially if the overload condition is protracted.

In essence, the overload protection is too sensitive. It should be possible to reduce the sensitivity while still providing adequate protection. The manufacturer has indicated that he will examine these criticisms with a view to modification.

When the A750D is teamed with the other components in the system it matches very well. Overall sound quality is clean and there is adequate power for all normal listening requirements. However we did feel that a worthwhile improvement could be gained by substituting a better magnetic cartridge. The ADC K5E seems to lack brightness and clarity by comparison with a few other popular cartridges we teamed with the system.

To sum up, the Audiosound Motet 750 stereo system should be considered as a complete package deal. There is nothing extra to buy. The turntable plinth and perspex cover plus all the connecting cables are included in the basic price which is just $398 including sales tax. If purchased separately, these components would cost considerably more. For example, the Audiosound A750D is priced at $220 including sales tax.

Further information and a demonstration can be obtained at the showroom of Audiosound Electronic Services, 148 Pitt Road, Curl Curl, NSW 2096 (L.D.S.)



All of the circuitry is on the one large PC board which is designed for easy service. Output transistors are plastic Darlingtons.

News Highlights

Sydney's airport tunnel OK for heavy planes

The proposed introduction of wide-bodied jets posed a considerable problem for the Department of Transport: could the roadway tunnel under Sydney airport withstand the extra heavy loading?

The 380-metre long tunnel was built in the early 60s so that Sydney airport's runway could be extended into Botany Bay yet still retain a major six-lane traffic artery linking the city's eastern and southern suburbs.

The box-type construction of the tunnel is very sturdy indeed, having been designed to accommodate the loadings imposed by the largest aircraft envisaged at that time. However, recent proposals for wide-bodied aircraft have outstripped those original estimates.

There was only one way to find out how strong the tunnel really was—measure it.

Research officers from the Department of Housing and Construction and the CSIRO Division of Building Research set out to measure the deflections of the tunnel in response to the loading of a fully fuelled Qantas 747, the only feasible method of obtaining realistic loadings, both statically and dynamically.

In the static test, the 747 aircraft was precisely positioned at various locations above the tunnel while the response from a number of deflection and strain transducers was measured. With the aid of a computer, this data was incorporated into a mathematical model which enabled the tunnel's response to much larger loadings to be predicted confidently.

The tunnel was found to be clearly capable of withstanding larger static loads. But what of the dynamic forces?

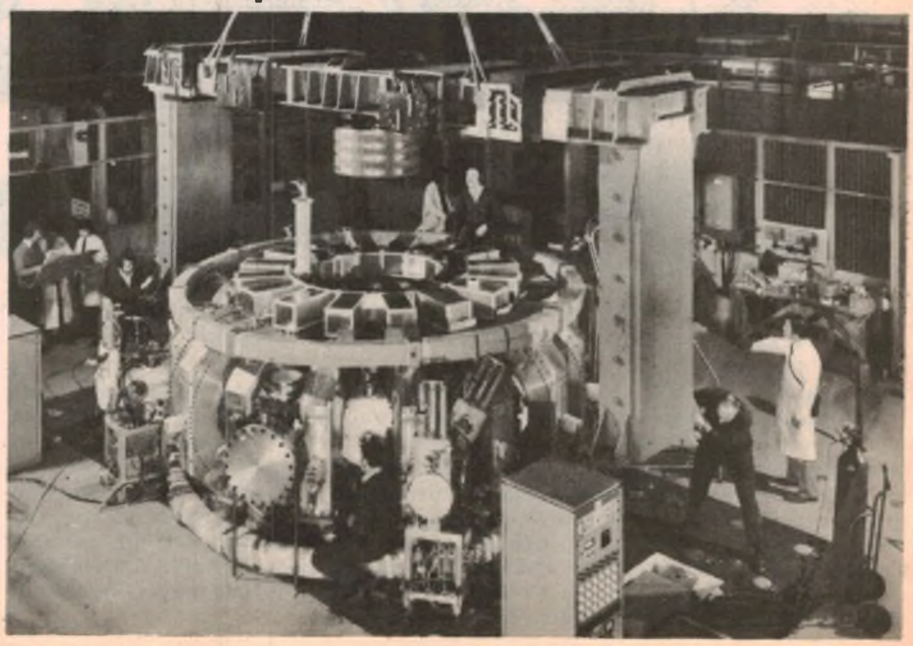
To answer this, the forces exerted by a moving aircraft, measured by strain gauges on the aircraft's undercarriage, needed to be synchronized with measurements of the transient response of the tunnel. Radio signals between the tunnel and the aircraft enabled all the magnetic tape and paper chart records to be co-ordinated. In addition, the instant when the aircraft passed over the precise centre of the tunnel was indicated on the records by the aircraft's interception of a light beam.

Eight powered runs, at speeds from 20 to 120 knots, were carried out over the tunnel—the maximum possible because of the cooling requirements of the plane's brakes—in the two hours that the tunnel and runway could be made available because of air and road traffic restrictions, including the 11pm jet curfew. It was also possible to have the aircraft towed at speeds up to five knots for a further four runs.

In a somewhat surprising result, it was found that, at all speeds, the tunnel's response to a moving plane was less than that to a stationary one. This is thought to be because the impacts generated by a moving plane are offset by its aerodynamic uplift at speed and by the increased effective stiffness of the tarmac under transient load.

So the way is clear for still larger jets to cross the tunnel before expensive modifications need be considered. The tunnel tests, through detailed measurement of actual runway forces, have also provided comprehensive information for the future design of runway pavements as well as data by which the tunnel could be strengthened if necessary in the more distant future.

Advanced UK tokamak nears completion



Shown in the accompanying photograph is the DITE tokamak apparatus, now in the final stages of construction at Culham laboratory in the UK. The apparatus will be used for studies into the heating and confinement of high temperature plasmas as part of the nuclear fusion research program at Culham.

Two methods will be used for heating the plasma confined in the toroidal vacuum chamber—first by passing a large current (200,000 amps) through the plasma, and secondly by the injection of energetic neutral atoms.

The current, induced in the plasma by transformer action, will also be used to provide one of the confining magnetic fields. The second field will be provided by a set of liquid nitrogen-cooled coils encircling the torus.

In addition to the plasma heating and confinement studies, the apparatus will also be used to study the extraction of impurity atoms from the plasma by means of a magnetic diverter.

British Post Office unveils Viewdata

A radically new telephone service, in which a wide range of information can be called up over the telephone and displayed quickly on an ordinary television set, is being planned by the British Post Office.

Known as Viewdata, the service would be completely automatic, providing information at the touch of a button. It could be available in three or four years' time if trials, due to start next year, are successful.

With Viewdata, information on a wide range of subjects—for example, news, entertainment, holidays and job advertisements would be stored in a computer databank connected to the public telephone network. By having their telephone linked to their TV sets—suitably modified—users would have access to this information.

To get Viewdata information, users would first switch on the TV set and then call up the service over the phone by pressing a button on a hand-held control unit. They would not even have to lift the telephone receiver. Then, at another touch of the button the Viewdata opening display—an index listing the subjects on which information is available—would appear on the TV screen. Users would select the information they wanted by pressing further buttons.

Doing business with China—a guide

A new 276-page report on the rapidly expanding electronics industry and market in the People's Republic of China has been announced by Fred Glynn/ Marketing Research, USA.

Entitled "China's Electronics Industry and Market," the new report brings together virtually every major reference that would be of use to the electronics marketer doing business (or considering doing business) with the People's Republic of China. The report contains a forecast of the market potential for 116 types of electronic components and 129 types of equipment.

Business practices, trading organizations, legal considerations and other information on doing business with China are covered in detail. Also included is a section covering China's capability in virtually every phase of production of electronic products—telecommunications, computers, consumer electronics, radio and TV broadcasting systems, military electronics, microwave equipment, test and measuring equipment, semiconductors, tubes, etc.

Priced at $US75 per copy, the report is available from Fred Glynn/Marketing Research, 2200 Sacramento Street, Suite 1206, San Francisco, California 94115, USA.

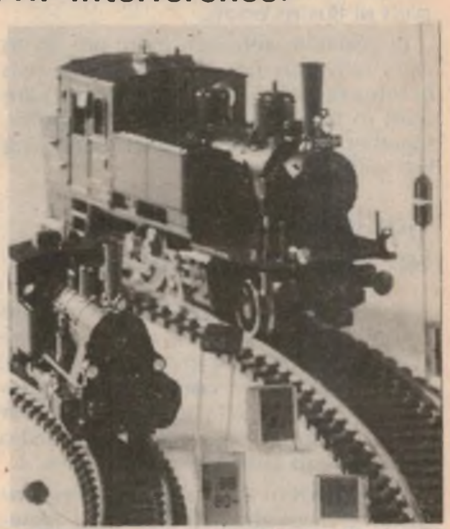
Experimental wind turbine delivers 100kW

NASA and the US Energy Research and Development Administration (ERDA) have officially opened a 100kW experimental wind turbine at a site in Sandusky, Ohio. The new generator was designed and built for ERDA by NASA.

The wind turbine will be used primarily for experimental purposes, the main objective being to determine the economic characteristics of wind energy systems for the future generation of commercial electric power. Performance data obtained from the prototype will be used to develop larger, more advanced systems.

The Sandusky wind generator is the largest of its type now in operation, and the second largest ever built. Its construction marks a renewal of interest in wind energy conversion in the US, an interest that has lain dormant since the construction and intermittent operation of a 1,250kW machine between 1941 and 1945 at a site near Rutland, Vermont.

Full speed ahead—without RF interference!



Christmas has come and gone and there are no doubt numerous toy engines using HO and N gauges now running at full speed. Although they are driven by low voltages, the RF interference caused by the motor and the current collector may reach significant values.

TV and radio reception can be kept free of interference by fitting RFI suppression components to the engine and to the stationary transformer. These components include a range of ceramic capacitors and VHF chokes, such as made by Siemens Industries Ltd, 544 Church St, Richmond, Vic 3121.

Readers are referred to our article entitled "Suppressing RF Interference from Model Railways", which appeared in the June 1975 issue of "Electronics Australia".

Electrical power transmitted via microwaves

Engineers at NASA's Jet Propulsion Laboratory at Goldstone in the California desert are making by far the most powerful wireless transmissions of electric power ever undertaken.

Broadcasting a 2.388GHz microwave beam, the engineers have succeeded in tapping more than 30kW of direct current power from a receiver array of 17 flat panels mounted on a hilltop tower a mile away. At this distance the cone of the beam is about 85ft across and all but 12 percent of the beam power "blows by the side", according to JPL engineer R. M. Dickinson.

The transmitting apparatus consists of a 450kW klystron feeding an 85ft bowl-shaped antenna called Venus. Maximum power transmission from the little publicised experiments was achieved on June 5 last, and other tests have been successfully conducted since then.

Already, the results have given an air of practicality to an almost science fiction concept now being studied with increasing seriousness by some energy experts. This concept involves the placement of a giant solar energy collector in space. The collector would consist of an array of either mirrors or solar cells, and would be stationed above the equator.

From this vantage point, the solar station would beam down power to vast receiver arrays on the ground. However, even proponents of the scheme put it some decades into the future. Not only has the necessary transportation system yet to be developed, but many years of research are required to determine the potential biological hazards.

Infra-red fingerprint foils credit card cheats

There are now more than 500 million credit cards in use in the United States, and loss from fraud is said to exceed $300 million a year. In view of this the implementation of electronic fund transfer systems (EFTS) has become a major concern of both card and EFTS terminal makers. Addressograph Corporation believes it has come up with a virtually foolproof security system.

The Cleveland-based company's anti-fraud system uses randomly spaced and sized reflectors embedded beneath a magnetic stripe. When interrogated by an infra-red sensor, these reflectors and their position relative to the magnetically encoded data create a "fingerprint" that is unique to each individual card. This "fingerprint" is known only to the card issuer's central computer.

The infra-red sensing head is capable of detecting the reflector positions between flux reversals to an accuracy of 0.001 inch. In practice this means that even if someone could identify the positions of the reflectors it would be extremely difficult to correctly align several reflector positions to discrete pairs of flux reversals.

In addition, although there are six to eight reflectors on each card, only two or three randomly selected reflectors are used to transmit data to the computer, together with a key character identifying the reflectors selected.

Radio trades course for country apprentices

The Newcastle Technical College has advised that their block release course for the radio trades is to continue in 1976. The course, which commenced operation in 1975, is primarily intended for country apprentices and trainees who are unable to attend formal lectures.

The format of the course is three consecutive days attendance at the Newcastle Technical College every third week for a total of twelve visits per year. This pattern is repeated for stages 1, 2 and 3 over a three year period. Newcastle students may also attend should this format be preferred.

Total cost of the course is $2.00 Student Union fee plus approximately $20 per year for text books. There are no college fees. For bona fide apprentices and trainees, a return rail warrant for each visit and an allowance of $3.50 per day is provided through the Department of Labour and Industry.

Intending students should advise the College of their desired enrolment no later than 6th February, 1976. All enquiries and enrolment applications should be addressed to Mr J. Horsnell, School of Applied Electricity, Electronics Division, Newcastle Technical College, Maitland Rd., Tighes Hill, NSW 2297.

New antenna will improve weather forecasts

Scheduled to go into service in mid-1977, this new 15-metre antenna will help improve the accuracy of weather forecasts for the European region. The new antenna will partner the European Space Agency's weather satellite "Meteosat" which, when placed in geostationary orbit 36,000km over the equator, will take photographs of the area bounded by Northern Europe, the Atlantic and the Indian Ocean every 30 minutes.

Photographs taken by the satellite will be transmitted to the main ground station at Michelstadt, 50km south of Frankfurt in West Germany. A computer linked to the ground station will then compare successive photographs to ascertain such factors as wind direction and velocity, which are important for large-area weather forecasting.

Main contractor for the ground station is Siemens AG which is currently erecting the antenna, shown here with the reflector being mounted into position. Siemens is also developing the on-board communications for the satellite.

First Intelsat IV-A satellite now in orbit

The first in the series of Intelsat IV-A commercial communication satellites that will improve worldwide telecommunications has been successfully launched from Cape Canaveral.

The satellite will be used to meet the demand of telephone, data and television transmissions to and from the United States, Europe and West Africa. It has been placed over the Atlantic into synchronous earth orbit 22,300 miles above the Equator.

British Aircraft Corporation Electronic & Space Systems Group at Bristol, under contract to Hughes Aircraft Company of the United States, manufactured major sections of the Intelsat IV-A, including the spun structure, booster adapter, despun components, cable harness and solar arrays. Work is well advanced in the manufacture of identical subsystems for the remaining five Intelsat IV-A satellites.

Intelsat IV-A is larger and more powerful and has about two thirds more communications capacity than its predecessor Intelsat IV—seven of which are in worldwide service. The new satellite will have an average assigned use of 6,000 circuits or 20 colour television channels, or various combinations of telecommunication including telex, facsimile, telegraph and data.

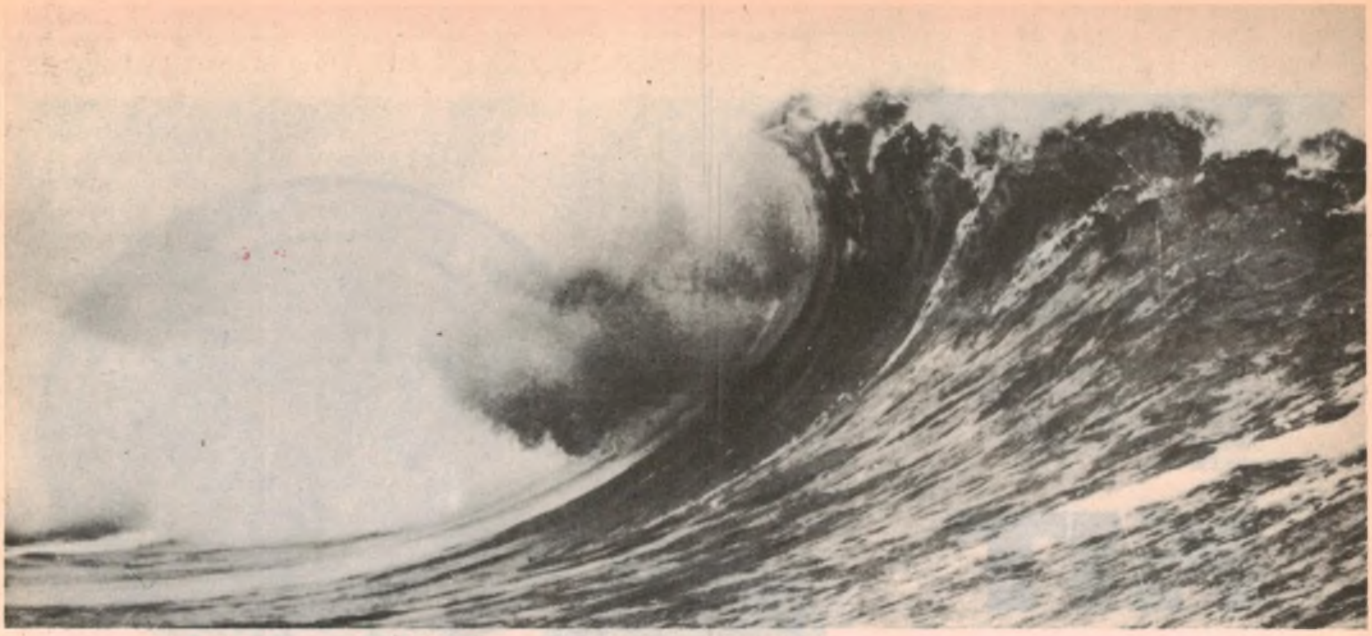
Major breakthrough in colour film processing

A major advance in the processing of colour photographs has been made by Anthony Pippard, seen here in the darkroom where the system was developed for the British firm of Photo Technology.

The new system, called Photocolor II, drastically reduces the time and the number of chemicals needed to produce both colour negatives and colour prints.

Films go through the development-fix cycle and are ready to dry in 6¼ minutes; dry prints can be produced in seven minutes. The two chemicals used for film processing are retained for the print processing. Temperature control demanded of the former colour process no more than a one percent variation; Photocolor II allows up to six degrees C.

Readers may direct their enquiries to Photo Technology Ltd, Cranbourne Estate, Cranbourne Road, Potters Bar, Herts, England.



Wave power: energy for Britain's future

Faced with a dwindling supply of fossil fuels, the world's industrialised nations are now exploring alternative energy concepts. At the forefront of the various alternatives are the so-called natural energy resources which are, as yet, virtually untapped. In Britain, the concept of generating electricity from sea waves is receiving serious attention, as this article reports.

by MICHAEL KENWOOD

Technology Editor, "New Scientist", London.

Natural energy systems are very much in vogue these days, as it is now generally accepted that oil and gas reserves will begin to run out in the foreseeable future. There are alternatives available, including nuclear power and coal, but wouldn't it be much better if we could develop energy systems that do not depend upon energy reserves?

Wave power is one system that fits into this category, along with solar power and wind power. These energy supplies will be continuously renewed for as long as the sun shines.

Britain has shown more interest in wave power than in other "natural" energy systems and for a very good reason—she has a long coastline that is continuously battered by waves. Among the advantages of wave power are the enormous amount of energy freely available, and the fact that power output would be at a peak during winter when the weather is roughest. This is the reverse of the oft-mooted solar power schemes, which are not considered feasible for northern latitudes.

The earliest indication that there was any official support for wave energy in Britain came in a report prepared in 1974 by the Central Policy Review Staff—the government's "think tank"—which said that wave power "has some favourable features in the United Kingdom context. The usable coastline amounts to some 900 miles (1500km) and the energy theoretically available from its exploitation on a reasonable economic basis would sustain a capacity of up to 30,000MW." This is about half the country's installed generation capacity.

The British Government has given support to the idea. To begin with, it commissioned a study of the subject from the National Engineering Laboratory (NEL). The NEL report has since been submitted to the government, although it has not yet been published.

The second government move was to set aside £110,000 for research on wave power. This money was awarded to Dr. Stephen Salter of Edinburgh University's Department of Mechanical Engineering to continue investigations into a system he has devised for converting sea waves into electricity.

In another project, a team of engineers is working on a different approach. This team, Wavepower Ltd, has as one of its leading lights Sir Christopher Cockerell, who invented the hovercraft.

When Salter first looked into wave power he came to the conclusion that the old idea of designing something that would extract energy from the waves by bobbing up and down was not the best one. Waves may look impressive as they rise and fall but most of the energy is in the to and fro motion of the water. Salter's first move was to design a vane that could rotate with the motion of the waves.

Basically simple in concept, Salter's method would involve the stationing, at suitable offshore locations, of large concrete breakwaters fitted with these moveable vanes. Calculations have shown that a structure the size of a supertanker, submerged to a depth of 10 to 20 metres and with vanes protruding a metre above the surface, could generate 5 megawatts of electricity throughout the year.

Wavepower suggests that its system might produce useful energy in a similar way, but the engineers working on this project believe their technique would require less development and could be brought into operation more quickly.

Wavepower's concept is extremely simple. The energy collector would be a string of floats hinged together in a line. The floats would take energy from the waves as they travelled along the line of floats. There would be hinges between adjacent floats, and pumps on these hinges would absorb power from the relative motion of the floats.

Malcolm Woolley and Jim Platts, two engineers working with Wavepower, say that their aim is "to develop a wave-power device that, within the bounds of current technology, is simple, cheap, made up of relatively small mass produced units, can be installed in sections and can be easily maintained a section at a time."

Wavepower has carried out some small model tests in tanks at the British Hovercraft Corporation. These showed that the hinged float system could be as efficient at taking energy from waves as Salter's rotating vane. However, efficiency is less important than the cost of the equipment when you don't have to pay for the fuel.

An important factor in the Wavepower system is the length of the floats. These have to be short enough to rotate in relation to one another as the waves travel along the line of floats. If they are too long then waves will travel from one float to the next without creating any rotation between the two.

Woolley and Platts say that a float should be about a quarter the length of the waves it operates in. Clearly waves aren't always the same length; but if a float is short enough to extract energy from the shortest useful waves it will also be able to take some energy from longer waves.

In fact, while a big wave carries more energy than a small wave there are more small waves than big waves. So while an optimised float might miss some of the energy in big waves it will operate more efficiently in the more frequent small waves.

Wavepower's engineers have calculated that a wave-power float system operating in the Atlantic should have floats about ten metres long and the floats might be between 20 and 40 metres wide.

Clearly it could take a lot of work to translate small models into large engineered systems, but Wavepower believes its ideas can be put into operation with very little development. According to Woolley and Platts: "All the parts of such a device, even on a full ocean scale, are well within current technology and we believe that a system of floats could be developed relatively quickly. All the components can be mass produced, which makes a considerable difference to cost."

A float system could be built up a bit at a time, as money was available or as energy was needed. And if anything went wrong it would be possible to take out a single float and put a temporary bridging piece in its place while the float was repaired. So servicing operations would not bring the system to a halt.

It is interesting that an idea as unconventional as wave power has received so much support. The Department of Energy in London explains its interest in terms of an "insurance policy". It expects that Britain will meet most of her future electricity demand from nuclear power stations but if it was ever necessary to turn away from nuclear power, there would be a desperate need for an alternative system. Wave power could be that alternative.

Even Britain's Central Electricity Generating Board (CEGB), the world's largest electricity utility, is showing interest and has begun its own assessment. According to a CEGB study: "The need for an insurance policy to guard against possible adverse circumstances in the future justifies a small program of research in this area."

British scientists study alternative energy sources

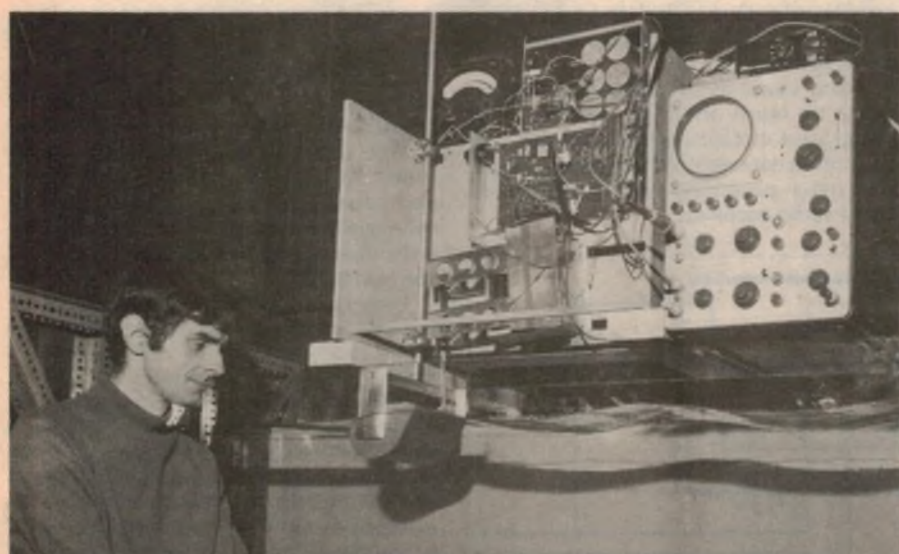
Machine tools driven by centralised hydraulic power instead of individual electric motors, geothermal power stations, solar power and wind power—these are some of the ideas being examined by a new British think tank called the Energy Technology Support Unit. Set up by Britains Department of Energy, the unit is located at Harwell in southern England.

The team is cautiously enthusiastic about the possibility of developing geothermal power in Britain, particularly in Cornwell in the south-west. Rising oil prices have dramatically altered the economic picture for the expensive drilling required, while the granite outcrops in Cornwell bring "hot rocks" relatively close to the surface.

Solar energy for water heating is considered a potential economic proposition, for south-west Britain at least. Installation costs will, however, need to be reduced considerably.

Wind power is considered a much less attractive proposition than wave power. The problem here, of course, is what to do when there is no wind, since long term storage of electricity is not feasible.

According to the experts there will be big problems in the rapid expansion of nuclear fission, the world's oil resources cannot last forever, and the dream of unlimited power by means of nuclear fusion will not begin to be realised until well into next century. There will thus be a growing need for alternative energy sources towards the end of the century.



Dr Stephen Salter with his test tank at the Department of Mechanical Engineering, Edinburgh University, Scotland. Dr Salter has been awarded £110,000 by the British Government to continue investigations into sea wave energy conversion.

1926 IC radio sold 1,000,000 models!

The world's first integrated circuit

Did you know that the world's first integrated circuit was produced in 1926? Not that it was anything like the familiar solid state devices of today but was, instead, the unwieldly product of vacuum tube technology. However, this did not deter it from going into mass production for incorporation into a highly successful radio receiver which sold more than one million models.

by WILLIAM A. GOLD, B.Sc (Eng.)

To most of us, integrated circuits are a fairly modern development. They are the familiar looking "beetles" or "tin hats" which have revolutionised the electronics industry in recent years, and will have an even greater impact in the future.

The modern era of integrated circuits began in 1958 when prototype microcircuits were developed by both Texas Instruments Inc., Dallas, Texas, and Westinghouse Electric, Youngwood, Pennsylvania. These prototype ICs were rather crude devices, consisting of separate semiconductor chips carrying transistors, diodes and resistors, all mounted on a common header. Since then manufacturing techniques have improved enormously.

Over the last two years or so, the trend to what is termed large scale integration, or LSI has gathered momentum. More and more complex circuits and subsystems are being crammed into integrated circuit packages, making possible a range of high technology products for everyday use. Witness for example the explosive growth of the calculator industry during the past eighteen months; or the increasing application of minicomputer systems and microprocessor equipment.

Because of this, we associate integrated circuits exclusively with the electronics of today. They range in application through all branches of electronics—radio and TV receivers, hifi equipment, process control systems, digital clocks and watches, computers, communications and broadcasting equipment, and instrumentation, to name just a few.

It may come as something of a shock, then, to learn that the world's first integrated circuit was developed just over fifty years ago. What's more, the IC was mass produced and incorporated into a radio receiver.

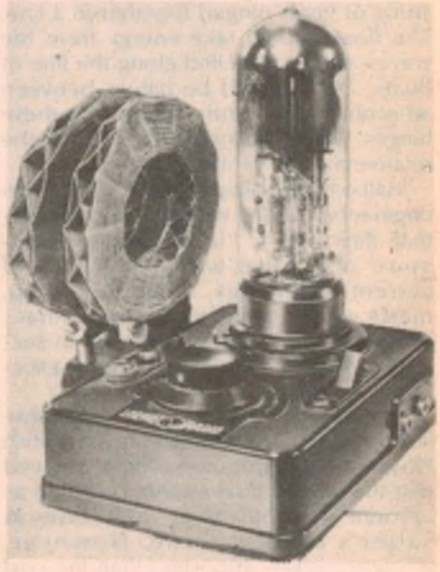


Fig. 1: the Loewe OE333—the world's first million selling radio receiver.

Of course, the world's first integrated circuit looked nothing like the IC's of today, although the basic concept was the same. As would be expected, it employed vacuum tube technology, the device essentially consisting of three triode valves and a number of resistors and capacitors encapsulated in a common glass envelope. By today's standards, the device was quite bulky and somewhat fragile.

The man credited with developing the world's first integrated circuit is Dr. Siegmund Loewe, founder of the Loewe-Opta electronics company of Berlin, Germany, who was granted a patent for his idea in 1924. The patent application described a vacuum tube device containing two valves, two coupling capacitors and two resistors within a common glass envelope. External connections were brought out to a polarised pattern of access pins, which could be plugged into, or withdrawn from, a corresponding socket.

By 1926, a device slightly more complex than that described in the patent application had been designed and put into production. This was the

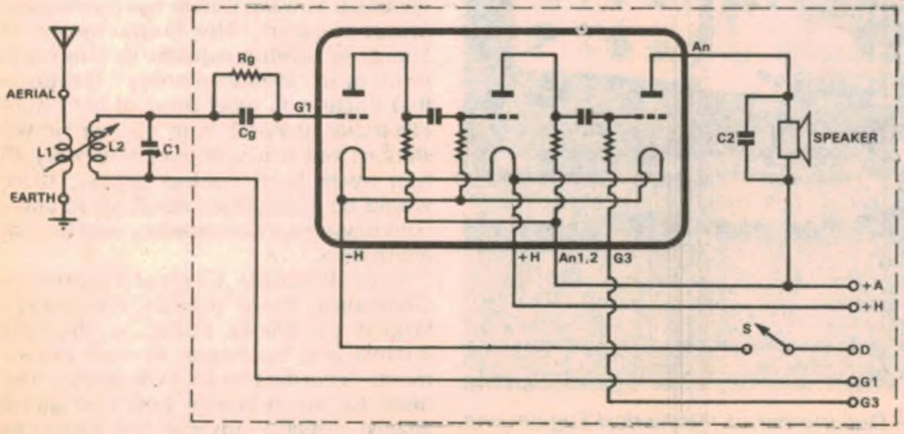


Fig. 2: the circuit diagram of the Loewe OE333 radio receiver. The triple triode IC comprised all those components within the solid dark line.

triple triode integrated circuit referred to above. It was incorporated into the Loewe OE333 radio receiver, more than one million of which were sold within twelve months of its 1926 launching.

Basically, the triple triode IC used in the OE333 contained virtually a complete radio receiver within a single glass envelope. The only other components required were a tuning coil, a "swinging" aerial coupling coil, a tuning capacitor, a loudspeaker, and the high tension and low tension batteries which supplied anode and filament power respectively.

The complete circuit diagram of the Loewe OE333 radio receiver is shown in Fig. 2. Battery operated, the receiver simply consisted of a triode anode-bend detector stage, followed by two stages of triode valve amplification.

Fig. 4: a 1928 version of the OE333 in use as an amplifier for record playing equipment. Note the hand-cranked turntable.

Fig. 3: the Loewe OE333 IC radio with batteries, frame aerial and speaker.

The anode-bend detector was RC coupled to the first amplifying stage which, in turn, was RC coupled to the second. Output from the second stage was then direct coupled to a loudspeaker, almost certainly of the high impedance moving reed type, although moving coil loudspeakers were in use in high grade equipment at that time.

The receiver was said to provide good loudspeaker performance using an indoor aerial in areas served by effective local and regional broadcast transmitters. An outside aerial was required for more distant station reception.

Fig. 3 may evoke nostalgic memories for some of our older readers. It shows the OE333 receiver surrounded by the now antiquated high-tension battery, a low-tension acid-filled accumulator used for heating the valve filaments, an exponential horn loudspeaker, and the once quite common diagonal frame directional aerial. The latter could be used to replace the more compact pancake-wound aerial and tuning coils, and was of such inductance as to correctly tune across the broadcast band with the aid of a tuning capacitor.

Fig. 4 shows the OE333 of 1928 in record player guise. Here the triple stage vacuum tube integrated circuit is being used to amplify the signal from a primitive electromagnetic pick-up head grazing an old 78 rpm gramophone record. A hand-cranked clockwork motor supplied rotational power to the turntable.

Cost of the OE333 receiver without batteries and loudspeaker was 39.50 Reichmarks, equivalent today to about $A10. The currency translation is, however, only approximate due to inflation, the lapse of time, and the momentous political events between 1926 and 1976. Certainly for its time the OE333 must have been very competitively priced, it being the first radio receiver in the world to sell in excess of one million units.

It would be a cynical electronics engineer of today who did not concede that Dr. Siegmund Loewe—engineer, inventor and founder of the Loewe Opta Company of Berlin—was the man who gave the world its first cost effective integrated circuit, and successfully mass produced more than one million such ICs half a century ago.

Infra-red astronomy: a fresh look at the stars

Many objects in space shine most brightly at infra-red wavelengths, a fact that has resulted in increased emphasis on the, as yet, relatively undeveloped field of infra-red astronomy in recent years. One of the foremost countries in this field is Britain, which is planning the largest infra-red telescope in the world—a 150-inch device at Mauna Kea in Hawaii.

by ANTHONY TUCKER

Major contracts are being placed for a new British infra-red telescope, 150 inches in diameter, which when complete towards the end of the seventies will be the largest instrument of its kind. Together with other special observing equipment the new telescope is to be financed by the Science Research Council and, combined with a new high altitude balloon infra-red telescope system being developed by astronomers at London University, will keep Britain at the forefront of this young branch of astronomy.

Comparable in promise to radio astronomy in its early days, infra-red astronomy is now expanding in importance as well as scale, and has already revealed objects and events both in and out of our galaxy which are either invisible or barely visible to optical astronomers. Stars shine as they are born and as they die, and it happens that they shine most brightly in the infra-red.

Because of the blocking effects of the atmosphere, earthbound astronomers look through a strictly limited number of "windows" where the atmospheric absorption is least.

The human eye can detect, of course, only a tiny portion of the total spectrum of electromagnetic radiation reaching us from the Sun and other sources of energy in the universe, and optical astronomy is locked basically to that portion of the spectrum plus any extensions that might accrue from special photographic emulsions.

Yet only those objects whose temperature is high enough—say millions of degrees Kelvin (K) (that is degrees centigrade above absolute zero)—radiate significant amounts of energy in visible wavelengths, whereas all objects with a temperature above absolute zero radiate in the infra-red region.

This difference in the characteristics of radiation in relation to temperature underlies the emphasis given to astronomies in "new" wavelength bands, for the addition of observational information of the same object at different wavelengths can provide wholly new insights into the nature of the processes that are causing its radiation emissions. Hence the extension of observations not only to the infra-red but also to X-ray and gamma ray wavelengths, as this very high frequency radiation is indicative of extremely high temperatures or of particular kinds of processes. Since there is already evidence of energy production in some distant starlike objects on a scale that requires mechanisms far more efficient than any nuclear process now known, the unravelling of their mystery could ultimately be of great importance.

Infra-red astronomy, which operates at wavelengths for which no photographic emulsions exist, came into existence as a practical science on the back of infra-red detectors developed for more sinister purposes. Yet it happens, as historians of astronomy are quick to point out, that Britain pioneered infra-red astronomy long before electronic detectors were brought into service. In 1856 Professor Charles Piazzi Smyth, then Astronomer Royal of Scotland, made an expedition to the top of Mount Cuajara in Tenerife and there, using a "thermo-multiplier," made measurements of the infra-red emissions from the Moon. These, it has since been shown, were remarkably accurate, but it was more than a century before infra-red astronomy grew to the point at which an observatory was built, on a Tenerife mountain top, for other British astronomers to follow the trail.

High, clear sites are more important for infra-red observation than for optical viewing, because the image quality in the infra-red is degraded not only by atmosphere turbulence (the scintillation of the twinkling star) but by water vapour which absorbs infra-red energy. It happens that the mountain tops of Tenerife, where Britain's existing 60-inch diameter instrument is sited, and Mauna Kea in Hawaii where it is planned that the new 150-inch instrument will be operated, are particularly "dry" sites.

But the extent of absorption by the atmosphere varies very strongly with wavelength and although Tenerife provides good viewing at wavelengths of 1 to 3 microns, it is not good enough for the longer wavelength region—10 to 30 microns—planned for the new instrument. Hence the need to go to Hawaii, one of the best US observing sites, even though it is very much less convenient for British university groups.

In spite of its complex electronic sensing and recording devices, and the need to provide a "chopping" system so that the observed areas of sky can be continuously compared to adjacent regions to enable IR "noise" to be eliminated, infra-red telescopes cost no more than about a quarter of the cost of a comparable optical instrument.

For purely optical reasons accuracy to which the collecting mirror—the flux collector—has to be worked to provide a useful instrument, about a quarter of a wavelength at the desired observing frequency, is very much more difficult to obtain at optical frequencies than at infra-red.

Hence Britain's ability to field what will be the largest instrument in the world specifically for infra-red astronomy. Although NASA is proposing a large instrument for an observatory alongside the British site in Hawaii, the new US instrument is intended for both optical and infra-red studies and, presumably for cost reasons, is somewhat smaller than the British instrument. But the fact that Britain, the US, Russia, and other European countries are all extending their ability to make observations in the infra-red is an indication that this new chink through which to view the universe could become a dominant source of information during the next decade.

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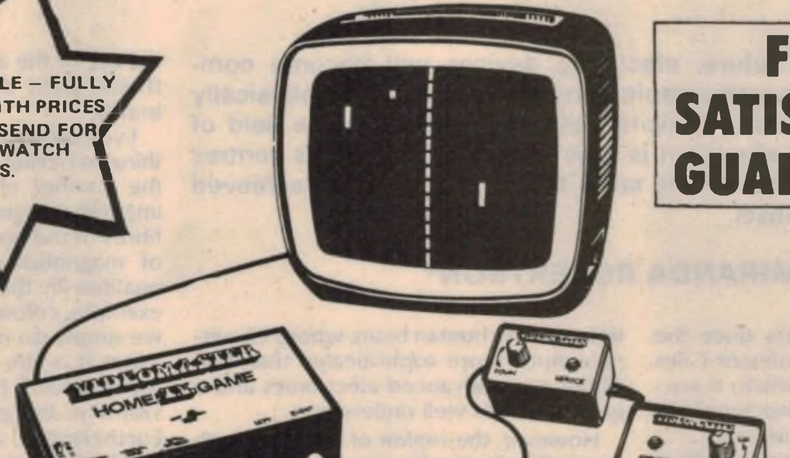

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How close to reality is artificial vision?

Within the immediate future, electronic devices will become commonplace in a wide range of humanitarian applications for the physically disabled. One of the most promising research areas is in the field of artificial vision, and development is now underway at various centres throughout the world. This article takes a look at the results achieved thus far by British scientists.

by MIRANDA ROBERTSON*

It is now almost ten years since the British neurophysiologist Professor Giles Brindley began a project which, if successful, will enable some blind people to see by means of an electronic "eye".

Unfortunately rapid progress is impossible in this field because of the prolonged testing necessary for the device, part of which has to be actually implanted within the skull. But since the first trial on a human patient in 1968, the microelectronic technology on which the device depends has undergone considerable evolution.

At the same time biological research has underlined some of the physiological problems which will have to be faced.

The electronic eye works by delivering pulsed current through radio receivers to platinum electrodes in contact with the visual area of the brain. These pulses can be controlled by outside sources such as punched paper tapes, switches or perhaps eventually a camera.

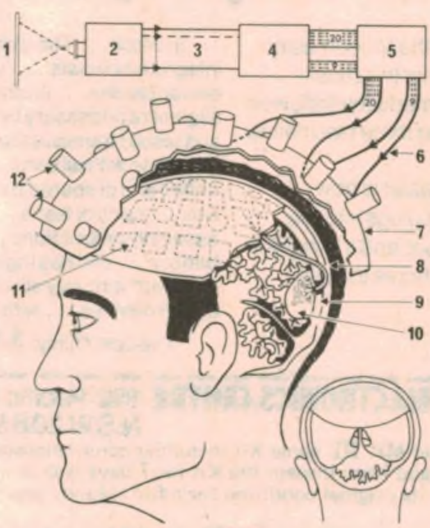
The direct stimulation of the brain in this way causes sensations of light known as phosphenes—stars or bars of brightness—like the stars that are proverbially seen after a hard knock on the head and for much the same reason. The visual area of the brain has been given a jolt.

The device is the most sophisticated so far of a family of electronic prostheses (spare parts), of which the cardiac pacemaker is the best known. But although its designer, Mr P. E. K. Donaldson of the Medical Research Council, puts the visual prosthesis among the "progeny of the pacemaker", it is a much more ambitious project.

First it is technically ambitious because it involves the development of an autoclavable, non-toxic, microelectronic device which will operate indefinitely in "an environment which is virtually warm seawater". Secondly, it is physiologically ambitious, depending on direct interaction with the human brain, whose circuitry is much more sophisticated than that of the most advanced electronics and a great deal less well understood.

However, the region of the brain with which the electronics actually make contact has a relatively simple and well understood anatomy. It is the area which receives input from the eye directly, in such a way that the image on the retina is represented point-for-point in topological order in the nerve cells of the brain.

The device is thus strictly dependent on the brain having a normal intact visual area, its application being confined to those people blinded through damage to the eye or the optic nerve. It cannot help those with damaged or abnormal brains.



Principle of the proposed 180-point visual prosthesis system: 1—pattern; 2—picture source; 3—180 video signal lines; 4—implant driver logic; 5—modulators; 6—pulse amplitude modulation signal; 7—removable transmitter hat; 8—scalp; 9—skull; 10—rubber cap with electrodes; 11—implant with receivers and AND gates; 12—inductive loop transmitters.

Even then it is by no means the same thing as having a real eye. For one thing, the number of electrodes that can be implanted is smaller than the number of fibres in the optic nerve by three orders of magnitude. For another, there are qualities in the brain's visual input—for example, colour—that are coded in ways we simply do not understand.

But it is the philosophy of Professor Brindley and his colleagues that poor vision is better than no vision at all. Furthermore, advances in both electronics and the understanding of the brain may make possible achievements that cannot yet be foreseen.

In a pilot experiment to see how much he could hope for, Brindley completed the first prosthesis for implantation in 1968. The patient was a 52-year-old woman blinded by glaucoma some six years before. The prototype prosthesis had 80 stimulating channels—electrodes fed by radio receivers—through which Brindley could test the feasibility of feeding information electronically into the brain.

He used oscillator probes to stimulate each electrode in turn, asking the patient each time to say what she "saw". The results were encouraging. Her phosphenes proved well defined and did not run into one another, provided the electrodes were 2.4mm apart.

Equally important, if several electrodes were stimulated simultaneously the pattern of phosphenes formed was quite predictable. This meant there was some hope of building up "readable" stimuli by the use of groups of electrodes.

Thus encouraged, Brindley and his colleagues went on to develop a second prosthesis of improved design. One problem they had to overcome with the second device was a simple matter of matching the oscillator probes of the driving component with the radio receivers on the patient's head.

The finished prosthesis with its driving oscillators is essentially a set of three hats. One sits on the back of the brain, under the skull, and contains the electrodes. A second is implanted only under the scalp and carries the receivers. The third, the implant driver, is an external helmet bearing the oscillator probes.

The two implanted parts which consti-

* "Nature" science magazine, London.

tute the actual prosthesis are wired to each other through a multi-core cable passing through the skull. But the external oscillator probes can be shifted a critical 5mm off their respective receivers by a mere change in hairstyle.

This difficulty could be overcome by reducing the number of receivers which had to be matched. The problem was to do it without reducing the number of electrodes, already so pathetically few.

Brindley solved the problem by using a matrix system. The electrodes were divided into rows and columns, each fed by a single receiver—so that m x n electrodes could be driven by only m + n receivers. Each row/column intersection had an AND unit feeding an electrode.

The snag was that if two electrodes were to be used together—as they must if the device is to work—the receivers would turn on not only the desired intersection but any intervening ones as well.

Fortunately there is one sense in which the resolving power of the electronics is better than that of the brain; that is in the discrimination of asynchronous pulse trains. The brain sees them as simultaneous, the AND units do not. So asynchronous pulses were adopted as the answer to that problem.

The final design consisted of five rows and 15 columns of electrodes. The electronics consisted of 15 column units to rectify RF energy and direct it to an intersection for each row; 75 AND gate transistor units for the intersections; five row coils tuned to 10MHz, accepting RF energy and opening the row gates; and zener diodes to limit the voltages.

These had to be made up into packages of thick film hybrid circuitry, joined by insulated wires and sealed into a casing that would fit snugly over the skull without making an unseemly bulge under the scalp.

The choice of silicon rubber as the optimum substance with which to seal the microelectronic packages was based on tests whose results came as something of a surprise to scientists educated in the notion that a sealant should be an impermeable barrier. Clearly the water-sensitive components had to be well protected from the saline environment in which they would have to function, yet they seemed to survive best when sealed with silicon rubber which is highly permeable and relatively non-absorbent.

Mr. Donaldson believes that the paradox can be resolved by considering two factors. One is the insensitivity of most water-sensitive electronics to water vapour. The other is the excellent surface adhesion of the silicon rubber. Probably silicon rubber allows the passage of water vapour but because of its adhesive qualities prevents the access of water itself to the surface of the microelectronics.

At any rate, it works. A year's operation of trial equipment submerged in warm saline is what you might really call soak testing.

View above shows Mr P. Donaldson examining one of the latest microcircuit developments for an artificial vision system. Future developments could lead to an artificial vision system with the definition of primitive TV pictures.

When in 1972 the second prosthesis was finally implanted into the second patient, a man of 64, two snags immediately became clear. One was electronic; the other physiological. The electronic problem was simple: one entire column of electrodes was lost through a single fault in the prosthesis—a predictable penalty of the matrix system which was such a desirable design feature from other points of view.

The physiological difficulty had more profound implications. When Brindley and his co-workers came to test the new subject they found that his phosphenes were larger, more diffuse and therefore less useful than those of the first patient.

The explanation can probably be found in the patient's history. He had been totally blind for more than 30 years. What was more, he began to go blind quite early in life. It is probable that in the absence of input the visual brain deteriorates.

So it looks very much as though that will be another limitation to usefulness of the prosthesis. It will best serve people who have not been blind for very long and whose vision was normal during their childhood. Nonetheless, with very little practice Brindley's second test subject was able to read English text translated into Braille symbols from a teleprinter tape (which he himself operated) at a rate of seven letters a minute and with 90% accuracy.

Although still very much a project for the future, a new design is already in the pipeline. The emphasis now is on incorporating more and more electrodes, into the unit, and on saving space.

The matrix system has been dropped and the aim is to eventually design a 1000-electrode array. This will involve—and is already involving—the development of new electronics technology, though progress is maddeningly delayed by the need to test everything extensively under water.

There are also other grounds for avoiding the application of such devices to people blind for many years since early youth. The first corneal grafts to restore sight to cataract patients showed that the psychological task of adapting to the sighted world after many years of adjustment to blindness can prove too much.

Instead of elation at the new world now open to him, the erstwhile blind may be unable to cope and relapse into severe depression. There is more to interfering with the brain than the mere mechanics.

Automatic lamp dimmer for creative moodlighting

Our new light dimmer, christened the Autodim, is based on a new integrated circuit, the SL440. This provides all the active circuitry required for phase controlling a triac or similar device, and as a bonus, includes a stabilised power supply which can be used with external circuitry.

by DAVID EDWARDS

Over the years since gas lights were replaced by electric lights, most people have forgotten one of the principal advantages of a gas light: that it can be "dimmed". It is only in recent times that it has become possible to "dim" normal incandescent lights.

Typical situations during which softer lighting is of use include parties, dining, watching television, listening to music, as well as other more private activities. There are also situations where an automatically dimming light is of considerable use: one that springs immediately to mind that of the young child who requires the light in his bedroom to be left on, during the time he is falling asleep.

Commercially available light dimmers do not generally provide this last feature. They also suffer from the problem of "snap on". This is an effect whereby the dimmer control has to be turned through 30 to 40% of its rotation before the lamp begins to glow. At this initial setting the lamp will be quite bright. The light can be reduced by rotating the control in the opposite direction, but at the lower setting a momentary drop in mains voltage may extinguish the lamp completely.

A second disadvantage of these types of dimmers is that they produce relatively high levels of radio interference. This can be very severe in outer metropolitan and rural areas. Our new dimmer, which utilises an integrated circuit, has no "snap on" at all, much reduced interference, and can be used to provide automatic fade ups, as well as fade downs.

The SL440 IC on which the new dimmer is based is a variable phase, full wave power control circuit intended for use in conjunction with AC power switching elements such as triacs. The incorporation of a servo amplifier provides for manual or automatic control under open or closed loop conditions. AC power is controlled in a proportional manner by the application of a low voltage DC signal to the circuit.

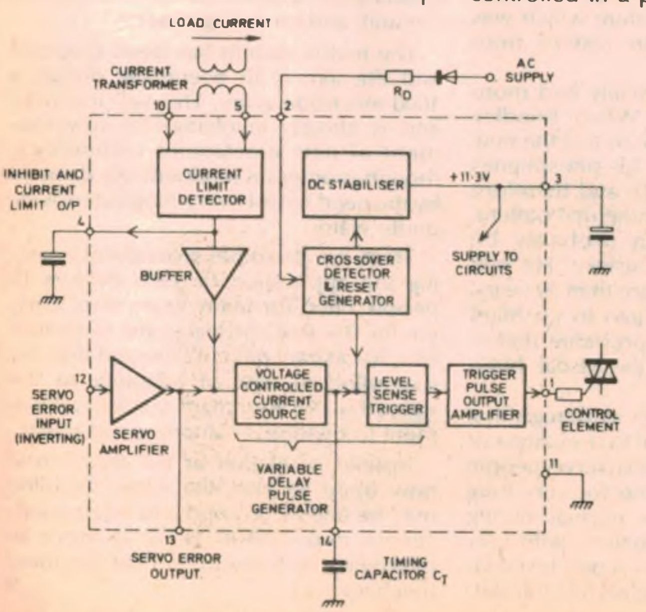


Fig. 2: functional block diagram of the SL440 IC. The device contains all the active circuitry required for phase controlling a triac.

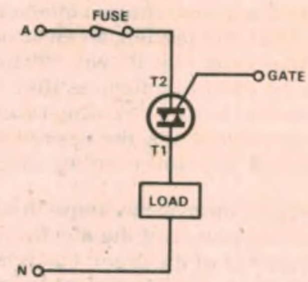


FIG. 1

Basic schematic illustrating triac power control in an AC system.

Its particular circuit features are a mains derived, internally stabilised low voltage DC supply; a mains waveform zero crossing detector; a synchronised, voltage controlled, variable delay pulse generator; and a servo amplifier. In addition, a facility is provided whereby power may be totally inhibited or limited according to AC load current.

Before we examine the circuit of the Autodim in detail, we will digress for a short time, and consider how a triac may be used to achieve power control in an AC system. A triac is a bidirectional device having three terminals. One of these terminals, called the gate, controls the operation of the remaining two terminals, called terminal 1 and terminal 2.

Consider an AC supply feeding a load via a triac interposed in the active line, as shown in Fig. 1. If a suitable pulse is applied to the gate at some point during either a positive or negative half cycle, then the triac will turn on and conduct, continuing to do so until the end of the half cycle.

If the pulse is repeated at the same point in the next half cycle, and the process is repeated indefinitely, the power developed in the load will bear a direct relationship to the timing or "phasing" of the gate pulse with respect to the point where the input supply voltage waveform passes through zero.

For a 50Hz supply, each half cycle will be of 10mS duration, so that to achieve a power control range from zero to full power, it would be necessary to vary the phasing of the gate pulse from 10mS to 0mS, taking the preceding zero crossing of the supply waveform as reference.

To do this we need a variable delay

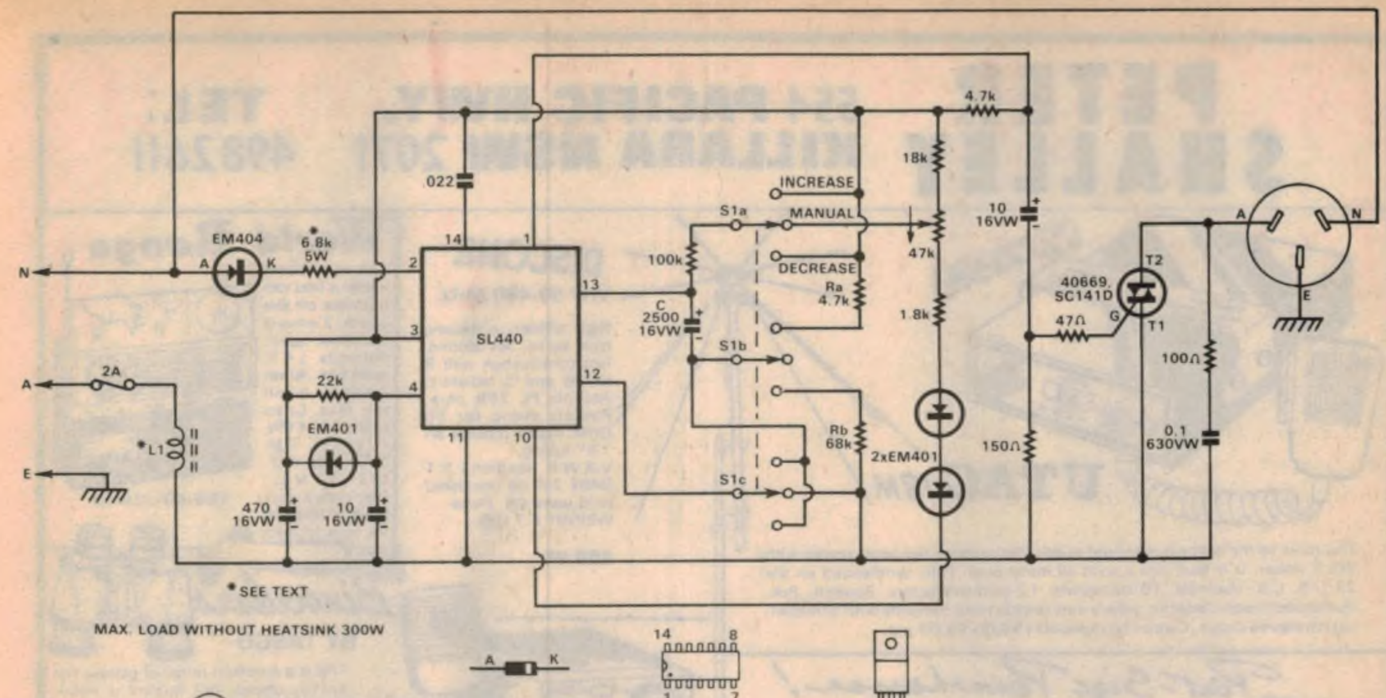


FIG. 3 AUTODIM

pulse generator, synchronised to the supply frequency, and having a range of delay control from 0 to 10mS. This in fact is what is provided by the SL440, in the form of a relaxation type oscillator.

Turning now to Fig. 2, we can examine the internal circuitry of the SL440. The timing capacitor C_1 is charged by a voltage controlled current source from the commencement of each mains half-cycle. When the voltage on the capacitor reaches the threshold of the level sense trigger, the output amplifier is triggered, and an output pulse is made available at pin 1.

The AC supply is connected to pin 2 via a series diode and a limiting resistor. The zero crossing points are detected in the crossover detector, and reset pulses fed to the pulse generator as required. An 11.3V DC supply is generated from the supply at pin 2, and made available at pin 3, where an electrolytic capacitor is used as a filter.

Pin 12 is the inverted input to the servo amplifier. The output of this amplifier is available at pin 13, which is internally connected to the control input of the variable delay pulse generator. Also connected to this point is the output from the current limit detector and buffer.

Fig. 3 gives the complete circuit of the Autodim. Overload protection is supplied by the 2A fuse connected in series with the active line. The 6.8k 5W resistor used to limit the supply current is composed of 5 x 33k 1W resistors connected in parallel. This is cheaper and gives better heat dissipation than the equivalent 5W resistor.

The 11.3V DC supply from pin 3 is filtered by the 470uF electrolytic capacitor. The diode, resistor and capacitor network we have shown connected to pin 4 provides a soft start facility on initial turn on. If this is not required, these components can be deleted, and pin 4 connected directly to pin 3.

S1 is a three pole three position switch, used to select the mode of operation of the dimmer. In the "manual" position, the servo amplifier is disabled by connecting its input to the neutral line, and the lamp brilliance is controlled directly by the potentiometer. One end of this pot. is connected to the 11.3V rail by an 18k limiting resistor, while the other end is connected to the active line via two silicon diodes and an internal diode connected to pin 10. This ensures that maximum power always occurs at the end of the pot. travel, and also provides some thermal compensation.

In the "increase" position, the servo amplifier is connected as a Miller integrator. This means that the output of the servo amplifier, and hence the input to the pulse generator, changes linearly with time, so that the lamp brightness increases progressively from zero to maximum. The time that this takes to occur is determined by RaC, and for the values we have used, it takes about 13 seconds.

In the "decrease" position, the time taken for the lamp brightness to fall from maximum to minimum is given by 20RaC, and for the values we have used, this takes about 45 minutes. The maximum achievable fade rate is limited by the input impedance of the SL440, and by the leakage resistance of the capacitor.

The 1.8k limiting resistor shown in series with the control pot. is required to

A view of the completed prototype, housed in a standard metal case.

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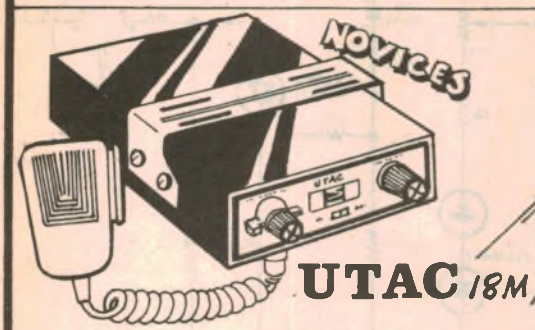

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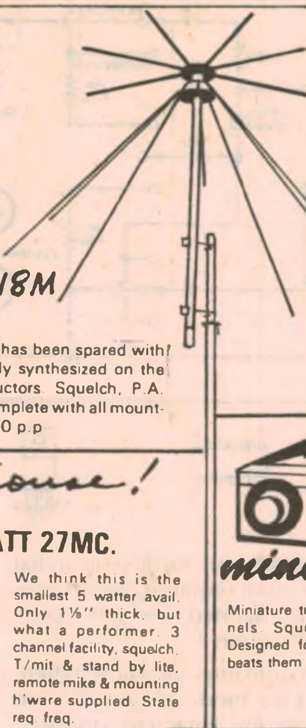

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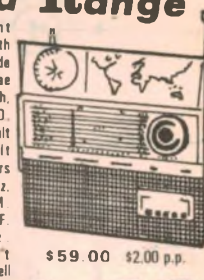

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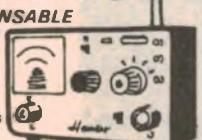

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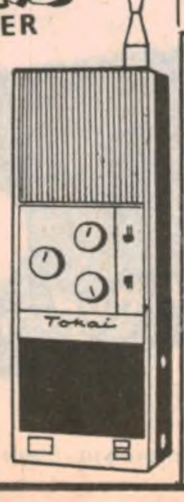

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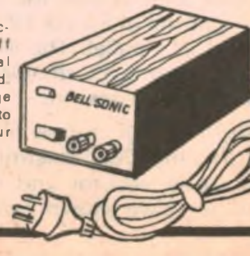


The Autodim

prevent damage to the internal diode connected to pin 10 of the SL440. Damage can occur when the pot. is set to maximum intensity, and switch S1 is operated. This is because the readily available rotary switches are shorting types, with contacts that "make before break". If a "break before make" type switch is available, this resistor is not necessary.

The output buffer amplifier connected to pin 1 is composed of a single transistor with an uncommitted collector. The 4.7k resistor connected to the 11.3V rail forms the load for this stage. When an output pulse is generated, the transistor shorts pin 1 to pin 3. The resulting pulse generated at the negative end of the 10uF electrolytic capacitor is transmitted to the gate of the triac via the 47 ohm resistor. The 150 ohm resistor ties the gate to TI, and ensures reliable triggering.

Interference suppression is provided by the inductor in series with the active lead. The RC network connected across the triac is a snubbing network. This will eliminate the possibility that the dv/dt rating of the triac is exceeded.

The SL440 is marketed by the Components Division of Plessey Australia Pty. Ltd. Stocks should be available from your usual supplier, or they may be obtained direct from Plessey. Further information may be obtained from Plessey Australia Pty. Ltd., Christina Road, Villawood, NSW 2163.

The triacs we have specified in the parts list are plastic pack types, and have the advantage that they can be used without any form of heatsink for resistive or incandescent loads up to 300W. Higher loads, up to 1000W, may be used, provided the triac is mounted on an adequate (and well insulated) heatsink.

Construction of the Autodim should not present any difficulties. All major components are mounted on a small printed circuit board, 121 x 64mm, and coded 75/pc/12. We used one of the new utility cases from Bespoke Metalwork, of 42c Sydenham Road, Brookvale, NSW.

These cases measure 105 x 137 x 60mm, and consist of a crackle-lacquer finished steel lower section with a brushed aluminium top section. A variety of colours are available, and they come complete with rubber feet and assembly screws.

As can be seen in the photographs, the PCB is mounted on the base of the case, with the mains input cable, clamp, terminal block and fuse assembly mounted on the rear section. The PCB must be positioned sufficiently far forward to clear the mains output socket, which is also mounted on the rear panel. The two rotary controls are mounted towards the top of the front panel, to allow clearance for the PCB underneath.

Construction is best started by fitting all the hardware to the case. The PCB is spaced off the bottom of the case using nuts as spacers. At least 5mm clearance is required, to ensure adequate insulation to the case.

The mains cord enters through a grommetted hole in the rear left hand corner, and must be securely clamped. The earth lead is terminated in a solder lug, which is clamped to the case at the cord clamp. The active and neutral leads are routed direct to the terminal block, which must have three connections.

The chassis mounted fuse is connected between the active terminal connection and the remaining spare terminal. The earth lead from the output socket is terminated with a solder lug, and clamped to the case with the input earth. The neutral lead from the output socket is connected to the neutral connection of the terminal block.

The remaining connections from the terminal block and the output socket can be left unconnected, till the PCB is installed.

L1, the interference suppression inductance, is not available commercially but is quite easily made. A 50mm length of 10mm dia. ferrite rod is required. If a longer length has been obtained, it can be cut by filing a groove around the circumference, and then snapping it as if it were glass.

Wind a layer or two of plastic insulation tape around the rod. Then close wind a layer of 22 B&S enamelled copper wire over the insulation tape. The actual number of turns is not critical; use as many as will fit comfortably.

Now wind another two layers of insulation tape over the copper wire,

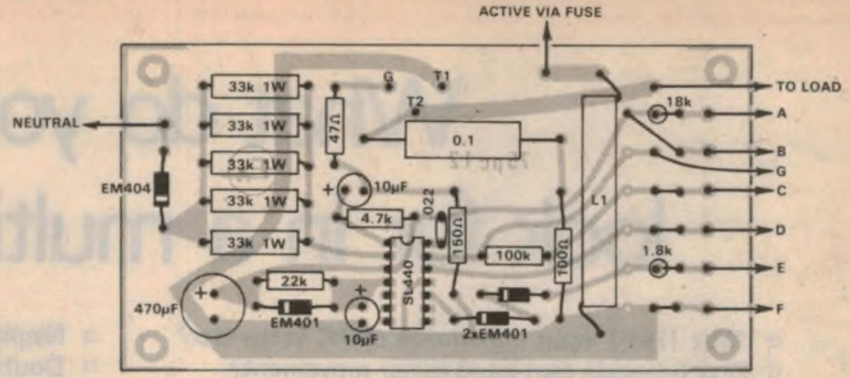
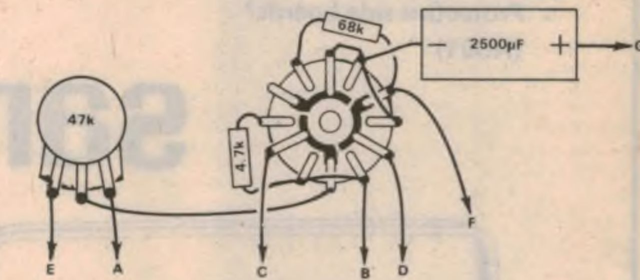


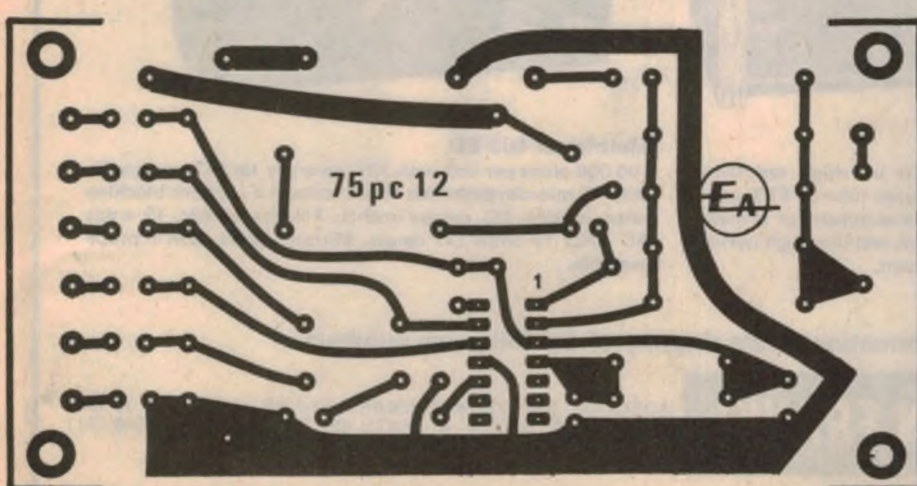
FIG. 4

The component layout shows the PC board from the component side. PC stakes are used to facilitate external wiring connections. Take care with polarised components.

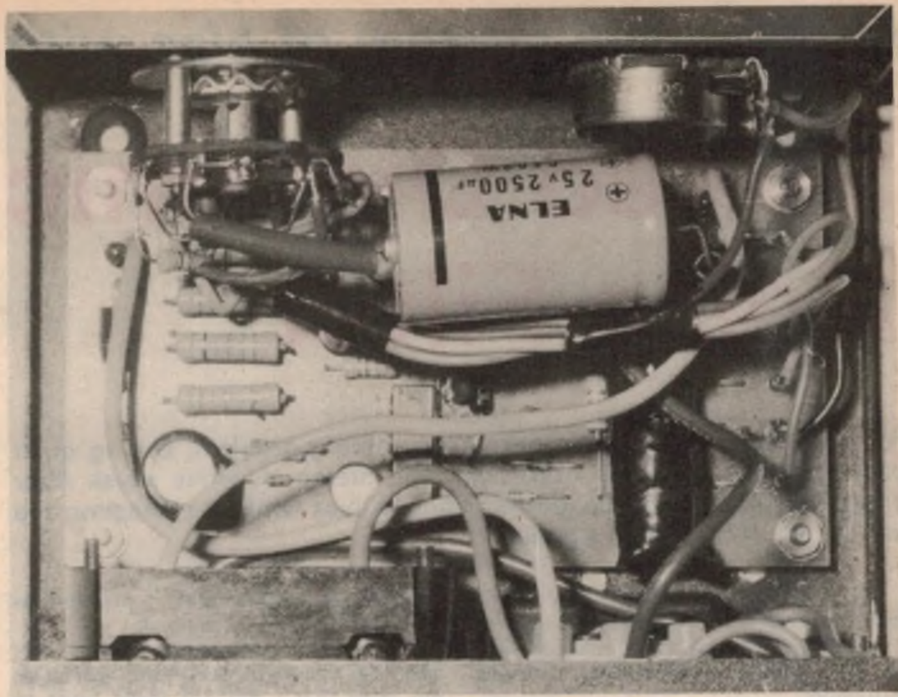


The wiring details for the two front panel rotary controls.

FIG. 5 SWITCH IN MANUAL POSITION



The PC board pattern, reproduced actual size to facilitate tracing.



Internal view of the prototype showing the disposition of the major components.

making sure that the tape is wound very firmly. If this is not done, the inductor will emit a buzzing sound due to the currents being switched by the triac.

The last step is to clean the leads to remove the enamel, and then to tin them with solder. An easy way to remove enamel is to scrape the wire with a sharp instrument, such as a razor blade (be careful, and use a single sided safety blade if possible).

We can now turn our attention to the PCB, and commence to fit components. The five 1W resistors should be mounted a little proud of the board, to allow for air circulation. There should be no difficulties with the remaining components. The only point to watch is that polarity conscious components are inserted correctly.

The triac can be soldered directly to the board, as can the SL440. If you have followed the dimensions given for the interference suppression inductance, you will find that it is a neat fit on the board. We recommend the use of printed board stakes for all external connections to the board, as these give a neat appearance, and make for easy assembly.

At this point a few words are in order concerning the arrangement of the external connections at the left hand end of the board. The arrangement used was chosen to provide flexibility in the wiring to the servo amplifier inputs and outputs, to allow the PCB to be used in a number of different ways. This has meant that a small number of links are required, as shown in the PCB overlay.

Using the accompanying diagram, the two rotary controls can now be wired up. Leave the leads to the PCB long enough to allow later servicing, if required. The 2500uF electrolytic capacitor is wired directly between the switch contacts and the PCB. The leads must be insulated with spaghetti tubing.

The remaining wiring to be completed is to the mains output socket and to the terminal block. Ensure that the active and neutral wires are not transposed. When all construction is finished, carry out a careful check for mistakes, and then fit the cover.

We made a front panel for the Autodim from 3M Scotchcal, using stick-on lettering on a piece of clear film as a negative. This gave a black panel, with the lettering appearing as silver. This process may be too complex for individual readers, so we suggest that you make up a small panel from scrap aluminium, and apply the stick-on lettering direct. This will give a quite acceptable alternative.

Plug a small incandescent light into the output socket, set the level pot. to maximum and the mode switch to "manual", and then apply power. After a short delay, the lamp should come on. Astute readers may notice the soft turn on which will occur. Next, check that the level pot. does indeed control the light output, and that maximum and minimum levels occur at or near the end positions.

Now set the level control to minimum, and switch to "increase". After about 13 seconds, the lamp should have reached full brilliance. Once satisfied that full brilliance has been reached, switch to "decrease". The lamp should now fade at an imperceptible rate, finally going out after about 45 minutes.

A few words are now in order concerning troubleshooting and servicing of the Autodim. As there is no isolation transformer, and because the circuit operates directly from the mains, most of the circuitry will be at active potential. This means that servicing will be quite hazardous, and should be avoided if possible. Provided all components are fitted correctly, and all solder joints are good, there should be little to go wrong, as all the active circuitry is contained in the IC.

If you do need to service the unit, we suggest you use an isolating transformer to avoid the risk of a fatal shock.

LIST OF COMPONENT PARTS

- *1 SL440 IC.*
- *1 plastic pack triac, SC141D, 40669 or similar.*
- *1 silicon diode, EM404 or similar.*
- *3 silicon diodes, EM401 or similar.*
- *1 0.022uF polyester capacitor.*
- *1 0.1uF 630VW plastic capacitor.*
- *1 2500uF 16VW electrolytic capacitor.*
- *1 470uF 16VW electrolytic capacitor.*
- *2 10uF 16VW electrolytic capacitors.*
- *1 47 ohm ¼W resistor.*
- *1 100 ohm ¼W resistor.*
- *1 150 ohm ¼W resistor.*
- *1 1.8k ¼W resistor.*
- *2 4.7k ¼W resistors.*
- *1 18k ¼W resistor.*
- *1 22k ¼W resistor.*
- *5 33k 1W resistors.*
- *1 68k ¼W resistor.*
- *1 100k ¼W resistor.*
- *1 47k linear potentiometer.*
- *1 3-pole 3-position rotary switch.*
- *2 knobs.*
- *1 case (see text).*
- *1 chassis mounting 240V 3 pin socket.*
- *1 fuse holder, chassis mounting, with 2A fuse.*
- *1 mains plug, cord, grommett, clamp and terminal block.*
- *1 printed circuit board, 121 x 64mm, coded 75/pc/12.*

Machine screws, nuts, washers, solder lugs, hook-up wire, insulation tape, spaghetti sleeving, 22 B&S enamelled copper wire, ferrite rod, solder, circuit board pins.

Note: resistor wattage ratings and capacitor voltage ratings are those used in our prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may also be used in some cases, providing ratings are not exceeded.

Rid your hifi system of hiss with this

Stereo Dynamic Noise Filter

by LEO SIMPSON

For many people, cassette decks have one big problem. During quiet passages hiss becomes obtrusive. The stereo dynamic noise filter presented provides a marked reduction in hiss while not affecting the bandwidth of high level signals.

The dynamic filter unit described here is interposed in the signal line between a cassette deck playback terminals and the tape monitor inputs of typical stereo amplifiers.

Basically, it monitors the signal level in both channels and when the signal rises above a predetermined level, it progressively switches out two single-pole filters which otherwise roll off the response above 7kHz. Maximum rate of attenuation of high frequencies is 12dB/octave.

High level signals switch the filter circuits out and extinguish the two LED indicators.

A CMOS quad bilateral switch is used to switch the filter sections in and out of circuit in both channels.

Let us state at the beginning that in our opinion most users of cassette decks do not need this unit. For a start, a major part of the population just are not aware of tape hiss as being a problem. If you are over 30 and/or cannot hear the normal 15,625Hz whistle of television flyback circuitry, or the somewhat more intense whistle of the switching regulator used in many colour television receivers, then you probably fall into this group.

Taking the comparison a little further, if you can hear no appreciable difference in quality between the average disc and a cassette copy of that disc, then you probably also do not have a problem as far as tape hiss is concerned.

For the few acute-eared readers, cats and dogs still interested in this article, let me state that I did not really want to alienate all those other readers. But at least they will not needlessly build this device!

Even for those of us with acute hearing (notice how the author has subtly included himself amongst the fortunate few) tape hiss really only becomes obtrusive when the volume control is well advanced to give an appreciable sound level and particularly while playing softly recorded passages. At other times you can largely "tune out" the hiss using the brain/ear combination's remarkable capability to resolve a noisy signal.

Of course if you are one of those fussy listeners who tends to "tune in" the hiss, i.e., you always listen for faults rather than enjoy the music, then you really do need a dynamic noise filter of this kind. There is a subtle catch, though and we will talk more about that later.

We should also state, at this point, that this filter is of no use in reducing noise or hiss on some discs. While we occasionally note that tape hiss is present on some records in our reviews it is very rare that this is obtrusive and certainly not to the same degree as present with cassette recorders. Nor is this unit really suitable for eliminating the residual hiss of Dolby cassette recordings.

Now have a look at the circuit. It is based on the same principle which was first featured in the December 1975 issue, in the article on a dynamic noise filter for movie projectors by Jamieson Rowe. However, I have not merely produced a duplication of Mr Rowe's circuit for the stereo version. While the principle is the same the circuit is quite different.

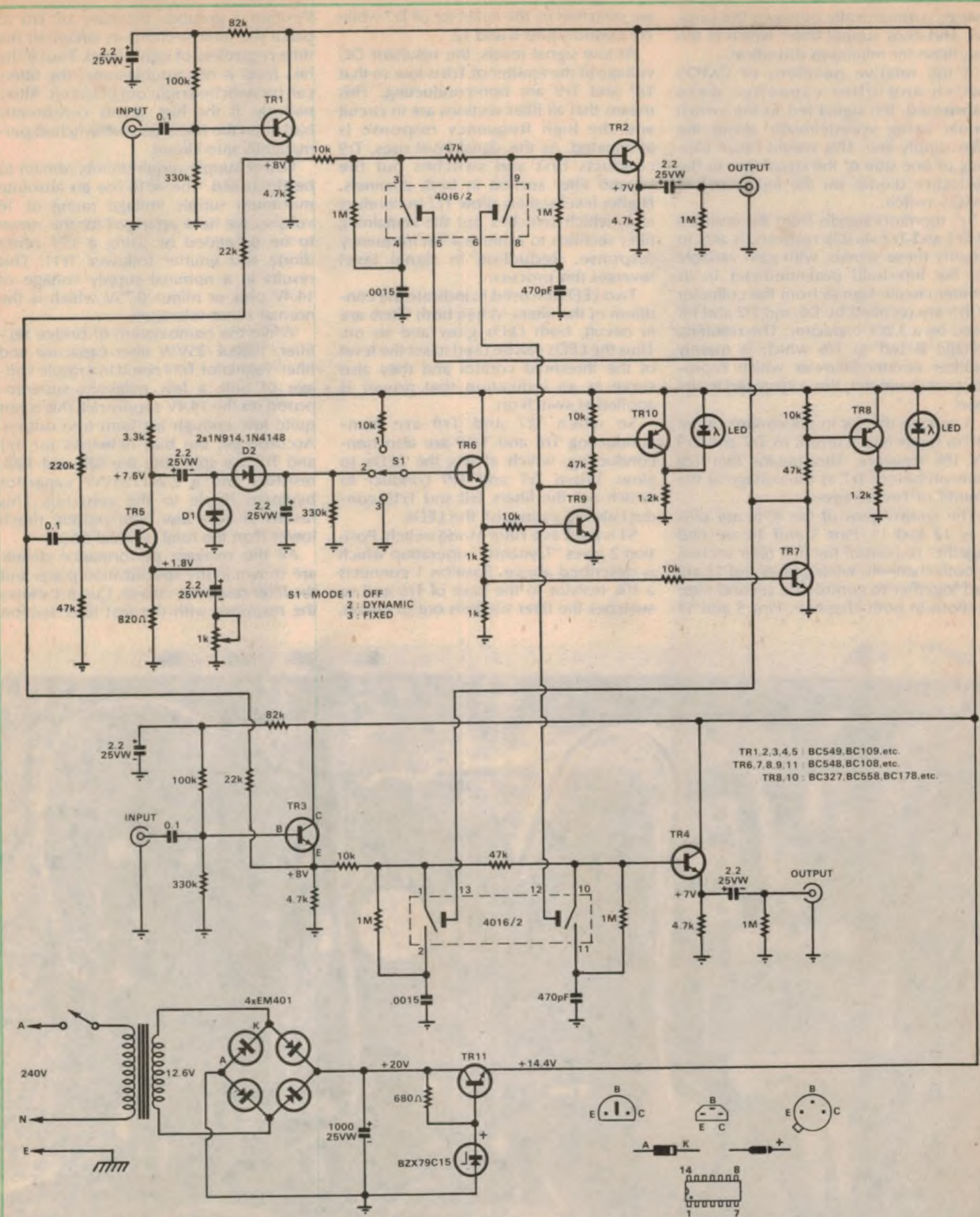
Tr1 (and Tr3) is an emitter-follower which feeds a cascaded pair of single-section low-pass filters each with a roll-off above 7kHz. When both filters are switched in, they give a maximum rate of attenuation of high frequencies of 12dB/octave. The first filter consists of a 10k resistor and .0022uF capacitor which results in a filter impedance of roughly five times less than the second filter (47k and 470pF) to avoid loading effects. Output signal of the second filter is buffered by a second emitter-follower, Tr2 (Tr4), to give a low output impedance.

So Tr1, 2, 3 and 4 provide the actual signal path for both channels, with an overall gain of slightly less than unity. Since four filter sections are involved, two per channel, then four switches are needed to place them in and out of circuit. The switches are provided by the CMOS quad bilateral switch IC, type 4016.

This CMOS IC provides four SPST switches which closely approach the ideal for our purpose. The signal path of each switch can handle signals of up to 15V peak-to-peak (i.e., equal to the supply voltage) with very low distortion and low cross-talk between other switches. The switches have very high OFF resistance and low ON resistance (typically 200 ohms), and all switches are closely matched. Isolation between control and controlled signals is extremely high, with resistance values in the region of 1 Tera-ohm being quoted. 1 Tera-ohm is 1 million megohms.

Finally, the feedthrough signal can be as high as 40MHz while toggle rates can be up to 10MHz. These figures add up to impressive performance.

There are two points about the circuit



STEREO DYNAMIC NOISE FILTER

which should be noted at this stage of our discussion. First, Tr2 is biassed via the 10k and 47k signal path resistors from the emitter of Tr2 (similarly with Tr4 and Tr3) so that the signal swings symmetrically between the supply lines (ie, with reference of approximately half the supply voltage). Second, each CMOS bilateral switch is interposed between the signal path and the rolloff capacitors which are .0022uF and 470pF. Thus the signal applied to the CMOS switches swings symmetrically between the positive and zero supply lines, which is the condition for minimum distortion.

If the relative positions of CMOS switch and filter capacitor were transposed, the signal fed to the switch would swing symmetrically about the zero supply line. This would cause clipping of one side of the signal due to the protective diodes on the inputs of the CMOS switch.

Tr5 monitors signals from the emitters of Tr1 and Tr2 via 22k resistors. It acts to amplify these signals, with gain variable via the threshold potentiometer in its emitter circuit. Signals from the collector of Tr5 are rectified by D1 and D2 and filtered by a 2.2uF capacitor. The resulting voltage is fed to Tr6 which is merely another emitter-follower which reproduces at its emitter, the voltage fed to the base.

A voltage-divider in the emitter circuit of Tr6 feeds base current to Tr7 and Tr9 via 10k resistors. This means that Tr9 turns on before Tr7 as the voltage at the emitter of Tr6 increases.

The control pins of the 4016 are pins 5, 6, 12 and 13. Pins 5 and 13 are tied together to control the first filter section in both channels, while pins 6 and 12 are tied together to control the second filter sections in both channels. Pins 5 and 13 are switched by the collector of Tr7 while Tr9 controls pins 6 and 12.

At low signal levels, the resultant DC voltage at the emitter of Tr6 is low so that Tr7 and Tr9 are non-conducting. This means that all filter sections are in circuit and the high frequency response is attenuated. As the signal level rises, Tr9 conducts first and switches out the second filter section in both channels. Higher level signals allow Tr7 to conduct also, which switches out the remaining filter sections to achieve a flat frequency response. Reduction in signal level reverses this process.

Two LEDs are used to indicate the condition of the filters. When both filters are in circuit, both LEDs glow and so on. Thus the LEDs can be used to set the level of the threshold control and they also serve as an indication that power is applied at switch on.

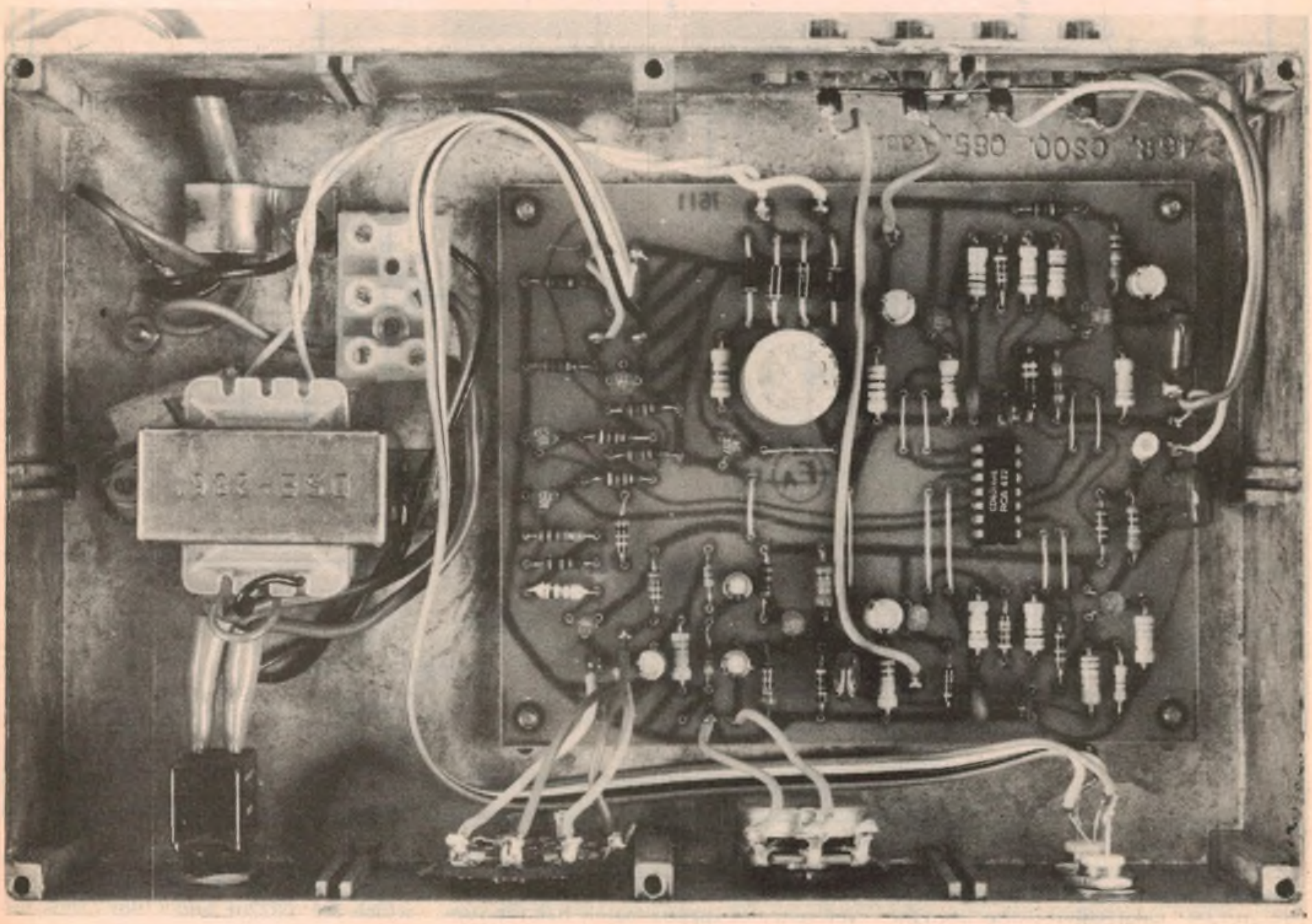
So when Tr7 and Tr9 are non-conducting Tr8 and Tr10 are also non-conducting, which allows the LEDs to glow. When Tr7 and Tr9 conduct to switch out the filters Tr8 and Tr10 conduct also to extinguish the LEDs.

S1 is used as a Filter Mode switch. Position 2 gives "Dynamic" operation which is described above. Position 1 connects a 10k resistor to the base of Tr6 and so switches the filter sections out of circuit. Position 3 grounds the base of Tr6 to place the filter sections in circuit all the time regardless of signal level. Thus if the hiss level is not troublesome, the filters can be switched right out of circuit. Alternatively, if the hiss seems consistently bad, then the filters can be switched permanently into circuit.

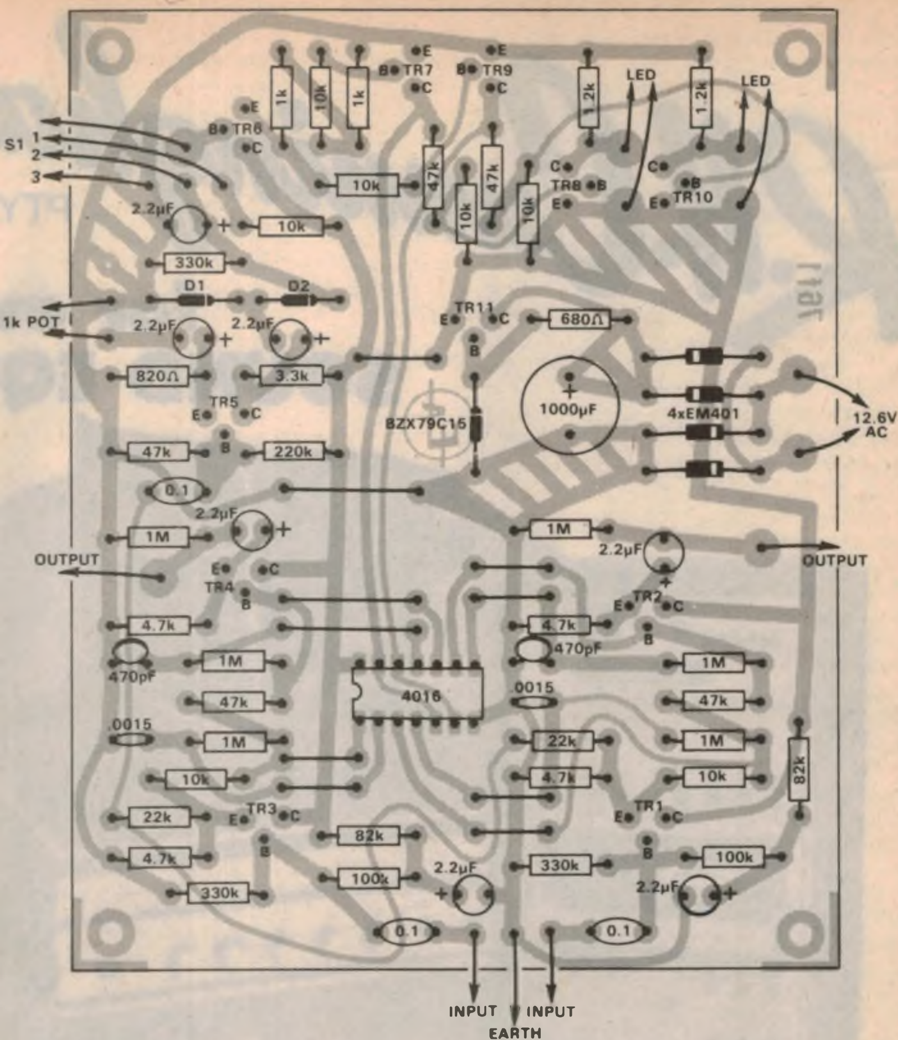
Power supply requirements remain to be discussed. The 4016 has an absolute maximum supply voltage rating of 16 volts so we have arranged for this never to be exceeded by using a 15V zener diode and emitter follower Tr11. This results in a nominal supply voltage of 14.4V plus or minus 0.75V which is the normal zener tolerance.

While the combination of bridge rectifier, 1000uF/25VW filter capacitor and filter/regulator Tr11 result in a ripple voltage of only a few millivolts superimposed on the 14.4V supply rail, this is not quite low enough for hum free output. Accordingly, the bias networks for Tr1 and Tr2 are split with the 82k and 100k resistors and a 2.2uF/25VW capacitor bypasses ripple to the zero rail. This results in very low hum output, much lower than the total residual noise.

All the relevant performance details are shown in the specification panel and the filter response curves. Curve 1 shows the response with the first filter section



Readily available and economical components are used throughout. The 4016 integrated circuit sells for about $1.00.



When all the small components are soldered in, insert and carefully solder the 4016.

PARTS LIST

1 diecast case and lid
1 front panel to suit (see text)
1 PC board, 127 x 102mm, code 76f1
1 three-pin mains plug
1 power transformer, 12.6V secondary, Ferguson PF2851, DSE 2851, A & R 6474.
1 SPST toggle switch, McMurdo 475 series or similar
1 four-way RCA phono connector strip
2 decorative knobs

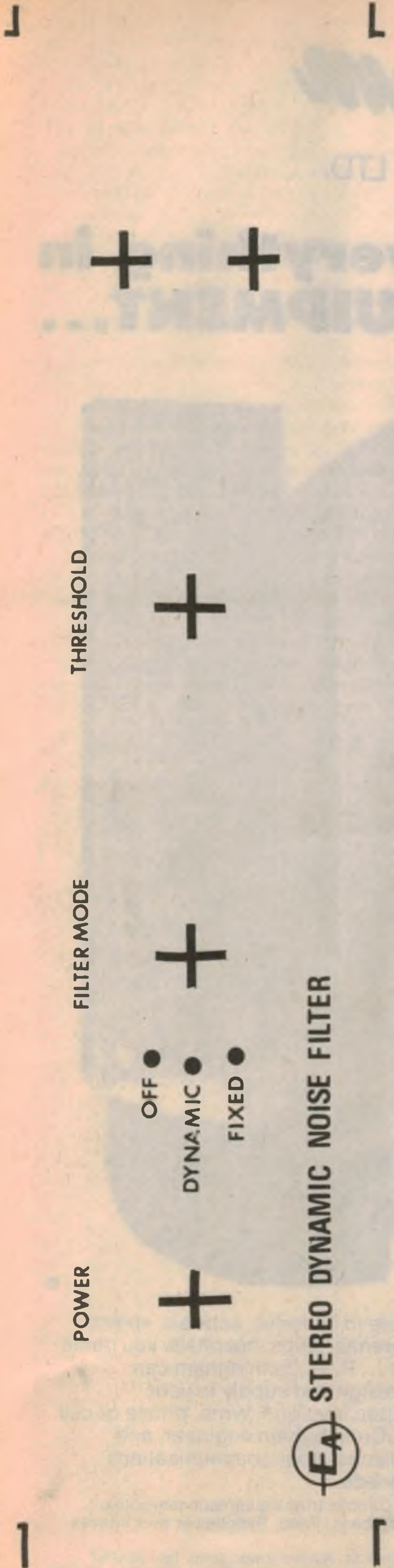
SEMICONDUCTORS
1 SCL4016A, CD4016 or equivalent CMOS quad bilateral switch
5 BC549 or equivalent low noise silicon NPN transistors
4 BC548 or equivalent general purpose silicon NPN transistors
2 BC327, BC558 or equivalent general purpose silicon PNP transistors
1 BZX79/C15 15 volt 400mW zener diode
4 EM401 silicon rectifier diodes
2 1N914, 1N4148 silicon signal diodes
2 LEDs with chrome bezel, McMurdo 3240-01-02 (see text)

CAPACITORS
1 x 1000uF/25VW PC electrolytic
7 x 2.2uF/25VW PC electrolytic
3 x 0.1uF metallised polyester
2 x .0022uF metallised polyester
2 x 470pF polystyrene or low voltage ceramic

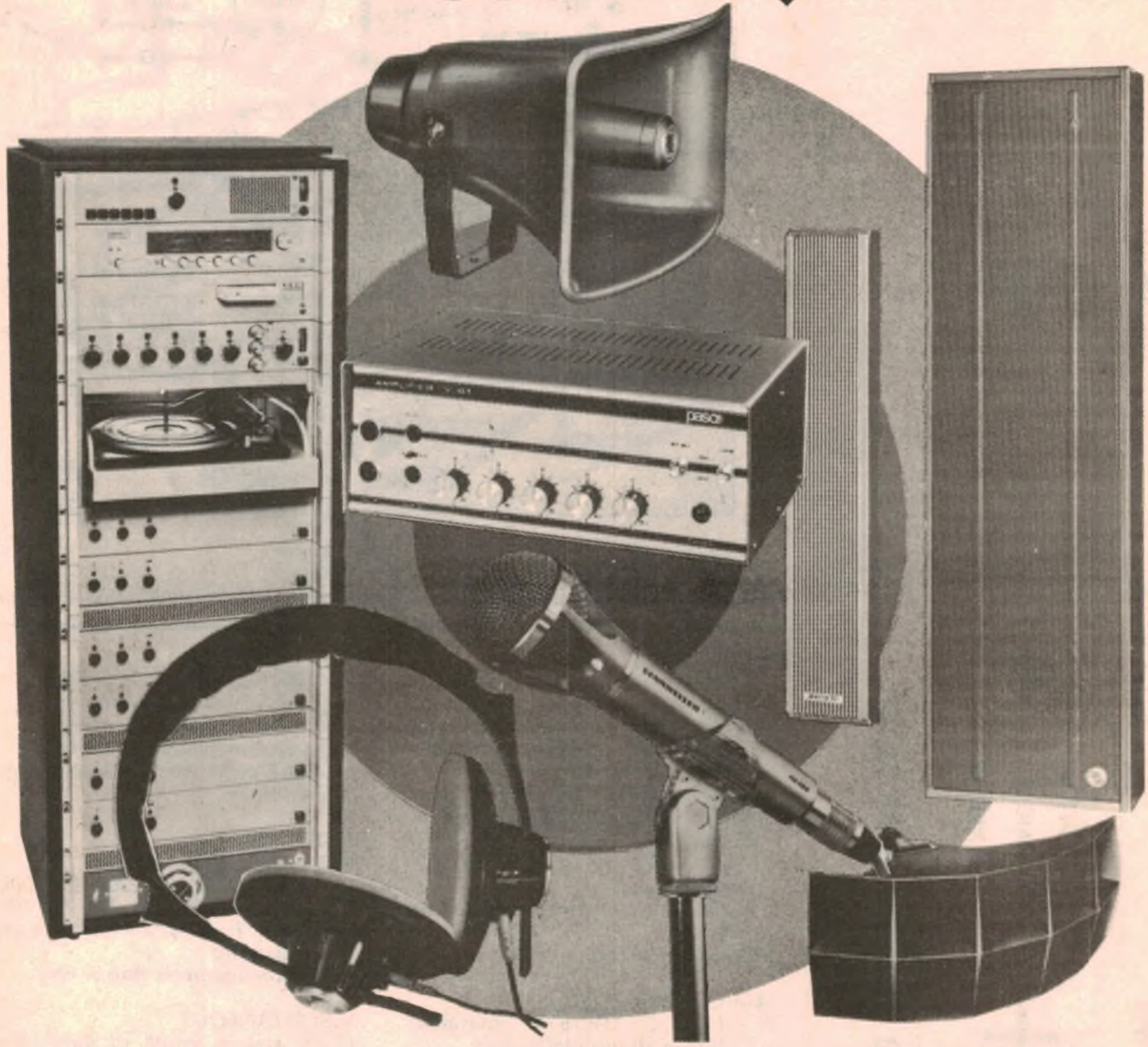
RESISTORS
(¼W or ½W, 5% tolerance)
6 x 1M, 3 x 330k, 1 x 220k, 2 x 100k, 2 x 82k, 5 x 47k, 2 x 22k, 7 x 10k, 4 x 4.7k, 1 x 3.3k, 2 x 1.2k, 2 x 1k, 1 x 680 ohms
1 x 1k potentiometer (log or lin.)

MISCELLANEOUS
17 PC stakes, length of three-core mains flex, 30cm of 1 flat rainbow cable, solder lug, grommet, rubber feet (if required), screws, nuts, lock-washers, solder, three-way insulated terminal block, cable clamp.

NOTE: Components with higher ratings may be used provided they are physically compatible. Lower rated components may also be used in some cases, provided their ratings are not exceeded.



Above is the artwork for the control panel.

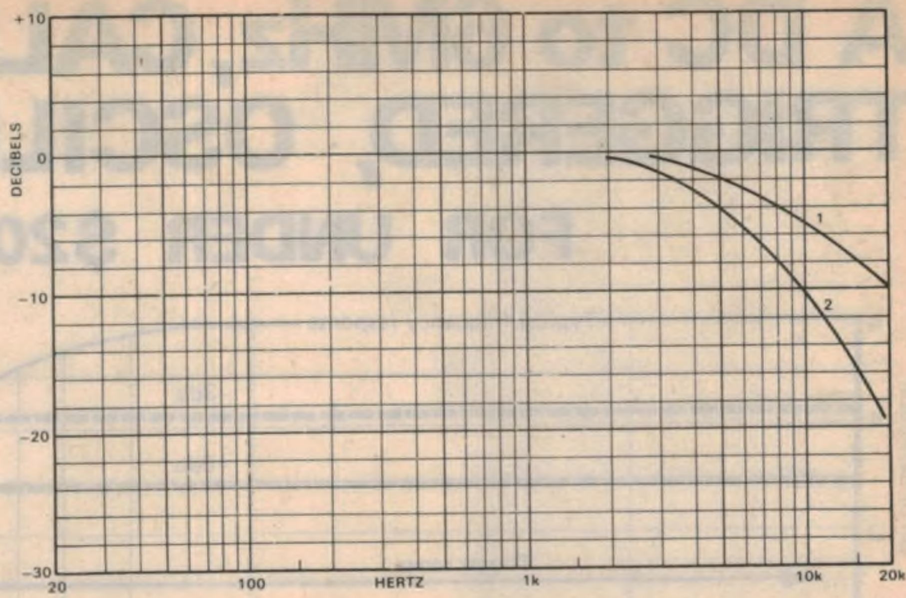


switched in while curve 2 shows the resultant response with both filters switched in. The maximum rate of attenuation as shown in curve 2 is closer to 10dB/octave than the 12dB/octave that simple theory would suggest. This can be explained by loading effects on each filter section.

Frequency response with both filter sections switched out is very flat, with –1dB points at 30Hz and 100kHz. Gain or insertion loss is minus 1dB, which is negligible.

SPECIFICATIONS

Frequency Response: 30Hz to 100kHz between -1dB points with filters switched out.
Insertion loss: 1dB (0.9).
Input impedance: 70k.
Output impedance: less than 1k. Output load should be more than 10k for low distortion.
Distortion: Less than 0.1% up to 3V RMS input.
Separation between channels: Better than 40dB.
Input overload: 4V RMS.
Signal-to-noise Ratio: Better than 63dB with respect to 100mV out; Hum output: less than 74dB with respect to 100mV.



Response curves for the filters. Curve 2 is the resultant curve with both filters.

Harmonic distortion is very low under all conditions and in fact we were merely measuring the distortion of our oscillator at most times. Accordingly, for signal levels below 3V RMS and for all frequencies in the normal audio bandwidth, we have quoted distortion at less than 0.1%. Actual distortion will be very much lower than this.

Maximum input signal before clipping is 4V RMS. Separation between channels is better than 40dB for all frequencies of interest. This is measured with the unused input unloaded so actual results would be better again. Similarly, signal-to-noise ratio is quoted at –63dB with respect to 100mV RMS with open-circuit imputs and with a noise bandwidth of 25kHz. Loading the inputs with a low impedance source improves the figure to 65dB. In practice, the unit causes no discernible degradation of an amplifier's S/N ratio and is considerably better than the average or even above-average cassette deck in this respect.

Threshold settings to actuate the filter control circuitry are variable between 50mV and 300mV RMS. Attack time is about 7 milliseconds while decay time is about 200 milliseconds (mainly determined by the beta of Tr6).

Now to explain the compromise or "catch" we mentioned earlier in the article. Notice that each filter section begins it rolloff (–3dB point) at about 7kHz and the total rolloff begins at about 4kHz. While this sounds drastic, this compromise was necessary in order to obtain a useful reduction in hiss. Now the catch is that people with acute ears may be able to hear the hiss being "gated" on and off by the arrival of high level signals. This can be more disturbing to some people than a constant background hiss. To reduce this effect, the rolloff frequency should be raised by reducing the filter section capacitors. However this means a consequent lesser reduction in hiss.

For those who wish to experiment with the rolloff frequencies, the .0022uF and 470pF capacitors are varied directly in proportion to the proposed rolloff frequency.

Whichever rolloff frequency you do decide upon, we think you will agree that this circuit is very attractive because it has no internal setting up adjustments and literally no distortion.

Our prototype was housed in a diecast metal box measuring 222 x 146 x 57mm, with the control panel on one side and the input and output sockets on the opposite side. The front panel was made using Scotchcal photosensitve aluminium. The artwork for the panel is included in these pages. For a final touch to the finish, install the diecast case in a veneered timber sleeve or finish to match the other components in your system.

A PC board coded 76f1 and measuring 127 x 102mm accommodates the circuitry. Assembly of the PC board can begin by installing all the small components, leaving the CMOS integrated circuit till last.

General-purpose small-signal silicon transistors can be used in this circuit. Ideally, Tr1, 2, 3, 4 and 5 should be BC549 or equivalent low-noise silicon NPN types to ensure the best signal-to-noise ratio and high beta requirements set by the high resistance base bias networks. However, the performance we quote in the specification panel was obtained using BC548's which were selected for beta of 250 or more. So if you have means for measuring beta and have BC548's or other general-purpose silicon transistors to spare, they may be pressed into service here.

Tr6, 7, 9 and 11 can also be BC548 or any equivalent type. Tr8 and 10 are BC327, BC558 or equivalent general purpose silicon PNP types. D1 and D2 can be any small signal diodes, germanium or silicon or small rectifier diodes such as EM401.

Resistors can be ¼W or ½W types with 5% tolerance. Use low noise types such as cracked carbon or metal glaze for the high value resistors, particularly those used in the bias networks for Tr1 and Tr3. The smaller ¼W resistors are preferable since they are easier to insert.

All the electrolytic capacitors are end-mounting PC types and we have standardised on 2.2uF (for all but the main reservoir capacitor) in the interest of the economy and simplicity. Capacitors used in the single-section filters, .0022uF and 470pF, should have 10% tolerance or better. If low voltage ceramic capacitors are used for the 470pF, they should be checked to ensure they are within 10% of value specified.

Use PC stakes or pins to make interconnections to the PC board. Seventeen will be required.

When all the small components have been inserted and soldered, you can deal with the CMOS integrated circuit. It will be supplied with its pins inserted into black conductive foam or wrapped in aluminium foil. Refer to the PC layout to determine the correct orientation for the IC and then insert and solder it, still with foil or foam shorting the pins. When soldering is complete, remove the foam or foil. Actually, if you have a low-voltage soldering iron with a grounded tip you can remove the foam or foil before soldering. This latter procedure is relatively safe for this particular CMOS IC since it has diode protection on all inputs.

This does not mean you can use your old 240VAC 100W soldering iron that your father used to solder galvanised guttering! That is asking for trouble. Care is still required.

Having completed assembly of the PC board, attention can be turned to the diecast case. Drill all the required holes and countersink where necessary. Now the hardware can be installed.

A four-way connector strip was used for the RCA phono input and output connectors. These require more filing and cutting of the case than if four individual sockets were used, but the final result is neater. Alternatively, if your system uses DIN sockets, then these are equally appropriate. The earth connections of the sockets are all connected together and then finally connected to the PC board earth but the signal earth does not connect to the case. This is earthed back via the three-core mains cord.

The transformer we used was a small unit with a 12.6V secondary. We used a DSE 2851 kindly supplied by Dick Smith Electronics, but a Ferguson PF 2851 or A&R 6474 are equally suitable and slightly smaller, which might be an advantage if a smaller case is used.

These transformers normally have a centre tap connection to the secondary winding but this is not used here. It should be coiled up and taped to avoid shorting to the case.

The three-core mains cord should be passed through a grommetted hole in the rear of the case and anchored with a cord clamp. Terminate the earth conductor to a solder lug on the chassis and the active and neutral conductors to a three-way insulated terminal block. Connections to the power switch and transformer are then made via the terminal block.

We used a McMurdo series 475 toggle for the mains switch. After wires are soldered to the switch, the connections should be covered with plastic sleeving to avoid contact with incautious fingers. The mode switch requires a single-pole, three-position rotary type but the one we actually used was a two-pole, three-position wafer. Both the rotary switch and potentiometer shafts should be cut to a length to suit the knobs before being installed. The potentiometer can be a logarithmic or linear type with value 1k.

Several choices are available as far as the LED indicators. We used LEDs with chrome bezels, as distributed by McMurdo. A cheaper approach would be to use LEDs with plastic clip-lock bezels or simply glue the LEDs into holes in the front panel with a suitable adhesive such as Araldite.

When all the hardware is installed in the case drop the PC board into place and make all the connections. There is no need to use shielded cable for the inputs and outputs nor would there be any noticeable improvement gained by doing so. A short length of multicoloured "rainbow" cable will provide all the necessary hook-up wire. It results in a neat job without the need for cable lacing. About 30cm of rainbow cable will be adequate.

Double-check your wiring and then apply power. Check voltages. These should be within 0.5V of those on the circuit. The main supply rail should be slightly less than 15V. If it exceeds 15V there is danger of "blowing" the CMOS IC. If all checks are OK you are ready to test the filter with a cassette deck and stereo amplifier.

First connect the output of the filter to the tape monitor inputs or high level inputs of the amplifier and listen for any hum or noise. Unless the amplifier has an exceptional signal-to-noise ratio, there should be no degradation, i.e., the amplifier should be no noisier than it normally is at a given volume control setting.

Now connect the line outputs from the cassette deck to the input of the filter and play a cassette. Adjust the threshold control so that the LEDs are extinguished when the playback signal exceeds about −15dB as indicated on the VU meters of the cassette deck. This adjustment will give you optimum results for most tapes but it can be varied to suit particular conditions.

It is important that the threshold control is not advanced to the point where the LEDs are flashing on and off with low level signals. In this condition the listener is more likely to be conscious that the signal is "gating" the noise on and off. As noted above, this effect could be more objectionable than continuous hiss.

In conclusion we note that this unit could be incorporated into a stereo amplifier with consequent savings on the case and power supply. If built as a free-standing unit like our prototype it would be possible to fit the PC board into a smaller case although more care would be required with layout and transformer location and orientation to ensure hum-free performance. It is also possible to replace the threshold control with a preset potentiometer soldered directly into the PC board, should you wish.

Actual size artwork for the PC board.

Simple novice transmitter for the 3.5MHz amateur band

Here is a simple transmitter design for those who hope to have their Novice Licence shortly. Using only four readily available valves, it will enable you to get on the air with a minimum of time and effort. A matching modulator and power supply will be described next month.

by IAN POGSON

The idea of a Novice Amateur Licence is one which has been under consideration for a number of years and at the time of writing it is almost a reality. Let us hope that by the time this appears in print candidates will have some definite information as to when they will be able to get going.

Meanwhile, we have been giving the matter some careful thought regarding the presentation of a suitable transmitter for the Novice Licensees. Although Novices will be licensed to operate on certain segments of the 3.5MHz, 21MHz and 27MHz bands, on CW, AM, SSB and narrow band FM, we considered that it would be rather too complex a project to attempt to cover too much in one hit. We have chosen a rather simple transmitter for use on 3.5MHz only catering for CW and AM. This unit is straightforward and should be quite easy for the novice to get going.

In addition to frequency restrictions for novices, the power input to the final is restricted to 10 watts and the transmitter must also be crystal controlled. All of these points can be met without any problems. The next question we faced was how we should go about designing a transmitter of this type—what physical form should it take, should it use solid state devices or should it use valves?

Perhaps the most important decision related to the use of solid state techniques versus valves. We settled for the latter, as valves are far more tolerant and easy to get going in transmitter applications. But the choice of valves was a harder one to decide, as a wide range of possibilities suggest themselves. Within reasonable limits, there are many valves which will do the functions required. More will be said about possible alternatives later on.

For the transmitter proper, that is, the crystal oscillator and final stages, we considered that two valves common to many television receivers would be suitable: a 6BX6 for the crystal oscillator and a 6CM5 line output valve for the final. We had already used the 6BX6 as an oscillator in the past, but we had not seen the 6CM5 used in the role of an RF amplifier. The characteristics of the 6CM5 appeared to be attractive for this application, being quite rugged with regard to dissipation ratings, compared with the power which we would be asking it to handle.

Having arranged a rough lash-up of a 6BX6 crystal oscillator and a 6CM5 RF amplifier, we soon had over 1.5mA of grid drive to the 6CM5, without any HT applied to the plate or screen. Further investigation led to suitable screen grid and plate circuit constants and we had no trouble in loading the 6CM5 up to 10 watts plate input. In short, the 6CM5 turned out to be an excellent valve for the application. Of course this investigation was restricted to the 3.5MHz band, and it remains to be seen just how well it would perform at higher frequencies. This can come later should the need arise.

The same question arises as to what should be used for a speech amplifier and modulator—solid state or valves. For similar reasons already stated, we decided that it would be best to use valves. What valves? For the speech amplifier, there are a number of alternative choices but we settled for a 12AX7. This consists of two high gain triodes and when used in cascade, these give enough gain for a microphone input to drive a pentode or beam power amplifier.

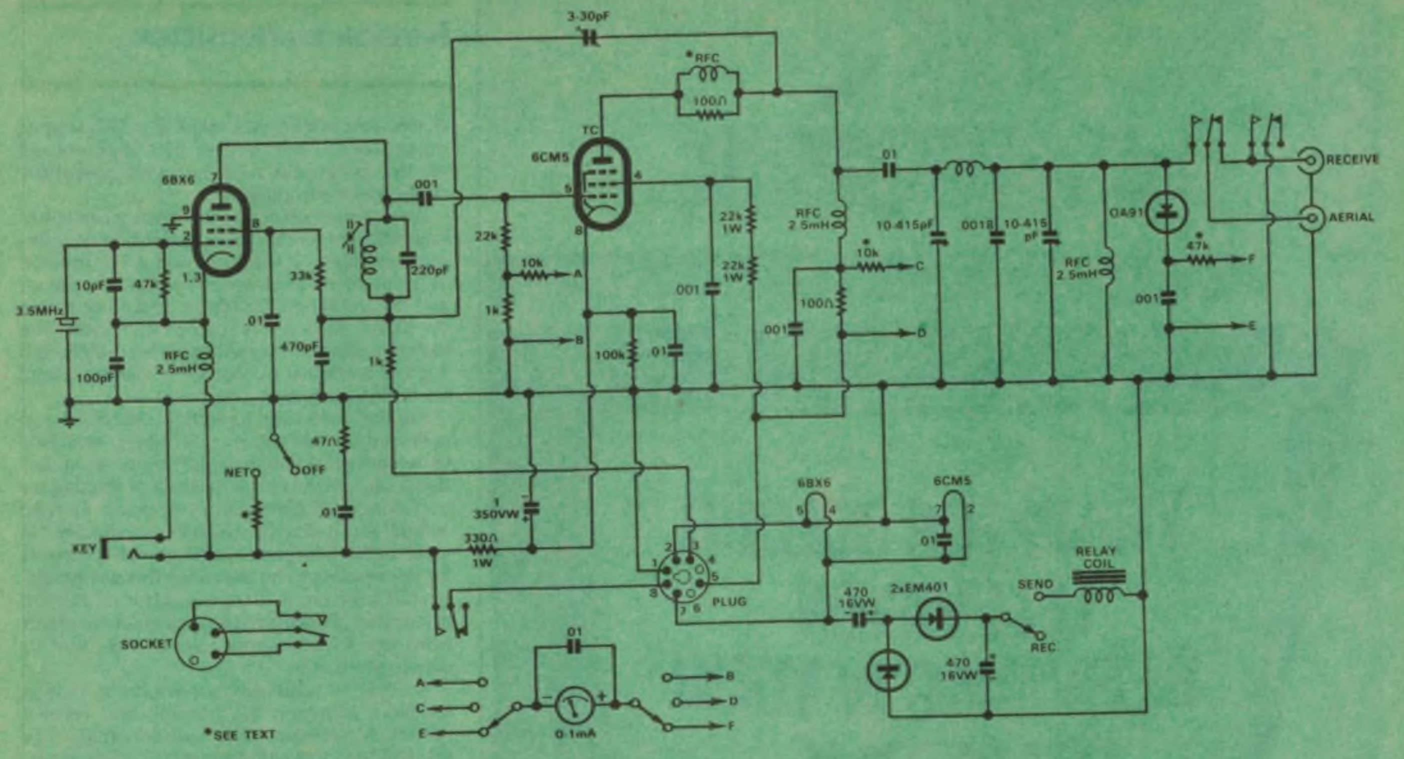
At first sight it may seem that there may be many power valve types which could be used as a modulator. However, this is not so. The need is for a single ended stage, operated in class A and which will give 5 watts output to the secondary of a modulation transformer. Also, to keep costs down, we elected to use a power transformer as a modulation transformer and this leads to further restrictions with regard to impedance matching between the modulator valve and the modulated RF amplifier. A 6V6 or similar, will give a maximum of 4.5 watts and by the time this is used to modulate the RF amplifier, there will be even less than 4.5 watts, resulting in inefficient use of the 10 watts of input to the RF amplifier.

The 6L6, big brother of the 6V6, will give sufficient power to modulate the RF amplifier but it is a high current device and requires a fairly low plate load impedance, points which are not compatible with our setup. The 6CA7 is very similar and so it is not suitable either.

Possibly the most suitable valve for our purpose is the 6BQ5 (EL84). This valve is rated to give 6 watts output with a plate current of just under 50mA. This suits our purpose nicely and it is the obvious choice. More will be said later on regarding the possibility of using other valve types.

The question as to whether the whole system would be contained in one complete case, or broken into two or more separate assemblies also had to be decided. While there is a lot to be said for including everything in one assembly, there are also arguments for separating some of the functions. It is desirable to keep the RF and audio sections separate,

At left is the completed prototype, built into a standard metal case. Full circuit details are shown on the facing page.



3.5MHz NOVICE TRANSMITTER

to avoid the possibility of RF getting into the audio circuits, with attendant problems such as distortion and RF feedback.

A fairly logical choice would be to make the RF sections into one assembly and combine the audio and power supply into another assembly. This is the method which we have adopted. Apart from the power supply requirement, the RF section is a complete CW transmitter and we will describe this part first, leaving the modulator and power supply to be described next month.

The circuit of the transmitter is conventional but for the benefit of novices it may be worth while to have a closer look at it. The crystal oscillator is a Colpitts, with the normal L-C tuned circuit replaced by a crystal. A pentode valve is used, with the screen-grid being bypassed and so grounded to RF so that it actually performs the normal function of the plate or anode.

The plate proper is "electron-coupled" to the oscillator part of the circuit and there is a tuned circuit in the plate which is resonated at the same frequency as the crystal. It may be of interest to note that the plate tuned circuit of such an oscillator may be resonated to a harmonic of the crystal frequency, so the complete stage could be used as a frequency multiplier in a more elaborate transmitter.

In order to achieve oscillation, a characteristic of the Colpitts oscillator is to use two capacitors in a voltage divider arrangement, with the capacitances selected so as to give the correct amount of feedback. This is achieved in this case with the 10pF and 100pF capacitors in series. A 47k grid leak is connected from the control grid to the cathode, which is also connected to the junction of the capacitor divider. An RF choke is used between the cathode and earth return, to provide a DC path for the cathode current and to keep the cathode at its correct RF potential.

Output from the plate of the oscillator is fed via a .001uF capacitor to the control grid of the power amplifier. In this grid circuit we have a 22k resistor for the grid leak. It will also be noted that there is a 1k resistor in series with the grid leak. This is for metering the amount of grid current passing through the grid resistor, by virtue of the RF drive from the previous stage. The current through the 1k resistor may be read off as a voltage drop. A 10k resistor from the junction of the 22k and 1k resistors is run to a 0-1mA meter, making it a 0-10 voltmeter. Thus, if a current of 1mA is flowing through the 1k resistor, it will read as 1V on the meter.

The cathode ot the power amplifier is normally grounded to DC and RF. But in order to achieve certain transmitter controls and functions this circuit is here somewhat more complex. We will leave this for the moment and return to it a little later on.

The screen grid of the power amplifier is fed from the modulated high tension supply, via two 22k, 1W resistors in series. The screen is bypassed to RF but the value of this capacitor must be such that it bypasses the RF while not affecting the higher audio frequencies. A value of .001uF meets this requirement.

The plate of the power amplifier is also fed from the modulated high tension supply, via a 2.5mH RF choke. This choke passes the plate current and also allows the RF output voltage to be developed across it. It may also be seen that there is another RF choke, shunted with a 100 ohm resistor, right at the plate of the RF amplifier. This combination is inserted as a precaution against parasitic oscillations, although we did not find it to be necessary.

Metering for the power amplifier plate circuit is done in a similar manner to that for the control grid. As the current will be much greater in this case, instead of a 1k resistor, we have used 100 ohms. A 10k resistor is connected in series with the same meter as before, and the voltage drop across the 100 ohm resistor is read on the meter, in terms of current (0-100mA).

From the junction of the RF choke, 100 ohm and 10k resistors is an RF bypass capacitor. As was the case with the screen grid bypass, this capacitor must bypass the RF at this point but as it is in the modulated HT line, it must not affect the audio frequencies. Again, a value of .001uF meets the need.

While it may be possible to avoid neutralising the power amplifier, it is quite a simple addition and one which we consider well worth while. Neutralisation is achieved by the series-capacitance method. A 3-30pF neutralising capacitor is connected back to a 470pF capacitor at the "cold" end of the crystal oscillator tuned circuit. The complete neutralising circuit is in the form of a bridge. Neutralising is correct when the ratio of the neutralising capacitance to the 470pF is equal to the ratio of plate-to-grid capacitance to the input capacitance to the control grid. This latter also includes the output capacitance of the previous stage, plus strays.

Returning now to the plate circuit of the power amplifier, the RF energy at the plate is fed via a .01uF coupling capacitor to a "pi-network". The coupling capacitor is necessary to block off the DC voltage from the tuned circuit, but at the same time passing the RF component.

The pi-network consists essentially of a tuned circuit, with a coil and two capacitors. Both capacitors are variable and one functions as a "tuning" capacitor and the other for "loading". The complete circuit is an impedance matching device, transferring the RF energy from a high impedance plate circuit, to a low impedance feedline to the aerial. The tuning capacitor is a somewhat lower value than that for loading, thereby achieving the required impedance transformation. To obtain sufficient capacitance for the loading element, a fixed capacitor is connected in parallel with the smaller variable capacitor.

It may be seen that there is a 2.5mH RF choke connected across the loading capacitor. This does not contribute to the functioning of the circuit but it is included as a safety device. Should the .01uF coupling capacitor break

Novice transmitter

down, this choke will short the DC supply, otherwise it would appear as a high voltage on the aerial and feedline, with potentially dangerous consequences.

Also connected across the loading capacitor is another metering circuit, consisting of a germanium diode, a capacitor and a 47k resistor. This circuit rectifies a little of the RF output, and the resulting DC voltage appearing across the .001uF capacitor is read on the meter. The meter reading is not calibrated accurately, but it gives a relative output level reading useful for tuning purposes.

All the metering functions described are achieved by the use of one meter, switched to whatever circuit may be required at any time. The grid circuit is capable of reading up to 10mA. The plate circuit is made to read 100mA and it may be necessary to modify the value of the 10k resistor in series with the meter for this reading to be accurate. This will be discussed later on. A .01uF capacitor is shunted across the meter terminals to protect the meter from any RF component which may find its way to the meter.

A relay is required to perform switching functions between the transmit and receive modes. A miniature relay with a nominal 12V DC winding and with four sets of changeover contacts is needed. The circuit shows one set changing the aerial connection between the receiver and transmitter, with a second set used to short-circuit the aerial lead to the receiver when the transmitter is on. A third set of contacts is used for the function involving switching between the phone and CW modes, while the fourth set is reserved for use in receiver muting during transmitting.

A special power supply is required for the relay coil. This supply is derived from the transmitter valve heater 6.3V AC supply. A half-wave voltage-doubler circuit using two silicon power diodes and two 470uF electrolytic capacitors give approximately 12V DC under load. This voltage rises somewhat off load.

As mentioned earlier, the cathode circuits are somewhat more than a simple arrangement. This is brought about by the need for a satisfactory keying arrangement for CW transmission. The classical method of achieving keying with this type of transmitter is to tie the two cathode circuits together and key both stages. A study of this part of the circuit will show that this is how we have done it.

Under "key-up" conditions, there is practically no cathode current at all. To stop the cathode potential from rising too high above earth potential, with the danger of heater-cathode breakdown, a 100k resistor is connected permanently between the power amplifier cathode and earth. This limits the voltage to about 150V between cathode and heater/ground.

A 330 ohm resistor in the cathode of the power amplifier performs two functions. In the event of loss of grid drive, this resistor acts as a bias resistor and limits the plate current of the valve to a safe value. This resistor is also part of the keying filter circuit, working with the 1uF electrolytic capacitor to soften the keying characteristic. The 1uF electrolytic and a .01uF capacitor in parallel function as RF and audio bypass for the power amplifier cathode.

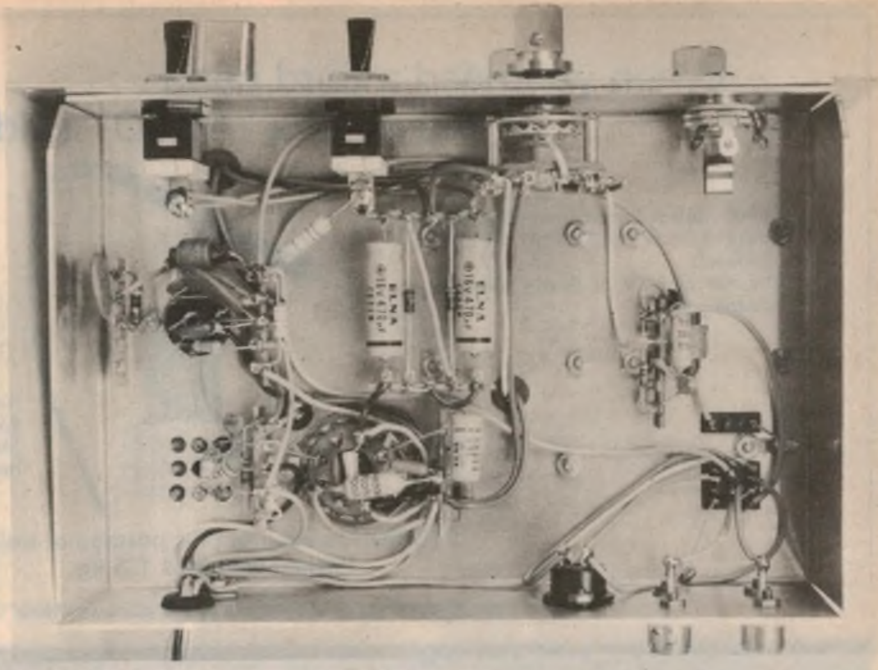
Another part of the keying filter is a 47 ohm resistor in series with a .01uF capacitor, directly across the key. This is to reduce sparking at the key contacts and so avoid key clicks.

A "net" facility is also included in the cathode circuits. A resistor is connected in series with a "net" switch, the two also being across the key. By operating this switch, the resistor limits the current to both stages but the oscillator will still give enough output to be heard in the receiver, which may be set correctly to the crystal frequency. The value of the resistor must be determined experimentally.

Having looked over the circuit, perhaps some comments on components may be helpful.

Resistors should present no problems at all. The only point to watch is that although most resistors may be ½ watt types, some must be 1 watt rating as indicated on the circuit and the parts list.

Some of the capacitors are reasonably critical and substitutions should be avoided unless readers have good reason for doing so. The two variables are quite standard and are made by Roblan. Although the spacing is fairly close, especially for the tuning capacitor, in practice we have found that it presents no problems with regard to flashover on modulation peaks. The 3-30pF neutralising capacitor used on the prototype is one of the older Philips "beehive" type. We suggest that you use this type if you can get one. Otherwise a substitute, such as the newer Philips trimmer with solid dielectric should suffice, although we have not tried them in this application.



This under-the-chassis view clearly shows the layout of the major components. Note the relative positions of the various tagstrips used to facilitate construction.

The .01uF coupling capacitor between the power amplifier and the pi tuning network should ideally be a stacked foil mica type. Unfortunately these are very difficult to come by these days and so most builders will have to content themselves with some other type. We used a ceramic disc type rated at 630V and this has proved quite satisfactory in operation. At this rather low frequency, it may be possible to use one of the polycarbonate types, also rated at 630V, in this position. We used one of this type across the loading capacitor.

The crystal must be within the frequency range 3.525MHz and 3.575MHz. We used two crystals provided by courtesy of Bright Star Crystals Pty. Ltd., 35 Eileen Road, Clayton, Victoria. The frequencies which we selected were on 3.530MHz and 3.565MHz, but frequency selection will be up to individual choice, within the limits laid down. You may order crystals from Bright Star Crystals Pty. Ltd., from another manufacturer of your choice, or you may even have one of the old FT243 types. In point of fact, we did our initial development with one of these old crystals on 3.540MHz and it functioned very well.

The meter is a readily available type and there should be no problems here. The knobs used on the prototype came from Messrs Watkin Wynne Pty. Ltd. These knobs are of machined aluminium and are quite attractive.

The rotary switch used for meter switching is readily available and we used an "Oak", made by MSP, on the prototype. We understand that Watkin Wynne are also able to supply a suitable switch under the Jabel brand. The toggle switches which we used were supplied by McMurdo (Aust) Pty. Ltd. These switches are rugged, have an easy to use paddle and are readily available.

The relay is a miniature type, with a 12V coil and four sets of changeover contacts. There are a number of different brands available and the one which we used was made by Varley.

There are two coil formers used in the transmitter, one in the plate circuit of each stage. The oscillator output coil is wound on a Neosid 7.6mm former, 32mm long and tuned with a grade 900 slug. The former is housed in a square aluminium can. The power amplifier coil is wound on a former which is 1¼in (32mm) diameter and 2⅝in (67mm) long. The former which we used was supplied by R.C.S. Radio and we understand that there are ample stocks of these formers. There are two types available, one with the standard 6-pin valve base and the other without pins. We used one without pins.

Three RF chokes are required and we found that in all cases a standard 2.5mH, single pi winding type was adequate. This applied also to the RF choke in the plate circuit of the power amplifier where an RF choke would normally need to be a more elaborate one and one which had an ample current rating. However this transmitter only has to operate on one frequency band and the plate current is only of the order of 40mA. The simple RF choke has been found to be very efficient, with no signs of overheating.

The subject of valves has been given quite a lot of thought. The types which we chose for the initial prototype are those which we feel should be readily available to many builders without even having to go out and buy them. Both the 6BX6 and the 6CM5 have been used in large quantities in black and white television receivers. Old receivers of this type may well be a source of valves for this project. Even if you are not that fortunate, then they are still available from most component houses.

LIST OF COMPONENT PARTS

1 Metal case, 9in wide x 6⅝in high x 5½in deep
1 Chassis, 8in x 5¼in x 2⅛in
1 Meter, 0-1mA, 65mm x 60mm
1 Crystal, selected frequency, HC-6/U, 30pF, ambient temperature, tolerance .003%
1 Socket for crystal
2 Toggle switches, SPST, McMurdo
1 Rotary switch, 2-pole, 5-position, Oak or Jabel
1 Jack socket, 6.4mm
3 Knobs, Jabel etc
1 4-pin miniature speaker socket
2 Coaxial sockets, McMurdo, Belling & Lee
1 9-pin miniature valve socket
1 Octal valve socket
1 Octal plug
2 ¼in flexible couplings
1 Relay, 12V winding, 4 sets changeover contacts
1 Socket for relay
1 Coil former, Neosid, 7.6mm x 32mm with can and grade 900 slug
1 Coil former, R.C.S. Radio, 32mm diameter x 67mm long
1 Valve, 6BX6
1 Valve, 6CM5
2 Silicon diodes, EM401 or similar
1 Germanium diode, OA91 of similar
3 2.5mH RF chokes
8 Miniature 5-tag strips
4 Rubber grommets
1 Anode clip for 6CM5 valve

RESISTORS (½W unless stated otherwise)
1 47 ohms
2 100 ohms
1 330 ohms
2 1k
2 10k
1 10k 1W (see text)
1 22k
2 22k 1W
1 33k
2 47k
1 100k

CAPACITORS
1 10pF NPO ceramic
1 3-30pF Philips trimmer (see text)
1 100pF NPO ceramic
1 220pF 630V polystyrene
2 10-415pF single gang variable, Roblan
1 470pF 630V polystyrene
4 .001uF 630V polycarbonate or ceramic
1 .0018uF 630V polycarbonate
5 .01uF 400V polycarbonate or ceramic
1 .01uF 500V ceramic (see text)
1 1uF 350VW electrolytic
2 470uF 16VW electrolytics

MISCELLANEOUS
Hookup wire, solder, solder lugs, screws, nuts, cable clamp.

Novice transmitter

There are a number of alternative valves which may be used in this transmitter, although we have not tried any at this stage. It is hoped that in the not too distant future we may be able to get time to investigate at least some of the alternatives. Such types as the 6EH7, 6AU6, 6AM6 come to mind as being possibilities for the crystal oscillator. In place of the 6CM5, such types as the 2E26, 6146, 807, etc., may be tried. These are all double ended types, in common with the 6CM5 but it may be possible to use some single ended types. Here the possibilities are numerous and such types as the 6V6, 6L6, 6BW6, 6AQ5 and 6M5 may be suitable.

The transmitter is built into a metal case, 230mm wide x 170mm high x 140mm deep, including a chassis 200mm x 130mm x 50mm. This metalwork is made by Wardrope & Carroll Fabrications Pty Ltd and should be available through most components houses. The metalwork is not drilled and this means that builders will have to do the necessary drilling and punching themselves. If required, copies of the metalwork drawings may be obtained from the Information Centre.

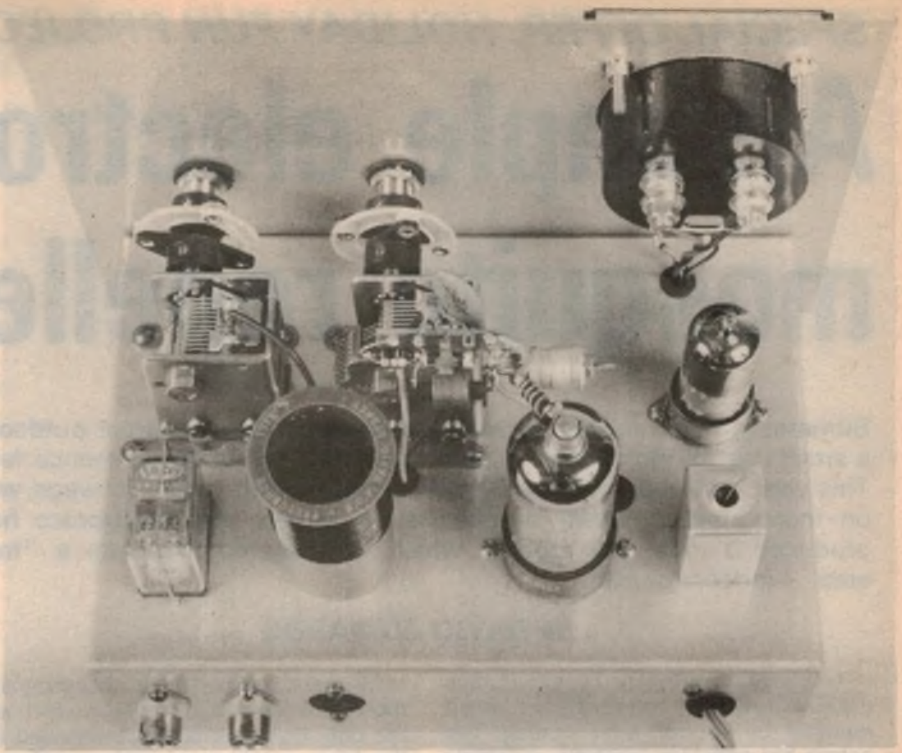
Before proceeding with the main assembly and wiring, it is a good idea to wind the coils. The oscillator plate coil consists of 50 turns of 28B&S enamel wire, close wound on the Neosid former. Each end of the winding may be anchored with a piece of good electrical tape, making sure that the winding is firm and not free to move. A spot or two of lacquer or paraffin wax could be used to advantage. The grade 900 slug should be stabilised with a short piece of thin shirring elastic, obtainable from haberdashery stores. The cotton should be removed before use. The coil winding should be terminated at the lugs which make for the shortest leads when the coil is wired into circuit. The aluminium can is fitted after the coil is completed.

The final tank coil is wound on the 1¼in diameter former, using about 20B&S enamel wire, 20 turns wound to 16 turns per inch, making the winding 1¼in long. Each end of the winding is anchored by drilling two holes about ¼in apart and threading the wire through. The winding must be firmly wound and carefully spaced and again, a small quantity of lacquer or paraffin wax may be used to ensure that the windings remain in place. A hole is drilled in the bottom of the former for fixing purposes later on.

The parasitic suppressor in the plate circuit of the power amplifier consists of four turns of about 20B&S tinned copper wire, wound over a 100 ohm ½ watt resistor. The leads of the resistor are cut off very short. The plate cap is soldered to one end and a short piece of hookup wire is soldered to the other end.

The process of assembly could conveniently start with the valve sockets. The oscillator valve socket should be orientated with pins 4 and 5 facing towards the centre of the chassis. The key of the power amplifier valve socket should point towards the position for its tank coil. The relay socket should be orientated as may be seen from the photograph. The three sockets on the back skirt of the chassis present no problems.

Before mounting the two variable capacitors, make sure that you solder a lead on the underneath lug for the stators of the loading capacitor. The oscillator coil is fixed with two 6BA screws and the tank coil may be held with one screw and nut and with the leads facing between the two variable capacitors. Grommets are fitted to the hole on the back skirt of the chassis, one behind the tuning capacitor, one in front of the oscillator valve and one between the power amplifier valve and the oscillator plate coil.



A topside view of the chassis, as seen from the rear.

Underneath the chassis, there are seven 5-tag strips. There is one fixed under each of the valve socket screws of each socket. Two more in about the middle of the chassis are held under screws fixing the tuning capacitor. The seventh one is located under a screw fixing the loading capacitor and close to the lead from its stators. The eighth tag strip is located on the body of the tuning capacitor. We fixed it with a self-tapping screw and the location may be seen from the photograph.

Turning now to the front panel, the crystal socket, meter and the two ¼in bushes may be fixed. Slip the flexible couplings on to each of the variable capacitor spindles. Now the front panel is assembled on to the chassis by means of the two toggle switches, the rotary switch and the jack socket. Two short pieces of ¼in diameter rod are required to be run through the bushes on the panel. The rods need to be long enough to be fixed to the flexible coupling and with enough protruding to take a knob. Suitable pieces of rod may be salvaged from offcuts of potentiometer spindles.

With the assembly complete, we are now in a position to do the wiring. Quite a lot of the wiring detail may be gleaned from the photographs but some comments touching on some of the more obscure points may be helpful.

All wiring which does not involve actual signal paths may be run as desired, keeping in mind the idea that leads should never be unnecessarily long and that they should be run neatly. Where earth points are involved, it is always best and indeed at times, essential, to make them as short and direct as possible. Where leads have to run between the top and bottom of the chassis, the hole through which it should run will be quite obvious.

All wiring around the sockets of both valves is done between the actual socket lugs and the lugs on the adjacent tag strips. Neatness and short, direct leads will result in a satisfactory job. Remember to earth the centre spigot of the oscillator valve socket, along with other points which must be earthed.

The electrolytics and diodes for the relay DC supply are strung between the two tag strips in the middle of the chassis. The tag strip to the right contains the items on the output end of the tank coil and across the loading capacitor. Care needs to be taken when wiring the relay, to identify the socket lugs correctly. One set of changeover contacts is run to lugs on the 4-pin socket on the back skirt of the chassis. These are for use in muting the receiver and the connections will be determined by individual requirements.

When wiring to the coaxial sockets, to avoid melting the insulation a plug should be inserted into the socket while soldering. The six leads running from the transmitter chassis are run through the grommet provided and the leads are clamped adjacent to the grommet. The leads should be long enough to run between the transmitter and modulator chassis but they should not be excessively long. We made those on the prototype about 50cm. An octal plug is fitted to the far end.

Most of the wiring above the chassis involves the final tuning circuits. The bottom end of the coil is terminated on the top rotor lug of the loading capacitor and the top end is terminated similarly on the tuning capacitor. The RF choke, resistor and .001uF capacitor are mounted on the tag strip. One lug of the neutralising capacitor is also soldered to the tag strip and a lead runs to the under-chassis from the other lug. The coupling capacitor is run directly between the tag strip and the top lug of the tuning capacitor. Note that the stopper is connected directly to the valve anode clip.

By the time you have completed the wiring of the transmitter, I imagine that the next issue of the magazine will be about due and we expect to be able to give details of the other unit, which includes the modulator and power supply. All necessary information will be included for adjustments and getting the complete transmitter operational.

SPECIAL OFFER, HOLIDAY FUN PROJECT!

A simple electronic mosquito repeller

Summer is here, and as we make our escape into the great outdoors a small, but by no means insignificant, pest makes his presence felt. This year, however, we have a new weapon with which to wage war on mosquitos. A clever amalgamation of sex and electronics has produced a mosquito repeller which is designed to create a "free area"—indoors or out.

by DAVID EDWARDS

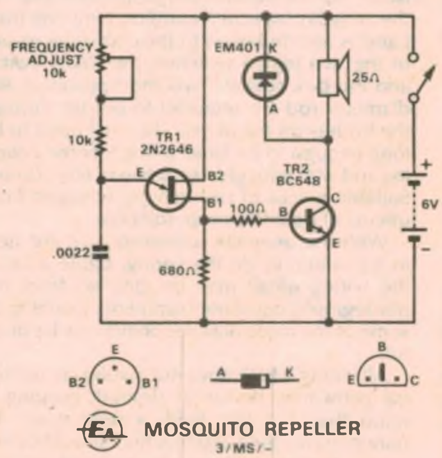
Years of university research has established that mosquitos can be repelled by sound. After mating, but before her eggs can incubate, a female mosquito needs blood. This is usually obtained from a convenient warm-blooded animal—you! During this time, the female will shun all male mosquitos (no doubt much to the chagrin of the males!). These desolate fellows, searching for conjugal bliss, emit a characteristic sound.

Intensive study has determined that this sound has a frequency in the range 21 to 23 kilohertz. Our electronic device generates a similar sound, and in fact simulates a large crowd of males. This of course will attract large numbers of mosquitos of both sexes.

In the interests of decency, we will not give details of all that occurs when the sexes meet. Suffice it to say that pregnant mosquitos (female of course!), which are the only type that bite, are repelled by the large numbers of males, real and simulated, and search further afield for their source of blood.

This means that all the lucky people sufficiently close to the repeller are safe, and should not be bitten. Due to the rush to get this article into print in time for summer, we have not been able to carry out any field tests on the effectiveness of the repeller. However, promising results were obtained from measurements made in our laboratory.

Turning now to the diagram, we can see how the required supersonic sound source has been realised. TR1, a unijunction transistor, functions as a relaxation oscillator. Operating frequency is determined by the R-C network connected to the emitter. The frequency stability with respect to voltage and temperature of this type of oscillator is more than adequate for the job in hand.



At left is our version of the mosquito repeller. Easy to build, it is an ideal holiday fun project.

Here is the circuit for the unit. As you can see, it is very simple. The unijunction and the diode are available at a special offer price, too.

Initially, the capacitor is discharged, and no current flows in the emitter. As the capacitor charges through the resistance, the emitter voltage rises. When this reaches the peak point voltage, TR1 fires, and discharges the capacitor through the circuit connected to B1.

As the capacitor is discharged, the initially high emitter current falls. When this current drops below the valley-point current, TR1 turns off, and the cycle starts again. The output voltage, obtained at B1, is a series of short pulses.

These pulses are applied to the base of TR2 b¯ the 100 ohm resistor. TR2 operates as a switch, applying pulses of power to the speaker at the oscillator frequency. With the component values shown, the duty cycle is about 10 to 1: i.e., the pulses last for one-tenth of the oscillator period.

Sound output is produced by a miniature speaker, of the type that is normally fitted to small portable radios. We used a 25 ohm type. Lower impedance speakers must not be used alone, as they will overstress TR2. If necessary, insert a resistor in series with the speaker, to bring the load back up to 25 ohms. With an 8 ohm speaker, use an 18 ohm resistor. Higher impedance speakers may be used, and in this case no resistor will be needed.

The diode in parallel with the speaker is to bypass inductive spikes from TR2.

In order to make the Mosquito Repeller portable, we have powered it from batteries. We used four penlight cells, connected in series to give a 6V supply. As the current drain of the circuit is of the order of 20mA, the service life should be in excess of fifty hours.

To help you in building this and other unijunction projects, Dick Smith Electronics are making another one of their special offers—5 unijunctions for $2, or 40c each instead of the usual $1.40! They are also offering handy 100V silicon power diodes at 50 for $2, or 4c each. Use the accompanying coupon to get them.

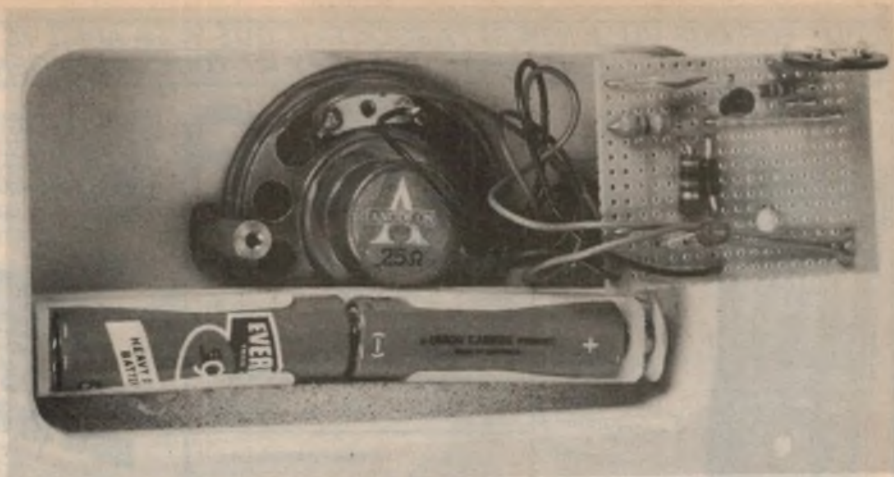
Construction of the Mosquito Repeller should be quite simple. We used a readily available plastic box as the case. Drill a neat pattern of holes in the top

PARTS LIST

- 1 *unijunction transistor, 2N2646, DS2646 or equivalent.*
- 1 *NPN transistor, BC548 or equivalent.*
- 1 *silicon diode, EM401 or equivalent.*
- 1 *100 ohm, 1 680 ohm, 1 10k resistor.*
- 1 *10k trimpot.*
- 1 *0.0022uF plastic capacitor.*
- 1 *miniature speaker, (see text).*
- 1 *case.*
- 4 *penlight cells, holder and connection clip.*
- 1 *piece Veroboard.*
- 1 *switch, single pole single throw.*

MISCELLANEOUS
Hookup wire, solder, machine screws, nuts, washers, threaded spacers, foam rubber.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with high ratings may generally be used provided they are physically compatible.


A view of our mosquito repeller, taken with the back off and the board swung out. Almost any small speaker can be used, as the text explains.

to act as a baffle for the speaker. This can be held in place using small screws, nuts and washers, placed around the circumference.

We assembled the electronics on a small piece of Veroboard. As the circuit is very simple, we have not provided any details of the actual placing of the components. An idea of our layout can be gained from the photographs. Connections to the various elements not on the Veroboard can be made using hookup wire.

The Veroboard is supported on a spacer fitted to one of the speaker mounting screws. Mount the board upside down, and orient it so that access to the trimpot can be gained through a small hole in the case. This will facilitate adjustments to the operating frequency.

The mounting screw for the Veroboard can also serve to hold the back panel on. The type of battery holder we used can be seen in the photographs. This was chosen because it was a press fit into the case, and only required a small piece of foam rubber to prevent movement. The on-off switch can be held in place using self-tapping screws.

Suitable labels can be applied to the front of the case, using stick-on lettering. When finished, this can be protected by spraying with clear lacquer. This completes construction, and the device is now ready for testing.

As the sound produced by the Mosquito Repeller is higher pitched than most people can hear, there will be no immediate indication that it is operating correctly. If desired, the timing capacitor may be temporarily increased in value to 0.01uF. This will lower the operating frequency into the audible range, and enable you to hear the device operating.

Once satisfied that all is working correctly, replace the 0.0022uF capacitor, and adjust the 10k trimpot so that the frequency is about 22kHz. If you do not have access to any frequency measuring equipment, set the pot to the middle of its range. If necessary further adjustments can be made under field conditions, in the presence of mosquitos!

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Forum

Conducted by Neville Williams

More about transformerless TV sets

In August last, these columns were devoted to a discussion of the topic "Why the ban on some colour TV sets?". Despite the intervening months and the introduction of other topics, we find ourselves with a backlog of letters on the general subject, and it is appropriate that we deal with at least a representative number of them.

As you may recall, the August article explained the problems of imported colour TV receivers using transformerless power supplies and half-wave rectification. While admitting to strong and varied reactions to the transformerless concept, as such, we pointed out that the real problem had to do with the direct current component fed back into the mains. It made things difficult for pole transformers, and accelerated corrosion by electrolysis in underground pipes and metallic structures.

Because of these problems, most supply authorities on Australia have classified receivers of this type as unacceptable for direct connection to their mains, leaving their owners potentially out on a limb. The question that has to be faced is whether the authorities will tolerate the limited number of such receivers sold before the alarm was raised or whether they will ultimately have to be modified in some way—at perhaps considerable cost to the owners or distributors.

Writing from Cambridge Park in NSW, a reader (V.M.) thanked us for alerting him to the situation but suggested that we should really have gone the whole way and listed the brands involved, so that prospective purchasers would be warned in precise terms.

In fact, our reason for omitting brand names did not flow from any kind of timidity. We could have named certain makes and models without hesitation because they had been quoted to us as problem sets. It would have been quite unfair to do so, however, without researching the total Australian market and adding to the list all other offending receivers. We simply did not have the time to do this.

A further consideration was that new models were being brought into line with Australian requirements and to mention brands could have given them a reputation in retrospect, which they would have had to live down. Our reaction, therefore, was to alert purchasers to the possible problem, leaving them to ask direct questions about any model that they may have fancied.

So much for that.

The same reader went on to ask why the problem of electrolysis could not be alleviated by using separate earth rods for each house and plastic rather than metallic waterpipes.

In fact, neither measure would provide an answer to the problem. A DC path through the earth between spikes would still tend to track to and through buried metal, causing electrolysis in so doing. Plastic waterpipes might eliminate one problem (though it may introduce others) but what about other pipes, cables and structures that still need to be metal?

(Perhaps we shouldn't be too smart in mentioning plastic phone wires; someone may just think of fibre optic circuits!)

As we pointed out in the August issue, the mere subject of transformerless receivers is enough to evoke strong emotions in the servicing industry and two letters which arrived in our office on the very same day are typical of the conflicting sentiments which correspondents expressed.

After pointing out that we have rules about wearing seatbelts and "gutter gripping" in cars to forestall possible injuries, the first correspondent says:

A power transformer in a receiver performs a similar function, minimising the risk of death through accidental contact with AC mains whilst servicing—or for someone just plain curious.

Overseas, rules regarding public contact with the AC mains in ordinary circumstances go to great lengths, including a standard size probe which is poked, into any holes to see if it will touch "hot" parts.

The function of a power transformer in a receiver, apart from altering voltage (here you must take my point) is to isolate people from the mains. It is our duty as technicians (colour, monochrome or radio) to openly and honestly examine the threat to the life of a curious child or adult who, whatever one may say, will one day open the back of one of these "hot" receivers and grab the coax lead, while also touching the live chassis. The result? Death!

From personal experience in the past, I truly know of servicemen being killed by a hot chassis and many others having had an AC mains shock during the working week.

Let us not allow a cost cutting binge to take someone's life in the future.

R.T. (Woodberry, NSW)

The letter very obviously reflects the "I hate live chassis" emotion that we referred to in the August issue and to which the author himself pleaded guilty. But it also contains an evident self-contradiction: R.T. quotes "overseas" as an example of care taken to isolate people from the AC mains—yet this is the source of all the receivers which are under condemnation. By contrast, Australia is notable for its strict electrical safety standards including standard fingers and its conservative approach to transformerless receivers!

I was intrigued also by R.T.'s reference to servicemen (plural) killed by hot-chassis receivers. Last August, we said we were unaware of any such occurrence and no one has come up with chapter and verse to prove otherwise.

In strong contrast with the views expressed by R.T., another reader has this to say:

Dear Sir,

Any TV set with a hot chassis is usually double insulated. Overseas, we find them safe to use without an earth wire and a polarised plug, as double insulated sets are not meant to be earthed.

A TV set is meant to be serviced only by a qualified technician. If an unqualified person wants to fiddle around with a TV receiver and complains that the chassis is dangerous, what about the deflection and EHT circuitry? Those parts are easily capable of killing a person with heart trouble.

If people are stupid enough to ask for trouble, they should not complain when they get it! A TV set is like many other creations of technology—useful but also dangerous if improperly handled.

K.C. (Melbourne)

I guess that one could pick at that letter, too: the only people likely to get a fatal shock from a hot TV chassis are (1) technically unqualified and (2) stupid. They deserve to die!

In between these two extremes, a reader from Queensland (B.B., Indooroopilly) draws a distinction between the early transformerless radio receivers and modern transformerless TV sets. He makes the point that it is essential first to rationalise the somewhat emotional aspect of the hot chassis controversy. Only then can one look dispassionately at the merits or otherwise of power supply systems:

"REMOTELY RELATED . . ."

The lethal mains-to-chassis plus a barretter arrangement of some 1930 vintage radio sets—the writer has been belted by a couple in times past—need to be viewed as only remotely related to modern printed circuit board systems which have return circuit wiring strips at other than earth potential.

A half wave transformerless set does not mean a 50% chance that the metal framework will be at line (240V) potential to ground at all. Such structural steelwork is, or should be, earthed; likewise the frame of the ancillary C.R.T. transformer, if any. The return circuits, probably capacitively bypassed to ground, are normally restricted to PCB's, and insulated jumper wires.

One would be a complete nut if one pokes about with an index finger on an energised circuit board which must be carrying several hundred volts of one kind or another. As the old "hot chassis" can be easily avoided at no cost penalty by the manufacturer, it is doubtful if any have actually been built as such.

The real problem is the prevention of DC mains return which causes anodic electrolytic destruction of the various M.E.N. (earthing) components.

OUR VIEW CHALLENGED

Another reader from Queensland (G.B. Spring Hill) queried our observations about using a 1:1 transformer to isolate transformerless half-wave receivers from the mains. We had suggested that such a transformer would not greatly modify the assymetrical load waveform but that it would remove the objectionable DC effect from the mains. However, there would be a DC effect in its own primary and upon its own core, such that there would be no hope of using anything like an ordinary 200W transformer; more like a 750W unit would be necessary.

Against this, G.B. maintained that the presence of the transformer would not overcome the problem at all. It would merely transfer the assymetric waveform to its primary, leaving the DC effect on the mains intact. There was simply no basis for our suggestion that the transformer needed a 750W rating.

He also believed that we had overstated the problem of earth current. He felt that earth resistance would normally be so much higher than the neutral return that the last named would carry 90% or more of the return current.

In fact, the argument about the role of the transformer was not new to us. We

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had thrashed it out between ourselves at the time the Forum article was being written. When we rang the Sydney County Council, it became evident that they had also been through the exercise, working it out mathematically and verifying that result by a practical test.

Their findings confirmed that, while an isolating transformer might not change the load waveshape, it would centralise the load excursions about a mean and would thereby eliminate the DC effect in the mains.

The problem of core saturation was put to us quite separately by engineers at Ferguson Transformers, and it was they who nominated a likely figure of about 750W. In fact, there is a close analogy with a modulation transformer where one winding carries current varying from near zero to cyclic peaks, but always flowing in the one direction.

As for the relative resistance of the earth and neutral return paths, we had no opinion about this; it is way outside our field. Our statement that most of the return current in an overhead system flows via the earth also came from Sydney County Council engineers.

On a more positive note, a reader mentioned earlier (B.B) came out in support of what we had to say in the August '75 issue and our reservations about a reader's suggestion in the October issue. This involved wiring a bridge rectifier between the AC input and the half-wave rectifier—a scheme that would have eliminated the DC effect on the mains (or transformer) input but with an unwelcome increase in the DC output to the receiver itself.

The relevant portion of his letter reads thus:

Dear Sir,

The kind of solution put forward by C.H. of Adelaide in your October "Forum" was considered by myself and others in 1957, when the problem first arose with transformerless monochrome TV sets. Following the various state electricity commissions frowning on the principle and the company concerned (a large one) the problem conveniently went away, without the need for regulatory coercion.

Had the situation persisted, and a cure been required, the transformer plus bridge system might have been resorted to, although in the face of difficulties such as you have mentioned.

Most of them can be avoided by the use of a capacitor ballast as shown in the accompanying circuit.

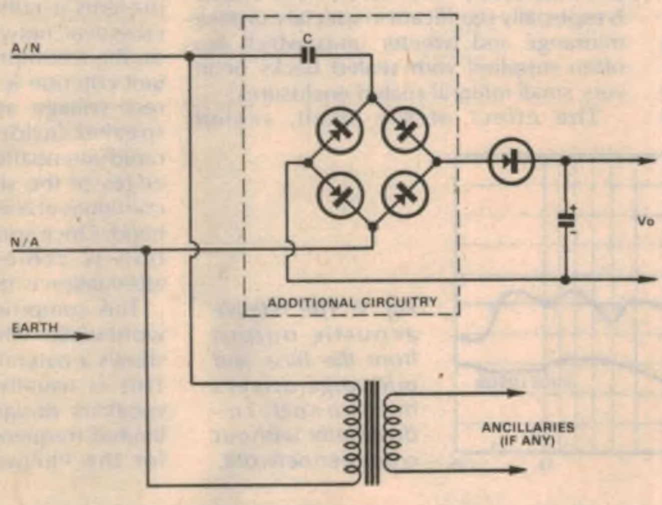
The use of a capacitive ballast and a bridge rectifier will provide a reasonably low cost, no heat, no extra lamination hum, no magnetic field, reasonably low weight, electrically viable system.

The possibility of modulation hum—raised by yourself—does not really arise as the original system must have been designed to accept the mains active line on either the diode-supply rail or on the return rail. Nothing has changed.

Not any capacitor out of the junk box will do, of course. It must be rated to carry about 0.8A AC continuously. The capacity would need to be chosen to have a reactance to give the voltage DC previously present on the supply rail. An oil filled paper capacitor with a few modular taps such as the type used in adjustable "Westat" rectifiers would be ideal. The likely capacity range would be 16-30uF.

I have used capacitive ballasts in similar applications to the above at various times successfully and can see no reason why it would not fill the bill in this case.

B.B. (Indooroopilly, Qld.)



Inserting a bridge rectifier in the mains input to a transformerless half wave supply obviates the DC effect but also increases the supply voltage to the receiver. This could be offset by the use of a suitable ballast capacitor "C".

B.B.'s suggestion is interesting but it does place a very heavy emphasis on the ballast capacitor. How large would it be, how costly and how reliable? One very uncomfortable aspect is that a breakdown could leave the receiver running in an over-voltage condition, without the user being aware of it. It caused one of our staff to remark that it might be cheaper and safer in the long run to settle for a ballast resistor!

Either that, or the authorities may simply agree to put up with the sets already in use, leaving the rest of the problem to go away—as it did before!

Designing a Speaker Crossover Network

The 82-litre loudspeaker system featured in our current Year Book used a frequency dividing network designed to meet a specific need, rather than as an exercise in conventional network theory. The philosophy behind the network is explained in this article by the engineers responsible for it: Philip Tracy and Howard Jones, of the Elcoma Division of Philips Industries Holdings Ltd.

Many crossover network designs seem to have been based on the questionable assumption that the loudspeakers approximated a resistive load equal to their nominal impedance and that the efficiencies of the various drivers were similar. Simple 6 or 12 dB/octave L-C complementary networks were presumably chosen from basic filter network tables and relative transducer efficiencies were not even considered.

In reality, the actual driver impedance may approach the assumed value only over a narrow band of frequencies, being far removed from it at other frequencies. In addition, modern limited frequency range speakers, optimised for individual desirable characteristics, often end up with mismatched efficiencies. These two characteristics—impedance and efficiency—must be taken into account in practical crossover networks.

LOUDSPEAKER IMPEDANCE: The two effects which complicate a loudspeaker's impedance are the reflected impedances which result from mechanical resonances and the voice coil inductance. The first of these effects is especially significant in special purpose midrange and tweeter units which are often supplied with sealed backs or in very small integral sealed enclosures.

The effect of the small, sealed enclosure is to produce a fundamental system resonance, often not far below the operating range of the speaker. As the speaker goes through its mechanical resonance, its electrical impedance goes through a maximum and, either side of resonance, it can be inductive or capacitive with a significant Q.

This change of impedance, occurring only an octave or so below the cut-off frequency of the high-pass filters, leads to unwanted resonances with the crossover reactances. This can easily result in a speaker having a higher output one octave out of band than it has inside the passband! Even after taking precautions, this effect is still evident at the low frequency end (around 300Hz) of the midrange speaker response.

The speaker's voice coil inductance can cause similar problems to occur with the low pass networks around the crossover frequency.

In recent times both simple and complex R-L-C networks have been proposed for use in parallel with the speaker to control the overall impedance presented to the filter. This approach allows more exact filter designs but can easily lead to a doubling of the number of components in the network.

DESIGN CRITERION: This article presents a rather different approach to crossover network design and is based on the assumption that the most important criterion is the provision of the correct voltage at the terminals of each speaker inside the passband. A very rapid attenuation of this voltage at the edges of the stopband is provided and continues at least an octave into the stopband. Once some 15 or 20dB of attenuation is achieved, a lower rate of attenuation is tolerated.

This compromise becomes especially worthwhile when the speaker output shows a natural roll-off in the stopband. This is usually the case when using speakers designed and specified for a limited frequency range and is the case for the Philips speakers used in the

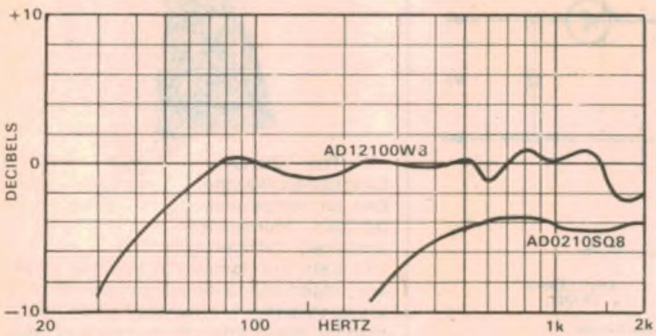


Fig. 1: The relative acoustic output from the bass and midrange drivers measured individually without crossover network.

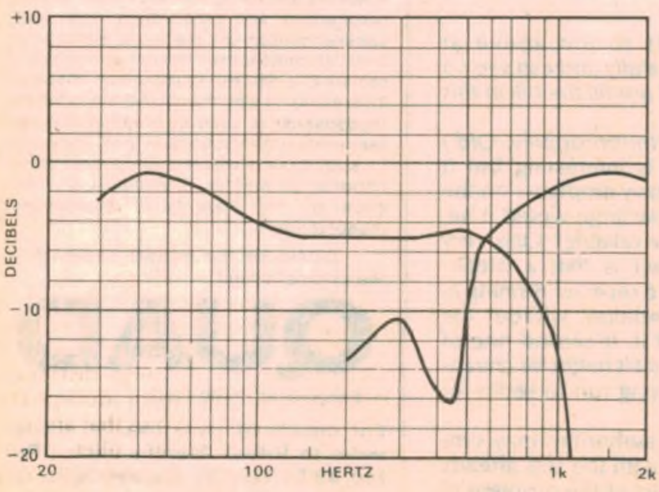


Fig. 2: The output voltage from the crossover, measured at the speaker terminals, with no mid-range attenuation.

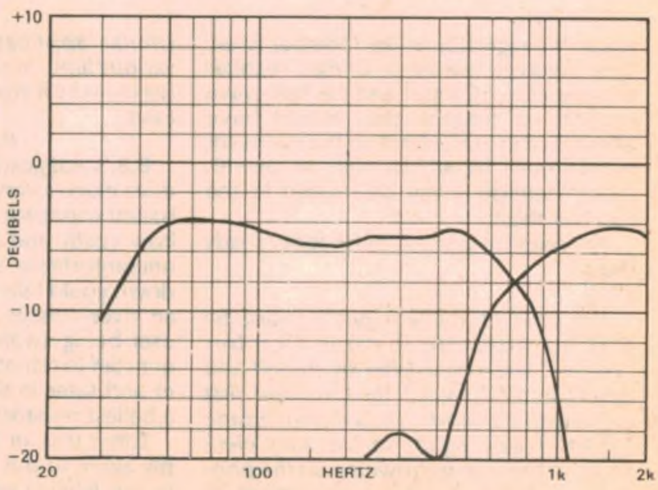
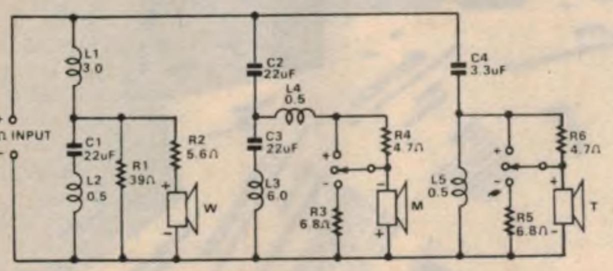


Fig. 3: Individual acoustic output from the base and mid-range drivers when fed with voltage as per Fig. 2.

82-litre system, as mentioned earlier.

The technique leaves the smallest possible frequency ranges in which two drivers will be operating simultaneously and so should reduce interference effects which might result in a poor polar response. It also reduces the regions of uncertainty which occur when simple measurement techniques are used to verify the acoustic outputs of each speaker.

The simple measurement technique employed to plot the acoustic output curves (Figs. 1 and 3) is that described



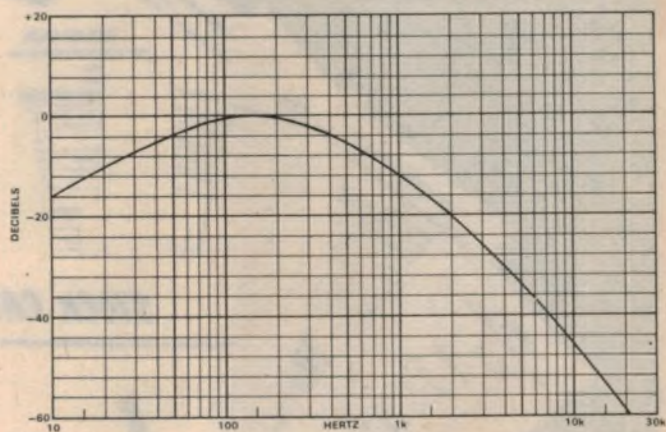


Fig. 5 (above): Circuit diagram of the 3-way crossover network ADF600/4000/8, as applied to a complete loudspeaker system, described in our current Year Book.

Fig. 6 (right): The frequency characteristic of the pink noise signal used for testing loudspeakers. (DIN 45573)

by D. B. Keele in the Journal of the Audio Engineering Society Vol. 22 No. 3 April 1974 and is based on the mathematical relationship which exists between the sound pressure very close to a speaker and the sound pressure at normal listening distances. The technique can give errors above the frequency at which a speaker can be assumed to operate as a rigid piston. This frequency is usually quoted as the frequency at which the cone circumference equals one full wavelength. Since all drivers in this three-way system must be called upon to operate beyond this limit, it becomes important to ensure that this region of operation be minimised. Once the crossover frequency is chosen as a compromise between this form of operation and operation of the next speaker away from its fundamental resonance, rapid attenuation is the simplest technique for reducing output in these difficult regions.

ATTENUATION TECHNIQUES: Having established the requirement for level matching and rapid stopband attenuation, two techniques not normally found in crossover systems have been employed. The first of these is the replacement of the simple L or C elements by series L-C pairs. These exhibit approximately the same L or C value as required by the filter at the crossover frequency but go to series resonance at frequencies between half and one octave into the stopbands. Figs. 2 and 3 show the effectiveness of this technique.

The second technique is the use of simple series resistance to attenuate the bass speaker to the level of the midrange unit. Published efficiencies of the bass and midrange units show a difference of 4dB and measurements by Keene's method (Fig. 1) confirmed this difference.

When considering a simple series resistor as attenuator, the effect on the damping of the bass unit must be closely watched and it must be recognised that the attenuation provided will not be constant but will be proportional to the inverse of the impedance of the bass speaker as measured in its enclosure. This means some additional care must be

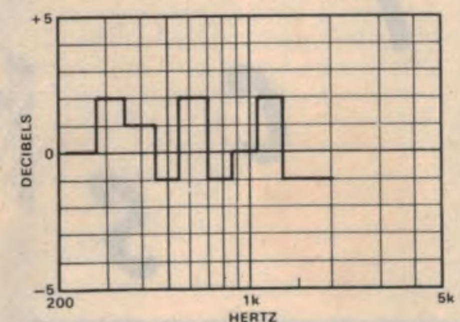


Fig. 4: An additional check of acoustical output through the crossover region using one-third octave pink noise analysis at a distance of 2m in a living room environment.

taken with the enclosure lining because mechanical loading of the cone, which occurs whenever a dimension from the cone to any side of the box becomes one half wavelength, results in minima of impedance. The natural "holes" in the acoustic output response are deepened by addition of external resistance to the voice coil resistance. Lining the enclosure with "Super" grade carpet underfelt eliminates this problem.

The bass resonance is measured at 45Hz and the response plot of the bass driver without crossover (Fig. 1) indicates an overdamped response with a system Q of around 0.6. The resistance required to achieve the desired attenuation in the range 100-500Hz is about 5.6 ohms. This will raise the system Q to around unity and produce a worthwhile extension of the bass response without undue peaking of the response. The slight peak in the measured response from about 55Hz to 90Hz with a series 5.6 ohm resistor follows the expected response for a system with total Q around unity.

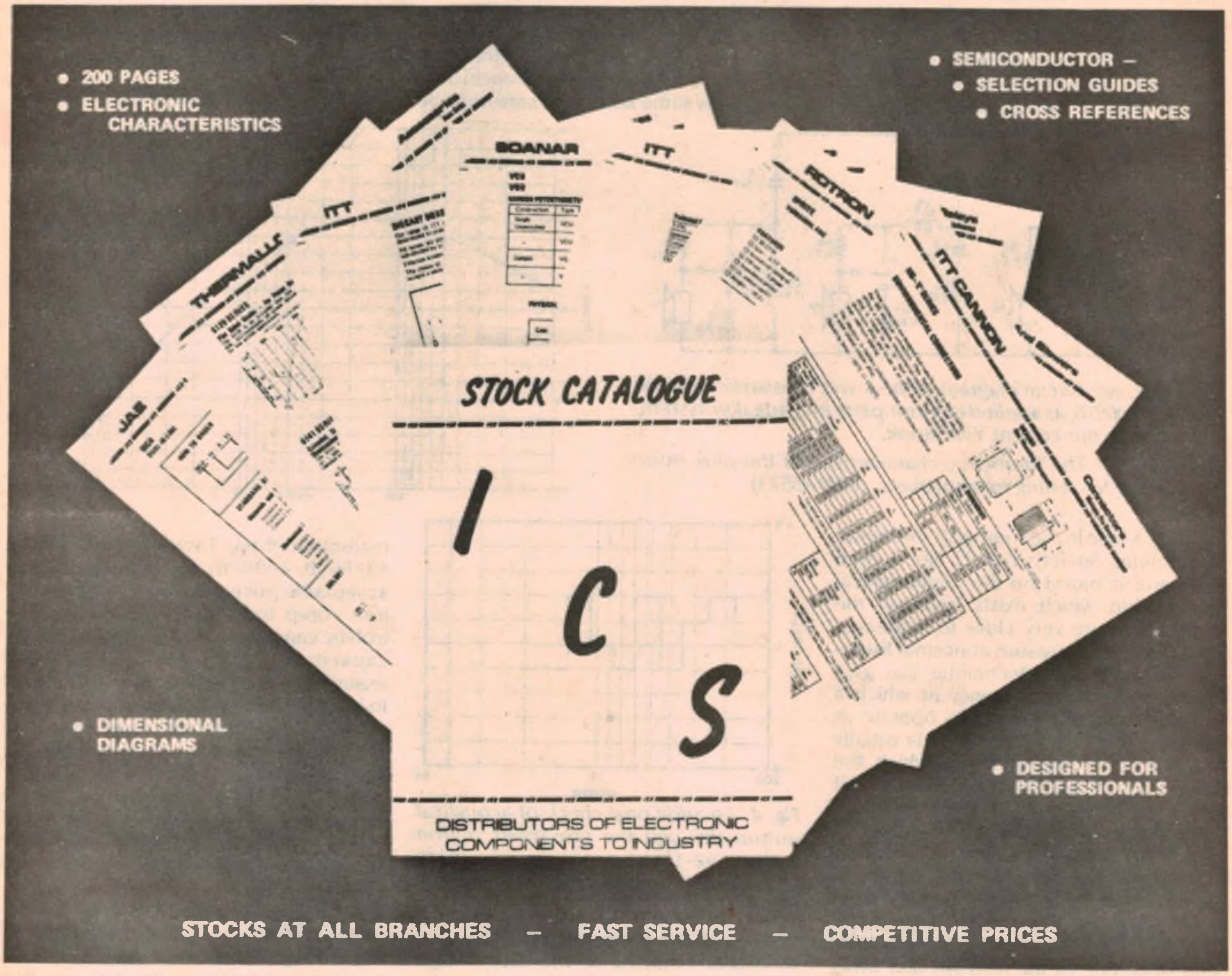
The shift in response corresponds to a shift from second order Butterworth to second order Chelyshev response but, in either case, the "ringing" or "reverberation" time of this system remains low when compared with vented box designs which correspond to higher order responses. This means the bass response has been extended to -3dB at 35Hz without introducing any audible "boom" in the bass response.(See Fig. 3.)

COMPONENT RATINGS: Practical realisation of the 3-way network (Fig. 5, ADF600/4000/8) at a commercially acceptable price necessitated the use of iron cored inductors and bipolar electrolytic capacitors. The tolerances for the capacitors, which are manufactured especially for crossover networks, need to be much closer than normal electrolytics and ± 10* tolerance types are used. The larger inductors are of iron lamination construction with a very large air gap. Their specification includes a requirement that inductance does not change with level and their inductance change from small signals to 40W level is less than 1%.

In order to choose the power ratings for the resistors used, some assumptions regarding the power they will be required to handle are needed. The first assumption made is that the peak to average power ratio in the input music will not be less than 4:1, that is the dynamic range will not be less than 6dB. For normal recorded music or even broadcast music which usually contains some additional dynamic compression, this figure of 6dB is considered conservative, even allowing that the user may further compress the dynamic range by driving the power amplifier into a severely clipping condition.

The second assumption is that the distribution of energy across the frequency spectrum is not uniform. IEC and DIN standards specify an energy distribution for the purpose of testing loudspeakers as shown in Fig. 6. It shows that any resistors in the low frequency filter must be able to handle the full average power resulting from driving the power ampli-

(Continued on page 87)



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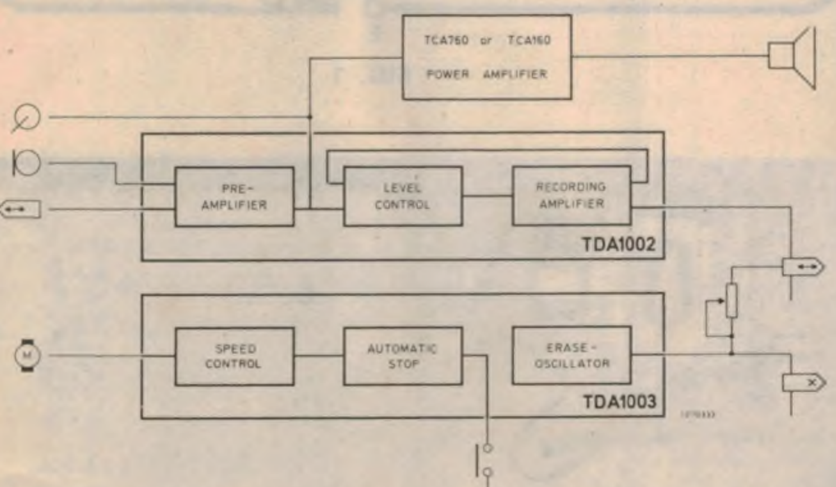
What's new in Solid State

Philips broad-spectrum consumer ICs

As the IC revolution has gathered momentum during the last few years, most of the flag waving and trumpet blowing has tended to come from the USA. Almost every week has seen an announcement of a new device or a breakthrough in technology from one of the firms in the US "silicon belt" spanning California, Arizona and Texas.

Needless to say, though, quite a significant proportion of IC research and development is taking place outside the US. The people concerned just don't make quite the same song-and-dance about it. But every so often it becomes apparent, like the development of MTL by Philips in Holland and IBM in Germany.

Philips in particular maintain quite a "low profile" in the IC field, rarely making any extravagant announcements. Yet it has become fairly clear that they are right up with the leaders in many areas, such as MTL and charge-transfer devices. They have also been quietly working away in the field of IC's for consumer products, to the point where they have now developed a very broad range of "new generation" devices covering monochrome and colour TV, hifi, AM/FM, car radio and tape recorders.



Many of the new TV devices have already been sampled to European set makers for use in designs likely to appear later this year. Some of the audio and radio devices have also been sampled, and are apparently due to become available for production use about June.

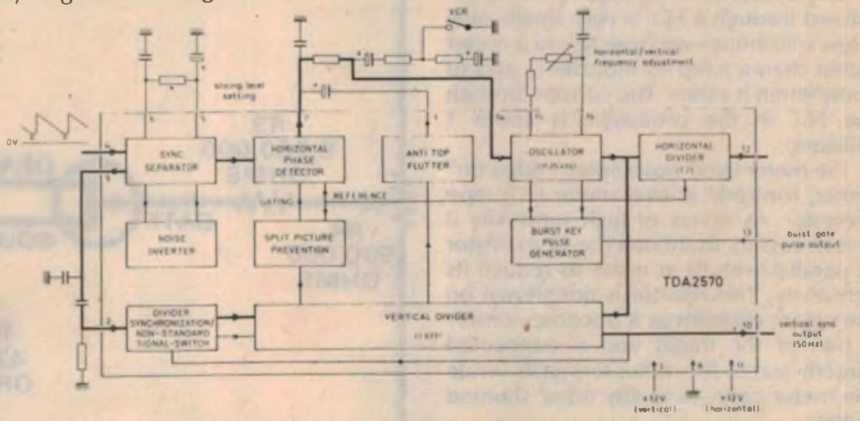
I gather that the situation in Australia is much the same, with some of the local manufacturers having been sampled with the appropriate TV devices. But Philips apparently doesn't foresee much local interest in the audio and radio devices, due to the very low level of manufacturing activity in this area.

What I find impressive about the new Philips range is the diversity of device functions. In the TV range they have devices for electronic tuner touch control and channel indication; varicap supply regulation; IF gain; sound IF and audio; sync separation; AGC; chroma gain and colour decoding; vertical sweep; horizontal drive; and switch-mode power supply.

Similarly in the audio-radio range they have preamps; AM, FM and AM/FM receiver chips; stereo decoders (both PLL and matrix); DC volume, tone and balance control chips; tape recorder amplifier and motor speed/bias-erase chips, in addition to a number of audio amplifier chips of various power ratings.

An interesting example in the TV range is the TDA2570, described as a sync processor. Designed to provide line, field and burst keying signals from composite video, this device is based on a PLL whose oscillator runs at twice the line rate—31.25kHz. Both the line and field signals are derived from the oscillator, the latter via an internal 625-times divider. This gives true flywheel stabilisation of field drive as well as line drive, thus giving much improved picture stability and interlace.

Interesting examples in the audio range are the TDA1002 and TDA1003, which together provide almost all of the active circuitry required for a mono tape recorder. The TDA1002 provides the preamp, auto level control and recording amplifier, while the TDA1003 provides motor speed control, auto stop and bias/erase oscillator. The only thing needed for a complete recorder is an audio power amp, for which two alternative devices (TCA760. TCA160) are available as well.



The diagram above shows the TDA2570 sync processor chip. At left are the TDA1002 and TDA1003 tape recorder chips.

The TDA1003 is especially interesting in two respects. One is that the bias/erase oscillator incorporates an ALC loop, to ensure a constant and undistorted sinewave output. This is to prevent interference during recording from FM stereo broadcasts, and also to minimise recording distortion. The second noteworthy feature is that the motor control circuitry incorporates corrections for motor temperature rise, and is also arranged to automatically stop the motor when the take-up spindle stops rotating at the end of the cassette (by means of a feedback scheme).

In short, then, Philips has a very big range of interesting "new generation" consumer IC devices coming along. (J.R.)

For further data on devices mentioned above, write on company letterhead to the firms or agents quoted. But devices should be obtained or ordered through your usual parts stockist.

Practical electronics demonstration

THE FIELD EFFECT TRANSISTOR

by A. J. LOWE

This Teach Yourself Board shows what a junction field effect transistor does.

The circuit diagram is shown in Fig. 1, and the layout of components matches this, as shown in the photo. The arrowhead on the current flow line indicate the direction of conventional current.

As the maximum current which can be passed through a FET is very small—only a few milliamps—we have to use a meter rather than a lamp to indicate it, and to show when it varies. The current through the FET in the prototype is about 1 milliamp.

The meter used was a spare "edge on" meter, formerly a level meter in a tape recorder. As it was of high sensitivity it was necessary to shunt it (i.e. fit a resistor in parallel with it) in order to reduce its sensitivity. This resistor is not shown on the circuit diagram as it becomes simply a part of the meter and is connected directly across the meter terminals inside the meter case—as in any other shunted meter.

The value of shunt resistor needed depends on the meter and FET used. In the prototype a resistor of 150 ohms was used. The value selected should be such that the meter reads full scale when the potentiometer R4 is turned fully clockwise.

The original scale of the meter was covered with white Contact with the word "CURRENT" put on with press-on letters. A "0" was added at the zero position, but no other calibration points marked.

Junction FETs are of two types, N channel and P channel. The FET used here must be of the N channel type. A readily available BFW 61 was used in the prototype.

PARTS LIST

2 4700 ohms resistors ¼ watt
1 8,200,000 ohms resistor ¼ watt
1 500,000 potentiometer
1 meter (see text)
1 N channel FET BFW61 or similar
1 9 volts battery
1 crocodile clip, wire, aluminium, etc.
1 resistor to shunt meter (see text)

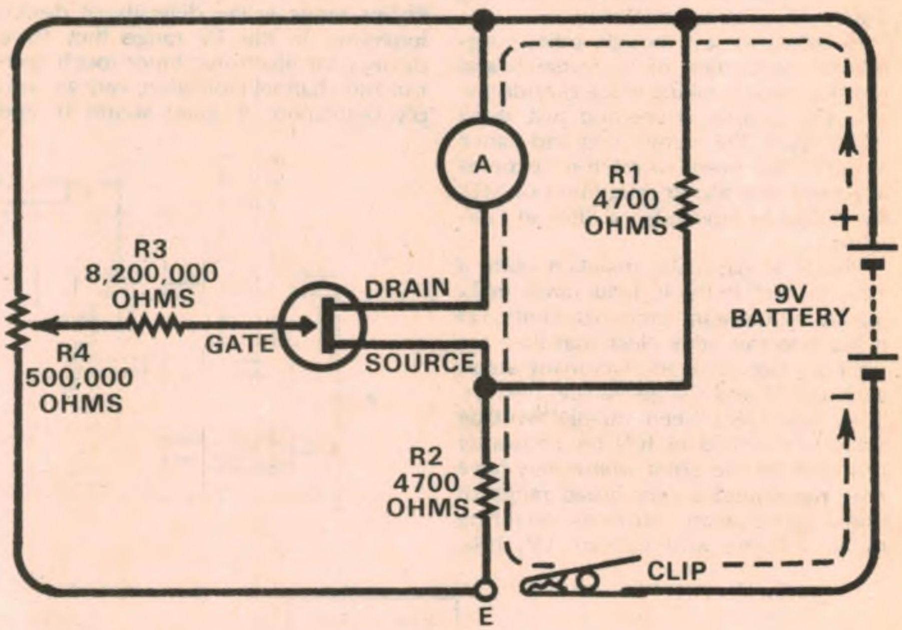
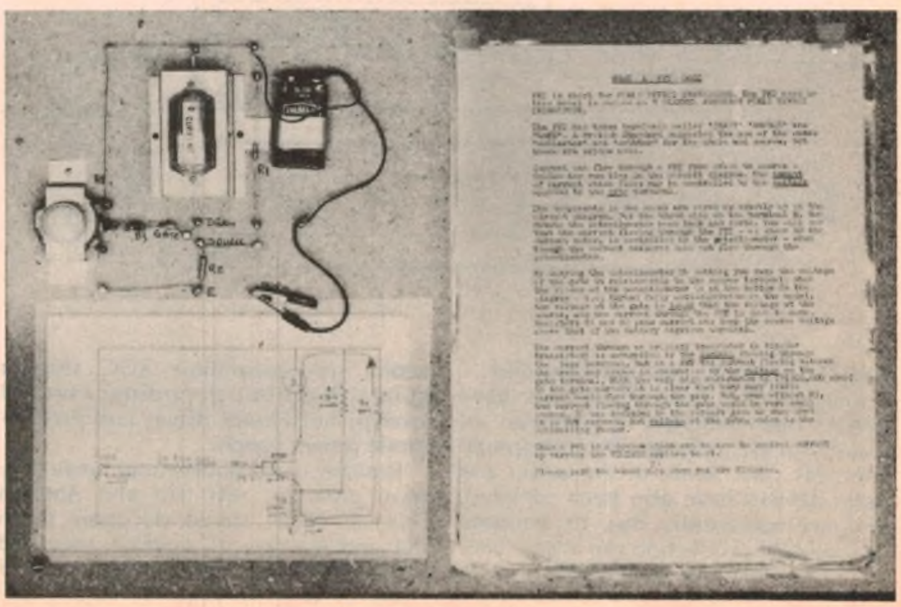


FIG. 1



WHAT A FET DOES

FET is short for FIELD EFFECT TRANSISTOR. The FET used on this model is called an N CHANNEL JUNCTION FIELD EFFECT TRANSISTOR.

The FET has three terminals called "DRAIN", "SOURCE" and "GATE". A British standard suggested the names "collector" and "emitter" for the drain and source, but these are seldom used.

Current can flow through a FET from drain to source—follow the dashed line in the circuit diagram. The amount of current which flows may be controlled by the voltage applied to the gate terminal.

The components in the model are wired up exactly as in the circuit diagram. Put the black clip on the terminal E. Now rotate the potentiometer knob back and forth. You will see that the current flowing through the FET—as shown by the current flowing through the FET—as shown by the current meter—is controlled by the potentiometer, even though the current measured does not flow through the potentiometer.

By varying the potentiometer R4 setting you vary the voltage of the gate in relation to the source terminal. When the slider of the potentiometer is at the bottom in the diagram—i.e. turned fully anti-clockwise in the model—the voltage at the gate is lower than the voltage at the source, and the current through the FET is down to zero. Resistors R1 and R2 pass current and keep the source voltage above that of the battery negative terminal.

The current through an ordinary transistor (a bipolar transistor) is controlled by the current flowing through the base terminal, but in a FET the current flowing between the drain and source is controlled by the voltage on the gate terminal. With the very high resistance R3 (8,200,000 ohms) in the gate circuit it is clear that very little current could flow through the gate. But, even without R3, the current flowing through the gate would be very small indeed. R3 was included in the circuit just to show that it is NOT current, but voltage at the gate, which is the controlling factor.

Thus a FET is a device which can be used to control current by varying the voltage applied to it.

Please park the black clip when you have finished.

DID YOU MISS OUT?

Supplies of the 1975/76 Electronics Australia Yearbook are running out fast! If your newsagent has none left, there may be a few copies available from our editorial office—but you'll have to hurry. Write or call in now: Electronics Australia, 12th Floor, 235-243 Jones Street, Broadway (near Central Station). By mail: PO Box 163, Beaconsfield, 2014. Price: Only $1.00, plus 60c p & p where applicable.

The Serviceman

More on foreign set conversion

I have rather a mixed bag this month, being mainly a round-up of all those items which, for one reason or another, I have had to put aside when they first came to hand. The most recent one, on converting overseas colour sets, should be of particular interest to English migrants planning to settle in Australia.

The following letter on converting overseas colour sets to suit Australian standards was prompted by the letter in last September's notes, from Mr P. T. of Box Hill, Victoria, but it describes a quite different and very interesting approach to the problem.

Dear Sir,

I was interested to read your column (September 1975) where Mr. P. T. described the conversion to Australian standards of a UK-standard colour TV set. I imported a Sony KV133OUB colour TV set from the UK last year, but took the precaution of first checking the costs of conversion. UK readers might be interested to learn that a small company, Portatel Conversions, in Surrey (UK) specialise in replacing front ends and retuning sound demodulators to conform to Australian, South African, or any other standards.

However a simpler, cheaper and (for a ham-fisted amateur) safer solution was to purchase a frequency converter to convert Australian VHF signals to the UHF band, and to use the set's existing UHF tuner. Such frequency converters are used in the UK in large blocks of home units, where CATV companies install a UHF antenna with a UHF/VHF converter and distribution amplifier near the masthead. From there easily-manageable VHF signals are distributed to VHF sets (rented from the CATV company), or to residents' own UHF TV sets, each equipped with the step-up converter on the antenna input. I bought this latter device—the "Teleng Superverter"—from Kindue Aerial Installations in London for about $25; it is mains powered and draws only 1.3W, so is left operating permanently.

On arrival in Australia, the TV set (with converter) produced excellent colour pictures in the predicted positions on the UHF dail (continuously variable on this model) corresponding to the sum of the VHF channel frequency and the converter's local oscillator. (The "mirror image" of these frequencies, corresponding to the difference product, produced rather poorer colour pictures at the other end of the dial.)

To receive the sound it was necessary only to locate and adjust the sound IF transformer, discriminator and sound trap pre-sets in the same way as described by your correspondent P.T. The Sony service department in Sydney were most helpful in providing this information. Additionally, I found that the AFC reference frequency needed a slight adjustment, possibly as a result of receiving signals with a fractionally closer frequency distribution of energy than in the UK.

Should UHF TV ever become the Australian standard, I can simply discard the converter. A word of warning to any potential duty-dodgers, however—a set must be owned and used by the intending importer for at least 12 months before shipping. Additionally, some foreign-market sets (mine included) do not use full PAL-D decoding, which means they could display irritating Hanover Blinds in problem reception areas.

Thank you for a most interesting column which provides fascinating "Whodunnits" for readers both inside and outside the repair trade.

A.M.

Hornsby, NSW

Well, so much for standards conversion. Assuming the ready availability of the UHF/VHF converter, it would seem about the least traumatic approach to the problem. Anyone with friends or relatives in England, who are contemplating moving to Australia, could perhaps do them a favour by sending them a copy of the letter.

The next letter deals with TV at a different level; a black and white valve set with an obscure fault which turned out to be a classic component failure; only the symptoms were changed to make it harder!

Dear Sir,

After a frustrating time servicing the line output stage of an AWA K86 I feel compelled to write to somebody about it. I was called to the set by the owner, a pensioner, who claimed that the set had been serviced by a technician from another town, and that it only lasted two days. Three weeks of coaxing had not persuaded this gentleman to return!

A quick inspection revealed that he had replaced the 6AU4 (damper diode), the 6CM5 (horizontal output), and the 1B3 (EHT rectifier); the latter with a stick rectifier. He had also cleaned out the set and some components had been unsoldered at one end, presumably for testing.

I switched on and the sound came up OK but the picture was dark on the left hand side of the screen, getting brighter at the right hand side, but underscanning on the right, with a slightly wavy edge.

The 6CM5 looked distressed but not the 6AU4. The EHT transformer showed signs of melting wax. A shorted turns test on the yoke seemed to clear that component of trouble. The boost voltage was only 240 (HT255V) but adjustment of the horizontal hold control would bring the boost voltage to 550 for a few seconds. The boost capacitors were not shorted and appeared to charge normally on the ohm meter high ohms range.

Bias on the 6CM5 was -40V with the anode cap removed, but only -15V with it replaced. Another change of valves was tried, to no avail, so, fearing failure of the EHT transformer, I brought the set back to the shop, warning the owner that the repair could be costly.

Back at the shop I attacked the set with the CRO. With the 6CM5 out of its socket, the line oscillator wave forms were normal. With the 6CM5 replaced, some 100Hz interference showed up.

I removed the 6CM5 and shifted the CRO prod to the power supply, a voltage doubler circuit. The CRO showed a slight (about 8V) negative going pulse at 50Hz. When I replaced the 6CM5 it showed about 80V of 15,625Hz. Shunting the final filter capacitor with 100uF restored calm to the HT rail and full operation to the line output stage.

The hint I missed earlier was that wavy line at the edge of the picture but, to be fair, I do normally suspect filter capacitors in doubler supplies, particularly for sync faults. However, in previous supply problems I have found the sound to be degraded, and it was not in this case.

All this checking took several hours, unfortunately, and I cannot in fairness charge the owner for all the time I spent searching.

R.W.

Dunolly, Vic.

As I said, a classic component failure. But I have lost count of the ways in which a faulty power supply electrolytic can upset performance. And not only in TV sets, though they have more to be upset, but also in the humble radio.

In fact, my first experience of such a fault goes back to the days of the autodyne receiver using the 57, 58, 57 valve combination. The first 57 functioned as a self oscillating mixer, a notoriously cranky stage which would go out of oscillation at the slightest excuse. In this case it had a first class excuse—a virtual open circuit, at RF, of the second electrolytic in the power supply. Oh yes, the set hummed, but I didn't connect the two symptoms. After several hours the penny dropped and I learned a lesson I never forgot. (Which doesn't mean to say I haven't been caught since.)

On a number of occasions, readers have suggested that these notes should include data from manufacturers' service bulletins, in addition to the practical stories which are its main feature.

Unfortunately, there are practical problems to this idea, not the least being the extensive nature of some bulletins, which could easily account for most of the space in one month's notes. There is also the problem of ensuring that we get regular issues of such bulletins, and from as many manufacturers as possible.

Nevertheless, we have decided to try an experiment. Listed below is a brief summary of the bulletins issued to date by one manufacturer, Rank Arena. It lists the bulletin numbers and symptoms which they describe, but without the more detailed explanation as to the cause or the method of correction.

The idea is to allow readers to check, firstly, whether they have all the service bulletins from a particular manufacturer and, secondly, whether a particular symptom in which he may be interested has ever been dealt with. If it has, it would be logical to seek out this particular bulletin, either from the manufacturer or, in an emergency, a colleague. At least he would know what he was seeking.

Here then is the first listing:

RANK ARENA TECHNICAL SERVICE BULLETINS

ISSUE No. 1

Models C2201, 2202, 2203, 2061, 1451.
- Automatic fine tuning adjustment instructions.

C2201.
- Herringbone pattern on channels 2, 3 or 5 not due to overload.

C2201, 02, 03, C2601.
- Intermittent change of colour phase (green faces).

C1451.
- Incorrect horizontal centring.

C2201, 02, 03.
- Channel "O" lockout.
- Incorrect vertical centring.
- No colour kill.
- No colour or intermittent colour.
- Grey scale balance change over half to three quarters of an hour.

C2201, 02, 03, 06.
- No sound or intermittent.
- No sound, no picture, or intermittent.
- Low brightness, one or two colours predominating.
- 15kHz whistle.
- Insufficient vertical scan, or intermittent.

A1401.
- Hum bars on weak signals, usually on high channels.

ISSUE No. 2

C1451.
- Noisy sound (may be intermittent).
- Buzz in sound.
- Herringbone pattern on channels 3, 4 or 5.

GENERAL
- New video output board, PWC 368.
- Further note on issue No. 1 low brightness fault.

ISSUE No. 3

1851 and 2203B.
- Purity adjustment instructions.

ALL MODELS
- Interchangeability of PWC 296 (PAL) board.
- Further note on board interchangeability.

ISSUE No. 4

A1401.
- Hum bars on weak signals.

C1851, C2202, 03, C2601, 02.
- Permanent 180° colour phase reversal after replacing PWC 411.

C1451.
- Vertical cramping.

ALL COLOUR MODELS
- 180° colour phase reversal after replacing PWC 296 or T1004 burst transformer.

In lighter vein, here is a humorous story from a country colleague, which he is prepared to swear, on a stack of service manuals, is true.

A customer brought in a large radiogram for service, the complaint being that it wasn't loud enough. It was a rather elaborate system of some 20 years' vintage, normally capable of more than adequate output, and fitted with a heavy duty 12in speaker.

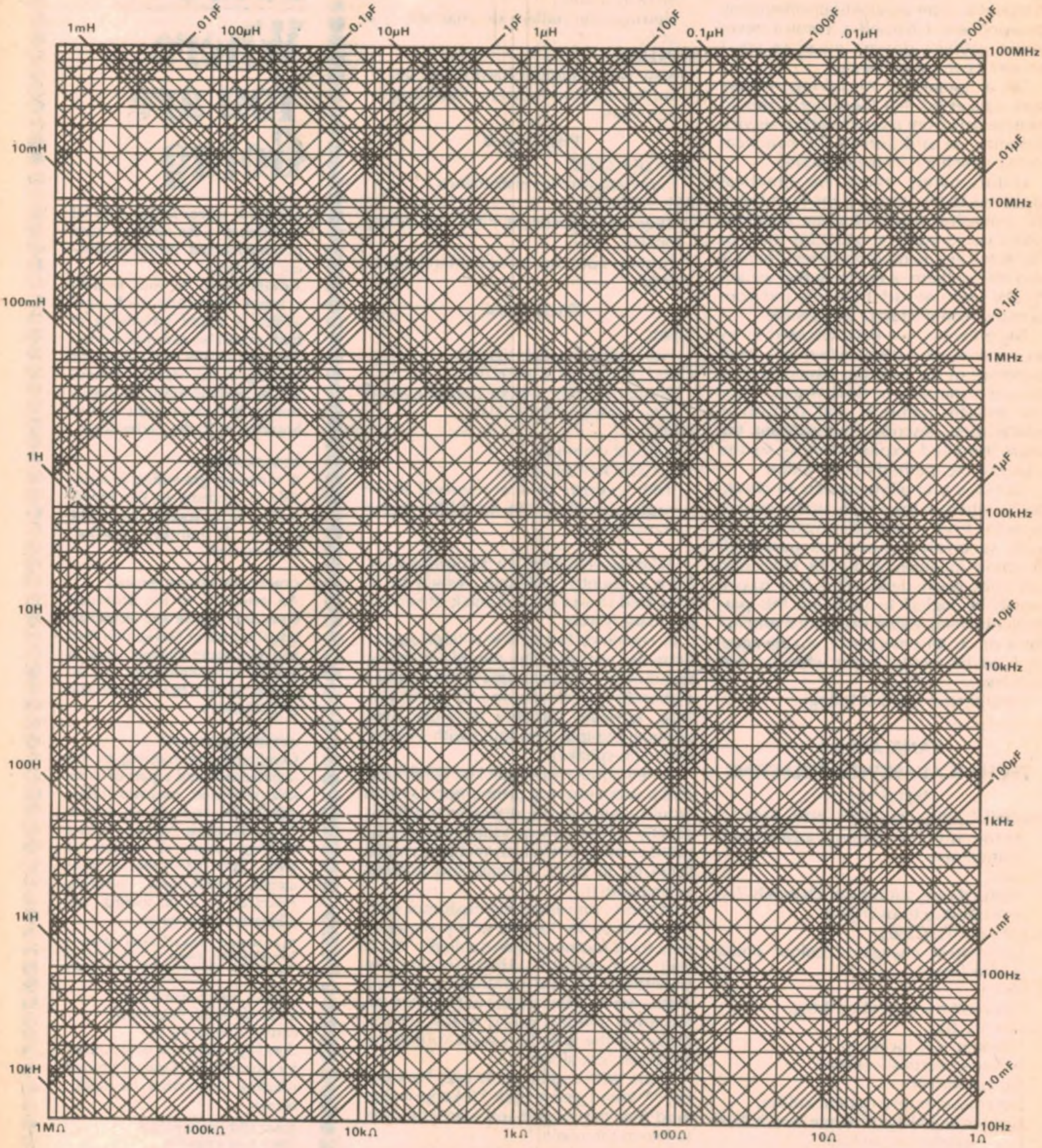
A few brief tests quickly confirmed that it was behaving pretty much as one would expect; plenty of power and, if not exactly high fidelity by today's standards, good clean sound which was pleasant to listen to. In short, I could find nothing wrong with it.

When I confronted the customer with the situation he looked at me thoughtfully for a moment, then replied, "But it isn't loud enough". Then, sensing my bewilderment, he continued, "Y'see mate—me and the misses ain't gettin' on too good and the kids is nearly got me drove up the wall. So I want something to drown 'em all out".

Then, with a glint in his eye, he went on, "When I get it back I'll keep it that loud that the so-and-sos won't be able to live in the place!"

Well, I'm glad he doesn't live next door.

REACTANCE-FREQUENCY CHART



To find the reactance of a capacitor at a given frequency, follow the 45° capacitance value line until it intersects the horizontal frequency line, then read downwards to the ohms scale at the bottom. The reactance of an inductor can be read in a similar manner.

The chart can also provide information about resonant circuits. For example, locate where particular values of L & C intersect and read off the resonant frequency. If frequency is known and either L or C, find the intersect and read off the remaining value. Again, by following along a particular frequency line, a variety of LC options for resonance can be determined.

To design simple 6dB/octave speaker crossover networks, follow the appropriate resistance line up to where it intersects the desired crossover frequency and read off the required values of L & C.

Interpolate for values between the lines, using a needle point for increased accuracy.

FM STANDARDS

SIGNAL CHARACTERISTICS

CHANNELS: Nominally as per list but individual stations may be offset by up to 100kHz to minimise interference.
SEPARATION: Not less than 800kHz in any area, or 400kHz in adjacent areas.
ANTENNA POLARISATION: As determined by the ABCB but normally the same as for TV transmissions in each area.
DEVIATION: Not to exceed ±75kHz, with a positive value of baseband signal producing positive deviation of carrier.

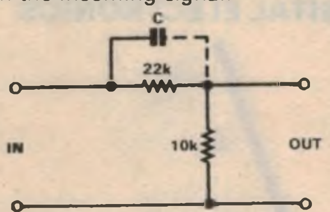
TRANSMISSION MODES

MONOPHONIC: Audio frequency range 30Hz to 15kHz, with treble pre-emphasis as per graph equivalent to 50uS.

STEREO: Established pilot tone system in which L+R information provides the baseband or compatible mono (M) component deviating the main carrier by not more than ±67.5kHz.
The difference component (S) is amplitude modulated on to a 38kHz carrier, which is then suppressed, the sidebands being frequency modulated on to the main carrier. A pilot tone at half the suppressed carrier frequency is also frequency modulated on to the main carrier, the permissible deviation resulting from these "S" components being the subject of detailed standards. Both the M and S channels have an audio frequency capability of 30Hz to 15kHz, and are normally transmitted with treble pre-emphasis equivalent to 50uS.
SUPPLEMENTARY MONO: The standards envisage the possible radiation of a supplementary mono channel for information or background music modulated on to a sub-carrier centred on 67.5kHz and deviating by not more than ±7.5kHz.
DOLBY PROCESSING: The radiation of audio processed in accordance with the Dolby-B noise reduction system is envisaged on an experimental or provisional basis. With Dolby-B processing, pre-emphasis should be reduced to 25uS to maintain reasonable subjective compatibility with receivers not equipped with Dolby-B decoding.

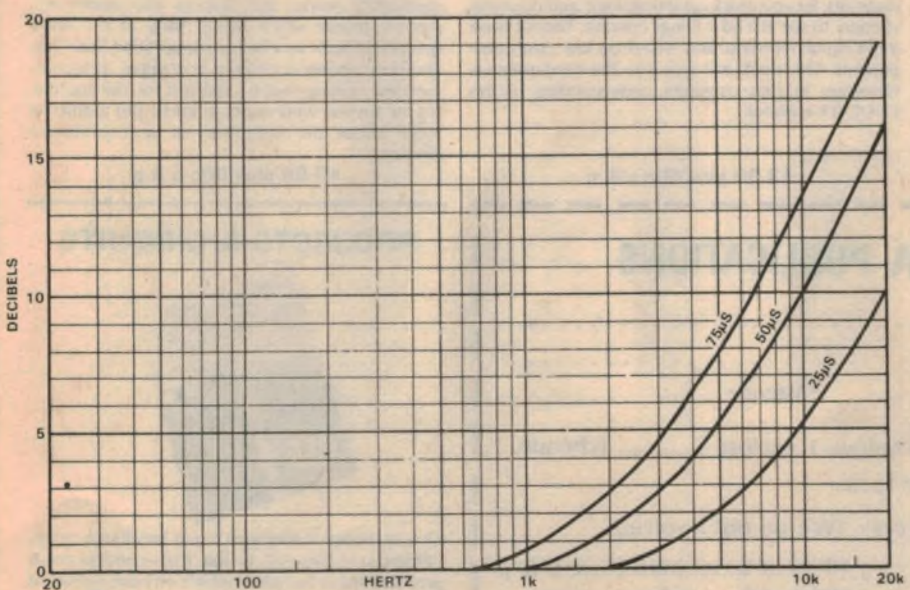
RECEIVERS

COVERAGE: Should be designed to encompass all channels as listed between 88MHz and 108MHz. Some receivers intended for overseas situations have a lesser coverage and may miss out on some Australian stations.
INTERMEDIATE FREQUENCY: Planning assumes that all receivers and tuners will use an IF of 10.7MHz, with the local oscillator operating at a higher frequency than the incoming signal.



An external network like this can be used to modify the in-built de-emphasis of an FM receiver. To reduce de-emphasis from 75 to 50uS, C = 820pF. From 75 to 25uS, C = 2200pF. From 50 to 25uS, C = 1350pF (typically 1200 + 150 or series 2700pF).

DE-EMPHASIS: Australian standard of 50uS conforms to European practice. Unless specially modified, equipment from USA and Japan is more likely to provide for 75uS de-emphasis, equivalent to about 3.5dB loss at 10kHz. The difference is barely noticeable. It can be obviated by reducing the internal de-emphasis capacitors by 33%, by using an external compensating circuit as shown, or by advancing the treble boost on the amplifier by a small amount.



Australian FM transmissions incorporate treble boost as per the 50uS pre-emphasis curve—in line with European practice and as used for TV FM sound. American and Japanese receivers, designed for 75uS pre-emphasis have too much de-emphasis (treble cut) for Australian conditions—by about 3.5dB at 10kHz. When receivers from any source are being used to actually process Dolby-B transmissions, their own de-emphasis should be reduced to correspond with the 25uS curve.

Australian FM Channels: numbers & frequencies

201	88.0—88.2	251	98.0—98.2
202	88.2—88.4	252	98.2—98.4
203	88.4—88.6	253	98.4—98.6
204	88.6—88.8	254	98.6—98.8
205	88.8—89.0	255	98.8—99.0
206	89.0—89.2	256	99.0—99.2
207	89.2—89.4	257	99.2—99.4
208	89.4—89.6	258	99.4—99.6
209	89.6—89.8	259	99.6—99.8
210	89.8—90.0	260	99.8—100.0
211	90.0—90.2	261	100.0—100.2
212	90.2—90.4	262	100.2—100.4
213	90.4—90.6	263	100.4—100.6
214	90.6—90.8	264	100.6—100.8
215	90.8—91.0	265	100.8—101.0
216	91.0—91.2	266	101.0—101.2
217	91.2—91.4	267	101.2—101.4
218	91.4—91.6	268	101.4—101.6
219	91.6—91.8	269	101.6—101.8
220	91.8—92.0	270	101.8—102.0
221	92.0—92.2	271	102.0—102.2
222	92.2—92.4	272	102.2—102.4
223	92.4—92.6	273	102.4—102.6
224	92.6—92.8	274	102.6—102.8
225	92.8—93.0	275	102.8—103.0
226	93.0—93.2	276	103.0—103.2
227	93.2—93.4	277	103.2—103.4
228	93.4—93.6	278	103.4—103.6
229	93.6—93.8	279	103.6—103.8
230	93.8—94.0	280	103.8—104.0
231	94.0—94.2	281	104.0—104.2
232	94.2—94.4	282	104.2—104.4
233	94.4—94.6	283	104.4—104.6
234	94.6—94.8	284	104.6—104.8
235	94.8—95.0	285	104.8—105.0
236	95.0—95.2	286	105.0—105.2
237	95.2—95.4	287	105.2—105.4
238	95.4—95.6	288	105.4—105.6
239	95.6—95.8	289	105.6—105.8
240	95.8—96.0	290	105.8—106.0
241	96.0—96.2	291	106.0—106.2
242	96.2—96.4	292	106.2—106.4
243	96.4—96.6	293	106.4—106.6
244	96.6—96.8	294	106.6—106.8
245	96.8—97.0	295	106.8—107.0
246	97.0—97.2	296	107.0—107.2
247	97.2—97.4	297	107.2—107.4
248	97.4—97.6	298	107.4—107.6
249	97.6—97.8	299	107.6—107.8
250	97.8—98.0	300	107.8—108.0

References and texts for your library:

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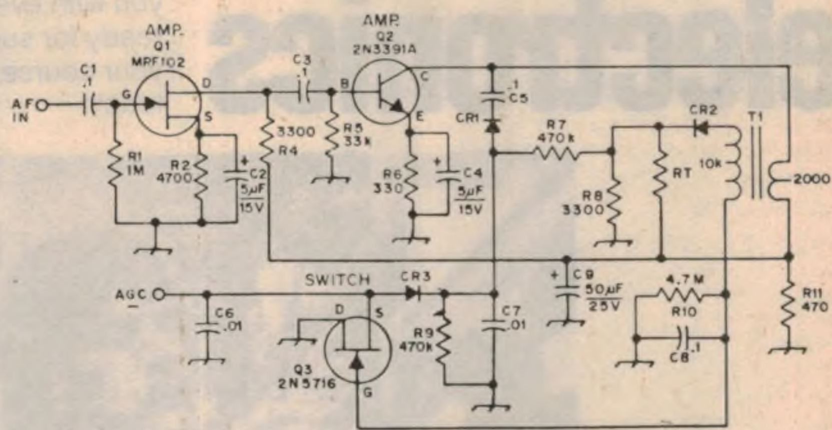
Circuit & Design Ideas

Conducted by Ian Pogson

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

Solid state hang AGC

Recently, I converted an early valve-type hang AGC circuit over to a solid-state system. It works as a hang AGC system should—very fast attack time with no AGC "pop". Q1 and Q2 function as audio amplifiers. CR1 is the AGC diode, with C7 and R9 serving as the charging network. Q2 output is stepped up through the 2k to 10k audio transformer. CR2 charges R10-C8 to a higher voltage than that across R9-C7, which keeps the FET (Q3) cut off. A 2N5716 was used because of its low pinch-off voltage. When the voltage across R10-C8 decays to a lower voltage than that across R9-C7, Q3 conducts and clamps the AGC bus to ground. CR3 is the charging diode for the .01uF AGC capacitor. AGC threshold is determined by the value of RT. The value should be between 100k and 470k depending on the AGC threshold desired.



Like the original tube version, the AGC line must be of very high impedance. This would be the case with a FET IF system. If this circuit is to be used with an integrated circuit or bipolar IF amplifier system, a low-impedance driver would be necessary.

(By Dick Stevens, W1QWJ, in "QST".)

A 2.304GHz signal source

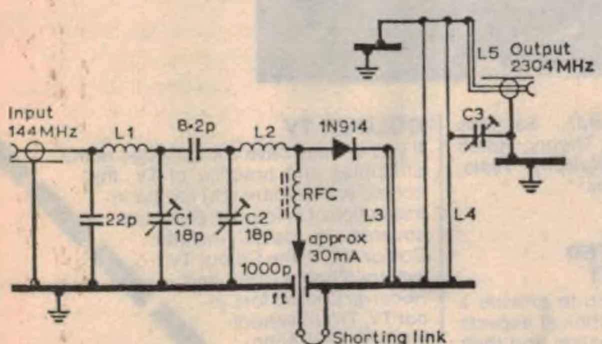


Fig 1. Circuit of a 144MHz 2·304GHz multiplier
L1: 4t 20swg enam copper ¼in id
L2: 5t 20swg enam copper ¼in id
C1, C2: 18pF tubular trimmer
RFC: 3t 22swg enam copper on ferrite bead
C3: 4BA screw in a nut soldered to pcb

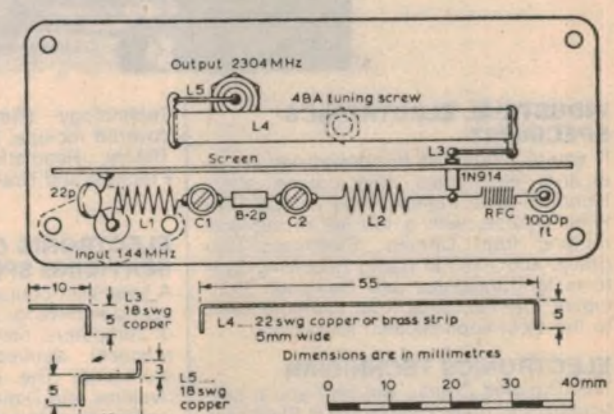


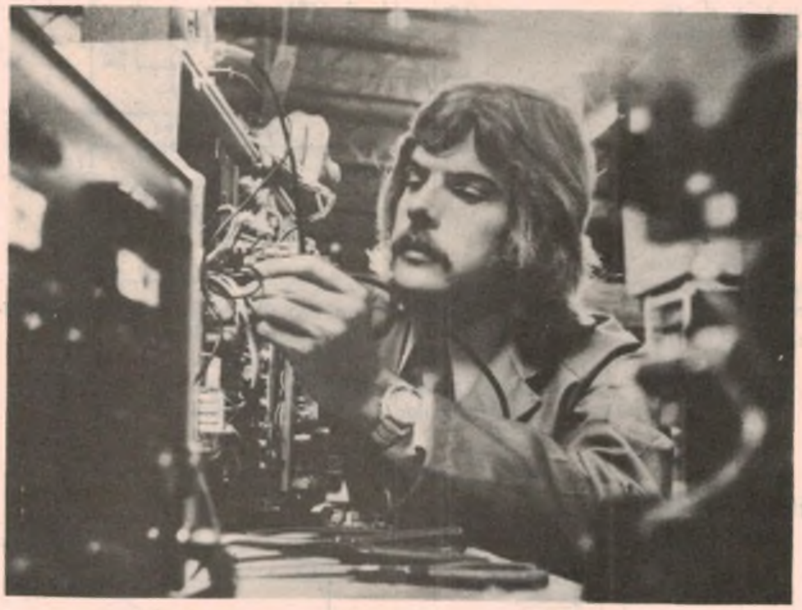
Fig 2. Layout of multiplier

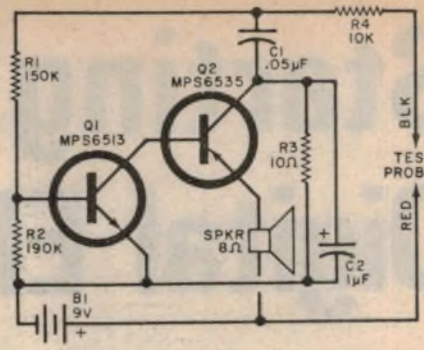
English radio amateur G8ADP has supplied details of the 2.304GHz source he uses in setting up his equipment. The unit shown in Figs. 1 and 2 is a x16 multiplier which requires 300 to 500mW of 144MHz drive from an exciter. The multiplier is built on a double-sided PCB which forms the lid of a standard 3.6in x 1.5in x 1.2in Eddystone die-cast box. It is aligned by applying the drive and tuning C1 and C2 to peak the diode current at about 30mA. The output line is tuned by the 4BA screw which constitutes C3.

(From "Radio Communication".)

Unique continuity tester

Checking an electronic circuit for continuity would appear to be a very simple job—just use a VOM, VTVM, or any other type of resistance measuring instrument. Unfortunately, the use of such instruments in a solid-state circuit is not a good idea since the current they put out for resistance measurements can damage semiconductor junctions.





The easy to build continuity tester described here has only 50 microamperes between the test probes in a short-circuit condition. This permits its use on most common ICs and discrete semiconductors, including MOS devices.

The "readout" on the continuity tester is audible so that there is no need to keep one eye on a meter when probing around in a circuit. Many a semiconductor junction has been damaged when a probe slipped from a certain point as the operator looked up to read a meter. With this tester, a good diode junction will "sound" good when forward biased.

Transistors Q1 and Q2 form a simple voltage-controlled audio oscillator, using a speaker as the output. The oscillation frequency is determined by R1, C1, R4, and the resistance between the test probes. Resistor R3 provides the collector load for Q2 and capacitor C2 is used for audio bypass. With the test probes open (unshorted), battery life is approximately the same as shelf life since no power is consumed where there is no continuity between the probes.

The continuity tester may be assembled on a small piece of perforated board and mounted, with battery, in an appropriate enclosure. A small speaker may be cemented to the top cover of the enclosure with holes drilled in the cover for the sound to escape.

Bring the test leads out through grommeted holes and terminate them with conventional metal tips with plastic sleeves. Colour code the probes with red for the positive side of the battery and black for the other side.

(By J. von Muecke, Motorola Applications Lab.)

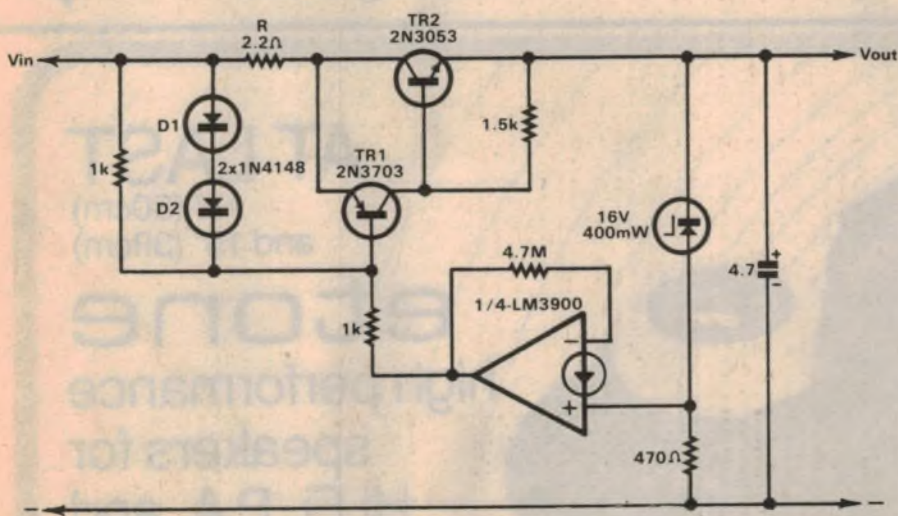
Low-cost quality power supply

A power supply exhibiting the features of a high degree of load regulation, hum, noise and ripple rejection, and current limiting can be built around one-quarter of the low cost LM3900 quad current differencing amplifier. The circuit is partly an amalgam of ideas from the Linear Applications handbook published by National Semiconductors.

The diagram is for a particular unit giving an output of 16.6 volts and a short-circuit current of 340mA. In general, Vout is the zener voltage plus 0.6V and the output current limit is approximately 0.78/R amps.

TR1 and TR2 constitute a complementary Darlington pair equivalent to a high current gain PNP transistor, a feature which permits unusually low values of Vin – Vout. The high current gain is necessary due to the low output sinking current capability of the LM3900. The particular transistor handling the full load current is an NPN, an economy feature. The diodes D1 and D2 may be 1N4148s, or any equivalent. The 4.7uF output capacitor is to ensure stability.

(By Mr L. R. Saunders, 8 Whitaker Place, Auckland 1, NZ.)



Reducing old valve receiver oscillator drift

Most older receivers employing vacuum tube oscillators do show a significant amount of drift according to todays standards and much of this drift is during warmup. A solution, empoloyed by Hallicrafters in their SX-101 series, is to simply add a 6.3V filament transformer of the correct current rating directly across the AC Line cord of the receiver, before the power switch and drive the heater of the tunable oscillator tube in the receiver from it. This way the oscillator tube is always heated (as long as the AC line is plugged in) regardless of whether the receiver is on or off, and warmup drift is almost completely eliminated or certainly significantly reduced.

Plate and screen voltages to any tunable stage in a receiver—particularly the local oscillator, should also be regulated for greater stability.

(By Irwin Math, WA2NDM, in "CQ".)

Starting: a new, updated Digital Electronics Course

In 1966-67, Electronics Australia ran a series of articles which formed an introduction to the important and then rather new field of digital electronics. The articles were very popular, and it became evident that they filled a real need both for hobbyists and for students in technical colleges and schools. When the series ended, we published the articles as a handbook—which subsequently sold in very large numbers, and ran through many reprintings.

While still one of our more popular handbooks, the original Digital Electronics is now getting rather dated. Digital technology has developed quite dramatically in the intervening ten years, with many new facets and applications, and quite a few areas where techniques have changed.

This being the case, author Jim Rowe has decided to completely revise and update the course, over the next year or so. To give readers the benefit of the new material without delay, we plan to publish the new chapters serially in the magazine, as they are written and as space permits.

Even if you read the first course, we think you'll find this new course both interesting and of value.

The first chapter begins opposite, so why not begin reading now?

An Introduction to Digital Electronics—1

Signals, circuits and logic

One of the things which puzzles and confuses many people when they first come across digital circuits and systems is the many terms and ideas derived from fields apparently quite unrelated to electronics. In this introduction the author explains how it is that things like Boolean algebra, logic, number systems and computers have become an integral part of digital electronics.

by JAMIESON ROWE

In the broadest sense, electronics is concerned with physically manipulating an abstract quantity—information. This rather ingenious feat is done by using current or voltage changes to represent the information, often in encoded form. The current or voltage changes are given the general label of "signals".

There are essentially two quite different ways of representing information as electrical signals, to allow us to manipulate it. One way is to make an electrical current or voltage vary continuously, in a manner which directly copies the information itself. Because the current or voltage variations are effectively the electrical analogy of the original information, this technique is known as the "analog" approach.

Conventional radio and TV broadcasting both use the analog method, and so does sound recording. For example in a recording studio, a microphone is used to produce a very small varying current, which copies the sound pressure variations in the studio. This small signal is then amplified, to produce a larger varying current with substantially the same variations, and used to make a recording—say in the form of variations in the magnetisation of a roll of recording tape. Upon playback, a magnetic head generates a small electrical signal once more, and after amplification the electric signal is fed to a loudspeaker to recreate a very close approximation to the original sound information.

Although this analog approach works quite well, it is not without its problems. One major problem is that in order to handle analog signals faithfully, electrical circuits must behave in a very "linear" fashion—that is, their output should be directly proportional to their input. Perfect linearity is impossible to achieve, however, and as a result signals in analog form tend to become "distorted" as they progress through circuits.

Another problem is noise. All electrical circuits tend to generate small random current variations, known as noise. This inevitably tends to add to analog signals passing through the circuits, and because there is often no easy way of distinguishing noise variations from the "true" signal variations, the signals are effectively degraded.

The alternative approach used to represent information in electrical signal form avoids these problems. Instead of using the electrical signal as a direct analogy of the information, this method encodes the information and uses the electrical signal merely as a vehicle to convey the resulting code. The electrical current or voltage is not made to vary continuously, but is switched between a relatively small number of distinct levels.

Most frequently there are only two levels, one of which may correspond to no current (or no voltage). In other words, the two levels may be "current" and "no current", with the encoded information represented by various sequences of these two levels.

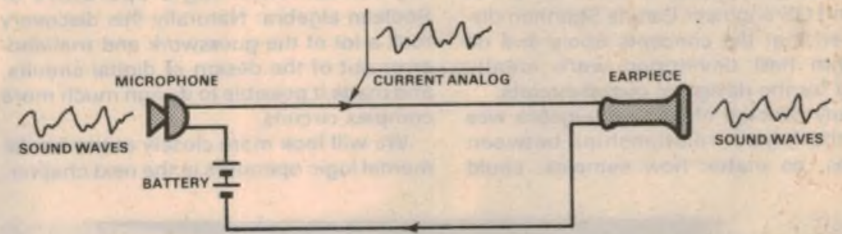
This method of representing and manipulating information in electrical form is known as the digital approach, mainly because the encoded information may often be visualised as a series of numerical digits.

The digital approach may seem less familiar than the analog method at first hand, but it has really been in use for a very long time. Most early signalling systems were digital; from the smoke signals of cave men, through fire towers and mechanical semaphore systems, to the early electrical telegraph systems based on Morse code.

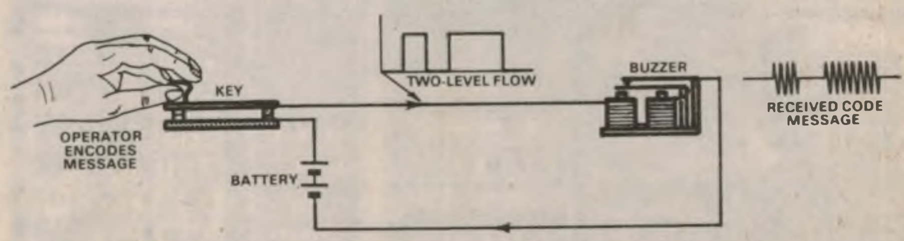
In fact the electrical telephone and telegraph are very simple examples which illustrate the difference between the analog and digital methods. In the telephone, the information is transmitted from one end to the other via a current which varies continuously as a direct equivalent of the sound waves striking the microphone—the analog approach. In the telegraph, the information is encoded and sent as a sequence of current/no current pulses, illustrating the digital approach.

In comparison with the analog approach, the digital method of representing and manipulating information tends to be less demanding in terms of electrical circuit performance. It does not require circuits to be "linear", merely requiring that they switch between two or more fixed and well-defined states—often simply "on" and "off", or "high" and "low". This means that distortion tends to be less of a problem.

Similarly because the levels used tend to be quite distinct, noise also tends to be less of a problem. For example with a digital system using only two levels—say "on" and "off"—any noise introduced into the system has to become very large indeed before it is capable of degrading the wanted information. In fact it has to



THE TELEPHONE—ANALOG INFORMATION TRANSMISSION



THE TELEGRAPH—DIGITAL INFORMATION TRANSMISSION

A simple illustration of the two ways of manipulating information electronically—the analog method and the digital method.

become large enough to make the "on" level capable of being mistaken for "off", and vice-versa.

Because of these advantages, digital techniques have become very widely used in electronics, and they are likely to become even more common in the future. It is already true to say that the digital approach has been used to advantage in almost every field of electronics—even in sound and television recording and broadcasting, which have been traditional analog strongholds.

An understanding of the basic principles involved in digital electronics is therefore going to be very necessary for anyone aiming to be involved with electronics in the future. Our aim here will be to provide you with this understanding.

Historically, the techniques of digital electronics grew from electrical telegraphy and from early work on switching and control circuits. Along the way, the people who developed the techniques found it worthwhile to borrow ideas and concepts from many other fields, some of which may seem at first sight to be quite unrelated to traditional electronics.

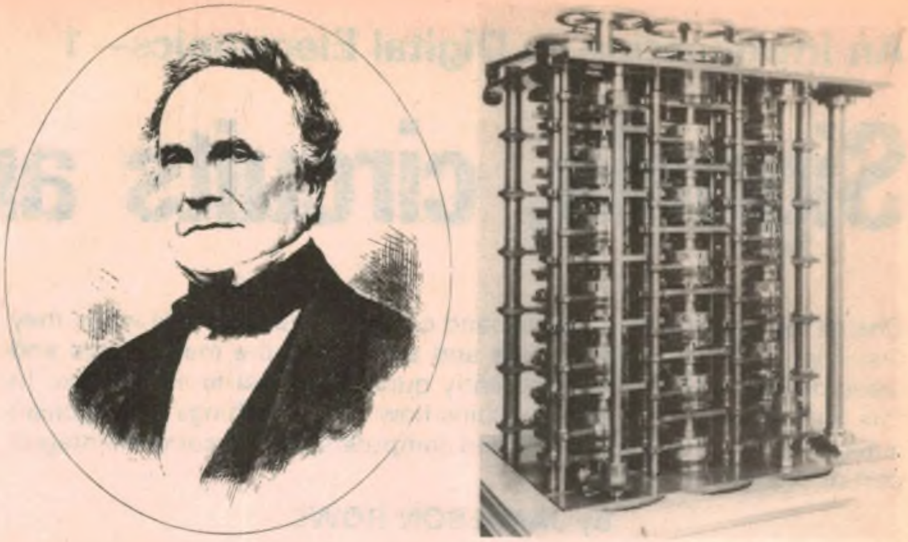
One of these fields was Boolean algebra, developed around 1850 by the logician George Boole as a way of representing and analysing the relationships between classes or sets of objects. The work of Boole and his contemporary Augustus de Morgan was regarded as rather abstract and theoretical at the time, but when digital electronics was starting to appear in the 1930's, the brilliant US engineer Claude Shannon discovered that the concepts Boole and de Morgan had developed were ideally suited for the design of digital circuits.

A key concept of Boolean algebra was that the logical relationships between classes, no matter how complex, could always be broken down into combinations of a relatively small number of basic or fundamental relationships. These "logical operators" were thus seen as the building blocks of all complex logical relationships.

Shannon discovered that the same concepts also applied to digital circuit design. If a circuit was required to perform a relatively complex function, it could be built up efficiently and elegantly using circuit "building blocks", based directly upon the fundamental logic operators of Boolean algebra. Naturally this discovery took a lot of the guesswork and trial-and-error out of the design of digital circuits, and made it possible to design much more complex circuits.

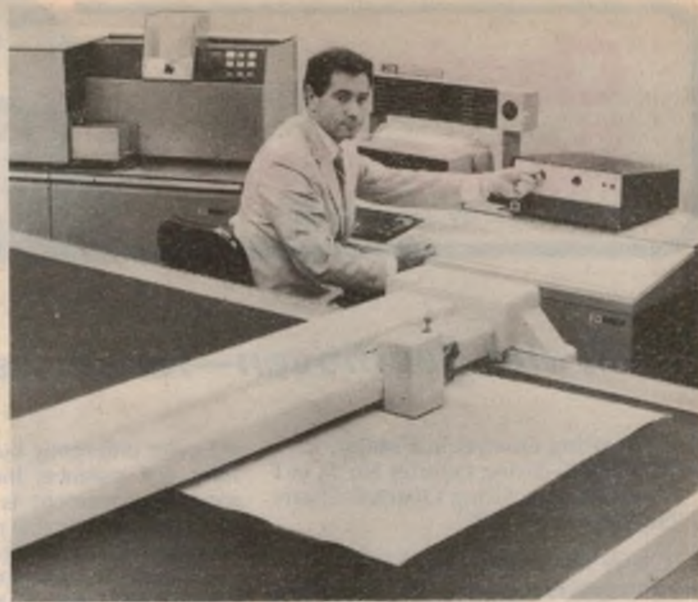
We will look more closely at the fundamental logic operators in the next chapter, as they are important enough to deserve a full discussion on their own. But perhaps you can see already why the concepts of logic start cropping up as soon as you look into books and articles on digital electronics. And also the reason why digital circuits are often alternatively called "logic" circuits.

Another field whose ideas became incorporated into digital electronics was the branch of mathematics concerned with numerical notation and number systems. In particular it was found that a number system ideally suited for use in digital circuits was "binary" notation, based on powers of two. This had been discovered early in the 17th century, by either Sir Francis Bacon or the Scottish mathematician John Napier (inventor of logarithms).



Charles Babbage, gifted mathematician of the early 19th century, and his "analytical engine"—an early mechanical digital computer.

EDSAC, one of the first electronic digital computers, built at Cambridge University in 1949. The shot at right shows Dr. M. V. Wilkes, leader of the team which produced the machine. It used more than 3000 thermionic valves. The name "EDSAC" stood for electronic delay storage automatic calculator.



Just a few of the many applications of digital electronics. At upper left is a minicomputer on a single PC board, both "naked" and in a case (Computer Automation); at upper right, a computerised drafting table (IBM, Gerber); at left, a programmable pocket calculator (Hewlett-Packard); above centre, an electronic clock (Digeec); above right, a digital multimeter (Non-Linear Systems).

Unlike the familiar decimal system based on powers of ten, the binary system requires only two different digit symbols—0 and 1. Numbers are represented by combinations of the two, using positional order to indicate the various powers of two. It is therefore very easy for numbers in binary form to be represented by the two current or voltage levels of most digital circuitry. Thus "no current" may be used to represent 0 and "current" to represent 1, or vice-versa.

Binary notation and binary arithmetic are in fact used very widely in digital circuits, and will be discussed in some detail in later chapters.

Another activity which not only influenced, but virtually became intertwined with digital electronics was the development of calculating and computing machines. Men had long dreamed of having machines to free them from the drudgery of repetitive and lengthy calculations, and as early as 1650 crude machines were developed.

Among the more notable were Blaise Pascal's adding machine, Gottfried von Leibnitz's four-function calculator, and Charles Babbage's "difference" and "analytical" engines.

But it was only in the 1930's and forties that really practical computing and calculating machines were developed, using some of the ideas of digital electronics, and in turn helping to expand the concepts of digital electronics in new directions. In 1944 a team led by Dr Howard Aitken at Harvard University produced a relay calculator, while two years later John Mauchly and J. Presper Eckert of the University of Pennsylvania produced "ENIAC", the first wired-program digital computer. In 1949 the first true stored-program general purpose digital computers appeared, developed almost simultaneously at Cambridge University, Manchester University and Princeton Institute of Advanced Study.

Since that time, of course, digital computers have developed in leaps and bounds, and digital electronics has developed largely in parallel with them. Further discussion of computers will also be given in later chapters.

Yet another seemingly unrelated activity from which digital electronics borrowed ideas was weaving. In 1801 the weaving loom maker Joseph Jacquard developed a method of "programming" a loom to automatically weave complex patterns, using cards in which holes were punched. The cards were strung together and fed through the loom in sequence, with sensing needles setting the loom threads according to the "instruction code" formed by the holes.

The idea became used very widely in the weaving industry, but it was not until 1889 that the US statistician Dr Herman Hollerith hit upon the idea of using punched cards to store information for calculating and manipulation. Subsequently, punched cards and punched paper tape played a very important role in the practical development of computers, telegraphy and digital control of machinery.

These and many other concepts from all sorts of other fields have gone together to produce the widely-embracing activity now known as digital electronics. And as you are probably already aware, the resulting techniques have application not only in the more dramatic fields of computers and automation, but also in areas like communication, broadcasting, sound and vision recording, electronic musical instruments and synthesisers, banking, cash terminals, medical instrumentation, games of skill and chance, printing, measurement and timekeeping. Many of these applications will be discussed in more detail as we progress through the subject.

Classical Recordings

Reviewed by Julian Russell

Ravel and Beethoven—recommended

RAVEL—String Quartet in F Major. BEETHOVEN—String Quartet No 11 in F Minor. Sydney String Quartet. Cherry Pie Stereo CPS 1022.

Cherry Pie, a pop label, has made an entirely successful entry into the classical field with this splendidly played and recorded disc. The Sydney String Quartet is a recently formed group whom I first heard giving a faultless performance of the Debussy String Quartet in the Sydney Opera House a couple of months ago. Their performance of the Ravel, reviewed here, is another such admirable accomplishment.

It was recorded live in the Recording Hall of the Sydney Opera House and on the evidence of the quality of the sound we have a winner in this hall. I can, of course, speak only of chamber music since I have yet to hear an orchestral item recorded in the same hall. The natural reverberation of the hall gives the sound life without post recording doctoring. The sleeve notes would have you believe that doctoring is a regular feature of recording though nothing could be further from the truth.

The big companies spend much time and money seeking just the right acoustics in a hall in which they record, and "doctoring" is the exception rather than the rule, at any rate in recordings of serious music.

When I write that no one would want a better performance or recording of this work I do not want to stress its Australian origin. We have now reached such a stage of efficiency in the technique that it would be rather like the old and very provincial question: "Have you seen our 'arbour?" True some overseas discs are better produced than others, even under the same label. But this one I am writing about could take its place with the best of any. Each instrument is given just the right weight when it is necessary for it to be heard above the other three. The ensemble is impeccable, the sound very natural and the surface absolutely clean.

The playing of the two works leaves absolutely nothing to be desired. The altogether charming Ravel quartet is played with sensitive tone nuanced to perfection. The tempos are always absolutely right. The more restless and passionate Beethoven is, of course, treated quite differently but no less successfully. For instance, the opening of the second movement is made to sound quite serene, all the more so after the virile turbulence of the first.

Later, necessarily, it subsides into what comes very close to hopelessness, and continues to sound so even under the strict discipline of polyphony. The scherzo never puts a foot wrong in all its jagged rhythms. The deeply introspective Largetto is followed by a quicksilver allegretto which may go a little faster than the marking suggested, but nevertheless whizzes along without a single falter.

Musica Viva Australia is to be congratulated on its paternal encouragement of this fine ensemble. I have no hesitation in giving this production my very warmest recommendation.

* * *

HAYDN—Symphony No 103 (Drum Roll). Symphony No 104 (London). London Philharmonic Orchestra conducted by Eugen Jochum. DGG Stereo 2530 525.

Anyone who regards Jochum as a bit of a fuddy-duddy, especially because of his diligent propaganda for the music of Bruckner, might well be astonished by this disc. In the matter of tempos it is more than brisk—in fact, it is often downright precipitous. In these fast movements the demands he makes on his orchestra are enormous and the LPO's response close to miraculous.

Owing to a particularly reverberent acoustic effect a little detail is sometimes missing in big tuttis. But to return to Jochum's unexpected treatment of Haydn's symphonies. Jochum made a great reputation in his conducting of the works of the late 19th century romantics, works that require expansive, emotional, and often self-indulgent presentation. Performers feel themselves at liberty to make a wide choice of tempos and indulge in an inordinate number of rubatos and other distortions. Not at all the sort of thing one would expect in these beautiful classical readings of Haydn symphonies.

To this classical line Jochum has insisted, at any rate in these late symphonies, on an unusually wide dynamic range. But he never depends on these characteristics to prettify the music. On the contrary; his aim seems rather to be one of strength and expansion. I think I can safely say that you will on this disc hear Haydn as you have rarely heard him before.

Everything seems to be on a bigger scale than usual. Haydn's many ingenuities can usually produce an affectionate smile on the faces of those who marvel at them, and those who have been give you the impression that Jochum's readings are without humour will be surprised to find the many witticisms still there to be enjoyed.

I have always held on to two sets of these later symphonies—Beecham's old ones and Szell's more recent interpretation, different though they may well be. Now here is a third interpretation different again in many important aspects but absolutely convincing to anyone prepared to give them unprejudiced consideration. The late symphonies of Haydn contain some of the very finest music he ever wrote and in these two examples you will find infinite pleasure in hearing them delivered in a new voice. Very highly recommended.

* * *

SCHUBERT—Piano Quintet in A Major (The Trout). Christoph Eschenbach (piano); Rudolf Koeckert (violin); Oskar Riedl (viola); Josef Merz (Cello) and George Hortnagel (bass). E Flat Major Trio for Piano (Eschenbach); Violin (Rudolf Koeckert) and Cello (Josef Merz).
String Quintet in C Major. Amadeus Quartet with William Pleeth as added cello.
Octet. Berlin Philharmonic Octet. DGG Stereo 2733 003 (Three discs.)

This Schubert collection (three discs is presented in a very handsome box though its contents are a little uneven. Thus in The Trout the slightly dry acoustic suits the piano admirably but deprives the strings of some of their tonal warmth. The playing is of unquestionable authenticity dominated by a truly fine performance by the pianist, Christoph Eschenbach. He manages this, however, without being "pushy" at any time. Indeed, though his role is given this prominence he is at all times discreet in its use.

Though the whole performance has much to recommend it—ensemble, nuancing, phrasing and so on—I didn't enjoy it as much as I had hoped. In the first place there is a lack of spontaneity about the playing and the players seem more intent on accuracy than poetry. Moreover The Trout is a smiling work and smiles are rare in this reading. Although this is apparent all through it is particularly obvious in some of the variations in the last movement.

But I must add that the performance cannot be dismissed off-hand for this reason. It has too much going for it for that. I can only say that I have heard other performances that I prefer. The one I would recommend is Decca's, which has members of the Vienna Octet collaborating with Clifford Curzon at the piano. If this hasn't been recently deleted, it should be obtainable on an Ace of Clubs label.

To fill one side of this disc you have the Nocturne, an Adagio for Piano, Violin and Cello. This is a single movement, and its intended use by the composer still remains a matter of doubt. But here you have more genial, even warmer playing, and its gorgeous melody should always charm you whatever your mood.

The great C Major Quintet is entrusted to the Amadeus with William Pleeth playing the extra cello part. In the first subject of the first movement the first violin's tone is a little shrill now and again on some accented high notes. Also I found the dynamic range of the ensemble a little wide for chamber music listening at home. It goes all the way from fff to ppp with disconcerting frequency. If you reduce the gain to make the very loud passages more tolerable you have to peer aurally into the softest ones.

And much as I admire the Amadeus they do tend to sound a wee bit fussy in this work. In the famous long adagio movement I found the reading a bit too fulsome, even for Schubert, and the Finale almost affected in its very detailed expression. I admit that this is the type of playing that many admire but it is not for me. Indeed to my ear—and mind—as played here by the Amadeus the whole work loses some of its endearing innocence.

The Berlin Philharmonic Octet is allotted the weighty Octet and gets through it with much credit. The added wind gives it something of an orchestral quality well sustained here by the beautiful balance of the recording. It is a fine achievement by this deservedly renowned group. To hear eight musicians play together with such complete unanimity of style and ensemble is really something.

* * *

BRAHMS—Piano Concerto No. 1 in D Minor. Alfred Brendel (piano) with the Concertgebouw Orchestra of Amsterdam conducted by Hans Schmidt-Isserstedt. Philips Stereo 6500 623.

The late, and very much lamented, Schmidt-Isserstedt introduces this concerto with great breadth while still preserving its lyrical quality, providing an anticipatory atmosphere all of its own. During the whole work both soloist and orchestra seem to be seeking the ultimately musical way of playing every bar, be if soft or loud. The result is one of the finest performances of this work on disc that I have ever heard in a very long time. I could use every inch allotted me in this column to gush over this superlative performance.

If I had one minor fault to find it is that here and there the piano tone loses some of its otherwise peerless musical quality. It seems to whiten for a few bars but soon regains its noble tone. This is a baffling thing to describe and experience so I shall leave my comment at that without seeking an explanation. However it's easily forgotten in the magnitude of the achievement in every other way. And if the partnership combines to take the Finale a little faster than is usual well, to me, it makes a fine contrast to the poetic meditations of the slow movement.

By the way this was the last recording Schmidt-Isserstedt made before his death in 1973 and I cannot imagine a more impressive swan song. If you have either the Gilels-Jochum or the Barenboim-Barbirolli version you needn't think of changing. If you haven't you should think seriously of acquiring the disc under review.

* * *

BEETHOVEN—Piano Sonata No 31 in A Flat. Piano Sonata No 32 in C Minor. Stephen Bishop (piano). Philips Stereo 6500 764.

It is the ambition of most first class pianists to give memorable performances of these two sonatas. And this Stephen Bishop has done at the comparatively early age of 35. There are several splendid accounts of these two great sonatas on record, all of them differing slightly from the other. This is because of the immense complexity of several aspects of the works.

Technique is not enough, nor technique allied to emotion. There must also be made apparent something of the almost intangible element of the composer's intentions, all of which in combination can produce many readings, alike in some respects and unlike in others. Moreover every interpretation, though different in detail, must be harmonious within itself. I admit these differences are subtle in the extreme yet their presence makes a great deal of difference in the overall conception of just how the works must be presented.

I don't think any of our best pianists, present or past, would claim that their reading is the best. Indeed any critic would be rash in choosing any one of those available on disc—and even some of these have been deleted and are now hard to come by—as "better" than the other. One can only welcome a new issue as being movingly great and just why it is so would take many words to explain, even if that were possible. An achievement of the magnitude of Bishop's is something to enjoy both intellectually and emotionally.

Most record buyers of really serious music already own one version that they have probably selected with great care. I can only say that here is another to add to the greats. Indeed the possession of one version should not deter the owner from listening to another with an unprejudiced mind, and if he can afford the outlay there is nothing bizarre about owning several. You will guess by what I have written the extent of my admiration for Bishop's new disc. I urge you to share my enjoyment of it. The engineering is fine, too.

CASSETTES

CHOPIN—24 Preludes, Op. 28. Prelude No. 25 in C Sharp Minor. Prelude No. 26 in A Flat. Claudio Arrau (piano). Philips Dolby Cassette 7300 735.

During Rudolf Serkin's recent tour of Australia much was made of the fact that this veteran was in his 70s, and that despite his age there has been nó serious deterioration in his playing. The same may be said of Claudio Arrau, also a septuagenarian. In my mind, his talent is even less affected by age than Serkin's. This can easily be confirmed by his performance of the Chopin Preludes. His fast passages are as beautifully articulated as ever, his range of expression as wide, his poetic sense unrivalled though perhaps equalled by that of Arthur Rubinstein.

There are 26 Preludes on this disc, all of them brief, all demanding the highest degree of concentration, accuracy and style. It is obvious that I cannot deal with every one at the length it would normally need.

All I can assert is that I enjoyed most of them vastly and that, on this cassette, Arrau sounds like a man in his early prime. He is opulent in his use of rubatos which, however, never pull the line out of shape. Arrau once stated that he was reluctant to record rubatos though he had no hesitation in using them on the concert platform. But it is impossible to play Chopin without his characteristic rubatos. The music would just not be Chopin's. But there is a certain level of self-indulgence that mustn't be overstepped, and this Arrau never does.

* * *

BRAHMS—Piano Concerto No 1 in D Minor.Claudio Arrau (piano) with the Concertgebouw Orchestra of Amsterdam conducted by Bernard Haitink. Philips Stereo (non Dolby) Cassette 7300 061.

This cassette is not Dolbyed, although the sound is still reasonably good. I did, however, find that a pretty heavy bass cut improved it. Even then Brahms' scoring sounds at its muddiest and Arrau sounds altogether too restrained. Indeed I thought the performance disappointing, not only on the soloist's part but on the orchestra's too. There are long passages where neither the conductor nor the soloist seems interested in what he is doing. Neither strikes sparks off the other. I think a better recording is bound to be issued before long and that it might well be worth waiting for.

Lighter Side

Reviews of other recordings

Devotional Records

SLIM WHITMAN. God's Hand In Mine . . . A Selection Of Songs Of Faith. Festival 2-record set, stereo, L-44225/6.

This is about as simple a formula as one could get for a Gospel album: a soloist, an electronic organ with very modest instrumental and choral support and 34 very well known devotional songs. Let me quote a few of them:

He Bought My Soul At Calvary — He Reached Down His Hand — How Great Thou Art — The Love Of God — I'll Walk With God — Whispering Hope — Jesus Took My Burden — I'm A Pilgrim — Each Step I Take . . . etc.

Slim Whitman has a light baritone to tenor voice and a C&W style replete with the odd yodel and dropped aspirate. His popularity indicates that he must have his fans and I can certainly concede that some will find pleasure anyway in the hymns he sings — with virtually faultless diction. But, having said that, I could not pretend to have enjoyed the recital personally. I'm afraid that I'm not a Slim Whitman fan. (W.N.W.)

* *

Sister Janet Mead

BUT I AM SMALLER THAN MY SONG. A ROCK MASS. Sister Janet Mead. Festival stereo L 35552.

If you like the enormously successful version of the "Lord's Prayer" by Sister Janet Mead then you will like much of "A Rock Mass". In many ways this album demonstrates what is wrong with traditional sung masses in the Romaum, take "Glory to God in The Highest" (the Gloria) or "Holy, Holy Lord" (Sanctus) which both demonstrate the exultant praise which is really appropriate. By contrast, "Lord Have Mercy" (Kyrie Eleison) and the "Wailing Song" (an offertory song) only just pass, having great potential to become dirges if they are sung by many mass congregations.

Many of the arrangements have a Beatles flavour which means they should have wide acceptance but, to my mind, the instrumentation is overdone in places and could be toned down without reducing the zest of the presentation or acceptability to the young.

Sister Janet Mead leads the singing throughout with a sincerity and enthusiasm that is infectious.

Recording quality is good throughout. Festival are to be congratulated for the overall presentation of the album although no doubt it is to their own good. It should sell very well. Words to all the music are included on the inner sleeve of the album. (L.D.S.)

HAPPY IN THE LORD. Sister Philippa. Stereo, Move. MS-3011. (From Move Records, Box 266, Carlton South, Vic. 3053. Price $5.95. Also on cassette, same price.)

Recorded in Hobart, this is Sister Philippa's third album, the preceding one having the with-it title of "Switched-On Praise". From the jacket notes, one would judge it to be very much an ecumenical effort. From the Convent of Mt. St. Canice, Sandy Bay, the "Singing Nun" is credited with having sung in many of Hobart's churches and is here backed by enthusiastic young people—instrumentalists and chorus—drawn from a variety of christian communions.

Apparently all her own compositions, the songs of praise and dedication could be taken and used in any denominational context: Let The Whole Word Sing — Be Happy In The Lord — Lord Jesus Come — When I Think Of The Cross — Christ Is Risen — Walk One More With Us — The Lord Is Here — I Heard About —Song of Faith — A New Song To Sing — Into Your Hands O Lord — Open The Door — Spend A Little Love — A Blessing.

The words are given on the back of the jacket and, with Sister Philippa's excellent diction, the sincerity and happiness of the songs communicate effectively. The jacket notes explain that the participants are not professionals but they do a fine job nevertheless and the whole atmosphere is refreshing, with a potential appeal to all age groups. Technically, the quality is excellent. (W.N.W.)

Instrumental, Vocal and Humour ....

GOOD MUSIC HITS VOL. 2. Festival Strings. Festival stereo L 25196.

Another album in the Festival Strings easy-listening series. This is the third I have reviewed in the last few months and, like the others, it has good arrangements and a recording quality right up to standard. Good buying at $3.99.

There are twelve tracks: Casey's Last Ride — A Place To Hide Away — Vincent — Sing — Rainy Days And Mondays — La La Love You — American Pie — For All We Know — And I Love You So — Top Of The World — Help Me Make It Through The Night — Love is Surrender. (L.D.S.)

* * *

ROBERT FARNON. The London Philharmonic Orchestra. Astor, quadraphonic. QUAD-1029.

Take the London Philharmonic, install it in London's Festival Hall, arrange a program of popular show tunes, record them in quadraphonic . . . and the result ought to be really something. Yet, I personally couldn't generate much enthusiasm for the end result. To the audience present on the occasion it would probably have been visually and sonically entertaining but, purely as a recording, my tip is that most would be happier with a more intimate, less pretentious performance of the music:

Colditz March — My Fair Lady Medley — Laura — Porgy & Bess Suite — Karnon Fantasy (A Star Is Born, Peanut Polka, Jumpin' Bean, Westminster Waltz, Portrait Of A Flirt, State Occasion).

In terms of quality, the sound is okay without being especially noteworthy. If the recording grabs you, it will be because you like your show music more heavily arranged and dramatised than usual. (W.N.W.)

* * *

A WINDOW TO THE SKY. Music From The Original Motion Picture Sound Track. Featuring Olivia Newton-John. MAPS (ASTOR) 7908.

This album is predominantly instrumental, with Olivia Newton-John contributing only the title track. Unfortunately, this is ruined by excessive sibilance, presumably due to faulty microphone placement. Apart from that, the music is pleasant enough, although is will not mean a great deal to anyone who has not seen the film. (D.W.E.)

Reviews in this section are by Neville Williams (W N W) Harry Tyrer (H A T), Leo Simpson (L D S), Norman Marks (N J M) and David Edwards (D W E).

SOUNDS LIKE JAMES LAST. Billy Burton Brass. Festival L 45485/6. 2-record set. $7.95.

In a way, this album is incorrectly titled. It should be called "Sounds Like James Last Used To" because, in my opinion, the James Last Band has never sounded the same since he adopted his drunken chorus. At any rate, if you like big and bright arrangements for brass band then this 2-record set will be attractive at $7.95. Recording quality is good.

Some of the 23 tracks are: Call Me Irresponsible – Days Of Wine And Roses – Surrey With The Fringe On Top – When I Love You – Man With A Horn – Watermelon Man – Oh You Beautiful Doll – Volare – Cherry Pink And Apple Blossom White – Call Me – People. (L.D.S.)

★ ★ ★

RIDE A ROCK HORSE. Roger Daltrey. Polydor 2383 346.

Who is Roger Daltrey? If you can't answer this question then you're probably not a rock fan, anyway.

Following on from his success in "Tommy", Roger has produced a fine album of rock. Tracks featured are—Get Your Love—Hearts Right—Oceans Away—Proud—World Over—Near To Surrender—Feeling—Walking The Dog—Milk Train—Born To Sing Your Song.

It is very difficult to single out any one track, in preference to the others, as all tracks are excellent. One is tempted to compare his overall style with that of Rod Stewart. Technical quality is good, the bass is tight and the highs are clean. (D.W.E.)

★ ★ ★

WIVES & LOVERS. George Golla. Festival stereo L 25205.

This is a re-issue of a well-produced local album featuring, besides George Golla, well-known musicians such as Don Burrows, John Sangster, Ed Gaston, Errol Buddle and a few others. The performance is polished, the arrangements for the most part very listenable and the quality good except for a trace of tape hiss on some tracks. A good buy at $3.99.

Track titles are: Bye Bye Blues—Waltz To Adelaide—Fool On The Hill—The More I See You—Day Tripper—This Guy's In Love With You—Wives And Lovers—Insensatez—Berimbau—I Want A Girl—Samba Del Orfeo—Dream A Little Dream. (L.D.S.)

★ ★ ★

SO YOU WANNA BE A ROCK 'N' ROLL STAR? (The "Scream Years" of Australian Rock, 1964-1966). Various Artists. Festival L45587/8. (Double Album.)

Do you know that "Kevin Book & The Bible" were refused airplay on a Sydney radio station because the name was deemed sacrilegious? If you didn't, and if you are old (or young!) enough to remember the early years of the Australian Rock Scene, then this double LP will send you down memory lane.

Compiled by Glen Baker, a self-proclaimed "child of the seventies", the thirty-two tracks on this album are all original Australian Rock recordings. Naturally, such (relative) giants as Billy Thorpe & The Aztecs, Normie Rowe and Johnny Young are featured, as well as a host of lesser groups, too numerous to mention.

There is very little new that I can say about this collection, as it has all been said in the excellent cover notes. So with a passing reference to the record quality (good), I'll finish here, with a recommendation that you hurry into your local record shop and examine it for yourself. (D.W.E.)

Old, mono, but good . . .

ALL STAR JAZZ SESSION. Earl "Fatha" Hines. Trip mono TLP-5087 (Astor release).

The title of this album fully explains its raison d'etre. It was recorded in 1954 and recaptures the zest and atmosphere of the roaring twenties big band era. Recording quality is good, although in mono. In fact, it is so good that no attempt has been made to "re-process" it for stereo. Go buy it while you can.

Nine tracks make up the album: Won't You Come Home Bill Bailey—My Monday Date—Relaxin' At The Touro—Ugly Child—When The Saints Go Marching In—Baby, Won't You Please Come Home—Mood Indigo—Caravan—Pops' Blues. (L.D.S.)

★ ★ ★

BOTTOM OF THE PUNCHBOWL. Quarefellas. Stereo. Harlequin L 25208 Festival Release.

The Quarefellas are four immigrants from Great Britain, at present living and working in Western Australia. Mick McCauley from Dublin, Alan Ferguson from Dumfries, Anita Blacker from London and Fred Rae from Cork all met at Mulligan's Irish Restaurant in Perth. They have built up a strong following in the western state, and have had many concert, TV and radio successes.

Listening to this album, it is easy to see why. Their full blooded sound and unusual drive and enthusiasm comes across very clearly. In the main, they sing traditional Irish, Scottish and English folk songs, although some Australian material is included in their repertoire.

The tracks are too numerous to list here, but rest assured that at least one of your old favourites is included. By the time that you read this, I am sure that all of the tracks will be among my favourites!

I could not fault the record technically, the sound is very clear and clean. So if you have a leaning towards traditional folk tunes, and if you like to sing along as well, buy it, turn up the volume and do so! I am sure that you will thoroughly enjoy yourself, as I did! (D.W.E.)

★ ★ ★

HAROLD SMART at the Thomas Organ. Stereo, Astor GGS-1466.

If you want a practical—and musical—demonstration of the sounds that can be won from a modern electronic organ, then you should hear this new album. Thomas have quite a reputation for their imitative voices and Harold Smart invokes them smoothly and unambiguously in the dozen numbers presented here. Mind you, he does use two organs—a "Celebrity Royal" with in-built Moog, and a "266 Californian Quad" but what an array of voices and effects they offer: piano, strings, tibias, vibramagic, harpsichord, mandolin, accordian, Moog trumpet, glide tab, guitar, arpeggio, and so on.

As for titles, here they are: The Entertainer—The Way We Were—Beyond Tomorrow—River Song—Heidi Jane—Paul & Michelle—What'll I Do—Golden Voyage Of Sinbad—Colour Of Goodbye—Last Tango In Paris—Summer Green Or Autumn Gold—Turning Point.

Technically, the sound ranges from brilliant trebles to solid bass, although there seemed to be some slight fuzz in the low-level background sound, possibly a heritage of multiple recording. But it has to go down as an interesting record, and one that is musically entertaining as well. (W.N.W.)

Smooth quadraphonic

SERENADE. Acker Bilk, His Clarinet & Strings. Quadraphonic, Astor QUAD-1031.

Many quadraphonic records tend to make their point by surrounding the listener with sound that compels his attention by its sheer quantity, complexity or brilliance. This one is different. It is as smooth as only Acker Bilk can make it, with his clarinet up front and the strings filling the rest of the room in the most convincing manner.

All told, there are twelve tracks: Canio's Tune – Some Other Time – Homecoming – If – What Would We Do? – Wichita Lineman – Sipping Cider – You Should Have Said – Theme From The Godfather Part II – Lazy Serenade – Auf Wiedersehn Sweetheart.

There is no hint of the encoding method on label or jacket but it responded well to both simple decoding and to SQ and I would recommend it to anyone with 4-channel gear who would like some very gentle, very tuneful sound. It's also a good one to show the difference between 2-channel and 4-channel reproduction. In terms of quality, it is very clean. (W.N.W.)

LIGHTER SIDE—continued

TWIN ORGANS, Featuring Len Rawle playing Yamaha and Hammond organs. Interfusion stereo, 2-record set L45443/4 ($7.95).

The double fold jacket offers two identical pictures of an attractive lass, two identical segments of a keyboard, two identical contents lists, but not a word about Len Rawle, about the instruments he plays, or the way the record was made.

While the Yamaha and Hammond appear to dominate records 1 and 2 in that order, there may well have been some intermixing and over-recording. Zealous electronic organ buffs could possibly have fun identifying which voice is what. Others will simply listen to the music as it comes—typical swinging club sound with a gentle percussion background.

There are far too many selections on the four sides to list but here are just a few at random: The Long & Winding Road —Early In The Morning—Raindrops Keep Falling—The More I See You—Wand'rin Star—What The World Needs Now—Why —Cecilia—Cabaret—Clair, etc.

The sound is smooth and clean and Len Rawles leaves no doubt about his ability to stir the stops but whether four sides for $7.95 represents a bargain will depend on your inclination to play that many organ numbers in a row. (W.N.W.)

★ ★ ★

MR CROSBY AND MR MERCER. MCA Coral. COPOS 7751. Astor release.

I think the unsung star of this record must surely be the engineer responsible for the remastering, as some of the tracks go back to 1936; yet the overall quality needs no apologies. Bing Crosby, with a number of his buddies, Johnny Mercer, Mary Martin, Jane Wyman, The Andrews sisters, Connie Boswell and Jack Teagarden give us a dozen of the most durable Crosby hits.

These are: Mr. Gallagher And Mr. Sheen — Too Marvellous For Words — Blues In The Night —Bob White — You Must Have Been A Beautiful Baby — On Behalf Of The Visiting Fireman — In The Cool Of The Evening — I'm An Old Cow Hand — Ac-cent-tchu-ate The Positive — Autumn Leaves — When The World Was Young — The Waiter And The Porter And The Upstairs Maid.

For any Crosby fans with aging 78's, this would be an excellent replacement. (N.J.M.)

★ ★ ★

GREATEST HITS VOL. 2; Jerry Lee Lewis, Charlie Rich & Johnny Cash. Harlequin L 25179. Festival Release.

At $3.99, this album would be a good buy for those who like the three featured artists. In order, the tracks are: There Won't Be Anymore (Charlie Rich) — Guess Things Happen That Way (Johnny Cash) — Who Will The Next Fool Be (Charlie Rich) — Ballad Of A Teenage Queen (Johnny Cash) — C. C. Rider (Charlie Rich) — Drinking Wine Spo-Dee-O-Dee (Jerry Lee Lewis) — I'll Be With You In Apple Blossom Time (Charlie Rich) — Whole Lotta Shakin' Goin' On (Jerry Lee Lewis) — Breathless (Jerry Lee Lewis) — Luther Played The Boogie (Johnny Cash) — I Can't Trust Me In Your Arms Anymore (Jerry Lee Lewis).

I have taken the trouble to list all the tracks, as for some reason or other, they are not all listed on the jacket. Overall, the twelve tracks make for very pleasant listening. Technically, the quality is good. (D.W.E.)

★ ★ ★

JOIN IN AND SING. GGS-1469 Astor release.

Without a doubt this would be the best sing-along record I have heard in a long time. With excellent quality, clear diction and first rate musical backing, it would make a good party starter, with titles like: Side By Side—By The Light Of The Silvery Moon—On Moonlight Bay—White Cliffs Of Dover—Daisy, Daisy—K.K.K.Katy—Show Me The Way To Go Home—On Top

Of Old Smokey—Maori Song Of Farewell—Ma, He's Making Eyes At Me—Those Old Time Songs—She'll Be Coming Round The Mountain—Long Haired Lover From Liverpool—When The Saints Go Marching In—Good Night Sweetheart—I'll See You In My Dreams.

Rush out and buy it for your next party (N.J.M.)

★ ★ ★

SONGS OF BATTLE. The Ralph Hunter Choir. RCA Camden ACLI-0807.

If you are old enough to remember World War II, most of these songs will bring the memories back with a rush, as quite a few of them were 'hits' of the period, particularly those of American origin. Some of the twenty-two titles are: Reveille — Madamoiselle From Armentieres — The Marines' Hymn — When Johnny Comes Marching Home — Comin' In On A Wing And A Prayer — Lili Marlene — Liberty Song — It's A Long Long Way To Tipperary — Over There.

The quality is good and the Military Band style of backing adds the appropriate atmosphere. (N.J.M.)

★ ★ ★

Maureen McGovern

MAUREEN McGOVERN. Academy Award Performances. Stereo, 20th Century (Festival) L-35564.

When you put this disc on the turntable you might be excused for believing that you have really skipped back to the thirties: the first 34 seconds "Thanks For The Memory" has been mocked up to sound just like a very old 78rpm disc — crackles and all. But then the sound reverts to the present with only the titles remaining behind (or at least some of them):

The Continental — For All We Know — When You Wish Upon A Star/Over The Rainbow — Lullaby Of Broadway — The Morning After — Windmills Of Your Mind — Swingin' On A Star — All The Way — We May Never Love Like This Again — You'll Never Know — Thanks For The Memory.

You've heard them all over the radio during the past couple of months? Of course you have and I can assure you that they add up to very pleasant listening when you own your album. So I remember when the numbers were first released? Sure, but they didn't sound like these modern versions and recordings! Recommended. (W.N.W.)

MOUNTAIN MAMA. Dianne Davidson. Stereo. Janus Records JLS 3048. Astor Release.

According to the "good ole record company hype" accompanying my review copy, Astor Records have decided to re-release this record, following recent heavy demand. It was recorded in the spring and summer of 1972, with the aid of a large number of Nashville session musicians.

Dianne has a very powerful voice, and she sings contemporary Country Music. Having said that, I can only say that if you have an interest in this type of music, then you'll probably enjoy this record. Tracks that I thought were particularly good were: Brand New Tennesse Waltz — When My Room Gets Dark Again — Song For Adam.

Technically, the record is extremely good. Surface noise is negligible, and the stereo separation has been used very effectively. (D.W.E.)

★ ★ ★

FOR YOU. Col Joye. ATA Records L 35489. Festival Release.

Col Joye has been around the Australian entertainment scene for quite a few years, and will be well known to most people. On this record, he presents a number of recent hits. Included are: Touch The Morning — Song Sung Blue — Never Been This Far Before — Tie A Yellow Ribon — Daisy A Day — The Most Beautiful Girl In The World — You're Sixteen — Sweet Gypsy Rose — Behind Closed Doors — Welcome Home — Through Children's Eyes — I Can See Clearly Now — Summer (The First Time).

He makes the songs sound pleasurably different and, although his Australian accent may seem disconcerting at first, one soon tends to forget it. All told, the album provides very easy listening, and would be a worthwhile addition to any collection. The technical quality is very good. (D.W.E.)

★ ★ ★

SONGS OF ROGER WHITTAKER. Featuring: The Last Farewell. The Durham Towners. Harlequin L 25213. Festival Release.

This $3.99 release contains a good selection of Roger Whittaker songs. Whether the versions presented here are improvements on the originals is open to doubt. There is no information on the cover as to who "The Durham Towners" are although they have taken their name from one of the included songs.

In order, tracks included are: The Last Farewell — Mamy Blue — Why — I Don't Believe In If Anymore — Mexican Whistler — I Believe — The Leaving (Durham Town) — Australian Whistler (Swaggie) — New World In The Morning — What Love Is (Love Is A Morning Sunrise) — Russian Whistler — Hello, Good Morning Happy Day.

As usual with Festival releases, the quality is quite good. (D.W.E.)

Books & Literature

FM stereo receivers

STEREO F.M. RADIO HANDBOOK by P. Harvey and K. J. Bohlman. Published by Norman Price (Publishers) Ltd, London, 1974. Cardboard covers, 21.5 x 14cm, 203pp, freely illustrated by circuits and diagrams. Price in Australia $7.95. Distributed by Electronics Publications (Aust), PO Box 107, Riverwood, NSW 2210.

Information on FM stereo tuners and receivers tends largely to come from general textbooks or from chapters in other books devoted to hifi-stereo in the broad sense. This new book has some general material on recording and reconstituting the stereo image but, for the most part, it is taken up by FM/stereo transmission, propagation, reception, and decoding, with very little attention to audio systems, as such.

The contents are clearly indicated by the chapter headings (abbreviated): Stereo basics; Transmitter encoding, modulation; Receiver tuning, demodulation; Decoding multiplex signals; Typical circuits; Decoder adjustments; VHF propagation, aerials; Stereo reproduction. In addition to the main chapters, there are four supplementary appendices, a bibliography and an index.

Both attached to the Lincoln College of Technology, authors Harvey (mathematics) and Bohlman (radio & TV) have produced what is obviously an up-to-date textbook on the subject, combining descriptive writing with supporting maths and graphical illustration. Perhaps reflecting the British rather than the Japanese scene, the book seems to assume relatively uncomplicated front ends but dwells much more heavily on decoding methods, circuitry and problems.

With FM/stereo moving further into the spotlight in 1976, it would seem to be a timely release for servicemen and others who will be concerned with the technicalities of receivers and tuners. (W.N.W.)

Colour TV servicing

COLOUR TELEVISION PICTURE FAULTS, by K. J. Bohlman. Published by Norman Price Ltd, London. Second impression, 1975. Soft covers, 112 pages 215mm x 135mm. Price $7.95.

This book is obviously intended for the student or service technician converting from monochrome to colour TV and, as such, should be a valuable addition to his library.

The book is divided into four major sections: (1) Extraneous Colour on Monochrome Pictures, (2) Loss of Colour, Wrong Colours or Bands of Colour, (3) Patterning and other Defects, and (4) Appendix.

Under these headings are listed some 30 specific faults, ranging from impure raster to 4.43MHz dot patterning and, most important, illustrated by no less than 106 colour illustrations. The illustrations are actual photographs of a TV screen, divided about equally between test patterns or bar patterns and live program material, depending on which is most suited to illustrate the particular fault.

Although considerable emphasis is placed on the pictorial nature of the book, it carries a lot of useful text explaining the cause of each fault. These explanations are in general terms, such as would cover most receivers. No attempt has been made to deal with faults peculiar to individual brands of sets or components.

While the best way to demonstrate a fault is to deliberately create it within a demonstration chassis, such facilities are not available to everyone. This book would seem to be the next best thing, with the advantage that the symptoms and explanations may be studied at leisure. Even where practical instruction is available, it would provide a useful back-up.

The review came from Electronic Publications (Australia), P.O. Box 107, Riverwood, NSW, 2210. (P.G.W.)

Radio history

THE STORY OF RADIO, by W. M. Dalton, published by Adam Hilger Ltd, London, 1975. Volume 1: How Radio Began. 150pp, 152 x 216mm, many illustrations. Price approximately $13.50. Volume 2: Everyone an Amateur. 157pp, 152 x 216mm, many illustrations. Price approx. $13.50.

These are the first two volumes in a comprehensive history of radio and electronics, written by British engineer and enthusiast W. M. Dalton—a man who has himself directly experienced a major part of the story he unfolds.

From the cover notes and the preface, it seems that he has undertaken the task of recording the material partly for the benefit of historians, and partly to give newcomers to the electronics industry a source from which they may acquire an identification with their endeavour and those who preceded them in it. These are both worthy motives, and by the look of these first two volumes, I believe he is likely to achieve them both admirably.

In the first volume he deals with the very early formative phase. The titles are headed 1—Magnetism and Electricity; 2—Electrical Engineering; 3—Wireless Telegraphy; and 4—The Thermionic Valve.

Volume 2 then looks and the fledgling days of radio itself, up to about 1925. The titles are headed 1—After World War 1; 2—Amateur Wireless; 3—The British Broadcasting Company; 4—Home Constructors; and 5—The Rediscovery of Short Waves.

Mr Dalton writes in a concise and informative fashion, but one which is at the same time very readable. My impression is that anyone with even a faint feeling for history of science and technology will find the books almost compulsive reading.

The text of both volumes currently available for review is generally well complemented by line drawings and halftone illustrations, with volume 2 rather better than volume 1 in this regard.

About the only criticism I can make about the project, on the basis of these first two volumes, is that it is biased rather heavily towards the contributions of British pioneers. However I expect this was very difficult to avoid.

Bias or no, however, I for one will be looking forward with keen interest to seeing the remaining volumes in Mr Dalton's series.

The review copies came from ANZ Book Company Pty Ltd, of 23 Cross Street, Brookvale, NSW, who advise that volumes 1 and 2 should be available from retail stores by the time this review appears. (J.R.)

Digital courses

DIGITAL COMPUTER LOGIC AND ELECTRONICS, a self-instructional course, by C. P. Gane and A. W. Unwin. Four volumes, soft covers, 210 x 300mm, 147pp total. Many diagrams. Price $13.00 including post and packing.

DESIGN OF DIGITAL SYSTEMS, a self-instructional course, by P. C. Pitman, Six volumes, soft covers, 210 x 300mm, 347pp total, many diagrams. Price $17.00 including post and packing.

Two self-instructional courses on digital electronics, of the "programmed" type. The first is an introductory course dealing with binary notation, logic circuit elements, logic network synthesis, flip-flops and registers. The second course also starts with fundamentals, but is rather more thorough and goes on somewhat further to deal with arithmetic circuits, calculator and computer architecture.

The first course seems to this reviewer to be rather less attractive than the second, for two reasons. The first is that it is more dated, having been written in 1970 compared with the 1974 dating on the second course. The second is that virtually all of its material is covered in the second course, which most people would want to read anyway because only it will take them to a point where they could actually put their knowledge to any use.

With regard to the second course, this seems quite well planned and executed. It should certainly allow those with no existing knowledge of digital techniques to gain quite a useful proficiency. Whether they will acquire a really sound grasp of the basic concepts behind the techniques is perhaps doubtful, though, as these are not much in evidence. In fact it would not be very easy to incorporate them in any course of this type.

Despite this possibly arguable shortcoming, the second course is undoubtedly good value for money at the price quoted, and would be very worthwhile reading for anyone wanting to delve into digital electronics from "scratch". I would merely suggest that you supplement with further reading.

The review copies came from the Australian distributors, Baber Enterprises Pty Ltd, of 2 Monomeeth Drive, Mitcham, Victoria 3132. (J.R.)

Tape recording

TAPE RECORDING FROM A TO Z, by Doug Crawford. Published by Kaye & Ward, London, 1974/5. Hard covers, 220 x 140mm 112pp, few illustrations. Australian price $6.80.

With the title as above, this book could hardly be anything but an elementary text, and this is what it turns out to be. Section 1—a very sparse 10 pages—explains the nature of sound, the idea of tape recording, and gives a few pointers about the choice of a unit.

Section 2—the bulk of the book, printed on stout coloured paper—is the A-Z part: reasonably full explanations of the terms which a tape hobbyist is likely to encounter.

Section 3—which might well be an afterthought, relates the foregoing to cassette machines, while all but ignoring the cartridge system.

In sample reading the text, I gained the impression that Doug Crawford has a commercial rather than technical background and the final jacket note confirms this. Early in the book he dismisses the disc system as involving too many processes, ignoring the fact that it is fully competitive with tape in terms of noise and quality. Towards the end, he ascribes the noise-free performance of cassettes substantially to CR02 tape and

(Continued on page 99)

New Products

3½ digit DMM from Trio has 0.3% accuracy

There are now several digital multimeters available at prices close to $100, and with features available until only recently on far more costly units. Here we review the Trio DL-703 which sells for $120 plus tax.

Dimensions of the Trio DL-703 are compact at 210 x 70 x 150mm (W x D x H), which is small enough to make it attractive and not so small as to make it fiddly. The photograph shows the front panel a little smaller than actual size. Mass of the unit is 1.2kg.

As you can glean from the photo there are only two knobs, Function and Range. There is no zero preset, as the circuit has automatic zeroing. Polarity indication is also automatic. Overload on any of the ranges is indicated by flashing of the display.

There are four DC voltage ranges, four AC voltage ranges, five resistance ranges and a single current range of 200 milliamps DC. While DC voltages of up to 1kV can be measured, AC voltages are limited to 350V. Resistance measurements can be made up to 19.99 megohms (not 20M as indicated by the Range switch).

Accuracy is quoted with different limits for each measurement function: plus or minus 0.3% of reading plus or minus 0.15% of range for DC voltages; plus or minus 1% of reading plus or minus 0.15% of range for AC voltages and all but the highest resistance range; plus or minus 2% of reading plus or minus 0.5% of range for the highest resistance range, while for the single current range it is 0.5% of reading plus or minus 0.15% of range.

These accurancy ratings apply for temperatures of 23 degrees Celsius plus or minus 10 degrees and less than 90% relative humidity. While the accuracy is considerably better than is achieved with ordinary moving coil meters it is fairly run-of-the-mill standard for digital instruments.

Trio quote sensitivities for the various ranges which amount to the smallest least significant digit on the range concerned. For example, on the 1.999V range, the sensitivity is quoted as 1mV. Strictly speaking though, this parameter should really be termed "resolution". Maybe we are hidebound, but sensitivity is relevant only to analog multimeters and is expressed in "ohms per volt". It does not apply to instruments such as this which have a fixed input impedance.

Construction of the DL-703 is simple and straightforward. Four screws attach wraparound covers, which remove to give access to the three PC boards. The circuitry uses TTL integrated circuits and LED seven segment readouts. There are no less than sixteen preset potentiometers, twelve of them on one PC board.

We performed limited checks on the accuracy on the DL-703 and found that the claims appear to be credible. In fact the accuracy quoted is really far more than is needed for most routine work. However the resolution available on the lower ranges is very handy, especially when checking offset voltages of op amps and similar tests which are not possible with ordinary multimeters. The accurate resistance measurements are also attractive, especially for low values.

The DL-703 is very simple to use and the readout is clear and unambiguous. Perhaps its only disadvantage is that it is powered from the AC mains. Apart from that it is an entirely satisfactory unit well worth the price. Accessories supplied with it include a set of connecting leads fitted with banana plugs and alligator clips, four fuses and the instruction manual.

Price of the Trio DL-703 is $120 plus 15% sales tax where applicable. It can be purchased from stockists of Trio test equipment or from the Australian distributors, Parameters Pty Ltd, 68 Alexander Street, Crows Nest, NSW 2065 or 53 Governor Road, Mordialloc, Victoria, 3195. (L.D.S.)

This photo shows the panel almost full size. It is shown here measuring a 1.8k resistor.

Multi-function electronic stopwatch

A new line to be added to the list of timing devices handled by Australian Time Equipment Pty Ltd is an electronic stopwatch called "Chronostop", made under licence from the well known Omega watch manufacturers. Somewhat larger than a conventional stopwatch, nevertheless it still fits snugly into the hand.

The Chronostop is housed in an attractive (but not elaborate) red and black moulded case. The dimensions are 42mm x 62mm x 114mm and it weighs 120g. A woven strap is provided so that the instrument may be carried over the shoulder or around the neck.

The heart of the "works" is a quartz crystal with a CMOS IC. The readout from a six-digit LED display is via an anti-reflective filter lens fitted to the front face of the case. The unit is powered by three size AA alkaline cells. Rechargeable nickel cadmium cells may be used instead of the alkaline cells if desired.

The Chronostop is very easy to control and it is made particularly versatile by means of its four controls. These are a reset button, a master control button, a display control button, and a programme selector switch. With these controls, a wide variety of functions are available to the user.

In addition to the four function positions on the switch, there is also a "O" or "off" position. Position 1 is labelled Start-Stop and this is used for timing a single event, or one followed by another and separate event, etc. To operate in this position, the reset button is pressed, which brings the readout to zero. At the start of an event, the master control button is pressed. At the end of the event, the same button is pressed again and the time is displayed on the readout. If another event is to follow, it is only necessary to press the same button again. The stopwatch automatically returns to zero and begins timing again. To save the batteries, the display may be switched off by pressing the display control button and the display is switched on again when wanted—the stopwatch continuing to operate during the interim.

The second function is labelled Lap Timing. After selecting this position, the reset button must be pressed to bring the readout to zero. By pressing the master control button, timing starts. When the button is pressed again, the time is displayed but the unit continues to time the next event or lap. Pressing the button at the end of the second event gives a display of its time, and so on. After a time readout has been given, if the display control button is pressed, the display will resume indicating the actual count, until the end of the lap.

The third switch position is marked Split. The display is zeroed by pressing the reset button and at the start of an event the master control button is pressed. Points along the event may be timed by pressing the master control button, after which the time is displayed. This may be continued until the end of the event, when the button is pressed again, giving the total time for the event. By pressing the display button, the time being calculated will appear on the display.

The fourth switch position is marked Totalizer. The display is zeroed as in all other cases. A number of events may be timed, with a rest in between measurements. Timing is started by pressing the master control button and stopped at the end of the event with the same button. After a period, during which no timing takes place, the master control button is pressed at the start of the next event and resumes counting from where it left off at the end of the previous event. This process may be continued for any number of events and the total time is finally given for all the events measured. The display may be switched off during timing by pressing the display control button. The zero set button does not work in this position, so avoiding accidentally cancelling the information during use.

The Chronostop is equipped with a special LED which gives a red light when the zero reset button is pressed and which goes out when the button is released. If the LED fails to light when the button is pressed, or if the light comes on spontaneously when the instrument is being used, then the batteries are exhausted and should be replaced. Any readings taken under these conditions should be considered as inaccurate and should be taken again, after new batteries have been fitted.

The makers claim an accuracy of .002% and although I have not attempted to check this, I have no doubt that this figure would give a fair idea of the precision of the unit. This would be much closer than that which would be needed in most circumstances. There is one point which I feel is quite unrealistic. The device is capable of measuring and giving a readout to one hundredth of a second. This would be fine if the operator has a reaction time somewhat less than this. I tried and failed miserably!

I found the Chronostop very comfortable and convenient to use. The unit is supplied complete with batteries and comes in a protective carrying case. Applications for this type of instrument are those where a stopwatch of the precision and facilities which this one offers may be necessary or desirable. Further details and price may be obtained on application to Australian Time Equipment Pty Ltd, 192 Princes Highway, Arncliffe, NSW. (I.L.P.)

Advent projection colour TV

Well-known in the US, where it has been available for about two years, the Advent Videobeam projection colour TV system is now available in Australia. Designed for large-screen TV presentation in business, education and entertainment situations, it offers an actual viewing area 52 by 69 inches, with a brightness of more than 20 foot-lamberts on axis—well within the SMPTE range for motion pictures.

Developed by Advent's President Henry Kloss, formerly with hi-fi firms Acoustic Research and KLH, the Videobeam system uses three specially designed projection CRTs. The tubes are made by Advent themselves, at their factory in Cambridge, Massachusetts. Each tube has a 63mm-wide phosphor screen, with Schmitt optics to project the images to the special aluminium-surfaced screen.

With no shadowmasks to limit beam current, the tubes can be run at very high brightness levels, and this together with the high reflectivity of the screen accounts for the very high picture brightness. Also with no dot or stripe structure on the phosphor screens, the resolution is not limited thereby; in fact Advent claims 1000-line resolving power.

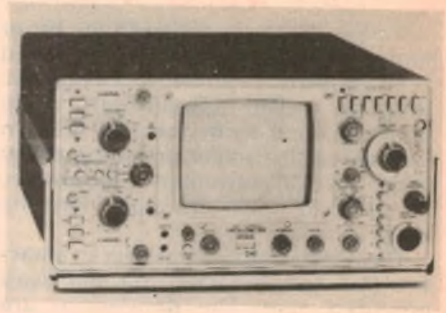
As with all projection systems, screen contrast is limited by ambient lighting, but Advent claims adequate contrast in a normally lit room. For full contrast, the room lights can be turned off.

The receiver features VHF and UHF tuners, a 9-stage phase linear IF and a comb filter for full chrominance bandwidth.

Price of the Advent projection colour system in Australia is quoted as $5960, plus sales tax if applicable.

Australian agents for Advent are Optro Pty Ltd, 11 Milgate Street, Huntingdale, Victoria. Trade enquiries invited.

100MHz dual-trace scope from BWD



The new model BWD 540 scope is a field portable DC to 100MHz dual trace unit which weighs in at only 9kg. Both channels offer 5mV/div sensitivity at 100MHz -3dB bandwidth, with channel 1 going down to 1mV/division at 30MHz bandwidth. Dual time bases extend from 50ns/div to 5 sec/div, with one serving as a delaying timebase. Extensive trigger facilities are provided. The CRT has an 8 x 10cm screen, and the EHT is 12kV to ensure a bright, crisp trace even at high speeds.

Power consumption of the scope is a mere 40W, and it will operate from either DC (20-30V) or AC (97-135V or 195-270V), with the AC frequency anywhere from 48 to 440Hz. Price of the basic instrument is $1300 plus sales tax if applicable.

Enquiries to BWD Electronics Pty Ltd, Miles Street, Mulgrave, Victoria 3170.

Mobile workbenches or goods trolleys

Two deck, three deck and basket models have now been added to the Australian designed range of Reflex trolleys.

For the electronics industry, trolleys have many useful applications. These include use in order processing, waste disposal and instruments handling and as mobile workbenches.

The Reflex trolley range, now known as "Series 230", feature attractive steel construction with large impact toughened nylon wheels suitable for all types of floors. Rubber impact bumpers to protect other items are available as an optional extra.

The trolleys reduce to basic parts for storage and model variation. 14 gauge (2mm thick) steel is used for the base, while the shelves are of 16 gauge (1.6mm thick) steel. The shelves can be inverted to provide retaining edges.

Three stock sizes are available: 510 x 510mm (2 models), 810 x 510mm (7 models) and 1110 x 510mm (7 models). Non stock sizes, stainless steel, or model variations can be supplied to order.

Enquiries to Reflex Engineering Pty Ltd, PO Box 351, Caringbah, NSW 2229.

New components company formed

An Australian company, C & K Electronics (Aust.) Pty Ltd, has recently been formed in association with the American principals C & K Components Inc., USA. The objective is to market the extensive range of C & K professional subminiature switches within Australia and New Zealand.

Mr Brian P. Cleaves (pictured), formerly of Plessey Australia, Components Division, Villawood, will head the company as Managing Director. As well as ensuring continuity of supply to Australian and New Zealand customers, Mr Cleaves will explore the export market potential.

C & K Electronics (Aust.) Pty Ltd is located at 2/6 McFarlane St, Merrylands, NSW 2160.

Losoid lubricants

The specialised range of Losoid lubricants, manufactured for over 50 years by Losimol, Hannover, West Germany, is now available in Australia.

Specialised lubricants find application in cameras, binoculars, microscopes, geodetic and nautical instruments, medical and electrical test equipment, radio and TV sets, hifi equipment and tape recorders.

In the preparation of Losoid lubricants, particular attention has been paid to the qualities necessary to ensure smooth motion of helical threads, axles and bushings, etc. Further information from Richard Foot (Australia) Pty Ltd, PO Box 78, Crows Nest, NSW 2065.

Speaker crossover network—Continued

fier to full output.

If a network is specified for use with a 40W amplifier then it must be able to handle peaks of 40W RMS without distortion. On the conservative assumption of a 6dB dynamic range this means that with music input it must handle an average power, averaged over a few seconds, of 10W RMS. If a 5W resistor is used in series with the 8 ohm bass driver then this combination is capable of withstanding more than 10W. Similarly the 39 ohm resistor which appears directly across the 8 ohm line could be called upon to dissipate 2W average.

The average power that can occur in the midrange or tweeter circuits is even lower and is determined by derating the 10W average power using the information contained in Fig. 6.

SUBJECTIVE CONSIDERATIONS: It may be noticed that most of the design effort has concerned the frequency range up to about 2kHz. This is because measurement techniques have proven reliable and repeatable and found to correlate well with subjective evaluations in this most important frequency range. To date no sufficiently convincing evidence exists in support of measurement techniques for the higher frequencies. Subjective opinion regarding the tweeter level is much more variable and is very dependent on the distortion content of the program source and the listening environment. For this reason, provision of a variable tweeter attenuator was considered the only satisfactory solution.

The ADF600/4000/8 crossover network was primarily designed for the Philips System 14 comprising the Philips 12" AD12100W8, the 2" dome midrange AD0210SQ8 and 1" dome tweeter AD0160T8 in an 82 litre sealed enclosure.

To achieve a constant sound pressure over the entire audio frequency range in a typical living room with Philips System 14 it was found necessary to set the Midrange Level Control to "+" and the Tweeter Level Control to "0" but these settings may be altered as desired.

If the slightly more efficient 5" cone midrange AD5060SQ8 is used (e.g. Philips System 07) then a constant sound pressure is achieved with the Midrange Level Control set to "0". Details of the application of this three-way crossover network with other Philips High Fidelity Systems will be released as further development is completed.

Letters to the editor

Isostat switches

We refer to an article in Electronics Australia October 1975, relating to push button switches.

In this article you have referred to the Schadow Isostat-style switches. We would hasten to draw your attention to the fact that Isostat is the trade name for a switch manufactured by the Isostat Company in France, and whom we have represented in Australia for the past 10 years. We can readily understand how people will identify this type of switch from manufacturers who have copied the design due to the high quality and versatility of the switch and hence the electronics industry, "Isostat" has become a household word.

We would however, appreciate your clarifying the situation that Isostat switches are in no way associated with Schadow switches and that the full range of Isostat switches are assembled in Australia by McMurdo (Aust) Pty Ltd, to the exact specification of the Australian customer and to the particular requirement of the Australian industry.

We are proud that Isostat should have such a good name that other manufacturers would attempt to identify their product alongside it.

W. R. Smith
Marketing Director
McMurdo (Aust) Pty Ltd
Clayton, Vic.

CD-4 records

In your November 1975 issue you refer to RCA CD-4 release and stocking policies. You are referring in this instance to the policy in the U.S.A. In Australia, where a record is released as an RCA Quadradisc (CD-4) there is only one inventory to cover the complete market. On the rear of the record album the following words appear:

> "This compatible stereo/4-channel record is designed for performance on stereo or CD-4 discrete quadraphonic systems."

Furthermore, leaflets are being prepared for distribution to record retailers to confirm that the Quadradisc record is suitable for playing on CD-4, stereo, stereo-compatible mono record playing equipment.

On page 105 under "Information Centre" in answer to a question you state that "Any cartridge with a playing weight of more than 2 grams will cause undue wear of the high frequency carrier after only a few playings . . .". This is erroneous. RCA in Australia as in the U.S.A. has developed a special compound for Quadradisc records which has as one requirement the capability to be played 100 times with a conical stylus at up to 4.5 grams playing weight while still maintaining adequate quadraphonic performance.

R. Darnell
Plant Manager-Manufacturing
RCA Limited
North Ryde, NSW

Wrong priorities?

With reference to your September 1975 Editorial Viewpoint "By way of explanation" surely there is something wrong with the implied priorities in paragraph three.

In my day the first priority in thinking and application was that we had to "deliver the goods" in order to earn a living, which is vastly different from we earn a living by you "taking what we deliver."

As to the so called "occasional Bug" why in the name of goodness especially in view of the expensive hoo-haa on the front cover about the special transistor offer is the Order Coupon to avail of it placed in such a position that one has to cut the "guts" out of the introduction to the Playmaster 146 AM-FM Tuner article. The same comment goes in respect to placement of other advertisers' coupons. It seems a logical first to me that all coupons should be so placed as to be backed by advertisements and not article texts.

Incidentally I built my first crystal set in 1920 also still have most if not all your issues over the past 20 odd years.

Here is hoping that in the thinking and application from top to bottom of the "simply a group of people trying to earn a living" your September editorial will not become a warranty to depart from the priority that "it is the customer that matters first."

R. P. Friend.
Camberwell, Victoria.

COMMENT: Frankly, you appear to have read into the paragraph concerned something it does not, nor was intended, to contain. If you are suggesting that in the "good old days" people made no mistakes, we must disagree. However when it comes to placing paramount importance in our customers' needs and wishes, we will certainly continue to do so. As our success or otherwise will be reflected in the circulation figures, we can scarcely afford to do otherwise—even if we were silly enough to want to!

Sound projectors

I'd like to take this opportunity to thank you for the series of articles on sound for movie projectors. I share your interest in motion picture equipment and films, and am in the process of updating an old but mechanically quite splendid Harmour and Heath projector.

I wonder if any of your readers could tell me something of the history of this Australian company, which I understand is now defunct. I'd like also to obtain any information, printed matter, owner's manuals, circuit diagrams, etc,—anything at all about this company and their products. I wished to obtain some spares, but I believe they are no longer obtainable.

Ralph Carlson
34 Cobham Rd
Mitcham, Victoria

COMMENT: We can't find any current information on Harmour and Heath, but perhaps a reader can help. We have published your address so that they can contact you directly.

Electronic organs

I noticed with surprise your comments on Page 105 of the September, 1975, issue under the heading "ORGAN KITS".

There you quoted a letter from S.E.S. of Glen Waverley, Victoria, who had got himself an organ assemble-it-yourself kit from Germany. But how about a well-established good old Australian firm who has been marketing just such kits for years and years? These people, Schober Organs (Australia), have been advertising with you for as long as I have been reading your magazine—and yet you did not give them a mention.

I have no particular axe to grind with Schober, but have successfully built three of their organs over the years, and my experiences might also be of interest to your readers.

Back in the 1960's I bought myself parts from UK and, working from all sorts of text books and magazine articles, made up a three-manual organ. But it was never all that wonderful, and to be very truthful, after five years of playing about with bits and pieces, and going through enough money to buy myself a decent sort of car, I finished up with a monumental heap of electronic parts and organ hardware.

During this time I had seen the Schober people's ads in your magazine and got their catalogue. I thought their price not cheap, but not all that bad, either. So, I went for one of their valve models. It was everything they claimed, and it went first up. Then in 1968 I built a transistorized Schober—their Recital Model—and it was a real organ in every way. I got rid of that eventually and, like the first, it finished up in a church. Now I have the Schober Theatre Organ and it is nothing short of superb. Also, I never did see—and can not now, either—any instrument of the same specifications which I can buy at even twice the price, readymade in a shop.

What I like about Schober's way of doing things is that you can build your own woodwork or they will supply it, and you can use your own existing hi-fi system for playing the organ through—as I have done.

By the way, while I am an inveterate tinkerer with electronics, I would never again set out to build an organ from scratch in buying my own bits and pieces. Getting a kit which is complete down to the last nut and bolt is the ONLY way. Take that from me, one who has learned the hard way.

"T.R.O.B." (Name supplied)
Maroubra Beach, NSW.

COMMENT: The purpose of the correspondence was to draw attention to Dr Bohm's organ kits. It would not have been appropriate for us to offset the reader's enthusiasm by injecting a reference to another brand. But that doesn't mean that you can't fly their flag for them!

Magazine style

Ever hear of a great mag that has gotten on the skids? It's just about the worst thing since J. Gutenberg's Bible hit the bookstalls. Chances are, the with-it kids have made a take-over bid; it's more than likely we shall all be zeroing in on glitches galore, before an electronics buff can say "Electronics America".

Ever find your radio poop out when you hit the switch? Here's why, a shot of current zapped the input trannies. One way to get around this, is to try just switching on; it works fine in other countries. Looking for a fast project? How about this? Fuzz, echo, reverb, big bass; they're all out now, you'll get with it with the wide-range funk box. Just crank the pot R7, and you'll get an extra twang from way down low to way up high. Etc, etc, ad nauseam.

This terrible journalist's disease of "sock it to 'em", with every sentence begun interrogatively and continued in a kind of future imperfect; words that have lost their meaning and relationship to others. It is not just slang here and there but tortured, mangled, language. Sad to say, the virus has reached "E.A."; already we have had many 'glitches', 'here's how', 'here's why', etc; not quite as bad as the above gems of illiteracy, culled from recent American electronic publications. However, straws show how the wind blows. There is no need whatsoever for "E.A." to depart from the high technical and literary standards of the past. Good writing such as we are used to, needs no trimming with such cheap and tawdry slang; it detracts from the pleasure of reading, apart from being less precise.

So please, hear my lone "cri de coeur", and put a "black ban" on such stuff before it is too late.

S. Hoy
Noble Park, Vic.

COMMENT: While you may feel that we have ventured too far in this direction, others have expressed the belief that we are still too dry and academic. While we appreciate both points of view, it is surely quite obvious that we can't please everyone. In your case there also seems to be the assumption that language is static and immutable, whereas in reality it is dynamic and constantly being adapted to the needs of those who use it.

More brickbats . . .

While I think your magazine has some quite good features, I have a few brickbats to throw. One has been simmering since April last year in that two articles, one an advertisement about a printed circuit radio with a hidden April fool sign. Even if someone had been caught by this one, it falls flat, because April fool jokes only apply till 12 noon on April 1st so the joker is the April fool. The other one was something about metric time, which appeared to be a serious factual report about impending changeover to a metric time scale. I hope jokes like this do not continue.

More important is your habit of incorporating coupons (Dick Smith's transistor diode offer and Choice magazine) to be cut out and sent away, on the back of technical articles meaning part of the information has to be lost to send the coupon. If you can defer part of an article to squeeze in an advert as is often done, surely an advert could be put behind the coupon.

A. Clapton
Mt. Hawthorn, W.A.

COMMENT: While some readers like yourself don't appreciate humour in the magazine, indications are that a majority do—if they are not overdone. Cutout coupons are not as easy to juggle as you may imagine, although we do try. Advertisers usually don't appreciate being placed behind them, either.

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.

The Amateur Bands

by Pierce Healy, VK2APQ

Elective subjects in high schools

During the past year, clubs based on the WIA Youth Radio Club Scheme have been formed in high schools and colleges to cater for students who have taken advantage of this curricula extension.

Since the YRCS was introduced as a WIA federal activity in 1962, there have been fluctuations in its growth and other aspects. At the present time, according to some opinions, the situation is not as flourishing as could be desired.

Although no official statistics have been received from other states, the situation in New South Wales, where the scheme originated, is very good. In addition, information from individual clubs, and included in these notes, appears to dispel any forebodings about future progress.

The "Elective Subject System", a relatively recent innovation by education authorities, allows students to select subjects or activities apart from the normal school syllabus.

Two reports included in these notes indicate that teachers and students interested in radio and electronics are keen to take full advantage of the system. With a proven YRCS course of theory and practical work available to teachers it could be that a new area of community service by the YRCS is opening up. This could supplant the original type of school radio club introduced by YRCS, which operated outside normal school class periods.

As is the custom each January these notes contain pertinent YRCS information, as well as reports from several clubs.

The objects of the scheme are:–

(a) To develop in young people an interest in radio and electronics as a vocation or worthwhile hobby.

(b) To provide students with a hobby which will reinforce their school activities in science and mathematics.

(c) To co-ordinate the activities of youth radio clubs and non-club participants, and to promote co-operation and exchange of ideas among club leaders.

(d) To assist leaders and instructors of youth radio clubs and non-club participants by providing ready made programs of activity.

(e) To co-operate with schools and youth organisations in fostering youth radio clubs.

(f) To be encouragement and recognition to club members and non-club participants who attain certain specified standards of skill.

A series of proficiency certificates has been developed to give a form of recognition to members who develop their knowledge to standards specified.

These certificates in several of the examination levels, are readily accepted by prospective employers as a positive indication of an applicant's aptitude.

The scheme is organised by a supervisor in each state, and the overall project by a federal co-ordinator.

There is also a correspondence section for those unable to participate through an organised club. Notes and projects are available for such persons who may, through self-training assisted by a correspondence supervisor, qualify for the various certificates.

Federal co-ordinator: Reverend R. Guthberlet, 31 Bandon Terrace, Marino, SA 5049.

There have been changes of supervisors in some states. Details of replacements have not been confirmed, so it is suggested that contact be made through the divisional secretary of the WIA. Details of the addresses appeared in last month's notes (Club Directory).

In New South Wales the YRCS state supervisor is– Rex Black, VK2YA, 10 David Street East, Springwood 2777.

Incentive packets are issued to NSW YRCS student members who gain a YRCS certificate, on the basis of one certificate one packet. These packets contain good quality items and help students with their constructional projects.

A safety program forbids the acceptance of mains operated projects for elementary radio certificates. Transistorised items are safer and cheaper and solid state techniques are preferred.

Craig Bryan, of the Box Hill Club, displays two of his projects.

Morse code tapes: In addition to the normal WIA Morse practice tapes, and in view of the 5wpm novice licence requirements, several novice speed training tapes are available. Club leaders can obtain dubbings onto their own open reels or cassettes from the following sources. Stamps for return postage must accompany the request.

YRCS Morse practice tape No. 1–Mr Kevin Connell, Science Master, Cessnock High School, Aberdare Road, Cessnock, 2325.

YRCS Morse practice tape No. 2–Mr David Wilson, Science Department, Whalan High School, Whalan, 2770.

YRCS Morse practice tape No. 3–Mr P. Dilworth, 45 Hawkesbury Road, Springwood, 2777.

Such tapes may be used as masters to supply students' own copies.

An approved syllabus was submitted to the school board by Mr Kevin Connell and now operates for the fifth form at the Cessnock High School. It is available to other science masters who forward a self addressed stamped envelope to Mr Connell at the above address.

For individuals, or clubs conducting novice licence courses, the YRCS has available elementary stage 1 and 2 theory text booklets. These texts cover basic theory to valve and transistor operation. These booklets of some 150 pages are available at $1.00 each and are said to be ideal for personal or club type study.

Further information from Sam Voron, VK2BVS, University of NSW, The Union Box 57, PO Box 1, Kensington 2033.

BOX HILL TECHNICAL COLLEGE RADIO CLUB: At the Box Hill Technical College Victoria, under electronics teacher Graeme Scott, VK3ZR, a class of 17 fifth form boys spend from 8.00am to 12.00pm every Wednesday studying under the subject heading "Electronics".

This is one of the elective subjects chosen by students, based on the career they wish to follow.

The course is based on the YRCS elementary certificate phase II theory, with relevant extras added, at the discretion of Graeme, as thought relevant or as class needs indicate.

Practical projects are varied and on a free choice basis within reasonable limits. Craig Bryan has been setting the pace by building a crystal checker, a transistor checker, a microphone input mixer, and a preamplifier, among other interesting projects. His speciality is miniaturising his construction techniques either on veroboard or his own printed boards.

Bruce Kerr has provided stiff competition for Craig by making a signal injector, a spring reverb unit, microphone pre-amp, a sine-square-triangular function generator, and a variety of other projects.

The college has a club station and operates each week under the call sign VK3BHT. It is equipped with an FT200 transceiver and operates on the 80, 40 and 20 metre bands. The antenna is a commercial trap vertical.

Novice licence classes are in progress with interest growing for both students and staff. Morse code, theory and regulations are being taught in a similar way to any other amateur licence course.

The interest in the novice licence is high among the boys and will no doubt lead to several active amateur operators.

Some of the boys will be doing either a Certificate of Technology (Electronics) course or an apprenticeship in radio during 1976. Three have already had radio workshop experience during the August, 1975 school vacation.

The whole course aims to give the students a good practical and theoretical background and to provide a basis for a career in electronics.

Summing up the value of such a course Graeme expressed this point of view.

"Some of the boys may not wish–or even be able–to enter a career in electronics. But the course has provided an appreciation of the electronics world and so the individual boy's attitude towards his career has been aided. In other words, it is better to find out what one likes and dislikes before one is committed to a formal career course or job."

BUNBURY CATHEDRAL GRAMMAR SCHOOL RADIO CLUB: An interesting letter and a copy of "NEWAI" (News Exchange West Australian Innovators) received from Keith Peterson, VK6PT contained some interesting news from West Australia.

Keither is Master in Charge of Science at the school and club supervisor. "NEWAI" is the newsletter of the Schools Commission's Western Australian Innovations Panel. The aim of the newsletter is the dissemination of information about Special Projects (Innovations) Program, funded by the Schools Commission.

Recently the Bunbury Cathedral Grammar School Radio Club received a $1409 grant from the Schools Commission to purchase an FT101B transceiver, a TH6DX beam, Ham II rotator, and a PFT203 for 144MHz, to equip the club station VK60T.

For the past three years, Keith Peterson has con-

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

ducted the radio option course at the school. The course is divided into three sections; theory, construction, and transmitting, WIA YRCS certificates are issued to students achieving the required level of proficiency for elementary, junior, intermediate and senior grades.

Extracts from the article in "NEWAI" gives an indication of the boost amateur radio has received in Bunbury.

"The benefit to students to date has been considerable. It has allowed students currently undertaking the Radio I and Radio III options to experience the thrill of making direct contact with other clubs and amateurs all over the world.

"Countries contacted by the school club station, VK6OT, include—United States of America (including Alaska), Russia, South Africa, Papua New Guinea, Japan and Great Britain.

"Recently, an amateur operator in Kuri Bay, in the North West of Western Australia, spoke to club members about the pearling industry with which he is associated.

"In addition, one of the school's fifth form students, at present on an A.F.S. scholarship in Japan, maintains monthly radio schedules with the school and is able to tell the students about the education, culture and geography of Japan.

"Contacts such as these has led to a tremendous surge of interest in radio as a means of communication, not only by the radio students, but by many other students at the school. The possibilities of further education value are unlimited.

"It is envisaged that the radio activities will be further integrated with other departments of the school in contributing to the total education of all students.

"Students are also gaining valuable experience, not only in the art of speech, but derive much of educational value in asking questions about geography, economics and history.

"The equipment is also used by the students of the Bunbury Catholic College, who join with the Grammar School students during the radio club sessions each Monday afternoon from 4.00pm to 5.30pm.

"The transmitting equipment is used during lunchtimes on other days of the week and regular schedules are kept with two other school clubs—Aquinas College, Perth, and Prince Alfred College, Adelaide."

Bunbury Grammar School Radio Club members with their FT101 transceiver.

WESTLAKES RADIO CLUB: An event of major importance for YRCS in NSW, was the official opening on the 2nd November, 1975, of the club's own premises in York Street, Teralba. The event was held in conjunction with the annual field day of the Hunter Branch, NSW division of the WIA.

The official opening was performed by Mr Merv Hunter MLA. Guests included the member for Shortland, Mr Peter Morris, Cr. Noel Dunn representing the Shire President, who is patron of the club, and visiting amateur operators.

The special guest was Bill Otty, VK2ZL an active amateur fBr over 60 years. In appreciation of his substantial assistance to the WRC building project and amateur radio, a plaque inscribed—

"William Otty Training Wing"

was unveiled during the ceremony.

All told about 300 persons attended the function.

A special four page supplement of the Westlakes Advertiser was published to mark the occasion. This told the story of the WRC, illustrated by a number of photographs. Also, the congratulations extended to the club from business houses in the Newcastle and local areas.

Back in late 1963, Keith Howard, VK2AKX, and Max McLachlan decided to form a club for licensed amateur operators and those wishing to obtain their licence. Keith had for some time conducted youth radio clubs at schools where he had been a teacher. In February, 1964 the inaugural meeting of the WRC was held. Thirty were present at the meeting in the old catholic church in Railway Parade, Teralba. Most of the foundation members are still active in the club.

Since then it has been necessary for the club to move first to the old Royal theatre in Anzac Parade, Teralba then to the Church of England Hall in Ranclaud Street, Booragul. In 1973 an old RAAF hut from Rathmines which had been used as a church at Dora Creek was acquired, and eventually moved to land procured from the local council in York Street, Teralba.

The clubrooms now comprises the rejuvenated hut, 24 metres in length and six metres wide plus a new five by six metre extension. With the exception of the plumbing all the work has been done by tradesmen among the members and other members acting as assistants.

Facilities include a main auditorium for meetings and showing of film screenings, canteen, library, transmitter room, lecture room, storeroom and office. A $500 government grant was used to connect sewerage and drainage to the site.

An eighteen metre steel tower supporting HF and VHF antennas is located at the rear of the building. The club call sign is VK2ATZ and may be heard in field day and other contest activities sponsored by the WIA.

YRCS classes are conducted for junior members of Saturday afternoons, and for senior members intent on gaining an amateur licence on Wednesday nights.

A community activity started in 1964, the WRC has grown into one of the influential radio clubs in Australia. With a present membership of 160, aged from 10 to 80 years, from all walks of life, a unique aspect is that some very active members only joined the club because their sons were interested in radio. In fact some of the dads became keener than their sons and are now active amateurs. Without doubt the instructural classes in radio theory have assisted more persons to gain their amateur operator's licence than any other club in Australia.

The WRC motto—Progress through Activity—has certainly been adhered to.

Senior officers of WRC are: Director—Keith Howard, VK2AKX; Senior Co-director—Joe Waugh, VK2IQ; Co-director—Stan Lloyd, VK2AYL; Secretary—Eric Brockbank, VK2ZOP; Treasurer—Max McLachlan; Educational officer—Colin Colgan; Social co-ordinator—Ray McCook.

THE MACKAY AMATEUR RADIO CLUB: This is another group of amateurs who are willing to demonstrate amateur radio and assist in community activities.

Recently members of the MARC manned a successful display at a hobbies and craft exhibition which ran for one week. The exhibition was organised by the Adult Education and local scouting movement. The Mayor, Alderman Abbott opened the exhibition and later participated in the contacts made from the exhibition station.

Items on display included home built and commercial equipment. The antenna was a G5.RV above the hall, 20 metres above ground. Many overseas contacts were made and the 3000 people who attended the exhibition showed considerable interest in the MARC display.

Details of the MARC appeared in the Radio Club directory in the December, 1975 issue of these notes.

BLUE MOUNTAINS BRANCH: The Branch conducts an "outreach" program to attract more people to amateur radio as a leisure activity and to assist individuals and groups who are engaged in offering training in radio and communications. A successful demonstration of amateur radio was held in the Springwood Scouts' Hall and a number of people have started to attend classes which the BMB conducts each Friday night.

Also, handouts of radio components have been made through the branch to the Katoomba High School, where a fifth form class studies electronics. Penrith High School receives constant supplies of recycled radio parts as does the Whalan High School. Cowra High School has received, on loan, a transmitter complete with crystal and microphone.

The branch also co-operated with the Sports and Recreation Service (Parramatta office) in organising a vacation course in radio at Springwood during the school recess from the 25th August, 1975 to 5th September, 1975.

A new club at Springwood High School has ten keen members, included in which are some potential novice licence candidates.

Early in 1975, the branch decided to offer prizes for (1) the best performer in the CAMTEC operation at Mount Victoria. (2) the best electronics student in the Katoomba High School approved course.

UNIVERSITY OF NSW AMATEUR RADIO SOCIETY: Members conducted an amateur radio demonstration and lecture course at the Beacon Hill High School on the 17th October, 1975. Seventy students participated throughout the day in activities which outlined the service and hobby aspect of amateur radio.

A highlight of the activities was two-way communication with several 15 and 16 year old high school students in Japan. The contacts were made on the 15 metre band.

As the result of the demonstration—which, the organisers say, was the most successful public relations activity yet organised by the UNSWARS group—the head of the maths department at the Beacon Hill School commenced a course for fifth form students called "An introduction to Radio Communications" and hopes to integrate YRS activities into the course.

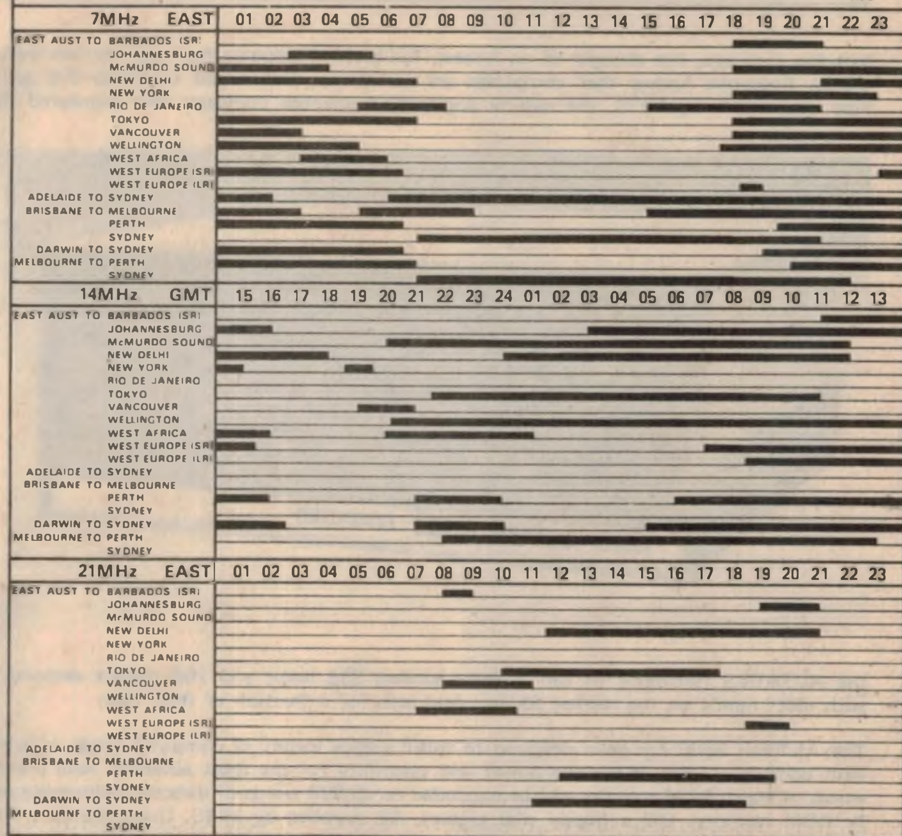
Both girls and boys are participating in the course as part of their assessment marks in the Higher School Certificate.

An earlier effort in community activity by UNSWARS was to provide and operate a station in the 1975 Jamboree-on-the-Air for the First Roseville Venturer Unit. Operations covered 48 hours and all HF bands except 160 metres were used plus continuous operation on 27.125MHz.

IONOSPHERIC PREDICTIONS FOR JANUARY

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open.

1.76



RADIO CLUB NEWS

CENTRAL COAST AMATEUR RADIO CLUB: All amateurs, their families, friends and all interested in amateur radio are invited to attend the Club's annual field day, at the Gosford Showground, Gosford, Central Coast NSW, 22 February, 1976.

Program:

8.30am to 10.30am: Registrations: Men $3.00; Ladies $2.00; Children 16 years or under $1.00. Includes—morning tea, lunch, outings, afternoon tea and entry fee for events.

8.45am to 9.15am: Mobile scramble in three sections—(a) High frequency bands. (b) 6 metres. (c) 2 metres. Contacts on AM tunable count 3 points, on net channels count 1 point. Log extract to registration table before 10.00am.

Before 9.45am: All items for disposal to be handed in.

9.45am to 10.30am: 2 metre Fox Hunt (AM and channel B).

10.00am to 10.30am: Morning tea served.

10.15am: Disposal sale open for business.

10.45am to 11.30: Children's events.

11.00am to 11.10am: 2 metre transmitter hunt for pedestrians.

11.00am: Quiz sheets available from announcer's table.

11.00am: Divisionsal news broadcast.

11.20am to 11.40am: 2 metre transmitter hunt for pedestrians.

11.30am to 1.30pm: Lunch—two sittings.

12noon to 12.10pm: 2 metre transmitter for pedestrians.

1.00pm approx.: Drawing of lucky numbers—numbers will be posted on notice board. Prizes must be claimed on day of drawing.

1.30pm: Completed quiz sheets handed to announcer's table.

1.30pm & 1.45pm: Bus leaves for visit to Reptile Park and tour of district.

1.30pm to 2.00pm: Talk-in fox hunt in two sections: Gosford repeater; channel B and 52.525MHz. (a) Full participation. (b) Listeners only.

2.00pm to 2.15pm: Junior 2 metre transmitter hunt—16 years and under.

2.30pm to 3.45pm: 2 metre fox hunt (AM and Channel B).

3.30pm to 4.15pm: Afternoon tea served.

3.30pm: Lucky dips.

4.00pm to 4.30pm: Presentation of prizes.

Other attractions: Local produce stall; jam and cake stall; ARTEX exhibition; spinning and weaving demonstration; de-gassing of 809's; soft drinks; children's events; lucky door prizes; disposals store; amateur television display; trade displays. Plenty of free parking.

The CCARC station VK2AFY will be operating from the Showground on Gosford repeater channel and channel B. The 2 metre fox hunts will be conducted on AM between 144MHz and 145MHz and on channel B 146MHz. Sniffers will be required on these fox hunts. Should the weather be inclement there is adequate shelter.

Those having items to be sold at the disposal sale should write to Bill Smith, VK2TS, RMB 100A, Mangrove Mountain, Gosford 2250 advise him of the number of lots and he will send forms and lot numbers necessary for booking in the gear. A small commission charge is made on each sale.

If you require overnight booking in or around Gosford for the weekend of the field day, book early because the "Festival of the Waters"—an annual event—is on at the same time and there will be thousands of visitors to the Central Coast.

1975 REMEMBRANCE DAY CONTEST

The South Australian division ran out easy winners in the 1975 "RD" contest. The scores were:

South Australia, VK5, 18140 points; Queensland, VK4, 10838 points; Tasmania, VK7, 3029 points; Australian Capital Territory, VK1, 2778 points; New South Wales, VK2, 2596 points; Victoria, VK3, 1838 points; Western Australia, VK6, 1629 points.

Judging from comments, some participants seemed to have overlooked the real purpose for which this event was instituted, and the team spirit implied.

As the name "Remembrance Day" signifies, the aim is to pay tribute to Australian amateurs who paid the supreme sacrifice in World War II. And, as the rules specifically state, there shall not be an outright winner among individual operators. Perhaps it is time these points were emphasised in the opening ceremony. At one time this included the Honour Roll, the Ode of Remembrance, and the National Anthem. Perhaps these should be reinstituted.

A COMPUTER CONCEPT BECOMES AN EXCITING REALITY

Not too long ago, the thought of an honest, full-blown computer that sells for less than $500 would have been considered a mere pipe dream. Everyone knows that computers are monstrous, box-shaped machines that sell for 10's and 100's of thousands of dollars. Pipe dream or not, MITS, the quality engineering oriented company that pioneered the calculator market, has made the ALTAIR 8800 a reality. It is the realization of that day when computers are accessible to almost anyone who wants one. The heart (and the secret) of the MITS ALTAIR 8800 is the INTELL 8080 processor chip. Thanks to rapid advances in integrated circuit technology this one IC chip can now do what once took thousands of electronic components (including 100's of IC's) and miles of wire.

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Shortwave Scene

by Arthur Cushen, MBE

The Voice of Greece has extended its foreign language broadcasts and now has two programs in Greek and in English for listeners in Australia and New Zealand.

According to the latest schedule Athens is broadcasting in English to the Pacific area 0915-0930GMT on 21460kHz and 2115-2130GMT on 7215kHz. Broadcasts in Greek are 0900-0915GMT and 0930-0950GMT on 21460kHz and 2100-2115GMT and 2130-2150GMT on 7215kHz. These broadcasts are carried on the 100kW transmitter located at Avlis, while a 35kW transmitter at Thessaloniki carries programs in Greek to Europe from 0600-0830GMT and 1100-1430GMT on 9710kHz and 1930-2030GMT on 7280kHz.

Transmissions to North America in English and Greek are broadcast 0000-0150GMT and 0200-0350GMT on 9520kHz, as well as 1500-1550GMT also on 9520kHz. A service to Europe 1900-1950GMT is on 5960kHz, while a service to Japan 1000-1050GMT is on 11720kHz.

The station confirms reception with a card from the Director of Technical Services, 16 Mourousi Street, Athens, 138, Greece.

Verification was received by airmail in a month. As well as the verification card, a complete schedule of foreign broadcasts carried on the 100kW transmitter, as well as the broadcasts beamed to Europe on the 35kW transmitter, was also included.

BROADCASTS FROM McMURDO

The American Forces Antarctic Network, reported many months ago when first heard on 6012kHz, has in recent months been received on other frequencies on a test basis. A verification letter from the station indicated that two frequencies have now been chosen for all future broadcasts of AFAN, which operates 24 hours a day. The station will now operate on 6012kHz from November 1 to February 28, and on 7215kHz March 1 to October 31.

This frequency change should overcome a major problem which has been of worry to AFAN—the interference to a nearby tracking station. The power of AFAN is 1kW, and the studios are in downtown McMurdo. Programs are mainly live and backed up by ARFS recorded programs.

The shortwave coverage has been extensive throughout the Antarctic area, and reports have also been received from listeners in other parts of the world. The verification letter is signed by Gene C. Valentine, Public Affairs Officer, American Forces Antarctic Network, Naval Support Force, Antarctic.

MAJOR PAKISTAN CHANGE

For many years Radio Pakistan has been broadcasting to Europe in English from 1945-2045GMT. In November, the transmission was cancelled in favour of a broadcast for morning reception in the United Kingdom, and this is now in operation 0830-1100GMT on 15110kHz and 17665kHz. A slow speed news bulletin in English beamed to the Far East 0230-0245GMT is now on 17830 and 21590kHz. Other slow speed news bulletins are broadcast to East Africa 0430-0445GMT on 11885, 15325 and 17830kHz; to West Europe 1100-1115GMT on 15110 and 17665kHz; and to the Middle East 1530-1545GMT on 9690 and 11885kHz.

Radio Pakistan has reduced its hours of transmission and now opens at 0045GMT, with the last broadcast ending at 1745GMT.

RADIO FRANCE EXPANDS

Radio France, the new broadcasting organization formed from the old ORTF, has expanded its transmissions in French. The programs are intended mainly for Africa, but are also well received in the Pacific area.

During our late afternoon new frequencies have been observed, including 9605kHz which is mxied with Radio Sweden until closing at 0700GMT, while another new channel 6080kHz is mixed with the Voice of America at the same time. At 0600GMT Paris is using 5990, 6045, 7135, 9525, 9605, 9675, 11710, 11735 and 11960kHz. The station uses a new card showing the new symbol. The address for reports is: Radio France, PO Box 9516, Paris.

MADRID USES 11880kHz

Radio Nacional de Espana Madrid has been heard with an English broadcast to North America on the new frequency of 11880kHz (replacing 11935kHz) closing at 0345GMT. At the same time, 6065kHz carries the same program. Two other transmissions from 0100-0145GMT and 0200-0245GMT are also broadcast on these frequencies.

The Spanish transmissions to Latin America are also heard on new frequencies: from 2300-0100 and 0100-0300GMT on 11945, 11775, 9630, 9520, 9360, 6120, 6085 and 5965kHz; and from 0300-0500GMT on 11775, 9630, 9360, 6120 and 6085kHz.

Radio Nacional de Espana's broadcasts in Portuguese to Portugal from 2030-2100 and 2100-2130GMT are currently heard on 6100kHz instead of 6065kHz.

RADIO KOREA EXPANDS

Radio Korea in Seoul, South Korea, has recently installed a 250kW transmitter and added additional frequencies for all its broadcasts. An English program has been received 0900-0930GMT on 9640kHz for many years and now two new frequencies, 9600 and 11850kHz, also carry this program.

English broadcasts from Seoul are of 30 minutes duration and are broadcast to North America 0500GMT and 0900GMT, to South America 1100GMT, to Europe 0630GMT and 1900GMT and to South East Asia at 1430GMT. The General Service is broadcast 0500, 0630, 0900, 1100, 1430 and 1900GMT. The programs are all broadcast on 9600, 9640 and 11850kHz.

SWEDEN'S PACIFIC SERVICE

The recent installation of three 500kW transmitters by the Swedish Broadcasting Corporation at Horby and Karlsborg has resulted in an expansion of the programs. An English transmission to Australia and New Zealand is expected to be commenced shortly. In the meantime a new service to the Pacific, which is a relay of the Swedish home program, is broadcast from 0630 to 0800GMT on 9605kHz. This same program is also broadcast on 6065kHz.

English broadcasts are noted 1100-1130GMT on 9630 and 21690kHz, and 1400-1430GMT on 11735 and 15305kHz. Broadcasts for our morning listening are from 2030-2100GMT on 6065 and 9635kHz.

The address for reports is: Radio Sweden, Stockholm, S105 10, Sweden.

INDONESIAN NEWS

According to Craig Tyson of Wembley, West Australia, some new signals from Indonesia have been noted. On 3360kHz Radio Daerah Kabupatan Lahat, Bali, Indonesia, was heard with station identification at 1435GMT followed by gamelan music. On 3925kHz Radio Republic Indonesia at Bogor was heard with Indonesian news from Djakarta at 1500GMT. Another frequency used by Bogor is 3952kHz. On 4357kHz Radio Permerintah Daerah Kabupatan Soppeng Sulawesi Selatan was heard with station identification after the Djakarta news relay at 1515GMT.

MEDIUM WAVE NEWS

HAWAII: According to Allan Roycroft, reporting in the NZ DX Times from Honolulu, the former KIOE on 1080kHz is to reopen again. The station will have the power of 10kW, and will share the mast of KNDI at Pearl Harbour.

BAHRAIN: A report in the New Zealand DX Times indicates that Bahrain has a 50kW transmitter under construction, and the station is scheduled to operate on 570kHz. Broadcasts, which will be in Arabic, will be between 0400-2200GMT.

SAUDI ARABIA: High powered transmitters are planned for installation at Duba near Sinai on the Red Sea Coast. Transmitter power will be 2000kW on 548 and 1520kHz. Another station at Qurayat will use 611kHz with 2000kW and 899kHz with 1000kW.

LISTENING BRIEFS
EUROPE

NORWAY: Radio Norway's broadcast to the Pacific from Oslo is carried by two transmissions, with the first broadcast 0700-0830GMT. At present the frequencies in use are 11850, 11895 and 17795kHz. The second broadcast 1100-1230GMT is on 6015, 11860 and 21655kHz. On Sundays the last 30 minutes of the program is in English.

POLAND: Radio Warsaw in its service to Europe in English 0630-0700GMT is giving good reception in this area on 7275, 7285 and 9675kHz. For morning reception, two transmissions offer reception possibilities: 2030-2100GMT on 6155 and 7285kHz, and 2230-2300GMT on 3955, 6135, 6155 and 7285kHz.

AFRICA

MALAWI: The present schedule of Radio Malawi, according to Craig Tyson of Wembley, WA, is: 0257-0520GMT on 3380kHz 100kW; 0500-2110GMT on 5995kHz with 20kW; 0600-1715GMT on 7130kHz with 100kW; and 1750-2215GMT on 3380kHz with 100kW.

REUNION: According to the World Radio Handbook short-wave transmissions from St. Denis and St. Pierre have been discontinued. Programs are heard only on medium-wave on 602kHz with a power of 8kW.

ZAIRE: According to the BBC Monitoring Service, a new regional station for the Voice of Zaire is now in operation from Bandundu. The power of the transmitter is 10kW and it operates on 7115kHz. A 50kW medium-wave transmitter has also been installed and uses 1007kHz.

AMERICAS

MEXICO: Radio Mexico has been heard on 15385kHz from 2000-2045GMT with Latin American music and many announcements in French, English and Spanish. Special request is made for reports, and those received will be repaid with pennants and maps. The address of the station is: Radio Mexico, PO Box 20620, Mexico City, Mexico.

VENEZUELA: According to Sweden Calling Dx-ers, Radio Nacional de Venezuela has been heard on 15400kHz between 2100-2200GMT with announcements in Spanish and English. According to the announcements they broadcast on 11750kHz and 15400kHz from Caracas over YVRN and YVRO.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT, add 9 hours for West Aust. Summer time, 11 hours for East Aust. Summer time and 13 hours for NZ Summer time.


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(BALANCE OF P&P TO BE RETURNED)
PLEASE FORWARD INFORMATION ON ....
NAME ....
ADDRESS ....

INFORMATION CENTRE

DC-DC CONVERTER: Could you please identify the windings of the DC-DC Converter transformer used in the 30W 12-240 PA Amplifier which appeared in your December, 1970 issue? Is the primary winding connected to the bases of TR12 and TR13, or to the collectors? Should the unit be inaudible in operation? Do the dots by the windings signify the starts of the windings?

I find the diagram on page 47 confusing, as it indicates there are two primary windings and no feedback winding. No mention is made of the actual connections in the text, or in the errata given in the March, 1971 issue.

Thank you for your excellent projects and interesting articles. (R.L.H., Kapunda, SA.)

• Thank you for your comments about the magazine, R.L.H. The primary winding is connected to the collectors of the converter transistors, while the feedback winding is connected to the bases. It is standard drawing practice to nominate the start of a winding by placing a dot next to the appropriate wire. When operating correctly, the converter should emit a high pitched squeal.

We agree that the diagram on page 47 is a little confusing, although if it is used in conjunction with the circuit diagram on page 45, it should be fairly easy to sort out how the wires from the transformer connect to the transistors.

TV RESTORATION: Firstly, I am a young reader of your magazine, which I find very helpful and informative. I am hoping to find the answer to a problem through your magazine.

Recently I acquired an old TV receiver with a view to restoring it to operational condition. However attempts to get a circuit diagram or other relevant information have been fruitless. The set is an H. G. Palmer type, model K32. The firm which produced this type of set now appears to be out of business. I am hoping that a reader could let me have a circuit diagram, or any other information that I may find useful. (K. Kavanagh, 8 Ellen St., Tea Tree Gully, SA).

• Thank you for your comments about the magazine, K.K. We have taken the liberty of publishing your name and address, so that any readers who may be able to help can contact you direct.

DEAD LETTER: We are currently holding a number of handbooks, originally addressed to Mrs. B. White, Roadside delivery, Calnen, Bairnsdale, 3875. These have been returned by the postal authorities marked "unclaimed". If Mrs White will contact us and clarify the address we will forward the books.

FM & TV AERIALS: I would like to compliment you on a fine magazine. I have been buying it now for 18 years. Would it be possible to publish design details for TV aerials, with the driven element matching 75 ohms? A complete list like you presented on page 49, May, 1962 would be fine. Also, I was interested in the 75 ohm FM aerial reviewed on page 25, July, 1975. What about making it a project with measurements so that readers who wish could build their own aerials? (D.G., Medina, WA.)

• Thank you for your kind remarks re the magazine. Your suggestion is a good one and although we have no firm immediate plans, we hope to do something along these lines as soon as we have time for it. The feed-point impedance quoted as 75 ohms is often a nominal one and the actual impedance can deviate quite appreciably from this ideal. Fortunately, in the applications which we have in mind, this is not a serious problem. The feed-point is usually a balanced one, suited to ribbon or other balanced feedlines. On the other hand, if you wish to use 75 ohm coax, which is unbalanced, a small "balun" can be inserted at the feed-point. In the meantime, we imagine that you have a copy of the aerial details published in May, 1962. If not, we can supply a copy from this office for a fee of $2.00.

LED FLASHER: Reference the flasher based on the LM3909, in the July 1975 issue. Would it be possible to control six LEDs from the one oscillator? My son has a large collection of matchbox cars, and flashing lights on the "road up" signs would be most realsitic. Also from the ceiling of his room hang several large model aeroplanes, and if the navigation lights worked it would enhance their appearance.

To me the magazine is very interesting, even though I have built only a few of the simpler projects. The articles on developments are welcome, e.g. the speakers for the earthquake films. (T.R., Kingswood, NSW.)

• We are pleased to read that you find the magazine interesting, and wish you success with your project building. In the LM3909 application notes, there is a circuit for flashing four LEDs simultaneously. We do not know if this idea could be extended to six. Copies of the application note should be obtainable from the NS Electronics office in your state.

PLAYMASTER 145 MIXER: Would there be any ill effect of the output of the mixer if the metering stage was omitted? Also could a simpler power supply be used if this was done? You state a mixer stage such as this can handle four inputs. If more inputs (6 or 8) were added, would the distortion increase be excessive?

Might I suggest, as a follow-up to this wonderful mixer, you consider a PA system which could be used by amateur pop groups, theatrical societies, etc. Either one fairly powerful unit or perhaps a unit designed for multiple slaving to suit varying power needs.

May I also take this opportunity to congratulate you on a fine magazine. As a high school student with little electronic knowledge I find it logically set out and easy to understand on most subjects. (C.J., West Pennant Hills, NSW).

• The metering stage can be omitted without any effect on the remainder of the mixer. However, the power supply still requires a regulator stage so there will be no change to the power supply components. Increasing the number of inputs will increase the interaction between them but will not markedly increase distortion. We have it in mind to produce a high power amplifier in the not too distant future. Thanks for the favourable comments on the magazine.

FM STEREO TUNER: I am most interested in building the FM stereo tuner introduced in the July 1975 issue of your magazine and I would appreciate your advice on including some modifications to it. Could I fit a socket for 8 ohm headphones, including an appropriate amplifier with volume control and using the common power supply? An arrangement for control over the audio output level, as my amplifier tuner input is for 25mV at 47k? Some of the new commercial models provide an outlet to connect a 4-channel sound adaptor. Could this also be added? (B.P., Sydney, N.S.W.)

• Undoubtedly, a facility for headphones could be added to the output to the tuner. However we are not in a position to supply details of this modification. The output audio level could be controlled by substituting 470k trimpots in place of the existing 470k output resistors. At this stage, we have no plans for 4-channel facilities. This could be added by readers who wish to, and in such a way to suit individual requirements.

PROJECT 250: I am a beginner in electronics and have queries you could assist me with in the projects I am working on. On the "General Purpose Player" of July, 1975, I wish to play a cassette deck, probably the Playmaster 144. Do I need a preamp? How would I connect the switching inside the amplifier to allow switching from phono to cassette?

Could you also advise me on a filter to fit between my Philips cassette player and my amplifier to remove 50Hz motor hum. I have a filter circuit (enclosed), but find the op-amp type CA 3032 is unavailable. Would a CA 3030 or CA 3029 be a satisfactory replacement?

In anticipation, many thanks, and also thanks for an informative magazine for a beginner. (J.H., Tennant Creek, NT).

• You will not need a separate pre-amplifier to use with the Playmaster 144 Cassette Deck, as these are part of the deck. We recommend that you wire a 5-pin DIN socket, a selector switch, and two 1k trimpots into your amplifier, as shown on page 60 of the June, 1974, issue. This will provide facilities both for recording and playback.

The circuit you have supplied is intended for use where hum has been recorded onto the tape, and would not be suitable for the use you have in mind.

We recommend the following articles: "That Annoying Hum" (October, 1972, File no. 8/AT/38), and "Hi Fi Compatibility Problems" (December, 1972, File no. 8/AT/39).

These articles should throw some light on the causes of your hum, and hopefully you will then be able to eliminate it. We are pleased to hear that you find the magazine informative.

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Dyeline transparencies, actual size but of limited contrast: $2. Specify positive or negative. We do not sell PC boards.

REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Only as available. Within last 6 months, face value. 7-12 months, add 5c surcharge; 13 months or older, add 10c surcharge. Post and packing for 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

BATTERY CLOCK: Following the article on the S1998 clock chip in "What's New in Solid State", I was wondering if it would be possible to make a battery powered clock using this chip. Would it be possible to use the 70kHz clock oscillator and converter, from the digital calculator guide, also in the May, 1975 issue, to derive the required 50Hz? If this is not possible, would you be able to describe in a future issue an article on a battery powered clock? Also, I have noticed in some advertisements, reference to "low power TTL", 74L74, etc. Are these the same as conventional TTL circuits, or are there differences? (T.S., Salisbury, SA.)

• The 70kHz clock oscillator and converter from the digital calculator would probably not be very suitable for use with the S1998 clock chip. As for battery operation, this will depend upon what one has in mind. The combination of a digital clock chip and 50Hz drive may be operated from a 12V battery (see the September 1975 issue, page 74) but if the idea is to use 1.5 or 3V dry cells, then this arrangement would really not be a proposition. We described a very low power clock in August and September, 1974, using discrete components. We also are keeping a close watch on the possibility of using an IC with a suitable readout for use with a couple of dry cells, but we have no definite plans at the moment. Low power TTL devices are essentially the same as their normal counterparts, except that they have been designed for lower power dissipation and the speed of operation is limited accordingly—but there is a further variant family, "low power Schottky TTL", which offers both low dissipation and high speed.

EMPLOYMENT: I am a 16 year old fifth form high school student whose hobby is electronics. I have been interested in this field for four years and during this period have constructed several of your projects.

I have also serviced various types of equipment and have some knowledge of computers.

I am looking for employment during the Christmas holidays and would appreciate if you could print my full name and address so that anyone interested in giving me work could contact me. Thank you. (G. Weller, 20 Turner Rd, Berowra Hts. NSW.)

NOTES & ERRATA

FM IF SUBSYSTEM (July 1975, File No. 2/TU/42): When the article was written, we stated that we would describe how the complete tuner could be aligned without the aid of a signal generator. However, due to an oversight this description was not given. The task of alignment without the aid of a generator is not as easy but provided that an FM signal of sufficient strength is available, it is possible to do so at least a reasonably satisfactory job.

We will assume that the IF board and the front end units have been completed and that they are ready for alignment. A good aerial system should also be available and connected to the front end. Fortunately, at this time of writing, the ABC FM transmitter has been put into operation under test transmission conditions and the signals so available in the Sydney area are very strong. It is possible that similar transmissions would be available in Melbourne and possibly Adelaide and Canberra.

Before attempting to look for any of these transmissions for alignment purposes, it would be a good idea to check the availability of a signal by using a portable or some other FM tuner. Assuming that the signal is on, switch on the new tuner and search for the signal. It should be found with the tuning gang about two thirds in mesh. Having found the signal, its position on the dial should be corrected by either opening up or compressing the oscillator coil as previously described in the article on the front end. The aerial and RF coils should be similarly treated to get maximum signal strength as indicated on the signal strength meter.

For the present, this is all that need be done as far as the front end alignment is concerned, as there is only a small band of 92 to 94MHz available at present for FM broadcasting.

By now, you may have a very strong signal, with the meter deflected full scale. To carry out the alignment of the discriminator, the signal strength should be reduced. This may be done by removing the aerial and substituting a short piece of wire, connected to one terminal, so that about half scale reading is obtained on the signal meter.

Now rock the tuning control to determine the point of maximum meter reading. This will set the signal very close to the centre of the 10.7MHz IF passband and the tuning control should not be touched for the rest of the adjustments. The rest of the adjustments are given in the last column on page 43 in the article on the FM tuner for July, 1975.

SIMPLE Q-METER (November 1975, File No. 7/F/19): Due to an oversight the winding data table for the four oscillator coils was omitted. The table is reproduced below.

COIL	FORMER	WINDINGS		FREQUENCY
			COLLECTOR	
A	Half of 455kHz IF Transformer (valve type)	35 tns 32B&S hank wound	Original wndg less capacitor	250-750kHz
B	"JABEL" ¾" grooved Grooves covered by layer of paper	15 tns 32B&S	130 tns 32B&S	530kHz to 1.85MHz
C	"NEOSID" or "ALLADIN" for 6mm core. (No core used)	5 tns 29B&S	55 tns 29B&S	1.8-5.75MHz
D	As for C	2 tns 29B&S	13 tns 21B&S	5.75-23MHz

VARIABLE DELAY WIPER: I have read the article for the Variable Delay Wiper system as given in the May 1975 issue, and was very impressed with the project. The car that I drive has a 6V electrical system. As described, the project is only suitable for use with 12V systems. However, it was mentioned that only the relay needed to be changed to provide 6V operation.

I therefore ordered a 6V 280 ohm relay, and was told that they are unavailable. I am wondering if a 280 ohm relay is required for 6V operation, or if another type of relay is required? I would greatly appreciate it if you could tell me what relay is required, and if any other changes need be made for efficient operation on 6V.

I take this opportunity to thank you in advance for any help that you may be to me. (I.E., West Moonah, Tas.)

• Any 6V relay is suitable for use with the Variable Delay Wiper, provided that it has a coil resistance greater than 50 ohms. This is determined by the maximum allowable current which the 555 timer can sink. Note, however, that not all relay types will be compatible with the printed board layout used in our prototype. This was designed for use with the relay type specified in the parts list. No other components need be changed for 6V operation.

CRYSTAL CLOCK STANDBY: With regard to your crystal clock standby unit for the electronic clock (September 1975, 7/CL/18). I originally purchased the LED readout version as did, I am sure, many others before the fluorescent version became available. Is it possible to use the circuit given to supply the pulses to the MM5314 but to alter the supply requirements for the LED readout or are the requirements compatible? It is a shame if those with the LED version cannot use the circuit for a standby unit. (D.W., East Bentleigh, Vic.)

• We have not seen a complete circuit of a clock using the MM5314 and LED readouts so we cannot comment directly on it. However, the clock driver circuit is compatible with any MOS clock chip using a 10 to 15V supply rail. For example, it is compatible with the LSI Digital Clock featured in the September and October 1973 issues.

INFORMATION CENTRE

CAPACITOR DISCHARGE IGNITION: I am interested in the CDI system described in the recent July issue (File No 3/TI/12) firstly because it is an electronics project and secondly because of the commencing phrase of the article "With car maintenance and running costs rising . . ." However before embarking on the project I would like to ask about safety. Is there any danger from electrocution from this unit. The 300V to the primary of the coil might be dangerous but current in that part of the circuit is not mentioned in the article.

The photograph of the 300V terminals certainly does not look like potentially lethal wiring! Column 2, page 46 states ". . . take all possible care in assembling this unit since its reliability could be a matter of life and death." This could either refer to electrocution or perhaps failure of ignition in heavy traffic.

At this stage of my knowledge (or ignorance) I believe that the HV would be no worse than that of the normal ignition system.

It would be appreciated if you could clear up this point of doubt in my mind before I start the project. (M.B., Hampton, Victoria).

• It is possible to receive a nasty electric shock from either the primary or the secondary of the coil in a capacitor discharge ignition system but you would be unlikely (and unlucky) to be electrocuted. The risk referred to in the article was that of ignition failure in heavy traffic.

PLAYMASTER CASSETTE DECK: I thought your readers may be interested in these additions to the Playmaster 144 cassette deck. Two 5k (log) slider potentiometers were mounted on the top panel to the right to the transport mechanism to provide output level controls. These are simply coupled in series with the 1k output resistors. A lamp was also provided to illuminate the cassette and the tape counter. The lamp socket is the type with both connections isolated and is mounted horizontally by means of the rear centre mounting screw. I used a 6V 250mA lamp and this required a 47 ohm 5 watt resistor in series with the 15VAC supply.

A panel mounting fuseholder was placed in the rear panel and connected in series with the active lead from the mains. A small neon bezel was also mounted on the front panel directly above the power switch.

• These all sound like useful additions, and other readers may wish to add them to their Playmaster cassette decks. Thanks for writing.

PLAYMASTER 132: I would like to say how much I appreciate your fine magazine. Over the years I have constructed many of your projects, one being the Playmaster 132 which has given commendable service over the years. However it has been plagued with one problem, this being an interference with TV channel 2 in the form of black wriggly lines across the face of the picture tube, representing a sine wave. This being modulated by the signal being reproduced by the amplifier. This signal is also evident in the TV loudspeaker. With all input and output leads removed from the amplifier and switched to headphones, the interference is still quite evident. The amplifier is fitted with mains filter and earthed metal cabinet. Help with this problem would be very much appreciated. (S.D., Alfred Cove, W.A.)

• It seems very likely that your amplifier is oscillating at a very high frequency and the resulting modulated signal is being detected by the TV circuits. As a first step in curing this problem we would suggest that you incorporate the modifications featured in the article "Playmaster 132 Reconsidered" from the May, 1974 issue. (File 1/SA/48.)

PAL-P RECEIVERS: Do you know if any manufacturer anywhere in the world is producing PAL-P (chromalock) colour TV sets? If not, why has the system not been used? (C.K., Malvern, Vic.)

• As far as we know no such sets are being produced. Out latest authority for this is Dr Bruch, inventor of the PAL system, to whom we put the same question when he visited Australia for the IREE convention in August. The reason is not clear, except that it offers only a marginal (almost academic) advantage over PAL-D and would probably cost at least as much as or perhaps a little more than the PAL-D type. We imagine that only the development of an IC which would substantially reduce costs would swing manufacturers in its favour. Even if this happens, the advantage will be mainly economic.

BURGLAR BAIT: I am referring to the Car Burglar Alarm featured in the August and September, 1973 issues. As I have built this device, I was wondering if you could design a circuit to detect the removal of the wheels, as I am sure many people have had their set of "mag" wheels stolen. Even locks on the wheel nuts do not seem to prevent the wheels from being stolen. Would it be possible to adapt the roof rack circuit to the wheels? (A.H., Canterbury, NSW.)

• The main difficulty in fitting a burglar alarm to the wheels is in making electrical connections to the wheels without interfering with the operation of the wheels (ie, the wheels must still go round!). Our investigations to date have not revealed a simple and effective way of overcoming this problem, although it appears that once overcome, the roof rack circuit could be used.

BOOKS

Continued from p.83

Dolby-B, seemingly unaware that top quality cassette recordings can now be made on ferric tape, even without Dolby.

These observations aside, if your knowledge of tape recording is minimal and you want to get some idea of what it is all about, Doug Crawford's book could doubtless be read without any great strain and to some profit. Our review copy came from Hicks Smith & Sons Pty Ltd, 301 Kent St, 2000. Ph. 29 1791. (W.N.W.)

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DOUBLE POTENTIOMETER Pack
10 for $4.00

VIBRATORS 6V
5211 A.W.A.
$1.00

POLY PACK The Best
50 for $2.00

5BP1 OSCILLOSCOPE TUBE
still only $1.50

SELENIUM RECTIFIER 2.5 amp
SPECIAL at $1.50

TRANSISTOR SPECIAL
MJ3055-2N3055
$1.15

8 ELEMENT AERIALS
406 or 215
$15.00 by train

PORTABLE PYE GRAM
cabinet only
$3.50

TRANSISTOR SPECIAL
BC147, BC148, BC149
10 for $1.20

TRANSISTOR
2SC463A equivalent
BU105 $2.60

T.V. BALUN
300 ohms to 75 ohms
80c

B.S.R. AUTO CHANGERS
Ceramic cartridge $41.00 G11204
Magnetic cartridge $49.00 G11302

WALKIE TALKIE

SANYO
The Best

⅓w $36.00
1 watt $46.00
5 watt Power
$75.00
27.88

SPECIAL IN VALVES

6CM5 $1.50	6DX8 $1.20
6BL8 $1.00	6BU8 $1.10
6BM8 $1.00	6GV8 $1.10
6Y9 $1.50	6GW8 $1.10
6X9 $1.20	6SN7 $1.00
6U9 $1.20	6JW8 $1.30
1S2 $1.00	6AL3 $1.15

MAGNAVOX SPEAKERS
6WR 8 ohms and 15 ohms $10.75
8WR 8 ohms and 15 ohms $11.85
10WR 8 ohms and 15 ohms $13.85

SPEAKERS DUAL IMPEDANCE
8 ohms & 4 ohms
5" $3.00
6" $3.20
7 by 5" $4.20
6 by 9" $5.20

Please add 15% to all parcels for postage and packing, thank you. For all heavy parcels please state nearest rail station.

WILLIS TRADING CO. PTY. LTD.

PERTH G.P.O. Box No. X2217, W.A. 6001

429 MURRAY ST., PERTH, W.A. 21 7609 21 7600

SCORPIO IGNITION SYSTEM KIT

The SCORPIO CD IGNITION ensures better performance with up to 50,000 miles between tune-ups.

"SCORPIO" CAR IGNITION KIT $27.50

VHF CONVERTER TUNER

110-136 MHz couples to broadcast receiver, $14.95 P/P 80c.

FM Monitor Receiver 2 Channel available for either Low or High Band. $110.00 plus Crystals.

6 DIGIT CLOCK KIT
Complete
with Cabinet
$32.95

Also Calendar Clock with alarm $45.00

Radar
Intruder Alarm
Microwave
Doppler Unit
—Kit of parts
$55.00

CUBE SPEAKER

4" 8 Ohm 4 Watt
50-20 kHz
In Modern Colours
$7.65

ACTION RADIO

Moulded in the Military Style AM FM AM PB WB 4 Band Radio AC & DC AFC Squelch. Only $49.00

TOOL KIT

Kit Contains:
Long Nose Pliers
Flat Nose Pliers
Cutters
2 Screw Drivers
1 Phillips Screw Driver
Electric Soldering
Iron
Tweezers
File
Vinyl Zip Case
Real Value at $19.95

Barlow Wadley

Specifications:
500 kHz to 30 MHz.

Dial accuracy within 5 kHz.
Modes AM LSB USB.

Sensitivity: antenna noise audible at all frequencies.
Price **$279.00.**

NOTICE TO ADVERTISERS

Certain provisions of the Trade Practices Act 1974, relating to consumer protection place a heavy burden upon advertisers, advertising agents and publishers of advertisements.

Section 52 of the Act imposes a general duty on everyone (individual and corporation alike) not to engage, in trade or commerce, in conduct that is "misleading or deceptive."

In addition Section 53 (read with Sections 6 (3) (c) and 79) makes it a criminal offence (punishable in the case of an individual by a fine of $10,000 or 6 months' imprisonment and in the case of a corporation by a fine of $50,000) for an individual or corporation to do any of the following in trade or commerce in connection with the supply or possible supply of goods or services or in connection with the promotion by any means (for example advertising) of the supply or use of goods or services, namely:–

"(a) falsely represent that goods or services are of a particular standard, quality or grade, or that goods are of a particular style or model;
(b) falsely represent that goods are new;
(c) represent that goods or services have sponsorship, approval, performance characteristics, accessories, uses or benefits they do not have;
(d) represent that the individual or corporation has a sponsorship, approval or affiliation [he, she or] it does not have;
(e) make false or misleading statements concerning the existence of, or amounts of, price reductions;
(f) make false or misleading statements concerning the need for any goods, services, replacements or repairs; or
(g) make false or misleading statements concerning the existence or effect of any warranty or guarantee."

Apart from the criminal sanction for a breach of Section 53, an individual or corporation infringing Section 52 or 53 is liable to proceedings for injunction and for damages suffered by an injured party. In view of the obvious impossibility of our insuring that advertisement submitted for publication comply with the Act, advertisers, and advertising agents will appreciate the absolute need themselves to ensure that the provisions of the Act, including the sections specified above, are complied with strictly.

It is suggested that in cases of doubt advertisers and advertising agents seek legal advice.

SUNGRAVURE PTY. LTD.

RADIO DESPATCH SERVICE

869 GEORGE STREET SYDNEY

**CNR GEORGE & HARRIS STS
RAILWAY SQUARE
TEL 211-0816, 211-0191**

TEST EQUIPMENT

CT500	20kOhms/V	VOM	$18.70
MVA100	100kOhms/V	VOM	$43.00
MVA1	1kOhms/V	VOM	$9.78
MVA80	80kOhms/V	VOM	$23.00
MVA50	50kOhms/V	VOM	$30.00
360TR	TRANSISTOR TESTER AND VOM		$45.00
360FET	FET/VOM		$47.61
TV7001	FET/VOM		$60.08
TR10	DIGITAL VOM		$132.25

OPEN SATURDAY MORNINGS

ELECTROCRAFT PTY. LTD.

**106A Hampden Rd.
Artarmon, 2064
Phone 411-2989**

Distributors of Belling Lee, Channel Master, Ecraft, Hills, HI.Q, Lab Gear, Kingray, Matchmaster. Largest range of aerial equipment in Sydney.

TELEVISION AERIALS, DISTRIBUTION AMPLIFIERS, EQUIPMENT AND ACCESSORIES WHOLESALE, TRADE AND RETAIL SUPPLIED.

ECRAFT

	Retail Price
Neosid Balun 75/300 uncased	$0.65
O.S.A.B. Outside aerial balun	3.81
6 SB 6ft. Balun Fly Lead	3.65
P.S.B. Plug and Terminal Balun	2.53
2 75 T/S 2-way 75 ohm Transformer Splitter box	4.41
3 75 T/S 3-way 75 ohm Transformer Splitter box	8.41
4 75 T/S 4-way 75 ohm Transformer Splitter box	8.94
5 75 T/S 5-way 75 ohm Transformer Splitter box	12.66
2 3T 2-way 300 ohm Splitter box	4.48
3 3T 2-way 300 ohm Splitter box	5.86
4 3T 2-way 300 ohm Splitter box	7.12
Adjustable Low Band Attenuator	6.31
10" diameter degaussing coil	24.00

COAXIAL CABLES

Attenuation per 100ft at 200 MHz		Reel Size	Price
Belden 9242) Double screened with	4.0 dB	500 ft	$42.28
Belden 9248) Duofoil and Braid	3.1 dB	500 ft	58.61
TVM1A Concordia Copper Screened	4.4 dB	100 metre	30.15
ASA/R10 foil with drain wire	3.3 dB	100 metre	28.98
Hartland WH89 Copper Braid	3.3 dB	100 metre	36.92
Hartland WH87 Copper Braid	6.0 dB	100 metre	26.56
Hartland WH86 Copper Braid	6.5 dB	100 metre	19.25
300 ohm Feeder Cable	1.8 dB	100 metre	8.80
Open wire line 300 ohm	1.5 dB	100 ft	9.90
Open wire line 300 ohm	1.5 dB	300 ft	29.80

MATCHMASTER

	Retail Price
"G" Unit 82/C/1	$14.73
Gutter Clip Aerial	10.33

KINGRAY AMPLIFIERS

	Retail Price
D15/500 m/V	$48.80
D30/500 m/V	57.95
D40/600 m/V	79.30
D12/1500 m/V	67.10
MH 20 Mast Head	64.63

INDOOR AERIALS

	Retail Price
Helifan High Gain	$7.96
Standard Spiral	3.27
Hills Rabbit Ears	8.56

LAB GEAR AMPLIFIERS VHF UHF

	Retail Price
Mast Head 22 dB	$72.43
CM 6014 DA 20 dB	60.25
CM 6034 DA 4 outlets 8 dB each	54.90
CM 6036 DA VHF 30 dB UHF 28 dB	84.63
Televerta (VHF to UHF frequency convertor)	67.48
Channel Master Telstar	58.91

F.M. AERIALS

	Retail Price
Matchmaster	$21.30
Hills 3 EL	11.17
HI Q 4 EL	15.91
HI Q Gutter Clip 2 E1	9.50

TELESCOPIC MASTS

20 ft	$19.30
30 ft	30.81
40 ft	42.06
50 ft	54.42
60 ft	58.00

ALL TYPES OF HARDWARE IN STOCK

Wall brackets, chimney mts. J Brackets, Turnbuckles, Guy Rings and Guy Wire. All types of masts etc.

TELEVISION AERIALS FOR COLOUR

HILLS

	Retail Prices		Retail Prices
EFC 1	$24.17	215 8 EL	$19.26
EFC 2	$32.06	216 9 EL	$24.10
EFC 3/24	$46.65	CY7 Colinear	$25.95
EFC 4/03	$58.68	2010 Airways	$42.50

CHANNEL MASTER

3111 Super Colaray	$36.50	638 8 EL	19.26
3110 2 EL Colaray	22.75	257 Colinear	26.07
		361A 17 EL Crossfire	54.95

HI.Q SINGLE YAGI'S

CH 2 4EL	$20.80	Gutter Clip Aerial 1 EL	8.90
CH 4 & 5A 8EL	27.74	Gutter Clip Aerial 2 EL	11.00

A MESSAGE TO COST-CONSCIOUS ADVERTISERS

The real cost of advertising is the cost to contact the readers, usually measured in cost per thousand circulation at 12x page rate.
Here is how they compare:

Electronics Australia	$8.37
E.T.I.	$8.69

So E.A. not only has the largest sales, it has the lowest cost.
(Data based on latest audited sales and current rate card)

SUBSCRIPTION SERVICE

ELECTRONICS Australia

Subscription Rates
$A12.00 per year within Australia.
$A15.00 per year elsewhere.

Make sure you receive every copy of the magazine by ordering it from your newsagent or the publisher. For publisher subscriptions post this coupon, with your remittance,, to Subscription Dept, PO Box M204, Sydney Mail Exchange, 2012. Subscription will start with first available issue.

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Advertising Index

PLAY SAFE

We hope you'll never need it!

THIS MAGAZINES SPECIAL OFFER!

There's a well known saying, that goes something like — "you shut the stable door after the horse has bolted". In the case of a handy fire extinguisher, not too many homes have them. Yet every year in homes, boats, cars, caravans and garden sheds, fires occur which could have been put out quickly and efficiently if a Chubb fire extinguisher had been handy. $14.95 is not much to pay for a feeling of security all year through. The model we offer readers is well designed and easy to operate. The body and operating mechanism is compact and made from plastic, which makes it rust proof and almost indestructable. It comes complete with a fixing bracket — ready to use!

The Dry Powder content is completely non-damaging and non-toxic in confined spaces. Fires fueled from petrol, oils, fats, lacquers, tar, alcohol, wood, paper and straw can be contained. The Chubb unit weigh s only 3 lb. 12 oz. (1.685 kgs.) and is 14.3/8" high (36.5 cm). Easy do-it-yourself refill kits are available. Each unit is carefully packaged and contains complete operating instructions.

$14.95
POST FREE

CHUBB FIRE EXTINGUISHER

HOW TO ORDER: Fill in BOTH sections of the coupon. In each section print your name and full postal address in BLOCK letters. Cut the entire coupon out around the dotted line. Send it with your money order or crossed cheque to this Magazine's Reader Service Department (Chubb Fire Extinguisher), P.O. Box 93, Beaconsfield, N.S.W. 2014. Cheques should be endorsed on the back with sender's name and address and made payable to this magazine. Offer is open to readers in Australia only. Please allow four weeks for delivery.

Name . . . .

Address. . . . .

. . . .

State . . . . Post Code . . . . .

Quantity . . . .

THIS MAGAZINE'S "CHUBB FIRE EXTINGUISHER" OFFER NO. 60/75

Name . . . .

Address. . . . .

State . . . . Post Code . . . .

Please send me. . . . . (state quantity) Chubb Fire Extinguisher/s.

I enclose my cheque, postal/money order to the value of $ . . . .

YOU'LL FIND IT QUITE AN EXPERIENCE

For those who are after a total package in Hi-Fi, JVC presents "CREATION 310" Components specially matched so that each and every unit complements one another.

Here are the components necessary for enjoying top notch stereo sound.

The power source is our integrated stereo amplifier JAS310 with a power output of 50 watts RMS. Tuner — JTV310 offers exceptional value in terms of quality FM/AM reception. Speakers — SK33 2 way 2 speaker Hi-Fi system. Cassette Deck — 1655 with tape selector switch and noise suppressor.

The JLA1 belt drive turntable with auto return/auto shut off completes this very impressive package.

"CREATION 310" is a precision marriage of JVC components designed to impress your ears. Your eyes too will be impressed, for an optional table is available to house this system in a neat package.

Ask your JVC dealer for a personal demonstration. You'll find it quite an experience.

JVC

VICTOR COMPANY OF JAPAN LIMITED

For further information please write to — JVC Advisory Service, P.O. Box 49 Kensington, N.S.W. 2033

Guaranteed and serviced throughout Australia and Pacific Islands by **Hagemeyer (Australasia) B.V.** Branches in all states.

WT GD71J