ELECTRONICS Australia

HIFI NEWS

MAY, 1976
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OFFER: SCIENTIFIC CALCULATOR FOR $29.95

BUILD A VIDEO GAME,

ADD-ON REVERB UNIT

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How to get two Hi-Fi units for the price of one...

Sony's new Stereo Receivers (STR7025, 7035, 7055) (Component-quality Amplifier and FM-AM Tuner with 1.7 μV high sensitivity, 60dB selectivity)

Now that FM high fidelity stereo broadcasting is finally here, most hi-fi fans are adding a quality FM tuner to their rigs.

But newcomers to high fidelity (and those who are upgrading) are in luck . . . with Sony's new STR Series FM-AM Receivers, they can get *both* a component-quality tuner and a powerful amplifier for no extra cost. Take the Sony STR7025, for instance. For under $350 you get a highly sensitive and selective FM-AM tuner, beautifully integrated with a 24 watt per channel stereo amplifier.

For anyone starting or improving a stereo system, the STR7025 is a great place to begin.

With Sony-engineered quality throughout, it will make even a cheap turntable or speakers sound better.

You get

- All the input and output controls you'd expect from Sony, including MIC mixing and four speaker outlets.
- Direct coupling for tighter, cleaner bass.
- Reserve power: 24 watts per channel (4 ohms) continuous RMS at 1 kHz.
- Low noise. Low distortion. S/N Phono 60 dB I.M.D. less than 0.8% at rated output.
- Frequency response: 30-40 kHz.

The tuner section's specifications are equally impressive:

- High sensitivity: 1.7 μV.
- Minimum interference is assured by FETs in the front end.
- Selectivity is 60 dB with solid state filters to reject adjacent channels.
- Extra wide tuning dial.
- Capture ratio as low as 1.5 dB.

The STR Series reflects Sony's usual crisp, appearance design, integrated here into an impressive whole. The two functions are of course wholly independent: your enjoyment is only limited by your own interest in experimenting with sound—beautiful sound by Sony.

Check out the STR Receiver Series at your Hi-Fi retailer soon. Sony STR7025, STR7035 and STR7055. One of them is the ideal source for your future stereo system.

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ELECTRONICS Australia

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

VOLUME 38 No 2

Now you can build your own home video game for less than half the cost of comparable commercial models. This unit has been specially designed in our laboratory, and should be very easy to assemble and get going. Full constructional article commences on page 38.

Electronic calculator prices have fallen dramatically in the last year, so much so in fact that we have been able to arrange for our readers a special offer scientific calculator for just $29.95. The unit is the Unitrex 901SN, and our article on page 114 has all the details.

On the cover

Our cover this month illustrates some of the latest home entertainment equipment available from Toshiba. Featured is the C-812 43cm colour TV set with vertical stripe black matrix picture tube, together with one of the new series 3000 integrated stereo systems. Further details on the C-812 colour set are given in our review on page 107. (Picture courtesy Toshiba-EMI (Australia) Pty Ltd).

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Editorial Viewpoint

A realist or a heretic?

While I was working away this month writing the current article in our series on building a modern electronic organ, it suddenly struck me how much my own attitudes to electronic organs have changed in the last year or so. I would like to think that they have been broadened, and made perhaps a little more objective.

Not very long ago I was one of those dedicated pipe organ enthusiasts who found it almost impossible to believe that any other single instrument could begin to approach the unique qualities of the traditional "king of instruments". Despite my involvement in electronics, it seemed very unlikely that any electronic instrument could produce the musical life and warmth created by many ranks of singing individual pipes.

Those who wanted to play around with electronic instruments I barely tolerated, convinced that they were pursuing unreal goals. Instead I took the alternative path, and bought the remains of an ancient pipe organ with the idea of rebuilding it. Many hundreds of hours later I gave up—beaten by the amount of work involved, the degree of skill required in an unfamiliar technology, and practical problems like reducing the noise from the blower below that produced by the pipes!

I still wasn't convinced that the electronic alternative held any real future, though. That is, not until I heard the big Rodgers touring organ demonstrated in the newly-opened Sydney Opera House. When I sat down in the concert hall and closed my eyes, I realised that it was impossible to tell that I wasn't listening to a pipe organ.

But in a sense, even this and subsequent demonstrations of large and costly electronic organs didn't fully convince me. There was still that feeling, deep down, that most electronic organs were dull, lifeless and lacking in musical life. This seemed to apply particularly to many of the low cost divider-type instruments, regarded with not a little disdain even by those promoting the more elaborate electronic organs.

So when I began working on the current series of articles, it was still with a vague reservation that although modern IC technology had made it possible to produce a divider-type organ far more easily than before, the end result might not be particularly satisfying.

It is embarrassing to admit that the more experience I have of modern electronic instruments of the divider type, fitted with synthetic reverb and multiple phase modulation, the less sure I am that they are in fact inherently less satisfying than either a pipe organ or one of the very costly multi-oscillator electronic instruments! And I find myself wondering how many other "purists" would be in the same position, if they were honest with themselves.

In short, either electronic organs have improved, or I've been turned into a heretic!

—Jamieson Rowe

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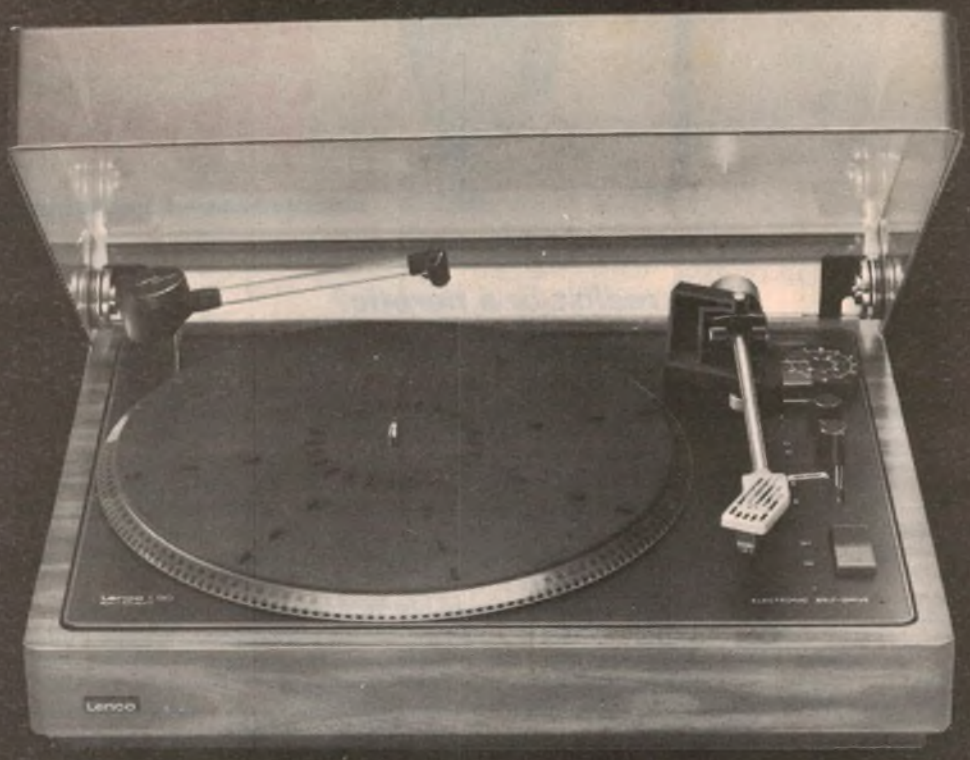

Lenco.

A masterpiece of Swiss precision.

Photimport proudly present the precision-engineered Lenco range of Hi-Fi turntables. In Australia, test results have shown that wow and flutter are almost impossible to measure in Lenco equipment. For those who seek near-perfection in sound reproduction at a reasonable price, Photimport highly recommend Lenco.

Engineered for incomparable sound.

L90

The L90 Lenco Electronic Hi-Fi – a new top-ranking belt-driven transcription turntable. 16-pole synchronous motor, illuminated strobe, dampened spring suspension, and anti-skating device. As precise as a Swiss watch – to give superb quality sound.

L65

The L65 Lenco Automatic belt-driven Hi-Fi turntable. Light aluminium tone arm. After selection of record diameter, tone arm lowers itself automatically onto the record. After playing, it returns itself to tone arm rest. Viscously dampened suspension. A high-quality instrument for excellent reproduction of sound.

L60

The L60 turntable, precision engineered for superb quality sound reproduction. Manual operation, but with all other advanced features of the L65. An opportunity for music lovers to obtain Lenco's renowned sound transcription at a moderate price.

PHOTIMPORT

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For descriptive literature and specifications send a 30 cent stamp to **Qualitron Industries Division** of Photimport at the above address.

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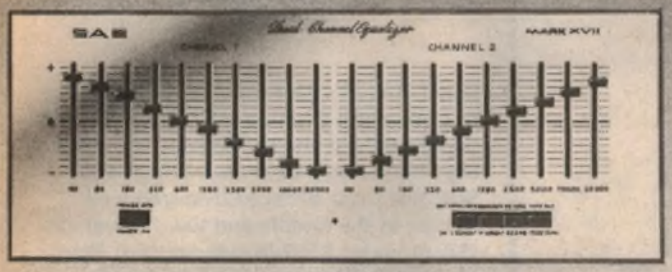
• MARK XVII octave equalizer



specifications...

Your tone controls are just not designed to compensate for
☐ Room acoustics
☐ Speaker placement
☐ Old or bad recordings.
We built the Mark XVII Equalizer to solve these problems and more. These are some of the ways:
☐ Individual Octave Control for each channel.
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You'd have to look a long time to find an EQ that delivers this much value. SAE innovation has done it.

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• MARK 2700B half octave equalizer

specifications...

Pink Noise Generator. A built-in pink noise generator assures an accurate reference for proper equalization of wide band speaker response, speaker phasing, channel power balancing and frequency equalization.

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IC Power Supply. Individual IC control for positive and negative power supplies further assures low noise circuitry and stability with changing line conditions.

The SAE 2700B Dual-Channel Half Octave Equalizer delivers +23dBm for recording applications, offers complete control, extremely low noise, accurate equalization, and the usual superb SAE quality.

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LER 119

TDK SA breakthrough in tape technology

Extracts from an address by Mr. E. Nakamichi, President Nakamichi Research Inc. at a recent Seminar in Sydney for Nakamichi dealers.

"TDK Super Avilyn Cassettes are recommended for use with all Nakamichi tape decks. Before leaving our factory, all Nakamichi equipment has bias voltages set for TDK SA to achieve optimum performance".

"Chromium Dioxide tape is not recommended for use with any Nakamichi tape decks."

"The wear on recording heads is significantly reduced by using TDK Super Avilyn as compared with any Chromium Dioxide tape."

Super Avilyn's performance exceeds that of Chromium Dioxide formulation which previously was the best choice for linear high frequency response and high-end S/N, but Cr02 suffered from reduced output in the middle and low frequencies (SA provides 1.5-2db more output than the best Cr02 in those ranges, equal output at high frequency).

SA also outperforms the ferric oxide tapes (regular or cobalt energized) which are unable to take full advantage of the noise reduction benefits of the Cr02 equalization because their high end saturation characteristics are not compatible with this standard (they require 1EC 120ms, normal or high EQ).

The net result of SA's characterists and this EQ difference is a tape with an impressive 4-5db S/N gain over the latest top-ranked high output ferric oxide tapes and more than 10-12 db S/N gain over many so-called low noise ferric oxide tapes.

From the report by Louis A. Challis & Associates Pty Ltd. Consulting Acoustical & Vibration Engineers, NATA laboratory.

"TDK Super Avilyn Tape looks like being one of the most important advances in tape formulations in the mid-seventies"

TDK

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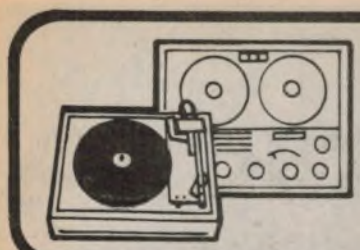


Hi Fi News

BSR ACCUTRAC: You dial the titles!

You place a disc on the stationary turntable, then return to your chair with the jacket and with a small remote control unit. When you are ready, you push the appropriate buttons and the player goes into its act—any tracks in any order, repeat any number of times, reject altogether or part way through. You can change your mind as you go or pre-program up to 14 tracks, with the aid of an in-built memory system.

The revolutionary accutrac record player has been introduced by the Audio Dynamics Corporation (ADC) of New Milford, Connecticut, USA, a company owned by the BSR group. The sponsors are not the least bit modest about their creation, hailing it as "the most unique and advanced electronic turntable in the universe"—a claim that may be as difficult to disprove as to sustain!

ADC held five press conferences around the world during the first week of March (in Zurich, London, New York, Los Angeles, and Tokyo) to present ACCUTRAC, "the first true innovation in record playback since the LP was introduced over 30 years ago". The products ADC unveiled were three ACCUTRAC automatic turntables incorporating electronic track selection, a computerized memory bank and remote control operation.

John H. Hollands, Chairman of the Board, Audio Dynamics Corporation and President, BSR (USA) Ltd., called ACCUTRAC "The ultimate marriage of state-of-the-art in micro-electronics, electro-optics, and mechanical technologies."

The Accutrac 4000 automatic record player with remote control unit and the spherical remote control receiver. The four knobs and four buttons to the left are presets for speed and record size. The remaining buttons are for track select and function.

"While ACCUTRAC has many special applications, especially for education and industry," he said, "the most obvious and consumer-oriented function of ACCUTRAC is that listeners need never touch either the turntable or the tonearm and are free to listen to whatever album tracks they please in whatever order and as many times as they choose. The resultant longevity and durability of an album, saved from manual cueing accidents and the usual wear and tear, is a benefit that music lovers everywhere will quickly realize."

The ACCUTRAC 4000, the first of the units available for consumer purchase, consists of three separate but interrelated component pieces: the automatic, direct-drive electronic turntable, a "space-age" remote receiver, and a hand-held cordless transmitter.

From the comfort of an easy chair, listeners can program exactly what they want to hear on a given album by selecting tracks indicated numerically on the transmitter. The message is then transmitted to the receiver which is located in convenient proximity to the turntable, and the receiver in turn activates the turntable's arm, which places the stylus precisely at the beginning of the track selected by the listener. The receiver's LED winking "eye" lets the listener know that the information has been received and stored in the memory.

Up to 24 commands can be programmed in any order the listener desires.

The secret of the Accutrac player lies in a tiny infra-red generator mounted in the cartridge mechanism, which focuses a beam of infra-red light on to the surface of the disc adjacent to the stylus. If the

"The March Of Musical Time" is ADC's caption to these three photographs accompanying their release material. At the left is Thomas Edison with his first phonograph, circa 1877. Ten years later Emile Berliner's circular disc model transformed the basic idea into something that could be mass produced. Then, in 1948, Dr Peter Goldmark introduced the hifi age with his LP disc. The LP format was adapted, in turn, to provide for stereo and then quadraphonic reproduction.

light strikes a plane surface, it is reflected back into an infra-red sensor alongside the generator, indicating that the reference spot is centred on a "land" outside, inside or between grooves.

Alternatively, if the infra-red spot strikes an area occupied by closely spaced grooves, it will be scattered rather than reflected and this is interpreted by the sensing circuits as "we're over grooves".

In this way, the mechanism can sense accurately the start of the first track, can count tracks as it moves inwards, can locate the start of the next wanted track, and its finish quite irrespective of the number and width of tracks on a given side. The arm traverse mechanism takes charge while ever the arm is being manipulated but, the moment the stylus touches the surface, the traverse system disengages, allowing the arm to track the grooves with no artificial constraint.

The manufacturers are quick to stress that, since track sensing is by purely optical means, actuating cams, levers and trip mechanisms are obviated, avoiding the consequent loading on the arm while it is in playing mode.

As for the turntable itself, it is a direct drive type, free of wheels, belts and pulleys and relying on an electronic servo system to set and regulate the speed with a high degree of accuracy.

While BSR/ADC see the Accutrac player as something of an ultimate for the home hifi enthusiasts, they are predicting its adoption in a variety of specialised situations:

- As an educational aid, where it becomes a simple matter to have the player repeat particular tracks as many times as necessary for language study, music appreciation, etc.
- As an audio visual aid, or as an accompaniment to slide presentations, where tracks can be pre-programmed in appropriate order.
- For evaluation sessions, where an artist or group can study tracks at their leisure, without someone continually having to fiddle with the player itself.
- For broadcasting or Disco situations, where events can be pre-programmed with the assurance that they will happen on cue. Two players would provide continuous program.
- For the blind, who have thus far been at a disadvantage with record playing equipment.
- For "music minus one" recordings, allowing a trainee musician to accompany tracks in a selected order, without having to leave his playing position.

Having only just been announced overseas, the Accutrac 4000 is not likely to be available in Australia for quite a while yet. But BSR Australia will obviously have plenty to say on the subject when the time arrives.

Incidentally, background literature with the Accutrac release note highlights the scale of the BSR enterprise. First organised as an electronics company in 1932, BSR is now centred in the Birmingham area, employing about 12,000 people in its main works and another 4,000 in wholly owned subsidiaries distributed around the United Kingdom. It produces over 200,000 automatic turntables a week plus several thousand other audio devices. Sales are handled throughout the world by a group of wholly owned sales and distribution companies, plus supporting independent distributors and agencies.

FROM AUDIO TELEX COMMUNICATIONS PTY LTD

The Telex 1400 series recorder/reproducer designed primarily for commercial applications. It covers 3.75, 7.5 and 15ips and has provision for mic and line inputs.

At right, the Telex cartridge changer model TMS200. Using standard 8-track cartridges, it can provide up to 16 hours continuous music before repeating automatically.

Mr Rod Craig, General Manager of Audio Telex Communications Pty Ltd.

AUDIO TELEX . . .

A new company has been set up in Australia to market Telex products. Registered as Audio Telex Communications Pty Ltd, its head office is at 54 Alfred Street, Milsons Point 2061, telephone (Syd) 929 9848. The Melbourne branch is at 828 Glenferrie Road, Hawthorn 3122, telephone 819 2363. The company is represented in other states. General Manager is Mr R. G. (Rod) Craig.

Prior to the setting up of the new company, Telex products in Australia were handled by the Philips organisation.

Like its principals, Telex Communications Inc. of Minneapolis USA, Audio Telex will be specialising in the needs of educational and other bodies which,

Hand made sound.

With JBL you know you're not just paying for the name. You're paying for a quality of sound that is impossible to mass produce.

JBL's require equipment so specialised we had to design and build our own.

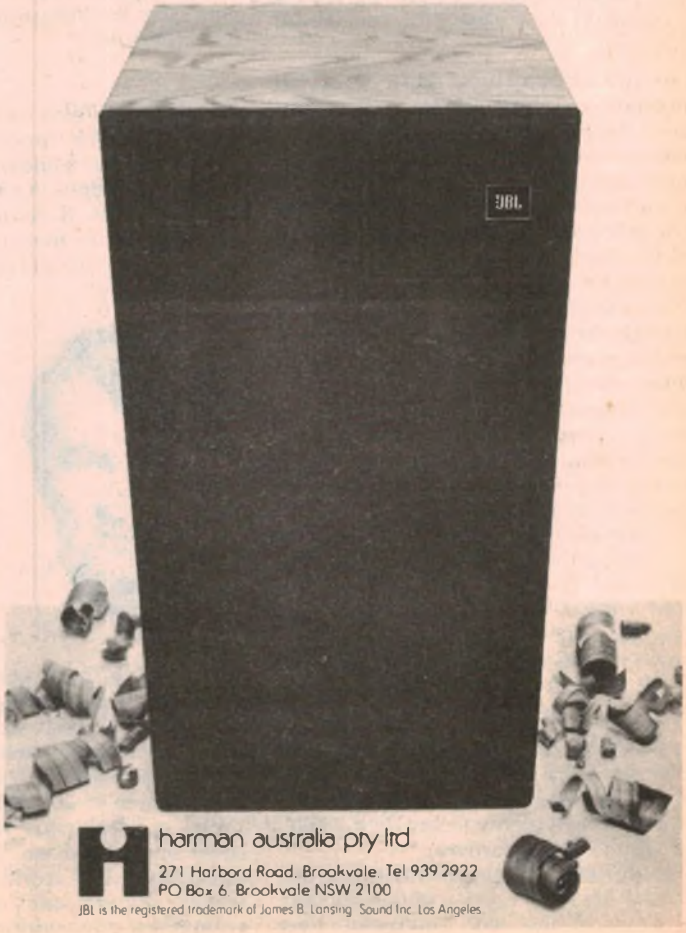
Cabinet tolerances are typically held to 1/64th of an inch.

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.

If we cut out all the things we do by hand, and the checking double checking and rejecting, we could probably produce a speaker for about 25% less. But then it wouldn't really be a JBL. Our reputation is based on an unchanging commitment to quality. We make no compromises. Never have, never will. The same applies to all the JBL range. Like the JBL Decades.

Near enough is just not good enough.



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PKB61001

according to General Manager Rod Craig, need something other than "spin-offs from domestic products". They need something designed specifically for their requirements, with a mix of reliability, price, robustness and service back-up which is different from the visual home hifi product.

Broadly, the Telex range covers high speed cassette and reel tape duplicators, broadcast and educational headphones, tape recorders for the educational and broadcast markets, background music machines, cassettes and reel tape transport mechanisms.

Illustrated herewith is the new Telex Magnicord Series 1400 reel tape machine. With mechanical and electrical specifications appropriate to the market for which it is intended, two models in the series are available, covering different head configuration requirements.

Model 1421 provides "full track erase, full track record and half track reproduce head or half track erase, half track record and half track play head".

Model 1422 is available in two head configurations: "half track two channel erase head, half track two channel record head, half track two channel reproduce head; or quarter track two channel erase head, quarter track two channel record head, quarter track 2 channel reproduce head, and half track two channel reproduce head".

Audio Telex state that their prices for such equipment are more than competitive with other units aimed at the same market sector.

The cartridge continuous player model TMS200 (also pictured) is intended for restaurants, stores, clubs, etc, which for one reason or another are not prepared to link up with a wired music service. Cartridges containing the preferred type and sequence of music can be purchased in local record bars and loaded into the machine. Twelve such cartridges will provide up to 16 hours of continuous music before the program is repeated or before cartridges need to be replaced—if desired—to provide a change in program.

Another item in the range, not illustrated, is the model 155 stereo cassette deck, expressly intended for continuous listening situations such as libraries, music rooms and resource centres. It is designed for flush panel mounting and is fitted with an accurate 3-digit counter and a review key, which enables the user to repeat sections of the tape instantaneously. The model 155 can be supplied either as a bare transport mechanism, or complete with an optional stereo amplifier capable of driving 8 or 600 ohm headphones.

While not seeking to criticise domestic hifi equipment in its intended role, Audio Telex have issued a press release intended for teachers and administrators suggesting the vital matters which should be considered when selecting a tape recorder/reproducer for teaching applications. The points listed include the following:

1. The tape recorder loudspeaker and volume should be sufficient for use in a normal classroom and with some-

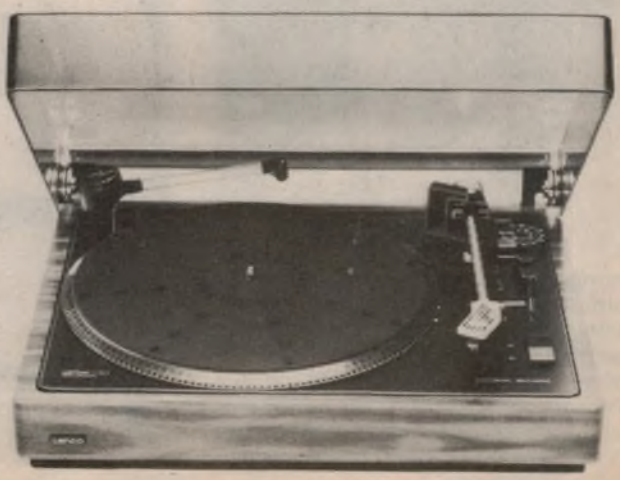
LENCO PLAYERS FROM PHOTIMPORT

Perhaps best known for their photographic lines (Minolta, Hasselblad, etc) Photimport (Australia) Pty Ltd have recently begin to diversify into the electronics field, beginning with Lenco record players and Dokorder tape equipment. In future, representation, sales and service for both product lines will be handled in Australia by Photimport. While represented in other states, head office of the company is at 69 Nicholson St, Brunswick East, Vic 3057.

Three current model Lenco quality record players are illustrated. At the right is the L-60, a simplified design intended for enthusiasts who prefer manual operation. It has a 16-pole motor, belt drive, anti-skating, and a rumble rating of 40dB unweighted or 60dB weighted DIN. Retail price is $176.65.

At $220.60, the L-65 below adds full automatic facilities and anti-skate adjustable for spherical and elliptical styli.

The L-90, lower right, is also fully automatic but it features electronic rather than cam actuation for the arm movements. It has an illuminated stroboscope, vernier speed control, and viscously damped spring suspension. It has the same wow and flutter rating (±0.08%) but lower rumble at −45 and −63dB. Price is $366.50.



thing in reserve. This requires an output of at least 5 watts RMS from the amplifier and a loudspeaker size of at least 5 x 3 inches. A tone control is also a desirable feature as the quality of prerecorded tapes can vary considerably and the tone control can often compensate for poor balance or excessive noise on the tape.

2. For long life and reliability the tape recorder should be equipped with at least two motors, one for fast forward and rewind, and a separate motor for the play mode. This ensures greater tape speed accuracy and therefore better quality performance. With the two motor system there is usually less to go wrong.
3. Automatic tape stop at either end of the tape is an essential requirement. The auto stop should disengage the capstan drive and cancel all operating controls. This avoids excessive wear and tear on the motor and/or rollers.
4. To avoid tape damage and jamming the tape recorder should be equipped with a stainless steel capstan drive which is preferably etched to give a firm grip on the tape. It is also desirable that the clutch mechanism is of the split type which automatically lifts the capstan roller off the drive if a tape becomes jammed. This latter feature can save on expensive repair bills as often a jammed tape will burn out a motor or cause the tape to become entangled in the workings of the machine.
5. The tape recorder should also have a three digit accurate resettable tape counter which will enable the operator to consistently locate segments of programmes on the tape.
6. Storage compartments for microphone, power lead and one or two cassettes will make portable use of the equipment much more efficient and convenient. For a tape recorder to be classified as truly portable it should not weigh more than 16 lbs.

In conclusion, the Telex release suggests that the user must be prepared to pay about 25 per cent above comparable domestic hifi prices for commercial equipment.

Amongst its many other facilities, the Nordmende "Spectra-Colour" TME TV receiver has provision for cordless headphones operated from an infra-red carrier system, as featured in our February and April issues. The transmitter is at the bottom right hand corner. (Sun Electric Co Pty Ltd, 28-56 Queensbridge Rd, Sth Melbourne.

Mr Keith Rowe, National Sales Manager, Toshiba-EMI.

Toshiba-EMI have just announced this new top-of-the-line front loading stereo cassette deck, model PC6030. Intended for the most demanding applications, the new deck conforms to DIN45500 specification and comes complete with Dolby facilities, provision for built-in calibration, separate spooling and capstan motors, large peak-indicating VU meters, stereo multiplex filter, dual-capstan tape drive, phase-locked loop servo for speed control.

"Feather touch" pushbuttons provide the normal user control over the mechanism but, in addition, provision is included for rewind and play, so that the deck can provide continuous auto play and rewind, if desired. Mic and line inputs are provided, together with headphone and line outputs—all with level control. Response is to 16kHz for normal tape and 17.5kHz for CR02, with S/N ratios of 58 and 60dB. (Toshiba-EMI (Australia) Pty Ltd, 301 Castlereagh St, Sydney 2000.)

NEW SPEAKER LINE: Readers of English electronic magazines may have noticed advertisements for professional quality loudspeaker drive units offered by the Acoustic Transducer Co Ltd, at the unlikely address of Pier House Laundry, Strand on the Green, Chiswick, London W4. Featured recently was a line of 12-inch drivers: 12" STD, 55Hz resonance, response to 6kHz; "Bass", 35Hz resonance, response to 5kHz; "Studio Bass", 25Hz resonance, response to 3kHz. Nominal power handling capacity is 75W.

Drivers from the company's range will be available in Australia through the East Recording Co, 14 Union St, Richmond, Vic 3121. Interested readers can contact Mr. Bill Hawtin direct by telephone (Melb) 429-1293.

Five different models are currently available in Australia, together with (apparently) associated items of equipment. Being aimed at the professional market, the products are not cheap (the 12-inch speakers run to around $200) but, in this field, engineers tend to buy on performance rather than price.

Peerless

PEERLESS FABRIKKERNE A/S is a DANISH company specialising in the development and production of loudspeaker units for the High Fidelity industry all over the world.

KIT 20.3

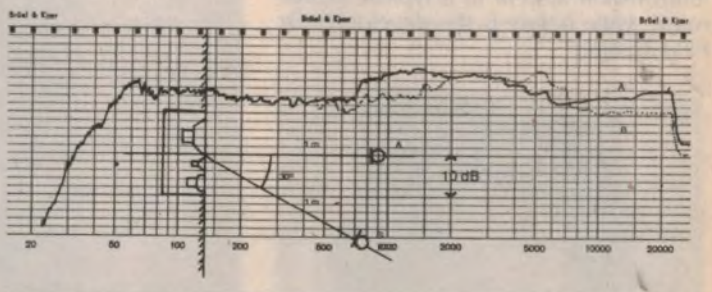
8" WOOFER–L 825WG
5" MIDRANGE–650 MRC
2¼" TWEETER–MT225 HFC

$124 PER PAIR

SPEAKER KITS ONLY
NO TIMBER

CROSSOVER FREQ.	1500 & 6000 CPS
POWER HANDLING	50 WATTS RMS
POWER REQUIREMENT	6 WATTS RMS
FREQ. RESP.	55-20,000 CPS
CABINET SIZE	20 LITRES

Sound pressure response curve for system 20-3.



Curve A: Axial pressure response frequency characteristic measured as per DIN 45500.
Curve B: Corresponding curve measured 30° from axis (normal listening direction by stereo).

Danish HI FI Southern Cross Plaza 638930 and Burke Road, Camberwell 824839 Melbourne. **Convoy Technocentre** Woolloomooloo 3582088 Sydney. **Danish HI FI** Mount Lawley 710100 Perth. **Brisbane Agencies Audio Centre** Fortitude Valley 219944 Brisbane.

An interesting new Australian development

Loudspeaker system has four horns and three drivers

Recently we were invited to preview a newly developed Australian loudspeaker system which uses horn loading. In fact, it has no less than four horns served by three drivers. Other features are sand-filled panels to control resonances and relatively compact enclosure size.

The loudspeaker system is the subject of a new venture, Rossiter Acoustic Developments, which has been formed to develop and eventually market the system and other related audio equipment. The principal, Dr Paul Rossiter, is a lecturer in the Department of Materials Engineering at Monash University, Victoria.

Initial analysis of the system involved the use of computer programs while subsequent development was facilitated by the comprehensive acoustic testing equipment, which includes a large anechoic chamber, available at Monash University. Several papers on the loudspeaker system have already been published in professional journals.

It may seem that while bass reflex and sealed box loudspeaker systems of modest efficiency are currently the overwhelmingly popular choice, a horn-loaded system is right away from the trend. And so it is. However, Dr Rossiter saw it as the solution to obtaining a better match between the low impedance presented by air to the relatively high impedance source formed by a typical loudspeaker cone.

Instead of accepting the inherent mismatch of conventional loudspeaker systems, the approach taken was to use an impedance transformer. One form of acoustic impedance transformer is the exponential horn which has a cross-sectional area increasing exponentially along its axis.

No less than four horns are employed. At frequencies above 7kHz the signal is handled by an imported horn tweeter, so that little design work was involved here apart from the cross-over network. A passive third-order Butterworth filter is used here, together with an attenuation network, to match the high efficiency of the tweeter to remainder of the system.

Other horns in the system are coupled to conventional cone drivers.

A photograph of the horn loudspeaker system shows that it has a relatively modest size. Actual dimensions are 45 x 99 x 58cm (W x H x D) while the mass is very hefty at approximately 140kg. A trolley is required to move the system around. A set of heavy duty furniture castors would seem to be a necessary refinement.

At right is a view of the new horn loudspeaker system in a typical lounge room while below is the developer, Dr Paul Rossiter.

While showing little detail, the photograph indicates that the enclosure is divided into two separate compartments. The upper compartment houses the midrange horn and horn tweeter while the lower compartment houses the bass driver and its two associated horns.

A rectangular cross-section is employed for the midrange horn. This is flared much more in one plane than in the other and is oriented to give wide horizontal dispersion and as a consequence, narrow vertical dispersion. Horizontal dispersion is 90 degrees which is appropriate for the intended corner position of the system.

The midrange response curve indicates excellent performance in this critical sector of the audio spectrum. Initial results from the midrange unit were poor necessitating considerable modifications to the cone. As well, a broad dip at about 1.5kHz was equalised out with a passive RLC network.

While both the tweeter and midrange horns are of quite conventional design, the bass driver and its associated horns represent a departure from normal practice as far as horn loaded systems are concerned.

Because of the long wavelengths of bass frequency signals, horns covering this range are usually very bulky and have a large mouth diameter. The dimensions at the mouth of the horn determine the "cut-off" frequency. A normal practice, to keep the cabinet dimensions within reasonable bounds, is to use the corner of a room to extend the mouth of the bass horn. This becomes a "so-called trihedral" horn which produces an inevitable mis-match with an exponential horn but is a necessary compromise.

Using the corner of the room means that the bass horn must be folded several times to keep it compact. This results in complicated cabinetry and worse, can result in reflections at the higher frequencies handled by the horn, if the cross-section dimensions become appreciable with respect to the wavelength.

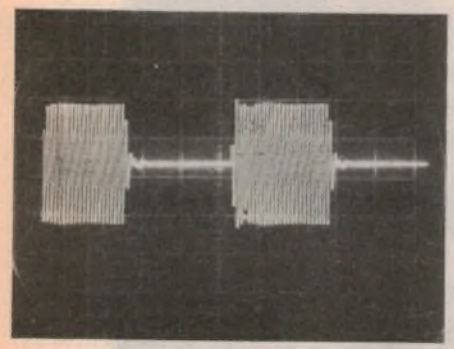
Optimum performance was obtained from the bass driver by coupling to two horns rather than one. So the driver radiates from the front into a horn with a cut-off frequency of 120Hz and into a rear horn with an effective cut-off frequency of 35Hz. The crossover at 120Hz is performed acoustically by decoupling the smaller horn from the front of the bass driver with an acoustic low pass filter and loading the rear of the driver with the lower frequency horn.

Since the lower section of the cabinet accommodates the low frequency horns it is subject to high pressures and consequently, panel resonances. These were eliminated by installing false panels and filling the spaces thus created with sand. This was the simplest way of reducing the resonances. It also explains the reason for the huge mass of the system.

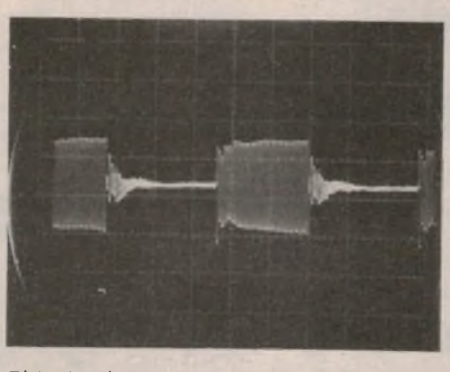
At the time of writing no complete response curve of the system was available due to the difficulties in finding a suitable environment. The anechoic chamber mentioned earlier is not suitable because it has an effective cut-off of about 80Hz and and could not provide the required "reflective" corner operating mode for the horn. This latter difficulty is also experienced in most normal rooms which use plasterboard walls—instead of being solid and reflective, they flap.

Nevertheless several third-octave pink noise test responses have been produced for a large listening room and these indicate quite smooth response over the whole audio bandwidth.

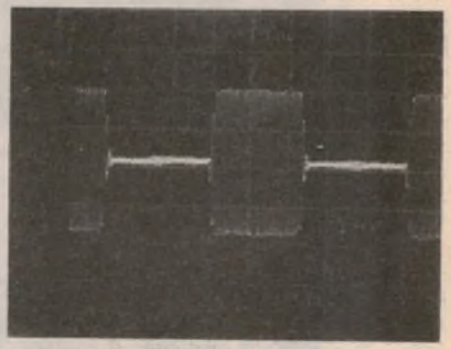
Excellent tone burst response is a feature of the system, as several photographs clearly illustrate. These are tone burst responses for the tweeter and midrange horns. Notice that while the system is efficient it is still well-damped, as indicated by the lack of ringing or "hangover".



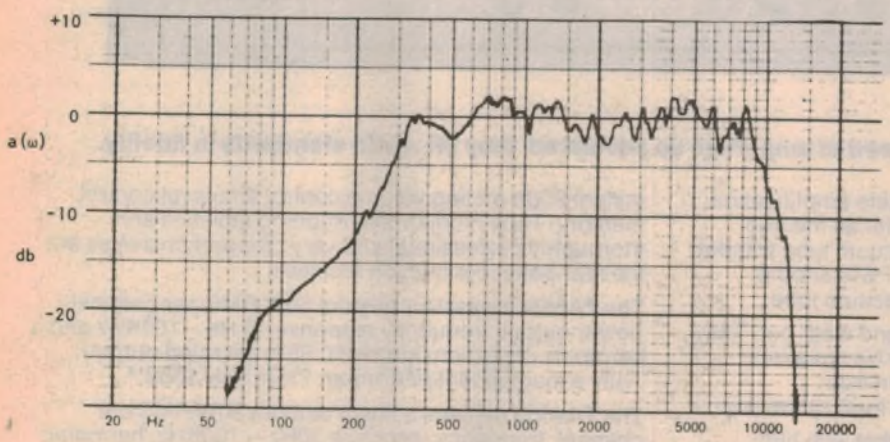
Tone burst response of the midrange horn at 1kHz. Notice lack of ringing.



This is the "worst case" tone burst response of the midrange unit at 3kHz.



This is the tone burst response of the tweeter horn at 10kHz.



Very smooth response is obtained from the midrange horn which uses a 10cm driver.

One of the advantages of the system is that it can produce very high sound levels with modest power input and low resultant distortion. The maximum sound pressure level obtained with a stereo pair of units at just before the onset of appreciable distortion (not specified, Ed) was 115dB measured at 3m on axis in a well-damped room (5 x 3 x 7m). This level produced a reading of 125dB at 30cm from the mouth of the midrange horn. These measurements were taken using recorded music as the signal source.

Clearly, this new horn-loaded loudspeaker system shows a lot of promise and could create a revival of horn loudspeaker systems. A great amount of time and effort has been devoted to the development of this system and it has evinced much interest at the limited previews so far.

Rossiter Acoustic Developments plan to eventually market the horn system in several stages of finish with projected retail prices starting from around $1400 for a matched stereo pair. For those who do not quail at this price further information can be obtained from Rossiter Acoustic Developments, 33 Murdo Road, Clayton North, Victoria 3168. (L.D.S.)

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Sansui TU-3900 FM-AM Tuner

A large number of FM tuners are in the under $200 price bracket and many of these offer very good performance for the money. This can certainly be said of the Sansui TU-3900 FM/AM tuner which has all-black styling, two tuning meters and good all-round performance.

Dimensions of the TU-3900 are 400 x 130 x 290mm (W x H x D) including knobs, rubber feet and rear mounted hardware. An extra 60mm clearance at the rear of the chassis is required to enable the ferrite rod antenna to be pulled out to its maximum distance from the chassis. The rod cannot be rotated in the horizontal plane for best AM reception so in some cases this may require positioning the tuner itself for optimum AM listening.

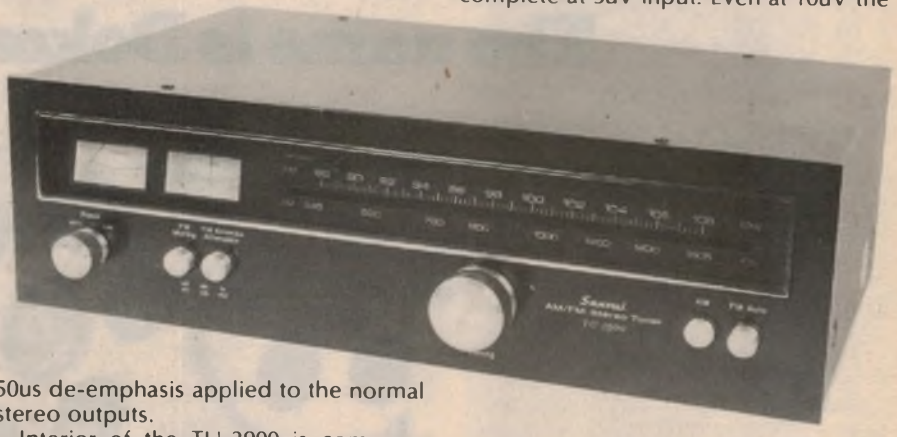
Two modes of reception are selectable via pushbuttons on the front panel: AM and FM Auto; FM Auto refers to automatic switching to stereo mode when signal condition exceeds a certain threshold. Two other pushbuttons on the panel are provided, for switching in or out the FM muting function and switching an Antenna Attenuator for very strong signal conditions.

Instead of having an inscrutable "midnight" dial which is only visible once the power is applied, Sansui have the dial calibrations printed directly onto a slotted escutcheon through which the pointer LED glows to indicate the frequency tuned.

The two meters are easily visible without the user having to crane his neck while tuning the unit. The tuning knob is flywheel-assisted for ease of use.

The styling will undoubtedly appeal to many potential buyers. However, it does not match other components in the existing Sansui range with which it may be used—for example, the Sansui AU-2200 stereo amplifier. Perhaps this unit heralds a new range, though.

Screw terminals are provided on the rear panel for connection of a long-wire AM antenna where the rod antenna is inadequate, also for a 300 ohm ribbon and 75 ohm coax cable for the FM signals. RCA sockets are provided for audio output, discriminator output and Dolby output. We gather that the latter outputs have 25us de-emphasis rather than the 50us de-emphasis applied to the normal stereo outputs.



Interior of the TU-3900 is comparatively uncrowded, with just two PC boards accommodating all the circuitry. A small PCB is used for the power supply components while a large PCB accommodates all the rest of the circuitry including the five-section tuning gang.

A major part of the circuitry uses integrated circuits, so that the total component count is relatively modest.

A two-core flex and two-pin mains cord is fitted instead of the three-core flex and three-pin plug fitted to other Sansui equipment such as the AU-2200 model referred to above. (This was reviewed in these pages in the August 1975 issue.) We trust that this inconsistency will be corrected shortly.

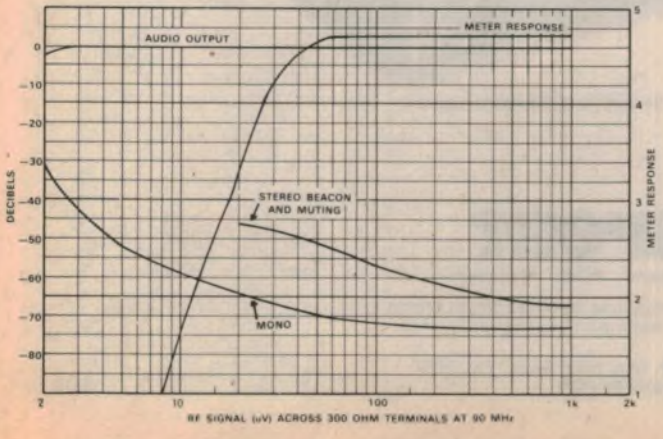
While the features described so far are commendable there is not a great deal to separate it from its competitors. What does set the TU-3900 apart is its performance. This is summarised in the accompanying performance curves.

Ultimate signal-to-noise ratio in the mono mode is 73dB and in the stereo mode it is a commendable 67dB. At the modest antenna input of 50uV the mono signal/noise ratio is excellent, at 70dB and 51dB in stereo. Limiting is virtually complete at 3uV input. Even at 10uV the mono S/N ratio is excellent at 59dB. Tuners costing many times the price of the TU-3900 do not exceed this quieting performance by more than a small margin.

On a negative note, the signal strength meter is almost saturated with antenna inputs of 50uV or more, which means that it is largely superfluous as a tuning aid.

Separation between channels was 30dB at 100Hz, 28dB at 1kHz and 18dB at 10kHz at the −3dB points. Harmonic distortion in the mono mode was 0.5% at 100Hz, 0.2% at 1kHz and 0.4% at 6kHz. It was slightly higher in stereo mode, with 0.3% at 100Hz, 0.3% at 1kHz and 0.5% at 6kHz. There is a slight anomaly in the distortion figures at 100Hz but the overall performance here is very good. 19kHz residual was well down at −56dB while 38kHz residual was slightly higher at −47dB.

Overall, the Sansui TU-3900 is an excellent performer at its recommended retail price of $199.00. Anyone buying a tuner can put it on his short list. Further information can be obtained from retailers or the Australian distributor, Rank Industries Australia Pty Ltd, 12 Barcoo St, East Roseville, NSW. (L.D.S.)



Quieting characteristics of the TU-3900 are very good but the signal strength meter is virtually saturated with antenna input signals of only 50uV.

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Marantz 4400 Quadradial Receiver

There have been many 4-channel amplifiers and receivers but most of them have lacked the power and performance of more expensive separate components. Here we review the Marantz 4400, which has 50 watts per channel in the 4-channel mode and 125 watts per channel in the stereo mode.

While it may not be obvious from the photographs, this Marantz 4400 is one of the largest and heaviest receivers we have ever tested. The unit we had for test is actually slightly different from that shown in the frontal and rear shots. A timber cabinet is not fitted and some of the labelling on the rear panel is different.

Dimensions of the 4400 are 490 x 142 x 430mm (W x H x D) including knobs, rubber feet and rear terminals. An extra 35mm is required at the rear of the unit to allow the rod antenna to be swung down from the back panel. Mass of the unit is 24kg.

There are quite a few features unique to the 4400, but space does not allow us to catalogue them all so we have to confine our remarks to the major points.

An immediately noticeable feature is the "gyro-touch" tuning control. This really amounts to a large heavy thumb wheel which is not so convenient when tuning from one end of the band to the other, but forms a very precise backlash-free tuning knob when tuning to a particular station.

A Dolby decoder is included in the receiver, for use with tape or cassette decks which do not have their own Dolby playback circuitry and also for use on reception of FM Dolby broadcasts.

Perhaps the most unusual feature of the Marantz 4400 is the oscilloscope display, which has multiple uses selected by the four push-buttons immediately adjacent to the small screen. One of the four buttons turns the display on. When not in use the display is actually in a standby mode whereby the oscilloscope tube filament is always energised while the receiver itself is in use. The standby mode would presumably increase the life expectancy of the tube.

Pushing the Tuning display button enables the scope to be used as a tuning aid for AM and FM reception. When tuning AM stations the scope display is a small horizontal bar which is displayed vertically according to the signal strength, so that it performs a similar function to a conventional signal strength meter. When tuning FM stations the scope display is a small vertical bar which is again displaced vertically according to the signal strength, but is also displaced horizontally and acts in the same way as a centre-reading tuning meter.

The "Multipath" display is similar to the tuning display except that in the case of ideal reception the display is a long horizontal trace and in bad conditions a very "hairy" bent display can be produced. The oscilloscope display of multipath reception is the best possible method for obtaining the optimum antenna orientation.

In the "Audio" mode the oscilloscope display varies according to whether the program is mono, stereo, CD-4, SQ or Marantz "vari-matrix". Here the display is useful for indicating channel separation and also gives a picture of the audio happenings.

Fitting an oscilloscope and attendant circuitry to the 4400 receiver undoubtedly puts the price up by a good few hundred dollars but it also puts Marantz way ahead in providing a facility for extracting the optimum performance from the FM tuner. And it's certainly a diverting gimmick for those who wish to "one-up" their neighbours!

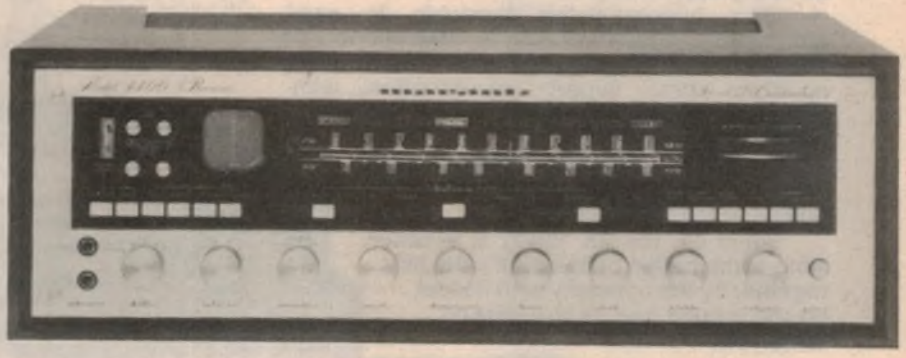
As well as having a "vari-matrix" 4-channel decoder there is also an optional full-logic SQ decoder which is installed in a pocket on the underside of the receiver chassis.

About the only facility lacking in the 4400 is an inbuilt CD-4 decoder or a "pocket" for an optional unit. As it is, the receiver has a set of four inputs intended to be fed by an outboard CD-4 adaptor.

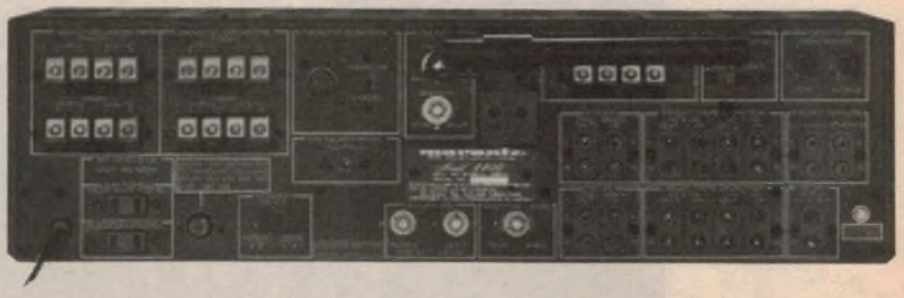
Since the 4400 is an expensive unit and is likely to be acquired as one of the steps toward obtaining a high quality 4-channel system, Marantz have made it double as a high-power stereo receiver. There is a switch on the rear panel which converts it from the four channel to the two-channel mode. In this mode the four power amplifiers drive the stereo loudspeaker pair in "bridge" configuration.

The interior of the big Marantz is crammed with componentry. Of special note is the massive transformer and large filter capacitors. Again, it would take too long to describe the circuitry so we have to concentrate on the performance results.

Power in the four channel mode is quoted as a maximum of 200 watts RMS, or 50 watts per channel. In the stereo mode, power is rated at 250 watts total or 125 watts per channel.



Comprehensive facilities are provided on the Marantz 4400.



A beautiful combination of components that were made for each other.

If you want a perfectly matched combination of stereo components without spending hundreds and hundreds of dollars and having your house look like a recording studio, it's hard to go past the Toshiba SX 150 C.

Each piece was designed with the other components in mind.

The receiver has all the features you would expect from separate units. A pre-amplifier, power amplifier and tuner all in the one space-saving unit. The performance is something that has to be experienced to be really appreciated.

The high-precision turntable is semi-automatic in operation with an MM phono cartridge and an S-type tone arm. The two-way speakers give superb reproduction with beautiful highs and lows divided between tweeter and woofer.

And if you buy two more speakers you can enjoy speaker matrix 4-channel effects at the flick of a switch.

All-in-all, the SX 150 C is a sensible combination of beautiful units put together by the company with its feet on the ground and its thoughts on tomorrow.

Specifications

2/4 channel speaker matrix. AM/FM/LW-FM stereo receiver with output of 6 watt x 2 (RMS at 8 ohms). Turntable is belt driven from 4-pole synchronous motor. Aluminium die-cast turntable. S-type tone arm. Two-way speakers comprising 2 x 16 cm woofers and 2 x 5 cm tweeters. Dimensions of receiver 450 mm (W), 331 mm (D), 110 mm (H), player 450 mm (W), 350 mm (D), 180 mm (H), speaker 280 mm (W), 170 mm (D), 460 mm (H). Power Source is 110/120/220/240 V AC, 50/60 Hz.

Price and specifications subject to change without notice.

Toshiba SX 150 C
AR201 Audio Rack—Optional extra
$339 recommended retail price

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MARANTZ 4400

We measured power in the four channel mode at greater than 65 watts per channel with 8 ohm loads, and in excess of 90 watts with 4 ohm loads. In the stereo mode the results were even more dramatic. We measured power at onset of clipping in excess of 160 watts per channel with both channels driven. With just one channel driven, the power was a whopping 200 watts.

We also measured power output with 4-ohm loads in the stereo mode, in spite of express instructions against doing so in the owner's handbook. This caution was made by Marantz apparently because there is danger of the protection circuitry operating. Whether this is likely to cause damage to the loudspeakers or amplifier circuitry was not made clear. At any rate, we again measured power output in excess of 160 watts per channel.

We could not accurately measure the harmonic distortion of the receiver in the four channel mode as it was close to the threshold of our measurement system—about 0.03%. We can state that the THD is well below 0.1% over most of the band.

In the two-channel mode it was a different story. Although the measurement system is ostensibly capable of making distortion measurements on a balanced bridge system as constituted by the 4400 when in the stereo mode, we were unable to "null" the distortion meter and read the distortion products. We would assume, in spite of our measurement problems, that distortion in the stereo mode is still quite low.

We made checks on all the preamplifer and amplifer performance specs and found them all within tolerances set by Marantz. We also ran our usual tests on the FM tuner. Most of these results are shown in the Quieting curves and the Frequency Response and Separation curves.

Quieting performance of the Marantz is very good and clearly ranks among the best we have tested. Notice also that the response of the oscilloscope signal strength display in the Tuning mode is very good and the most linear we have seen to date. Frequency response and Separation curves are also exemplary.

19kHz and 38kHz residual signals were unmeasurably low since they were below the residual noise of the tuner as a whole. This means that these residual signals are at least below 70dB. Who could ask for more?

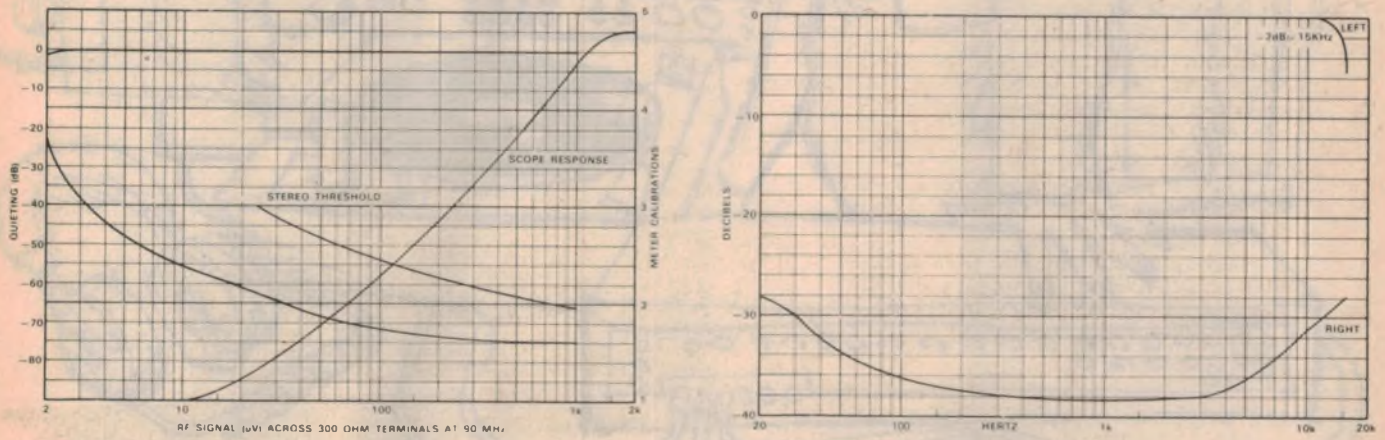
Total harmonic distortion for mono reception was 0.15%, 0.2% and 0.13% at 100Hz, 1kHz and 6kHz respectively. In the stereo mode of the tuner, THD was 0.5%, 0.4% and 0.4% at the same respective frequencies.

We did notice that there was some tendency to produce "pop" from the loudspeakers when the tuner was unmuted or switched to the stereo mode by the incoming signal, but this was certainly not obtrusive. In other respects the FM reception is excellent.

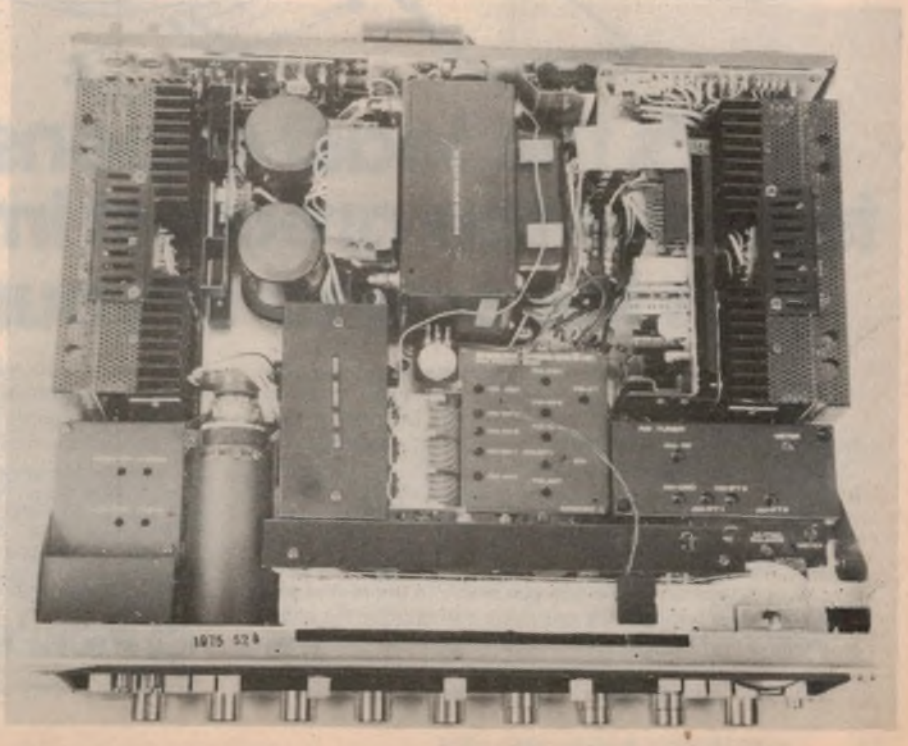
We have conducted protracted listening tests with the 4400 and can state that it is a very fine performer which would in most parameters equal the performance of the best "separate" components.

If you are in the market for a very high quality 4-channel system then you should certainly consider the Marantz 4400. All up price of the unit, including the optional SQ decoder and remote "joystick" control is $1840.00. Expensive, but perhaps a more practical proposition than a lot of equally expensive separate components to obtain the same system performance.

Further information can be obtained from the Australian distributors for Marantz equipment, Auriema (Australasia) Pty Ltd, 15 Orchard Road, Brookvale, NSW 2100. (L.D.S.)



Above are the mono and stereo quieting curves, plus the frequency response and separation between channels characteristic.



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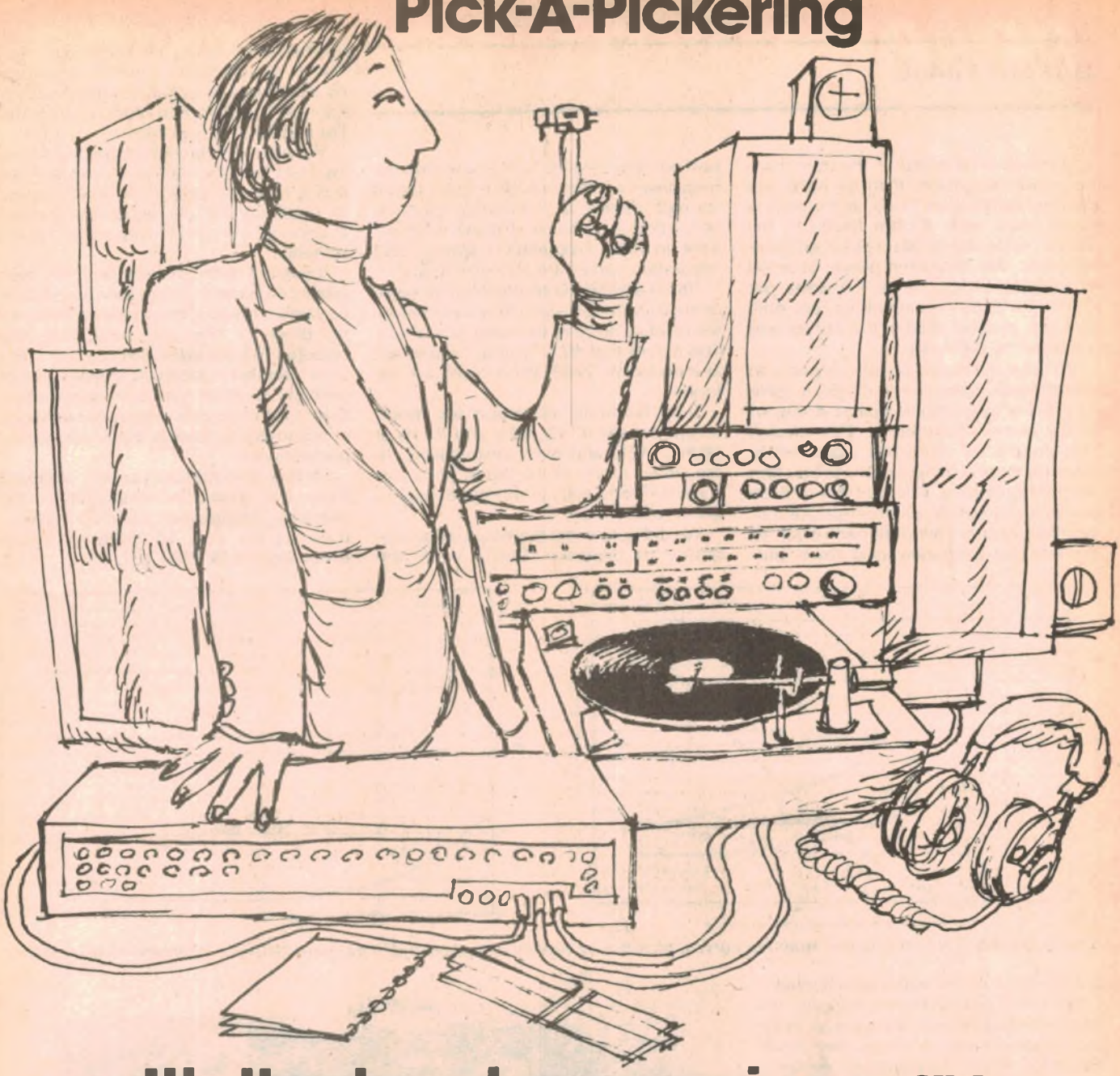

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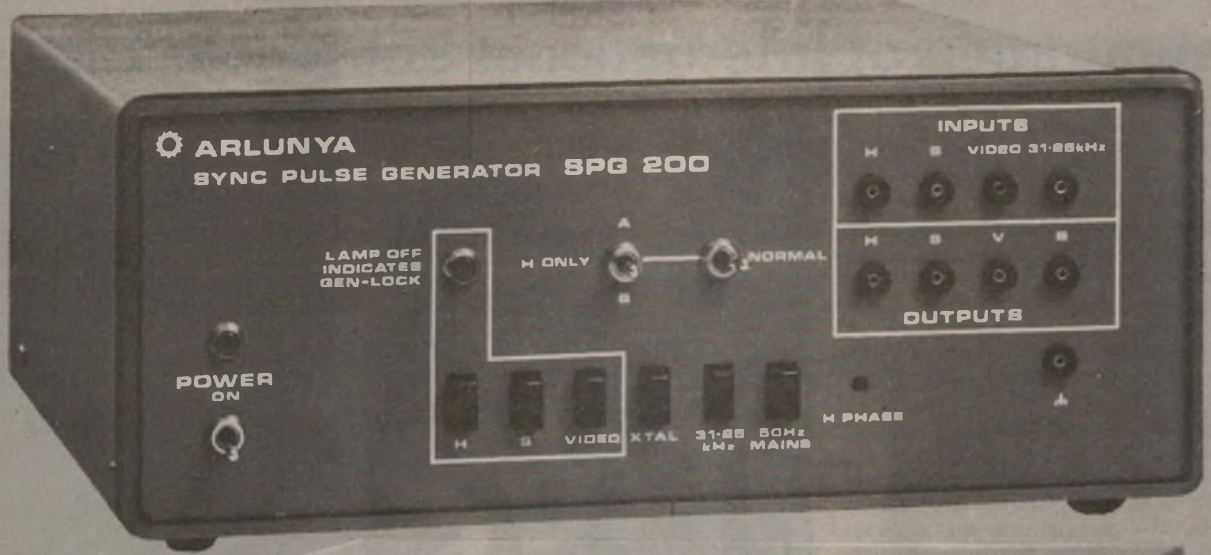

The Arlunya video processing system comprising the SPG.200 Sync Pulse Generator and the VPA.202 Video Processor will accept signals from any 625/50 PAL source, in particular from VTR's. It will clean up these signals by completely regenerating the blanking sync and burst components of the signal. System level, chroma level, white limit level, sync pulse amplitude, burst amplitude and phase can all be varied by front panel controls or remote DC voltages.

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These signals are composite sync and blanking, horizontal and vertical drives, 4.433619 MHz sub carrier output, burst flag and pal ident pulses.

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The SPG.200 and VPA.202 can be supplied in separate bench mounting cases are shown, or in rack mounting units.

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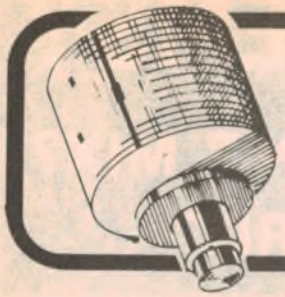

News Highlights

Inauguration of International Subscriber Dialling

International Subscriber Dialling (ISD), a service which permits telephone subscribers to make overseas telephone calls by direct dialling, has been introduced in Australia. Inauguration date for the new service was April 1st, the target date originally set by OTC and Telecom Australia.

Initially, ISD was available to telephone subscribers connected to 58 exchanges in the Sydney metropolitan area, seven exchanges in the main business area of Melbourne, and one city exchange in Perth. More exchanges are being added to the system progressively in these three cities. The service will be extended at a later date to other centres, and it is expected that by September 1st Brisbane, Adelaide, Canberra and Hobart will all have ISD facilities.

At the date of introduction, some thirteen overseas countries were either available on ISD or due for connection in the immediate future. These countries are: Austria, Canada, Denmark, Fiji, The Federal Republic of Germany, Greece, Hong Kong, Israel, Japan, Singapore, Switzerland, United Kingdom and the USA (including Hawaii). Services to other countries will be available later.

ISD callers are charged only for the time actually used, with no minimum (or maximum) time limit. This makes it possible therefore, to communicate a brief but effective message overseas at comparitively low cost. For example, calls to most of the countries listed above are charged at the rate of 9 cents (the current local call rate) for every 2.25 seconds. A minute call would thus cost $2.40.

Mr R. D. Somervaille (left), Chairman of OTC and Telecom Australia, and Mr H. White, General Manager of OTC, take part in the first official ISD call from Australia at the launching on March 9th. The call was made to Mr and Mrs Albert Deane of New Rochelle, New York. Mrs Deane was the first woman ever to speak by telephone from the USA to Australia, that call being made in 1928.

Because ISD call charges will, for the time being, be billed as metered calls along with STD and local calls, it was decided to introduce ISD on a 'barred access' basis. This means that if subscribers want access to the ISD, they will have to apply to Telecom Australia for the service. There is no charge to the subscriber for providing access, which involves making a simple modification at the local exchange.

AWA to make gunfire data display system

Amalgamated Wireless (Australasia) Limited, has been awarded a contract to manufacture items of equipment for an advanced artillery communications system which is now under consideration for the Australian defence forces.

FACE (Field Artillery Computer Equipment) is a mobile computing system for use in battery command posts for accurate direction of gunfire. It was designed and produced by Marconi Space & Defence Systems Limited for the British Government and is now in service with the British and Australian armies and many other countries.

FACE processes all of the information necessary to place a shell accurately on target and displays it on a console at the command post. A single system can process information relating to three batteries, each containing up to eight guns.

The firing data prepared by FACE can be relayed to each gun by voice transmission, through radio or via telephone channels. However, the battery can include up to 24 guns in different locations, and a quicker method of communication is required. AWDATS was developed by Marconi Space & Defence Systems Ltd., to give a visual display of firing data at each gun in less than 3 seconds, and adds significantly to the operational effectiveness of the batteries.

AWDATS provide a data display at each gun position by receiving, storing and displaying the required elevation, bearing and fuse length in turn on four nixie indicators. The data display unit (DDU) has a manual memory device to display the charge and fire order currently in force, and a built-in check facility before display to ensure that the data has not been distorted during transmission. Data transmission to the DDU is by FM audio frequency signal over existing radio or telephone channels.

In an initial $500,000 order for AWDAT equipment, AWA are manufacturing 144 data display units, and 24 coding units for digital data. The DDU's together with their batteries will be mounted on robust tubular frames suitable for use with towed weapons. AWA has also developed for Marconi a FACE simulator for testing AWDATS equipment.

Revolutionary solar cell tracks the Sun

A new solar panel that incorporates several revolutionary design features is currently under development at Standard Telecommunication Laboratories, Harlow, Essex. Among the various features is an elegantly simple method by which the panel will automatically track the Sun.

Basically, the panel consists of a water-filled trough on which plastic spheres about 30cm in diameter float freely. A Fresnel lens is formed in each sphere, and this serves to concentrate sunlight onto a gas thermo-electric cell. The power derived from each lens/cell combination is fed to bus bars which protrude from the side of the tank, so that power may be tapped off.

The way in which the lens is constantly focused on the Sun can only be described as ingenious. As the Sun's image moves off the cell surface, the light falls on one of four petal shaped gas reservoirs surrounding the cell. As the gas heats, the reservoir expands and moves a tiny magnet. Reaction between the magnet and an external magnetic field causes the sphere to move back into alignment with the Sun.

As a bonus, residual heat absorbed by the water, both by direct radiation and by absorption from the sphere cells, can be pumped around a house, for example, to provide heating. The system will be maintenance free, there being no mechanical drives, while all moving components are wear-free.

Fire detection device uses microcircuitry

A new type of fire detection head that used advanced micro-circuitry has been designed by AWA Microelectronics for Wormald International (Australia) Pty Ltd, manufacturers of fire protection systems. Produced at a cost comparable with conventional detectors, the new detector is claimed to offer exceptional reliability and easy adjustment and servicing.

The conventional detector head is an electro-pneumatic device which depends on two operating methods, either of which can trigger an alarm, ie, the melting of a low temperature alloy and/or expansion of air in a small chamber which is mechanically compensated for ambient temperatures.

The AWA Microelectronics' head is a monolithic integrated micro-circuit containing a sensitive electronic thermometer. The integrated circuit is mounted in a plastic moulding to form the ceiling-mounted head. Information from the thermometer is processed by other devices within the chip, which trigger an alarm when a crucial temperature change occurs.

Low-cost kit teaches computer concepts

A low-cost computer learning system that teaches the basics of computer programming has been developed by Bell Telephone Laboratories, USA, and is available in Australia. The new system, called "Cardiac", consists of an illustrated instruction manual and a cardboard working model that compares favourably with many plastic or metal models at many times the price.

Cardiac is manipulated by six cardboard slides that display the contents of registers through windows. Control procedures are shown by a marked path that automatically switches with the sign of the accumulator. For simplicity, Cardiac is a decimal device with a "three byte" word consisting of a two digit address plus OP code. The ten OP codes are read, clear and add, test accumulator, shift, print, store, subtract, jump and halt-reset. The contents of the 100 memory cells are entered and erased manually as indicated by an instruction decoder.

Loops, indexing, bootstrapping, double precision techniques and subrouting are all demonstrated by program exercises contained in the manual. The

manual also contains sections on the distinctions between language levels and between macro and micro flowcharts.

For further information contact Electro-Technics Pty Ltd, 36 Park St, South Melbourne 3205.

The "cultivation" of optical glass fibres

At first sight this looks like fresh cauliflower, but these structures are definitely not fit for human consumption. In fact they are extremely unpalatable, and undetectable to the naked eye.

The "miniature vegetable" in our picture—viewed through a scanning electron microscope—is actually only about two tenths of a millimetre in size. Such structures are produced when gaseous silicon compounds are precipitated as a glassy deposit on a quartz surface.

In the Siemens research laboratory this deposit is introduced on the inner walls

of pencil-thick quartz tubes. At a temperature of approximately 2000°C, very fine glass fibres several kilometres long can be drawn from half a metre of such a tube.

British plant locks atomic waste in glass

Now being commissioned, this 'Fingall II' pilot plant at the Harwell centre of the United Kingdom Atomic Energy Authority is designed to convert the radioactive liquid waste from the Windscale nuclear processing plant into a glass. Here, a stainless steel vessel containing atomic waste is lowered into the vitrification furnace.

Low-level radioactive wastes are now dumped at sea but wastes with high radioactivity, which take a long time to decay, are stored in special double-lined tanks at Windscale. Most of the isotopes in high-activity waste have a half life of about 30 years. Decay will be more or less complete after a few hundred years.

Scientists are examining ways of

dumping highly radioactive waste in deep geological faults or ocean troughs, where it can remain undisturbed until the activity has declined to a safe level. One possibility under investigation is storage in leached-out salt caverns, thousands of feet underground.

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NEWS HIGHLIGHTS

Solar-powered marine communications

The applications of solar energy are at the moment limited to the methods by which the Sun's power can be harnessed and stored. Possibly the most significant breakthrough has been the development, and production of a highly reliable and comparatively low-cost solar cell which converts the Sun's energy into electricity.

Philips solar cells, in panel form, are now powering two Australian projects which are paving the way for more applications in the important fields of marine research and communications.

Firstly, Philips have supplied solar panels for a program of marine research being conducted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) off the West Australian coast. The CSIRO is conducting this study of the eastern Indian Ocean to determine the movement of water masses and currents off the West Australian coast.

Free drifting oceanographic spar buoys are being used to carry out the CSIRO's study. These are four-metre long fibreglass tubes which float upright in the water. At the peak of each buoy is a Philips solar panel which powers the electronic circuits and instrumentation. Tracking is carried out by the polar-orbiting American Nimbus 6 satellite.

Philips solar panels are also playing an important role in bushfire prevention and detection in the ACT.

On top of 1,600 metres high Mount Tennant on the outskirts of Canberra City sits the main radio link and watchtower of the ACT Bushfire Board. The tower is the vital relay point between bushfire vehicles and the Board's central control room in Canberra.

The watchtower is in rugged country

which can be reached only by four-wheel drive vehicles. There is no electricity so a bank of Philips' solar panels provides the power to operate the two-way radio. The panels keep the tower's bank of 12 volt batteries fully charged throughout the summer and winter months, thus keeping it immune from power failure or generator breakdown.

New paging system for metropolitan areas

A new city-wide pager was introduced to the Sydney and Melbourne markets early in April. Its unique feature is that it alerts the user by "feel" as well as by sound. A simple flick of a switch allows the user to receive either an audible "beep . . . beep" or a silent pulsed vibration.

The new pager is manufactured by Bell & Howell Communications Company, Burlington, Massachusetts. Bell & Howell Australia has appointed Philips TMC as their nation-wide distributor, and the unit will be known to the public as the Philips Phonalert Pager.

The only other Telecom Australia approved pager available to the Australian public lacks the vibrato mode.

The pager will prove extremely useful in Australia, as it has already proved in the USA, to doctors, lawyers, business executives, librarians and others who require discreet signalling. The unit should also be invaluable in high-noise industrial areas, where audible paging is useless.

Test facility tows models underwater at 100kts

A million gallons of crystal-clear water and this huge rotating test-bed are being used in Britain to carry out research into the behaviour of vehicles and other objects at underwater speeds of up to 100 knots. This machine—known as the 'Arm'—and its circular water channel is at the Admiralty Research Laboratory in southern England.

The 'Arm'—weighing 60 tonnes and with a span of 37 metres—tows models down to 1.5 metres below the surface through specially filtered and purified water which permits high speed photographic observation of the underwater behaviour through windows let into the sides of the channel. Rotation of the water with the models is prevented by wave damping beaches and anti-swirl baffles which can be seen on the floor of the channel.

Instruments fitted inside the model continuously measure the forces acting upon it and, in the case of powered

models, the torque and thrust on the propeller shaft. These permit studies of the conditions necessary to ensure that the motion of the vehicle can be properly controlled at all times and will remain stable under all conditions.

AWA to make flight simulators

Production of the first flight trainers to be commercially manufactured in Australia will begin in Sydney later this year.

The trainers, GAT-1 models for training light aircraft pilots, will be built by Amalgamated Wireless (Australasia) Limited at their North Ryde plant to the well-known Link design, now produced by the Simulation Products Division of The Singer Company of America.

AWA will build 12 of the GAT-1 trainers under an Australian industry participation agreement to offset the purchase by Qantas of a Boeing 747 Flight Simulator from The Singer Company. The Australian industry participation plan provides that where an overseas country sells equipment to an Australian Government agency, Australian industry must be given the opportunity to tender for participation in this or a similar venture.

The GAT-1 simulates almost everything possible to experience in a light single engine aircraft. The cockpit and instrument panel follow the configuration of a typical light aircraft. Trainees working the controls feel the actual motion of climbing, diving, turning and banking, pitch, roll and yaw. Sound simulation and external environmental effects, such as wind and rough air add to the effect of realism.

The advanced analog-digital computer, which is the heart of GAT-1, enables it to perform realistically in response, not only to all pilot controls, but also to atmospheric, aerodynamic, and ground effects introduced by the instructor.

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An ordinary tape just won't do these days for most audio recording jobs. You need the hot Ampex 406/407 studio mastering tape, or the hottest, Ampex GRAND MASTER. With 406/407 you'll get 72 dB s/n ratio, high output, low noise and low distortion. If your requirements call for an even hotter tape, then you need Ampex GRAND MASTER. This spectacular mastering tape offers a full 76 dB s/n ratio and as much as 3 dB extra sensitivity on the high end. You can drive GRAND MASTER tape harder than you've ever driven a tape before. From a whisper to a scream, it responds with more undistorted output across the entire audible range than any other mastering tape available. It has high erasability so it is fully reuseable. And there's no need for bias adjustments: use GRAND MASTER at the same settings you've established for Ampex 406/407 or for 206/207.

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NEWS HIGHLIGHTS

Brain scanner gives pictures in 60 seconds

Following the success of the EMI Brain Scanner—which has received acclaim throughout the medical world—the company has recently introduced what is claimed to be the world's most advanced version with many new features in electronic and mechanical design. These include improved data handling and the extension of the scanning area down to the neck.

This new model allows two ranges of scanning angle to be selected; the standard 180 degrees or the increased scan angle of 240 degrees. The operator also has the choice of two scanning speeds; the standard scan of one minute or the high accuracy scan of four minutes. The whole system can be operated by one qualified person who first positions the patient, marks the area to be scanned and then controls the operation from a remote console. Once the scanning begins the readings are fed into the computer which can produce the picture from the scannings in under one minute.

Recent technological advances have also made it possible to replace the previous water-filled box on which the patient's head rested with a totally new system that allows greater flexibility in examination and shorter scanning times.

The Brain Scanner was the forerunner of the EMI Whole Body Scanner which produces highly accurate and detailed pictures of complete cross-sections through the human body.

Award for Aust. scientist

A Harwell nuclear physicist, Dr Joan M. Freeman, who was born in Perth and later lived in Sydney, is the joint winner of Britain's top award for her work in nuclear physics.

Dr Freeman is the first woman to win the award, which is made every two years for outstanding contributions to nuclear physics. She was due to receive the Rutherford Medal and prize at the annual dinner of the Institute of Physics in London on May 4.

Dr Freeman won the award for her work on Beta radioactivity of complex nuclei which involves the control of nuclear reactors.

Computer metric confusion at Dick Smith's

Apparently Dick Smith's new computer doesn't fully understand the changeover to metric yet.

Ian Smith is pictured holding a 'miniature' power supply box which the computer ordered in inch, instead of centimetre size. Ian, who is Purchasing Manager at Dick Smith's was understandably surprised when asked to accept delivery of two hundred of these boxes and the delivery turned out to be two truck loads instead of several medium sized cartons.

Bespoke Metalwork—erstwhile metalworkers to the gentry—delivered the order in their usual prompt fashion with no questions asked, although Ian recalls that they were rather more than usually pleased at the time they received the order.

It is better not to talk too much about Dick Smith's own reaction to the mistake as he thinks the sun shines out of his computer and would rather blame his 'hopeless' employees than cast doubt on his 'electronic genius'. He claims that the computer has done so much to ensure good stocks and speed delivery of electronic goodies to his customers that it couldn't possibly make such a basic mistake and even if it did—so what?

NOISE, THE URBAN

In modern urban society, noise is very much an unfortunate fact of life. The cacophony of sounds to which the individual is unwillingly subjected from aircraft, motor vehicles, industrial machinery, sirens and record players, to name just a few, contributes significantly to the stress of modern life. Noise is one of the most serious pollution problems facing man today, and unless dealt with can only serve to further degrade the quality of life in our cities.

by GILLES CREPEAU

Research Supervisor, Centre de Recherche Industrielle du Quebec, Canada.

In today's reality, particularly in industrialised countries, noise is unfortunately almost omnipresent. Air pollution and water pollution are quite justifiably causing city dwellers concern, but noise is certainly one of the most frustrating forms of modern pollution.

Generally speaking, the accepted definition of noise is a disagreeable, unwanted sound. This immediately introduces a psychological dimension; a sound may be identified as noisy by one person and pleasant by another. One example is in different types of music or different times of the day or night, when music, especially coming from a neighbour's house, is not always appreciated as a desirable, agreeable sound. But, with the exception of a few instances where agreement on definitions seems impossible, there is almost total unanimity on what constitutes noise.

Disturbance caused by noise is, among other factors, proportional to its intensity, or more precisely, to the logarithm of its intensity. For this reason sound—and therefore noise—is measured on a logarithmic scale. The noise level expressed in dB (decibels) is proportional to the logarithm to the base 10 of the ratio of the intensity of the noise being measured to an intensity reference which corresponds to the average threshold of hearing. Because a logarithmic scale is used, the sum of two noises is different from the arithmetic sum of their intensities expressed in decibels (dB). Thus the sum of two noises of 80dB intensity is not 160dB but 83dB.

The human ear appears strange when one attempts to find an appropriate sound intensity scale, as its sensitivity to different sound frequencies has special characteristics. The ear has little sensitivity to low frequency sounds, which is fortunate when one considers that the majority of natural sounds (wind, thunder) and mechanical sounds (internal combustion engines, ventilation systems) are most intense in the low frequency range. The ear's sensitivity increases with frequency to a maximum sensitivity zone which varies among individuals but is normally found at between 1kHz and 5kHz. The difference in sensitivity between 30Hz and 4kHz can easily reach 50dB, which is far from negligible.

To take this phenomenon into account, sound level meters (instruments measuring the intensity of a sound) are equipped with different weighting curves which attempt as best they can to imitate the response curve of the ear. The A-weighting curve is used almost universally for measuring all types of noise. When the A-weighting curve is used, the correlation between the annoyance and the physical measurement of most noises is much higher than when any other weighting curve is used. A sound measured by the A-weighting curve is expressed in dBA and not merely in dB.

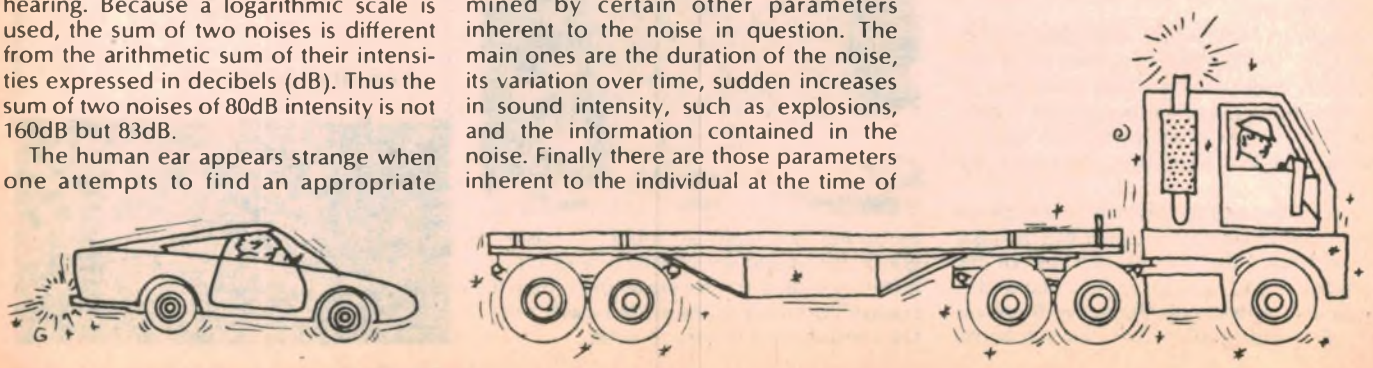
Annoyance from noise is also determined by certain other parameters inherent to the noise in question. The main ones are the duration of the noise, its variation over time, sudden increases in sound intensity, such as explosions, and the information contained in the noise. Finally there are those parameters inherent to the individual at the time of his exposure to the noise, for example, his state of mind, his physical health and the activity in which he is then engaged.

There are two main sources of noise: external noise and noise within buildings. External sources include motor vehicles, railways, air traffic, industry and construction sites. Noise within buildings incorporates work and leisure situations and noises in large residential units.

Before discussing ways of combatting this type of pollution, it is important to distinguish the different effects of noise in the following four categories; human, social, economic and political.

Human effects are those dealing with the individual as an entity, but not in his socio-economic environment. They can be subdivided into physiological effects and psychological effects.

Physiological effects may be divided into two: those directly involving the organ of hearing, and non-auditory effects. The damage to hearing is one of the worst consequences of noise pollution. Exposure to intensive noise (above 85dBA) for an extended period of time, more than half an hour for example, or exposure to a sudden but powerful noise (an explosion or a shot from a fire-arm) may easily, indeed most probably, cause temporary partial deafness. In some cases where the intensity of the sound



PHENOMENON

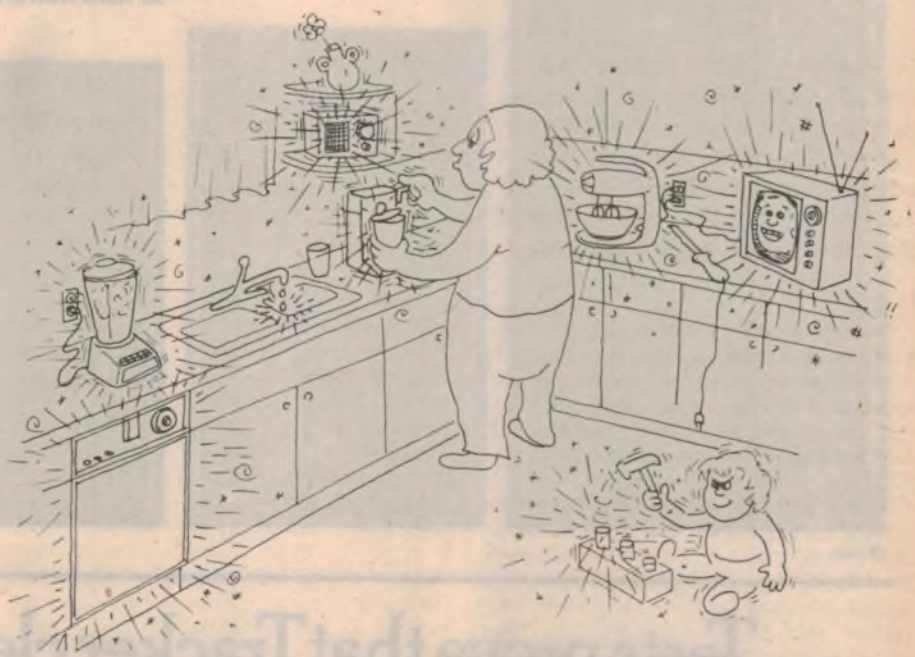
has been particularly high and/or the length of exposure greater than several hours, the individual may suffer permanent partial deafness.

Partial deafness means that the hearing threshold is raised by several decibels. As its name suggests, temporary deafness disappears after a while. There is a known mathematical relationship between the time needed to recover normal hearing and the severity of the temporary deafness. A noise with an intensity greater than 90dBA may cause not merely a temporary but a permanent deafness.

Although one or several instances of temporary deafness do not necessarily seem to constitute a health hazard, they are the swiftest and surest way to suffer partial permanent deafness. Instances of deafness from noise most often occur in industry where the period of exposure may be as long as 40 hours or more a week. For several decades now, research has been directed towards industrial deafness in an attempt to establish mathematical relationships between the sound environment and deterioration of hearing.

There are also non-auditory physiological effects which, although quantitatively less well documented than those having a direct bearing on the ear, are still of considerable importance. Examples are somatic reactions such as vasoconstriction; stress; disturbed or broken sleep patterns; and additionally, the effects on other sensory organs, including reduced visual acuity. This list is incomplete but nevertheless shows that the damaging physiological effects of noise are numerous.

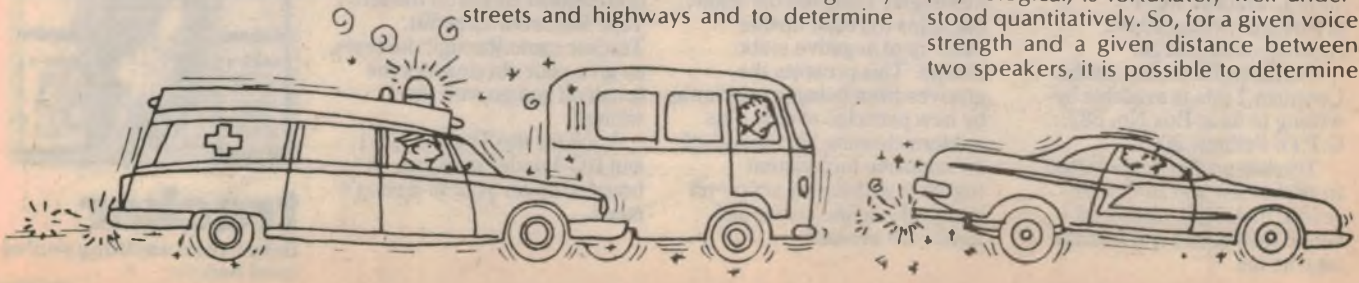
Psychological effects of noise are generally divided into three groups. Firstly there is general discomfort which attacks no particular activity in a specific manner but is rather an overall annoyance due to an auditory environment that is at least partially unacceptable. This state of annoyance is, as expected, proportional to the sound level, although it varies with the nature of the noise, the number of instances of noise, the temporal characteristics of the noise (continuous or intermittent, sudden or increasing), the time of day, and the mood of the individual.



In order to rationalise land development around major airports, several research studies have been undertaken to attempt to establish a precise correlation between the average sound level of aircraft flying overhead and the resultant disturbance. The researchers found that the disturbance was also proportional to the logarithm of the number of overflights, and constructed measurement scales incorporating this new fact. Similarly, to calculate the soundproofing for the walls of houses overlooking busy streets and highways and to determine the siting of future express highways, similar relationships have been obtained on the basis of noise from motor vehicles.

The second group of psychological effects includes discomfort or harm suffered in the completion of specific tasks or actions; the noise constitutes an obstacle to rest or relaxation, an impediment to the completion of intellectual or manual tasks. Although it is difficult to precisely quantify the correlation between the sound environment and the harm caused, some researchers have been able to establish quantitative relationships that can be usefully applied.

The third, and last, group of psychological effects is the obstacle to understanding speech or other communications. This effect, which might be more appropriately called psychophysiological, is fortunately well understood quantitatively. So, for a given voice strength and a given distance between two speakers, it is possible to determine



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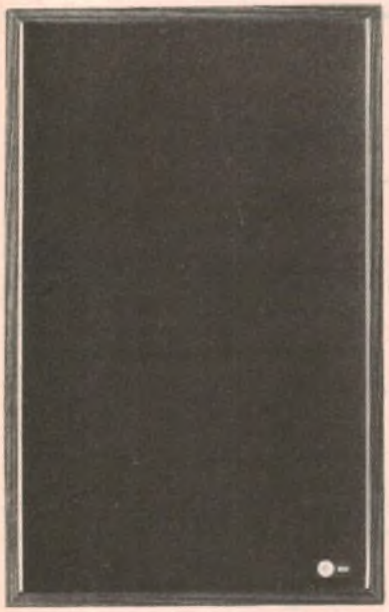

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PRO-LINEAR

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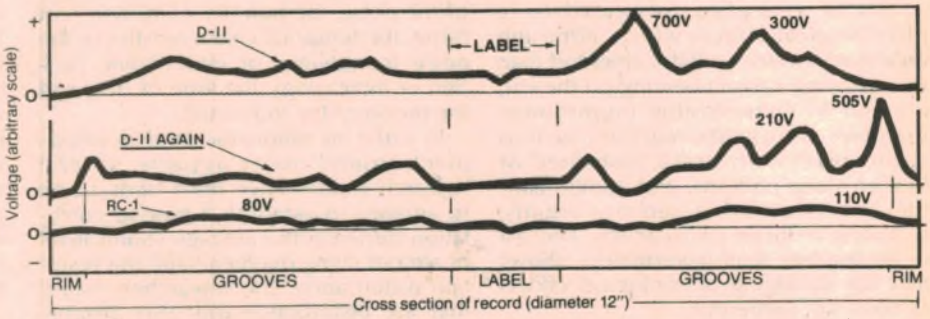
Various types of record cleaners have been available for decades. However, most of these products have failed to keep pace with modern advances in record materials and recording techniques. The Tracker RC-1 record cleaning solution was developed to meet these modern demands.

Tracker cleaning products went into stringent testing at the Chemistry Dept. at the University of Victoria, B.C., Canada in 1974 and as this chart shows, Tracker RC-1 dramatically reduced the records static charge.

Further information on the Canadian Tests is available by writing to us at Box No. 882, G.P.O. Sydney, 2001.

Tracker products are suited to all the new and advanced record materials, advanced sound techniques and delicate tape heads.



These 3 traces show static charge on a record after cleaning twice with competitive cleaning solution and then once with RC-1 solution.

There's the RC-1 Record Care Kit, that not only thoroughly removes the static, but helps to resist further build-up of negative static charge. This protects the grooves from being ground away by new particles of dirt. This modern cleaning kit consists of an exclusive formulation together with handy screw-on spray, plus a fine velvet pad. Refills are available.

And for your tape collection, Tracker provides delicate professional care with the HC-1 Tape Recorder Care Kit. Tracker came through the tests, so give your old cleaners the brush off and go with the winner!

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PKB88530

Noise: the urban phenomenon . . . ctd

accurately the sound level at which the message in the voice becomes practically incomprehensible.

Then there are the economic effects of noise pollution; the primary effect being a drop in productivity in different tasks, particularly work. This may be due to tiredness after a night's sleep interrupted by noise, or to the difficulties of concentrating in a noisy environment. These are relatively hidden costs. There are also more visible costs incurred in implementing noise-control measures, for example, soundproofing, pure and applied research, and the design and application of anti-noise laws and regulations.

A list of the effects of noise would be incomplete without the political dimension (in the widest sense of the term). Here the effects of noise are reflected primarily in the latent and open conflicts between noise producers (industries, construction sites, public and private transport) and the victims of noise (residents, and on behalf of residents, citizens' groups and environmental protection groups). These tensions may not be obvious to the ordinary citizen but they are real and important enough to appreciably influence the socio-economic life of major urban areas.

The 19th century made a significant contribution to pure acoustics research with the mathematical treatise entitled "Theory of Sound" by Lord John Rayleigh and the psychophysiological monograph entitled "Sensations of Tone" by Hermann Helmholtz.

Since 1910 it has been possible to measure different parameters of sound and even preserve the profile of a sound for further, more detailed analysis. Other discoveries in architecture, industrial, physiological or psychological acoustics have quickly followed.

Until the mid-1940s great improvements were made in measurement apparatus and techniques. Research in these areas has not slowed down since, but applied research in architecture, urban planning, engineering (mainly industrial), physiology and psychology has predominated, particularly in Western Europe and North America.

In architectural acoustics the emphasis was placed on the creation of new materials and on the development of construction techniques to deal with the problems. Research in materials focused on sound absorption. A wide range of products, mostly synthetic, made their appearance on the market; the most important were composed of fibres (fibreglass, for example) and foam. In addition to being extremely light, and therefore easy to handle, most of these materials have the advantage of being excellent thermal insulants. With the trend towards open planning in offices, these new materials have become popular for screens, ceilings and walls. In addition, older materials have been put to new uses; lead, for example, in thin sheets, can increase sound insulation in circumstances where the space factor is of prime importance.

As the principles of urban planning have developed over the last 25 years so too has urban acoustics. The first step was to geographically determine the disruption in the immediate vicinity of major sources of noise, airports, highways, factories and construction sites. Urban development was already beginning to surround a large number of major airports when commercial jet aircraft came on the scene.

To circumvent the problem, prevent the further deterioration of an unsatisfactory situation and above all plan future airports and their adjacent areas, a map of the sound contours in the vicinity of airports had to be plotted. This was easy to do for the take-off and landing of a single aircraft. But when it was necessary to consider different types of aircraft, different temperatures and different flight patterns, this procedure became much more complicated. In addition, as annoyance due to aircraft noise increases with the number of overflights, a simple average sound level would not adequately represent the reality. Techniques currently used to spatially represent aircraft noise take these factors into account.

A similar procedure is followed for the spatial representation of noise near highways. In this instance the first step is to establish the relationship between the volume of traffic and the noise level at the curb side. Once this basic sound level is determined, a correlation factor in dB is added for the relative position of the observer in relation to the roadway (horizontal and vertical distances). Several series of curves are drawn for different road cross sections.

This type of projective spatial representation of sound levels is not yet widely used for areas surrounding factories and construction sites, primarily because of the large number of parameters that would have to be considered in such instances.

To complement these models of spatial representation of noise and to be able to use them for regional development, detailed information is needed on the individual's reaction to these noises. Since the early 1960s many studies to this effect have been carried out.

One of the first was that undertaken in the vicinity of London airport, Heathrow, in 1960. Its principal aim was to determine the impact of commercial jet aircraft noise on those people living in the immediate vicinity of the airport. Replies to a veiled questionnaire in which the noise problem was disguised clearly showed the impact of aircraft noise on the people concerned.

This study illustrated, for the first time, that two parameters were needed to quantify annoyance due to aircraft noise: the average maximum sound level (the average of several overflights) and the number of overflignts. The result was the Noise and Number Index (NNI), the first of several similar indices to appear in various countries. This type of index would allow rational development of land in the immediate vicinity of an airport (where it was not already too late to remedy matters).

The same research team undertook almost simultaneously a survey in metropolitan London; this second survey attempted to gauge the impact of various

urban noises, particularly traffic noise. The following standards in dBA for dwelling units, inside houses (bedrooms for night noise levels), were laid down on the basis of this study :

	Day	Night
Rural area	40	30
Suburban area	45	35
Urban area	50	35

According to the researchers who set down these standards, these noise levels should not be exceeded more than 10% of the time.

More recently it has been observed that, in addition to the average sound level, the range of variation in noise intensity was a factor not to be neglected. In fact disturbance from noise grows in proportion to this range. From this fact emerged the "noise pollution level" (Lnp). This is found by adding the average sound level in dBA to the difference between the sound level that is exceeded 10% of the time and that exceeded 90% of the time. Obviously, existing standards had to be transposed into the language of this new index.

In the field of engineering, special emphasis is being placed on noise control at the design stage of the majority of hitherto noisy manufactured goods. Progress still remains to be made, particularly with regard to jet aircraft, snowmobiles, motorcycles, buses and trucks, as well as many tools such as the chainsaw and the pneumatic drill. The design of effective silencers is not far advanced but is based, increasingly, on rational thinking.

After much research on the subject, there is now a good understanding of the relationship between exposure to noise (taking into account the different parameters of exposure, such as duration, repetition, intensity, spectral shape, etc.) and the risk to the individual of temporary or permanent deafness.

A permissible limit of 85dBA has been established: above this the risk of temporary deafness (or permanent deafness after several occurrences of temporary deafness) would increase rapidly for an individual exposed to it for 40 hours every week. This limit, which represents an average maximum level, has been accepted either legally or in principle by the majority of countries in Western Europe.

In North America, where interest in noise control in industry is somewhat recent, the limit presently in effect is 90dBA. However a well organised lobby of different pressure groups and professional associations interested in the question seems close to achieving a lowering of the legal limit to the more realistic level of 85dBA.

Legislation encompasses not only laws as such but also the regulations contained in them. In the following discussion we shall briefly review the character and content of laws and regulations relating to noise and currently in force in Western Europe, the United States and Canada. Although Canadian and Quebec legislation is of special interest, it is still limited, very recent, and has yet to establish an identity. We shall discuss American laws, not simply because they have been longer established but because American legislative programs appear relatively coherent and rational.

Regulations and laws concerning noise outside buildings are divided into two sectors: vehicles and urban development. Standards for noise caused by different types of vehicles have been established by the International Organization for Standardization and the Society of Automotive Engineers Inc. These standards not only set down the sound level to be respected but lay down precise guidelines for measurement procedures in legislation—an important inclusion given the advanced design of these procedures.

The first laws concerned the utilization of vehicles. This is a useful approach but incomplete without legislation specifying the permitted sound level of a new vehicle that goes on sale in a given territorial area (province, state or country). Fortunately this is now general North American practice for certain types of vehicle, particularly the snowmobile, the motorcycle and off-road vehicles. These are recreation vehicles and were easy targets for legislation, because of their high noise level and the relatively small size of the manufacturing industries

concerned. In most cases however, standards evolve; the permissible sound level is lowered gradually by a few dBA every two to five years to allow the manufacturers to adapt to changes in vehicle technology and design.

These standards are measured in such a precise, detailed manner that it is practically impossible for the manufacturer to bypass them. As they gradually become law, they will, by the end of the 1970s, have considerably reduced the noise from snowmobiles and motorcycles. Hopefully such measures, accompanied by strict normative sound levels, will be applied progressively to cars, trucks and buses.

Before rounding off this discussion on legislation regarding vehicles we should briefly mention the US federal standard concerning the noise of the subsonic jet aircraft FAR 36. This standard, detailed and precise is, to our knowledge, the first serious attempt in the West to control noise from commercial jet aircraft by certification. For aircraft manufactured after the publication of this standard the normative sound levels measured at three positions (before landing, just after take-off, and sideline during take-off) and corrected for the gross weight of the plane at take-off must be respected before the certificate is issued.

With regard to urban development, although the field of activity is vast and the necessary tools are well developed, laws and regulations are unfortunately almost non-existent. Some North American municipalities have regulations indicating the sound level (expressed in dBA or in the form of a spectrum) which must not be exceeded at property boundaries. These regulations are addressed to the individual and apply above all to industrial properties. They are useful and even essential, but laws are needed for total land development with particular regard to the location and orientation of buildings.

Our discussion of planning is incomplete without mention of architecture and construction codes. What use is there in siting a building in an optimum location if the sound insulation of the windows or between two apartments is insufficient? The weakness of existing regulations in building codes is largely to blame for this.

Fortunately matters are improving. If results are to be positive, sound insulation techniques described in drawings should be realistic and above all adequate to meet the criteria of a construction permit. On completion of buildings, apartment buildings especially, sound insulation should be measured on the spot and if judged weak or insufficient the promoter or owner of the building project would, in addition to paying a fine, be obliged to indicate clearly that the sound insulation in his building is weak and inadequate and does not meet existing standards.

This procedure may seem harsh but it is no harsher than living conditions for those who must suffer insufficient sound insulation in apartment buildings, and pay high rents into the bargain.

Industrial noise pollution is, in North America if not elsewhere, the dimension most affected by legislation. The only major point of disagreement concerns the permissible sound level for an 8-hour day. The 90dBA North American standard will, we hope, be replaced by the 85dBA level almost universally applied in Europe.

Satisfactory legislation regarding noise emitted by everyday objects, such as lawnmowers and vacuum cleaners, will be obtained in the same way as that for motor vehicles. After certain standardization organizations, as well as those directly concerned in manufacture, have laid down the necessary standards, the relevant government departments can be expected to establish appropriate laws.

As mentioned previously, applied science is well advanced in noise control, so much so in fact that effective technical solutions are now available for almost all problems of noise. If these solutions have not yet been generally applied, this is because the optimum solution to any noise problem implies compromise on many levels—human, social, political and economic. This compromise is shaped by the priorities of those persons holding the relevant decision-making powers.

Until now, priorities have been primarily economic, or commercial, to be more exact. Measures to control noise, for instance from noisy vehicles (trucks, motorcycles, snowmobiles, jet aircraft and others) have been put to one side to accommodate marketing and sales requirements. It is no surprise, therefore, that noise pollution in urban areas continues to be a major problem.

The citizen, as he becomes increasingly aware of this situation, must make his priorities known. Pressure groups should be formed, either relating to specific problems or larger professional or neighbourhood interests. If results are to be achieved rapidly, then these pressure groups should have specialists capable of dealing with the matter in hand.

Society is the product of its major political and economic powers. But it is also, and primarily, the reflection of the citizen and his aspirations. If noise pollution continues to be a serious problem in the future, citizens will, we feel, only have themselves to blame.

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Laser research aims for X-ray frequencies

Laser research and development has been an exciting field since lasers were first developed in 1960. At London University's Imperial College a research team has produced the first laser that can be "tuned" in a region of the spectrum only recently opened up by a new type of laser. This laser also incorporates a new way of putting energy into the laser material, and is a step nearer to the much sought after X-ray laser.

by MICHAEL KENWARD*

The new Imperial College laser operates in what is known as the vacuum ultraviolet (VUV) region of the electromagnetic spectrum. Lasers were first developed from "masers", which operated in the microwave region of the spectrum. A microwave has a wavelength somewhere between 1mm and 30cm.

Lasers came next, producing light that was in the visible and infrared regions of the spectrum, where wavelengths are measured in millionths of metres (micrometres or um).

At Imperial College the VUV laser can produce light with a wavelength between 0.169 and 0.176um (169 to 176 nanometres). This is still some way off the X-ray region, which begins at about 10 nanometres and goes down to hundredths of a nanometre, but it is a significant step in the right direction.

Another advance made at Imperial College is in the range of wavelengths that can be produced from the same laser. Tunable lasers are not new, but the team has developed the first tunable laser in the VUV region of the spectrum.

Imperial College's optics unit, led by Professor Dan Bradley, made its step forward by redesigning a laser previously developed as an untunable device. It was in this first laser that the Imperial College team first employed its novel technique for putting energy into the laser.

In the VUV region of the spectrum it is difficult to put energy into the laser material. Every laser contains what is known as the laser "medium". Imperial College's VUV laser, for instance, is filled with xenon gas at a high pressure.

Energy is "pumped" into the laser medium. Then if the medium is suitable laser material, when the system is put into a laser cavity—usually two mirrors with the laser material between them—coherent laser light will come out of the system when the mirrors are properly aligned.

Lasers that emit light in the visible part of the spectrum are normally pumped by an electrical discharge if the laser medium is a gas—very much like a fluorescent light. A solid laser medium can be pumped by surrounding it with bright flashlamps—a bit like the electronic flash units used by photographers.

These are both successful methods of pumping energy into a laser medium. Unfortunately neither technique works when the laser has to operate at very short wavelengths, as they just cannot put energy into the system fast enough.

Imperial College's researchers got round this problem by using short pulses of very fast electrons to pump energy into the xenon gas. Something like 5 joules of electron beam energy were pumped into the laser medium in 5 nanoseconds.

The amount of energy that came out as laser light was 9 thousandths of a joule (9 millijoules), but this was an improvement of 50% on the efficiency of Imperial College's earlier non-tunable VUV laser.

It is not easy to pump enough energy into a laser medium with an electron beam. The approach that has been tried elsewhere—most notably in the USA—has used a massive flow of electrons that runs across the laser cavity, at right angles to the line of the mirrors.

The Imperial College team did not have an electron beam powerful enough for this technique, so it developed a "coaxial" excitation technique. This makes greater use of the electrons' energy by sending them along the length of the cavity, thus giving them a greater chance of passing their energy on to the xenon gas.

*Technology Editor, "New Scientist", London.

Professor Dan Bradley (left) and a member of his research team with the new VUV tunable laser recently developed at London University's Imperial College.

This novel technique, which might be useful for other types of laser, has been patented on behalf of the Imperial College workers by Britain's National Research Development Corporation.

The tuning device that allowed Professor Bradley and his team to cover the 169 to 176 nanometre wavelength was a prism in the laser cavity. The prism was put just in front of one of the laser's two mirrors. As the prism is rotated the laser operates at different wavelengths. It is too soon to know exactly what uses this new type of laser will be put to. There are, however, some unique properties of light in the ultraviolet region. The photons—the quanta of light energy— are so energetic that they can literally tear molecules apart. This makes the VUV laser a potentially valuable tool for spectroscopists and, as well, it might eventually find uses in chemical processing.

The tunability of the VUV laser makes it possible to select the wavelength of the light produced so that the light can stimulate particular chemical reactions and transitions. This makes it possible to carry out selective excitation spectroscopy.

Another possibility might be the use of a much improved VUV laser in laser fusion experiments. In these light energy blasts a small pellet of fusion fuel—deuterium and tritium are likely candidates—compressing it and heating it to such an extent that the atoms fuse together and release energy in much the same way that the Sun is fuelled.

Hours of fun for the whole family!

Build your own Video Ball Game

Do you find TV programs boring? If so, help is at hand. Our Video Ball Game will provide hours of fun, for all your family and friends. Using only thirteen CMOS ICs and a number of discrete components, the kit is easily assembled on a printed circuit board.

by DAVID EDWARDS

In recent months a large number of home video games have come onto the market. These usually cost in the vicinity of $100.00 or more, and are available either as fully assembled units or in kit form. Our Video Ball Game should cost you considerably less than this to construct—in fact it should cost you only about $40.

Used in conjunction with a standard VHF TV set, either colour or black and white, the unit produces a display similar in outline to that of a tennis court or ping-pong table. There is a central dotted vertical line, called the net, and upper and lower boundaries from which a small rectangular "ball" can be bounced.

Along the side boundaries may be moved small "bats", which can be controlled by two players using small hand-held units. The players move their bats up and down, hitting the ball to keep it in play. A player scores a point when his opponent misses the ball, and allows it to continue off the court.

The ball is brought back into play by pressing the appropriate serve button. Each player is provided with one of these buttons on his control unit.

The speed at which the ball moves, and hence the rate of play, is varied by a control on the front of the case.

Small slider switches are used to alter the display, allowing several types of games, by one or two players, to be played.

Turning now to the main circuit diagram, we can see how the display is produced, and how the design is implemented. 74C series CMOS logic has been used in the design, with gates functioning both in the normal digital manner and also as linear amplifiers. In addition to the CMOS gates, four discrete transistors have been used, as well as a number of diodes.

The box labelled "modulator" is a self-contained unit, which converts the video information generated by the remainder of the circuit into a form suitable for decoding by a standard VHF TV set. It is connected directly to the aerial terminals of the TV, and is described in detail later in the article.

Before commencing with a detailed description of the circuit operation, we will digress for a short time, and explain the way in which the IC gates have been identified. Only two types of ICs have been used, the 74C00 type, which is a quad NAND gate, and the 74C02 type, which is a quad NOR gate. Each of the individual gates in each IC has been labelled "a", "b", "c" or "d", while the ICs themselves have been numbered consecutively. Thus gate 1a is the first gate in the first IC. The pin numbers of each gate are shown next to the respective terminations.

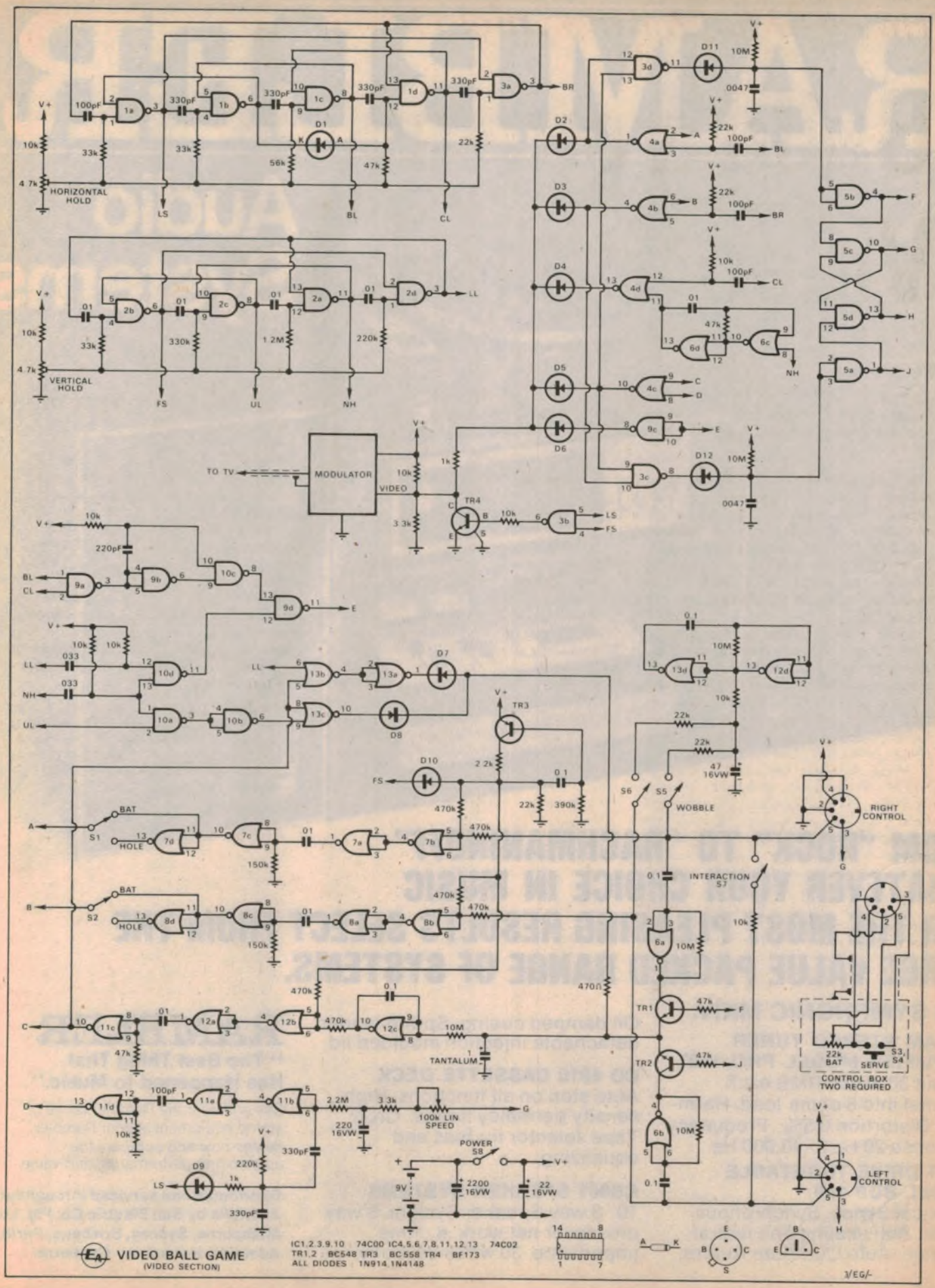
Five NAND gates, 1a, 1b, 1c, 1d and 3a are connected as a free running horizontal sweep oscillator. The horizontal hold control is used to set the operating frequency to about 15625Hz. In operation, a "low" pulse circulates through the gates, producing appropriate outputs at each gate. D1 ensures reliable starting and operation.

The line sync (LS), bat left (BL), centre line (CL) and bat right (BR) pulses produced by this oscillator determine the horizontal spacing of the display.

Four NAND gates, 2b, 2c, 2d and 2a are connected as another free running oscillator, this time with a frequency of about 50Hz. This oscillator produces the frame sync (FS), upper line (UL), net height (NH) and lower line (LL) pulses, which determine the vertical spacing of the display.

The LS and FS pulses are added together by gate 3b, to form a composite sync pulse, which is then injected into the video line by TR4. The LS and FS pulses

At left is a photograph of the completed Video Ball Game, showing the hand-held control units. On the facing page is the circuit diagram. Circuit details of the modulator are given later in the article.



VIDEO BALL GAME
(VIDEO SECTION)

IC1,2,3,9,10 : 74C00 IC4,5,6,7,8,11,12,13 : 74C02
TR1,2 : BC548 TR3 : BC558 TR4 : BF173
ALL DIODES : 1N914,1N4148

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are also used to generate line and frame ramps. The line ramp is produced by D9 and its associated components. The ramp is positive going, and is reset when the LS pulse discharges the 330pF capacitor through D9 and the 1k resistor.

The frame ramp is produced by TR3 and its associated components. A linear positive going ramp is produced as the 0.1uF capacitor discharges through TR3, connected as a Miller integrator. The capacitor is charged by the FS pulse, via D10.

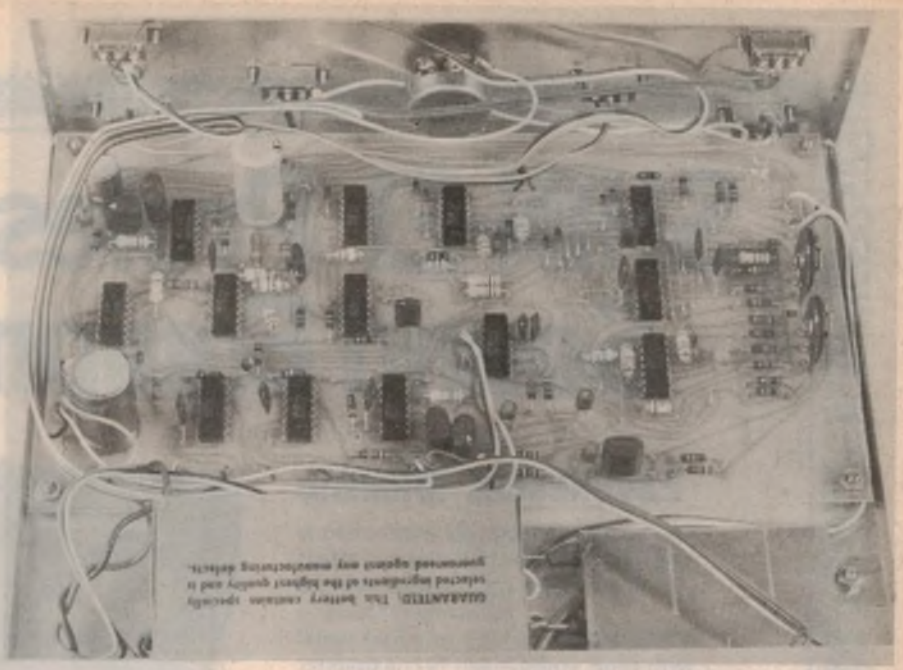
Gates 6c and 6d are connected as a free running oscillator, with a frequency of about 1000Hz. This oscillator is gated on and off by the NH pulse connected to pin 8. The oscillator output is combined in gate 4d with a differentiated CL pulse, and injected into the video line by D4. This forms the central dotted line called the net..

The two 22k bat controls are connected as potential dividers across the supply lines. The bat voltages are added to the frame ramp at the inputs to gates 7b and 8b. These gates act as comparators, and produce negative going transitions at their outputs whose positions with respect to the FS pulse vary directly with the positions of the bat controls.

These edges are squared up by gates 7a and 8a, and then differentiated. The differentiator time constants determine the vertical heights of the bats. The differentiated pulses are squared up by gates 7c and 8c, and then inverted by gates 7d and 8d. The bat pulses or their complements are selected by S1 and S2, and then passed to the inputs of gates 4a and 4b.

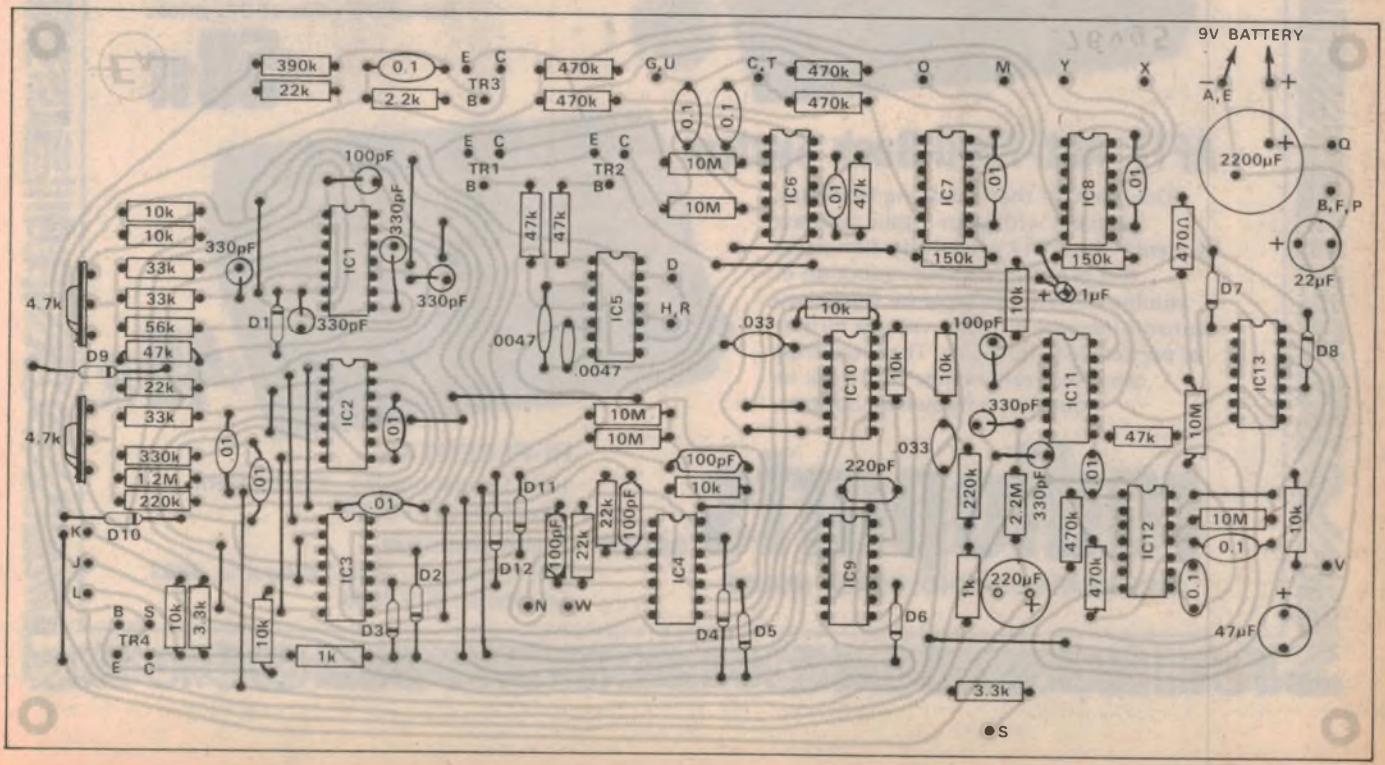
The BL and BR pulses are differentiated and fed to the remaining inputs of gates 4a and 4b. The width of these differentiated pulses determines the horizontal widths of the bats. The horizontal and vertical components of the bats are summed by gates 4a and 4b, and injected into the video line by D2 and D3.

As with the bats, the horizontal and vertical components of the ball are generated separately. The vertical velocity of the ball is represented by the voltage stored on the 1uF tantalum capacitor. This velocity is integrated by gate 12c, and the resultant voltage, which represents the vertical position of the ball, is added to the frame ramp at the input of gate 12b, to produce a negative going edge representing the vertical



This shot from the rear shows clearly the internal disposition of the component parts. The modulator assembly is shown in the lower right hand corner.

The printed circuit board component overlay is shown below. Pay particular attention to the polarity of diodes, electrolytic capacitors and integrated circuits.



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position of the ball.

This edge is squared up by gate 12a, and then differentiated to produce a pulse proportional to the height of the ball. This pulse is squared up by gate 11c, and fed to one input of gate 4c, and to the inputs of gates 13b and 13c.

Consider first the case when the ball is descending. The 1uF capacitor will be charged to a higher voltage than the threshold of gate 12c, and its output will be falling. When the ball reaches the bottom of the "court", gate 13b will register coincidence between the ball pulse and the LL pulse. The resulting output pulse is inverted by gate 13a, and discharges the 1uF capacitor via D7 and the 470 ohm resistor.

The integrator output (gate 12c) will now commence to rise, and so the ball will "bounce" off the lower line, and commence to approach the upper line. When this occurs, a coincidence is registered between the ball pulse and the delayed UL pulse. (This pulse is delayed so that the ball will bounce off the bottom of the upper line.)

The positive pulse from gate 13c will now charge the 1uF capacitor again, via D8 and the 470 ohm resistor. Thus the ball is constrained to stay between the upper and lower lines on the court.

The voltage on the 220uF electrolytic capacitor represents the horizontal position of the ball. This voltage is added to the line ramp at the input of gate 11b, producing a negative going transition at the output corresponding to the horizontal position of the ball. This is squared up by gate 11a, differentiated, and then squared up again by gate 11d. The width of the ball is determined by the differentiator time constant.

The horizontal and vertical components of the ball are added together by gate 4c, and then injected into the video line by D5. Gates 3c and 3d detect coincidence between the ball and the left and right bats. These coincidence pulses are stretched by D11 and D12 and their associated circuitry, and then squared up by gates 5a and 5b.

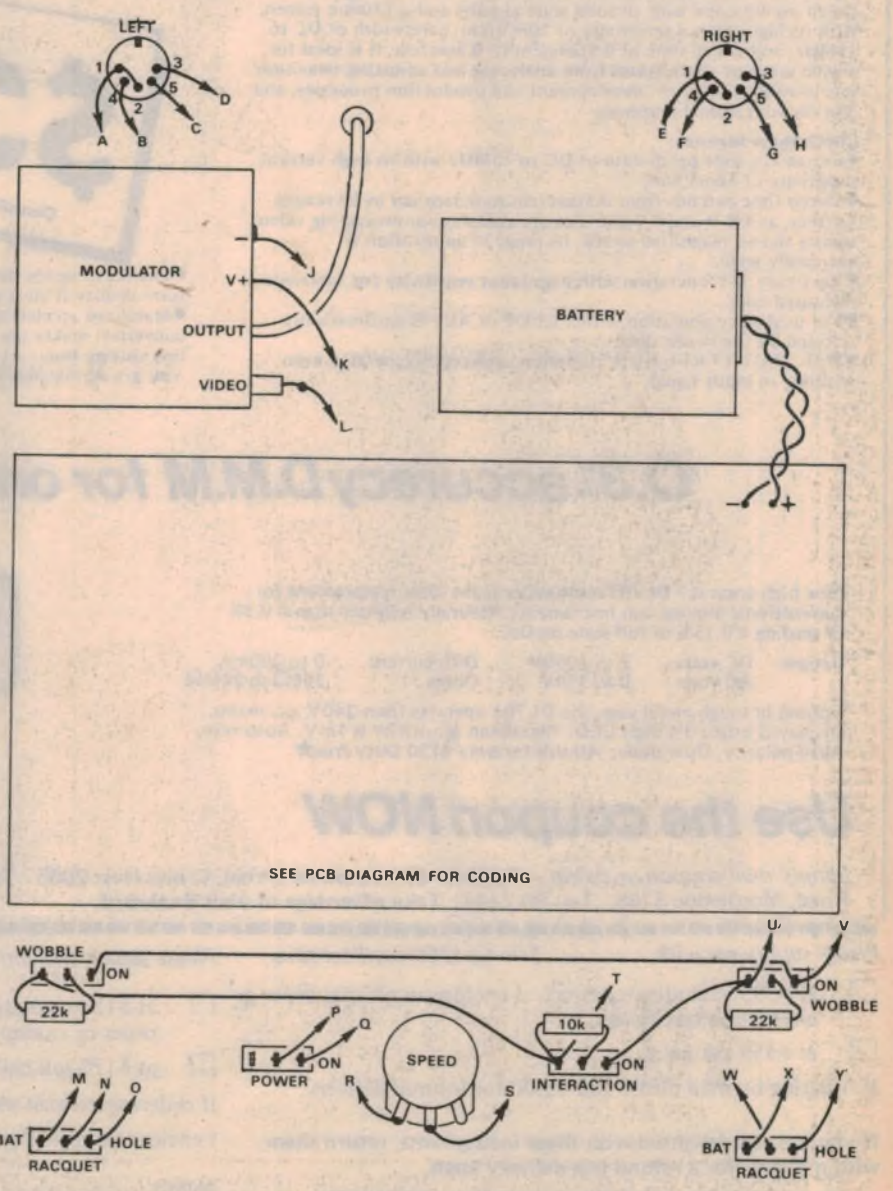
Gates 5c and 5d are connected as a flip-flop, and used to control the horizontal direction of the ball. If the ball is moving to the right, the output of gate 5c will be low, and the 220uF capacitor will be discharging via the 100k speed pot and limiting resistor. If the ball hits the right-hand bat, gate 3d will register coincidence, and gate 5b will toggle the flip-flop. The 220uF capacitor will now commence to charge up, and the ball will move to the left. When it hits the left bat, its direction is reversed in a similar manner.

The coincidence gates have a further function, not previously mentioned. Gates 6a and 6b are used to differentiate the outputs from the bat controls, giving voltages proportional to the bat velocities. The coincidence gates are used to switch these voltages onto the 1uF vertical speed capacitor at the moment of impact. Transistors TR1 and TR2 act as switches to perform this function, thus allowing the players to partially control the speed and direction of the ball.

If the ball misses one of the bats, the ball flip-flop is not toggled, and the ball continues past the bat and off the screen. Eventually the 220uF capacitor becomes fully charged or discharged, and a stable state is reached. The ball is returned into play by pressing the appropriate serve button, which simply toggles the flip-flop. The speed of play is regulated by the 100k pot which controls the rate of charge or discharge of the 220uF capacitor.

The upper and lower lines on the court are generated by gates 9a, 9b, 9d, 10c and 10d. These combine BL, CL, LL and NH pulses to produce the required video signal, which is injected into the video line by gate 9c. Gates 10a and 10b are used to delay the UL pulses, so that the ball bounces off the bottom of the upper line, rather than the top.

Gates 13d and 12d, which would otherwise be spare, are used to form a very low frequency oscillator. The output from gate 12d is filtered by an RC network, and used to wobble the bats up and down, under the control of switches S5 and S6. Switch S7 connects the wipers of the two bat controls together via a 10k



This wiring diagram will aid in final assembly of the game. To facilitate later tracing of the circuit, use colour coded wire for all interconnections. Lace the wiring into a loom to achieve a neat finish.

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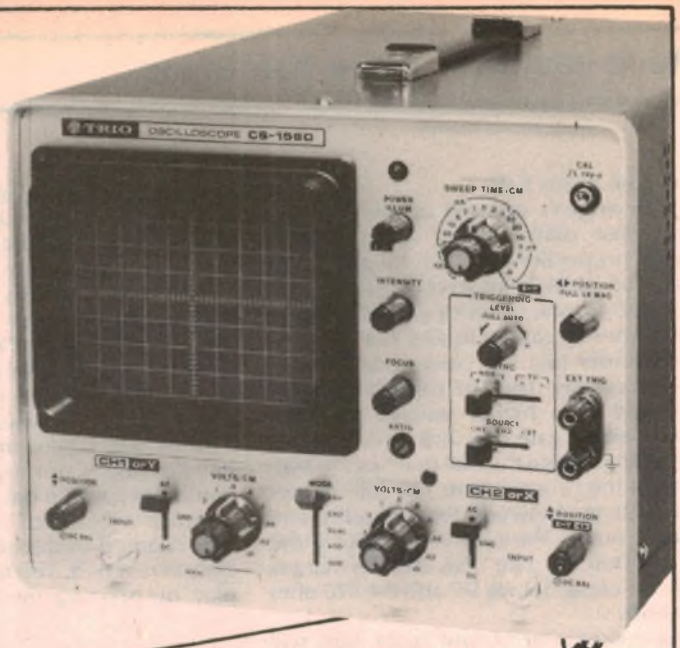

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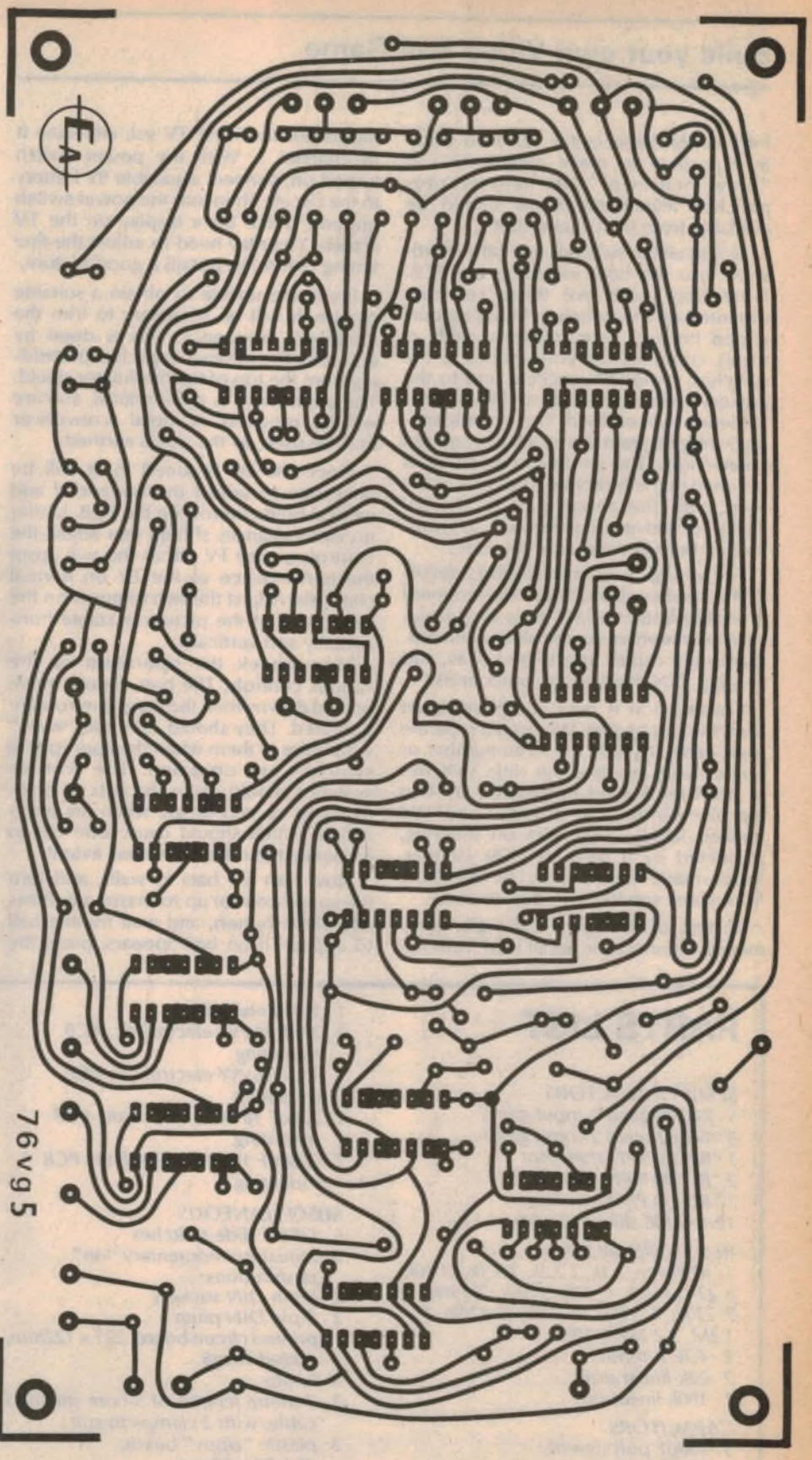
Video Ball Game

Shown at right is a full size replica of the printed board pattern, which can be traced if required.



resistor, to provide interaction if this is required.

The power supply for the game is provided by a 9V battery. A 2500uF electrolytic capacitor is used to ensure a low supply impedance, and is connected permanently across the battery. Turn-on transients are eliminated by the 22uF electrolytic capacitor connected on the circuit side of the power switch, S8.

The composite video information, available at the collector of TR4, is fed to the modulator, along with suitable power supply voltages. This modulates the video information onto a carrier centred on 57.25MHz, for demodulation by a VHF TV set tuned to channel 1. The modulator is connected into the aerial socket of the set, so no modifications to the set are required.

Construction of the game is quite simple, as almost all components are mounted on a single printed circuit board. There is a separate board for the modulator. Do not remove the CMOS ICs from their protective packaging until they are to be inserted into the PCB. All other components should be fitted first.

There are 23 wire links to be fitted to the board, none of which need to be insulated. Use tinned copper wire for these (cut-off component leads are ideal).

Next mount all resistors and capacitors, making sure that the polarity conscious capacitors are fitted correctly.

We recommend that circuit board pins be fitted to the 19 external connection points, as this will make final assembly much easier. The twelve diodes and four transistors can be fitted next, taking care that they are inserted with the correct orientation.

The CMOS ICs can now be fitted. It is not necessary to use IC sockets, provided the following procedure is followed. First, ensure that the tip of your soldering iron is earthed, and also earth the PCB, at the – battery terminal. The easiest way to do this is to attach a flying lead to the body of your iron, so that it is in contact with the tip. Fit a crocodile clip to this lead, and simply clip it to the board. Remember to have the clip on for all soldering while you insert the ICs, and also for any soldering later.

The ICs can then be removed from their protective wrapping, and inserted into the board with the minimum of handling. If required, bend the leads by pressing against an earthed metal surface (not plastic) so that they are the required 7.5mm apart. After checking that the IC is in the correct place, and that its orientation is correct, solder first pin 7, and then pin 14. The remaining pins may be soldered in any order, applying a minimum of heat and solder.

When all soldering is finished, spend a few minutes checking the board for solder bridges and misplaced components. A little time spent at this stage may well save a lot of frustration later.

We can now turn our attention to the case and associated components. Metalwork dyelines are available from our

Information Services for $2.00, so those in a position to make metalwork can "brew their own". Alternatively, pre-punched aluminium boxes should be available from the usual sources.

Mount all the switches and other hardware into the box, including the PCB. Note that there are three resistors mounted on the switches. Using colour-coded hookup wire (rainbow cable is ideal), complete the connections to the switches, 5-pin DIN sockets, and to the battery, remembering to keep your soldering iron earthed. The accompanying wiring diagram shows all the required connections. The modulator assembly is fastened to the bottom of the case, at the rear, with the aerial lead to the TV clamped and passing through a grommetted hole in the rear of the case.

The wiring diagram also gives details of the hand controls. These are mounted in small plastic "zippy" boxes, with the controls mounted on the aluminium lids. Clamp the cables inside the boxes, and fit 5-pin DIN plugs to the other ends.

Construction is now complete, apart from the front panel. We used a separate front panel, to hide the large number of screw heads holding the slide switches in place. It is held in position by two machine screws, one at either end. We applied labels using stick-on lettering, protected by a layer of clear lacquer. Ready-made panels may be available from some suppliers, in due course.

Testing of the game can now commence. Connect the aerial lead from the modulator to a VHF TV set, and tune it to channel 1. With the power switch turned off, connect a suitable 9V battery to the circuit. Then turn the power switch on, and check for a display on the TV screen. You may need to adjust the fine tuning control to obtain a good picture.

If you are unable to obtain a suitable picture, it will be necessary to trim the modulator frequency. This is done by adjusting the trimmer capacitor protruding from the top of the modulator shield. The adjustment is quite critical, so care will be required. A metal screwdriver may be used, as the slot is earthed.

Once the set is tuned in, it will be necessary to adjust the horizontal and vertical hold controls on the PCB. Under no circumstances should you adjust the controls on the TV set, as this will upset the performance of the TV on normal channels. Adjust the two trimpots on the game so that the picture is stable horizontally and vertically.

Now check the operation of the various controls. The bats should move up and down when the hand controls are operated. They should turn into "walls" with holes in them when the appropriate switches are operated. The wobble switches should cause the bats or holes to move up and down, while the interaction switch should cause one bat to influence the other to a small extent.

Now turn the bats to walls, and turn the speed control up to maximum. Press one serve button, and wait for the ball to appear. If no ball appears, press the other serve button. If the ball still fails to appear, turn the power off, wait for a little while, and turn it back on again. Once you have found the ball, turn the speed down to a more manageable rate.

The ball should bounce from both walls, and also from the top and bottom lines. If the walls are moving when the ball hits them, some of the wall velocity should be imparted to the ball. The balls should pass through the holes in the walls. Once satisfied that all is correct, return the walls to bats, and commence to play.

To return the ball into play when it has been missed, press the serve button on the opposite side to the one the ball disappeared through. Thus if the ball goes off the left hand side of the screen, press the right hand serve button. The time taken for the ball to return depends on the speed setting and also on how long it has been left off the court.

Various types of game can be played, by appropriate manipulation of the switches. Tennis or ping-pong is played using the bats, while catch-ball requires the use of holes. Single players can have enjoyable games by setting up a wobbling hole in one wall, and trying to hit the ball through this with a bat. Skilful players can enjoy harder games by making their bats or holes wobble, while adding interaction adds to the difficulties yet again.

In fact, the number of different games which can be played is limited mainly by the imagination of the player or players. Be warned, however, that if you have children, you may need to purchase a second TV set, as otherwise you might be forced to miss your favourite program!

PARTS LIST

SEMICONDUCTORS
- 5 74C00 quad 2-input gates
- 8 74C02 quad 2-input gates
- 1 BF173 NPN transistor
- 2 BC548 NPN transistors
- 1 BC558 PNP transistor
- 12 1N4148 silicon diodes

RESISTORS (all ¼W):
- 1 470 ohm, 2 1k, 1 2.2k, 2 3.3k, 11 10k, 6 22k, 3 33k, 5 47k, 1 56k, 2 150k, 2 220k, 1 330k, 1 390k, 6 470k, 1 1.2M, 1 2.2M, 6 10M
- 2 4.7k trimpots
- 2 22k linear pots
- 1 100k linear pot

CAPACITORS
- 5 100pF polystyrene
- 1 220pF polystyrene
- 6 330pF polystyrene
- 2 0.047uF LV polystyrene
- 8 0.01uF LV polystyrene
- 2 0.033uF LV polystyrene
- 5 0.1uF LV polystyrene
- 1 1uF tantalum
- 1 22uF 16VW electrolytic, PCB mounting
- 1 47uF 16VW electrolytic, PCB mounting
- 1 220uF 16VW electrolytic, PCB mounting
- 1 2500uF 16VW electrolytic, PCB mounting

MISCELLANEOUS
- 6 DPDT slide switches
- 2 miniature momentary "on" pushbuttons
- 2 5-pin DIN sockets
- 2 5-pin DIN plugs
- 1 printed circuit board, 221 x 122mm, coded 76vg5
- 3 knobs
- 2 2-metre lengths of 5-core shielded cable, with 2 clamps to suit
- 2 plastic "zippy" boxes, 80 x 50 x 28mm
- 1 aluminium case, 230 x 205 x 68mm
- 1 modulator assembly (see text)
- 3 grommets
- 4 rubber feet
- 1 9V battery and clip

Hookup wire, solder, circuit board pins, machine screws, nuts, washers, self-tapping screws

RF Modulator

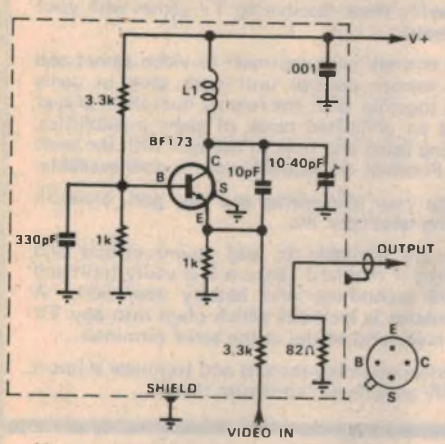
- 1 BF173 NPN transistor
- 1 10pF ceramic capacitor
- 1 10-40pF trimmer capacitor
- 1 330pF plastic capacitor
- 1 0.01uF ceramic capacitor
- 1 82 ohm, 2 1k, 2 3.3k resistors
- 1 printed circuit board 66 mm x 66 mm, coded 76m5
- 1 tinplate box, see text
- solder, machine screws, nuts, 75Ω co-axial cable, 22 B & S gauge enamelled copper wire

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

Finally, a word about troubleshooting the game, should this be necessary. First of all, check that the battery is okay, as strange things can happen with a flat battery. Next, check the symptoms against the description of operation given earlier, and try to isolate the faulty section. Thus if the ball goes through the left bat only, the trouble is likely to be around gate 3c. If various elements of the picture are scaled incorrectly, then the trouble may be due to incorrect RC networks.

The most likely cause of a complete lack of picture is failure of the horizontal or vertical oscillator. Remember that the circuit works in a logical manner, and you should be able to track down most faults by analysing the fault in conjunction with the circuit diagram.

THE RF MODULATOR



L1 : 10T. 22 B & S ENAMELLED COPPER WIRE, 3mm DIAMETER. SEE TEXT.

EA VIDEO MODULATOR

The circuit for the modulator assembly is shown above.

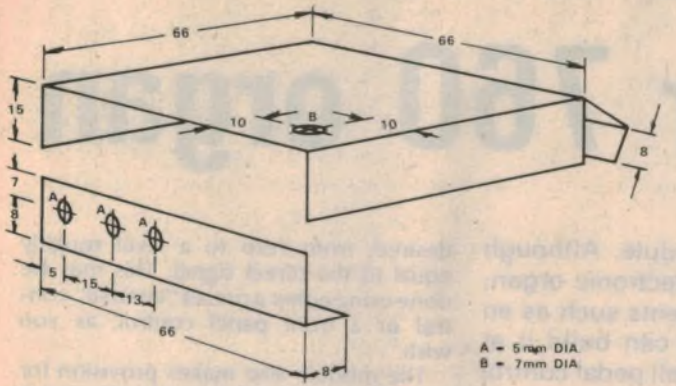
The RF modulator uses a single transistor, an NPN type coded BF173. It is enclosed in a small tinplate box, to minimise spurious radiation. The output has an impedance level of 75 ohms, and is coupled to the aerial terminals of the TV set by a shielded cable.

Operation of the modulator can be followed by referring to the circuit diagram. The transistor is connected as a Colpitts oscillator. Base bias is provided by the 3.3k and 1k resistors, connected as a voltage divider across the supply line. AC grounding of the base is provided by the 330pF capacitor.

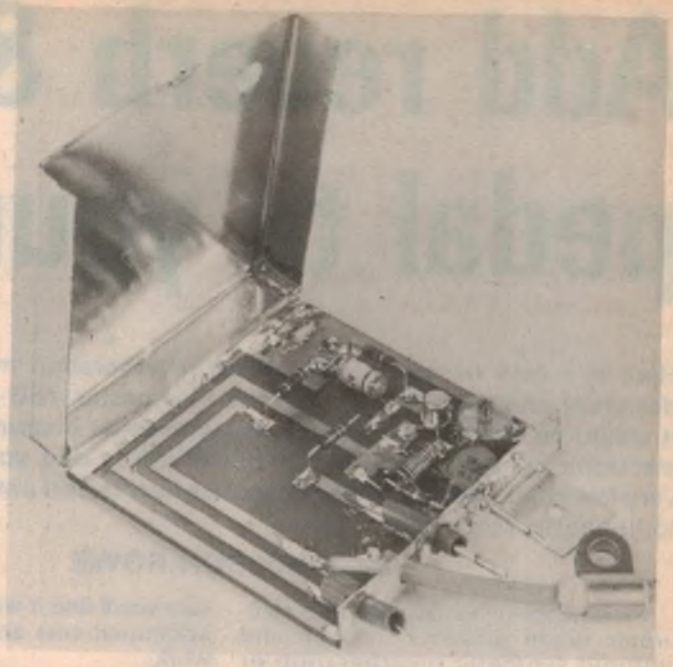
Frequency of operation is determined by the LC network formed by the inductor in series with the collector and the 10-40pF trimmer shunting the collector to ground. Feedback to maintain oscillation is provided by the 10pF capacitor between emitter and collector.

The input video signal is coupled into the emitter by a 3.3k resistor, and amplitude modulates the oscillator. The RF output signal is "sniffed" by a loop close

Video Ball Game



Above: This dimensioned drawing of the modulator shield, which is fashioned from tin-plate, will aid construction.



Right: A view of the completed modulator assembly, just prior to spot soldering the lid in position.

to the emitter lead. One end of this loop is terminated with an 82 ohm resistor (the closest preferred value to 75 ohms), while the other end is connected directly to the output cable.

Fine tuning of the oscillator frequency is provided by the trimmer capacitor, while coarse tuning is achieved by varying the number of turns in the inductor. Access to the trimmer capacitor is available from outside the shielding case.

The inductor is fashioned from ten turns of 22 B & S enamelled copper wire, wound with a diameter of 3 mm. In conjunction with the specified trimmer, this allows the modulator to be tuned to channel 1 or channel 2. Reducing the number of turns to 5 enabled us to tune all channels between 3 and 9. Thus if channel 1 or 2 is in use in your area, and you are suffering from interference effects, it is possible to tune the modulator to another, unused channel.

The modulator is constructed on a small printed circuit board, measuring 66 x 66 mm, and coded 76m5. A piece of double sided board is used, with a pattern etched on one side only. The other side acts as a ground plane. All components are mounted on the copper side of the board, so no holes are required in the board itself.

The shield is fashioned from tinplate, obtainable from jamtins, and is made in two pieces. An "L" shaped section with three holes in it forms the front section. The connections to the supply rail, the modulator input and the output are made through these holes.

The second section has a more complicated shape, and forms the lid and remaining sides of the case. It has a single hole in it, to provide access to the tuning capacitor. Dyeline drawings of the shield will be obtainable from our Information Service.

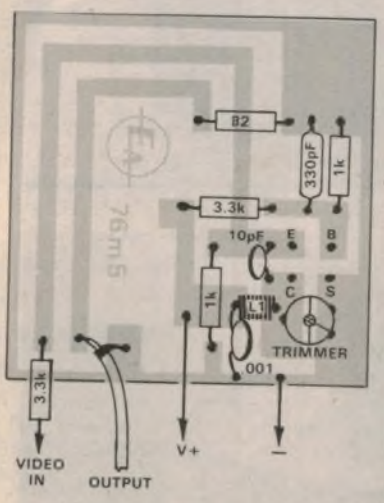
Before the components are mounted on the PCB, it is best to solder the shield to the PCB. The lid can then be hinged upwards, the components fitted, the lid pushed down again, and soldered at selected points. If you are making your own shield, make sure that you drill all the holes before you make the bends, as this makes it much easier.

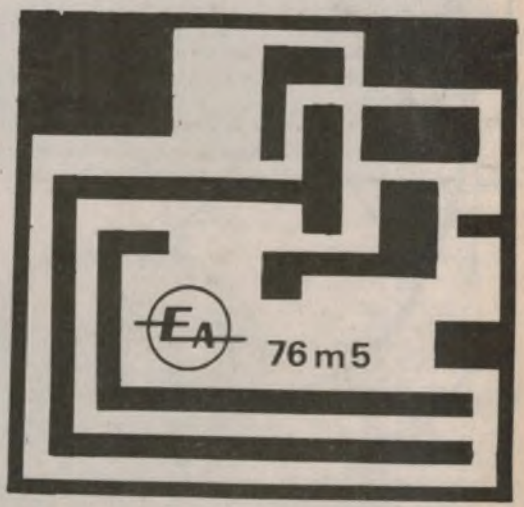
Make suitable bends in the component leads, as required, remembering to keep all components close to the PCB. The coil is wound on a convenient former, such as a knitting needle or similar object, and the ends then cleaned and tinned. The trimmer capacitor must be mounted so that the adjusting screw is aligned with the hole, and so that the earthy side is connected to ground. This will enable a metal screwdriver to be used for adjustment, if desired.

The 3.3k video input coupling resistor is passed partway through the appropriate hole, and soldered to the pattern. The flying end is used as the terminal point for the lead from the video board. A piece of insulated hookup wire is placed similarly for the positive supply terminal. The earth connection is simply soldered to the shield.

The output co-axial lead is stripped for a short distance at one end, passed through the hole in the shield, and soldered in position. The lid can then be hinged down, and spot soldered in selected places. We fastened it down in position with two small angle brackets fashioned from tinplate.

Once the modulator has been connected to the video section, the TV is tuned to an appropriate channel, and the power switched on. The trimmer is then adjusted to obtain a suitable picture, with good contrast. No sound information is generated by the modulator, so the volume control can be turned right down to eliminate any spurious noise.





At left is the component overlay diagram, while on the right is a full sized copy of the PCB pattern. This should be etched onto one side of a piece of double-sided board, the unetched side acting as a shield.

Add reverb & a swell pedal to your 760 organ

Here is a new design for an add-on reverberation module. Although designed primarily for use with the Playmaster 760 electronic organ, it would be equally suitable for use with other instruments such as an electronic guitar. It uses a handful of parts, and you can build it at very low cost. The article also describes how to add a swell pedal control to the basic 760 organ.

by JAMIESON ROWE

Most people who have heard an electronic organ played both with and without synthetic reverberation or "reverb" have no hesitation in describing its effect as a dramatic improvement. In fact some go further, and regard it as nothing less than essential for a musically satisfying result.

The effect of adding reverb to a small organ such as the Playmaster 760 is certainly very worthwhile. The instrument suddenly seems to "come to life", and exhibits a freshness and warmth which one realises were previously lacking. It is for this reason that I am describing here an add-on reverb module, as the first suggested way of expanding the basic organ design into a more satisfying instrument.

Even if you do not intend making the organ into a more pretentious instrument, I would suggest that you seriously consider adding the reverb module. I'm sure you'll find it well worth the modest additional cost and small amount of work.

Incidentally, while the module has been designed with the 760 organ project primarily in mind, I have made it quite flexible in terms of input and output matching requirements and control facilities. As a result it should be equally suitable for adding to other electronic organ designs, and also for use in other applications altogether—such as with electronic guitars.

As you can see from the circuit, the module is fairly straightforward and uses only a handful of parts. It accepts medium-level signals from the tone colour filters of the existing organ circuitry, and produces a composite direct-plus-reverb signal at a similar level for feeding to either the internal or external amplifier. The amount of reverb signal in the composite signal may be adjusted as desired, from zero to a level roughly equal to the direct signal. This may be done using either a preset "internal" control or a front panel control, as you wish.

The module also makes provision for volume control of the composite signal, using either the original panel control or a swell pedal control. More about this later.

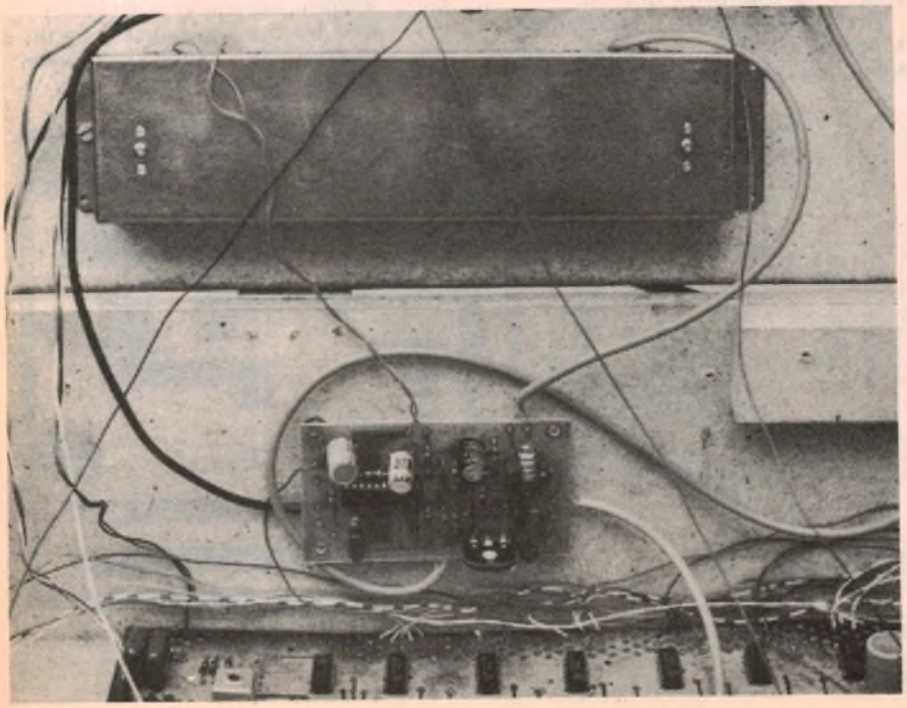
The input signal fed to the reverb module from the stop filters is passed through an LM380 integrated circuit amplifier. This is used primarily as a driver for the exciter transducer of the delay line, but it also provides some voltage gain for the "direct" output signal, to compensate for mixing losses. The amplifier has a gain of 50 times, and a resistive voltage divider across its output gives an attenuation of approximately 11 times. The two together therefore produce a nett gain of about 4.5 times, which more than compensates for mixing losses.

The reverb signal generated by the sensing transducer at the end of the delay line is amplified using a single BC549 or similar transistor, connected in the conventional common-emitter configuration. The emitter resistor is unbypassed, giving a very modest gain of about 6.5 times. This gain is all that is required, however, and the advantage of having the emitter resistor unbypassed is that the amplifier has a good overload margin. This is desirable because the output of wire spring delay lines tends to vary quite widely, due to standing-wave effects at various frequencies.

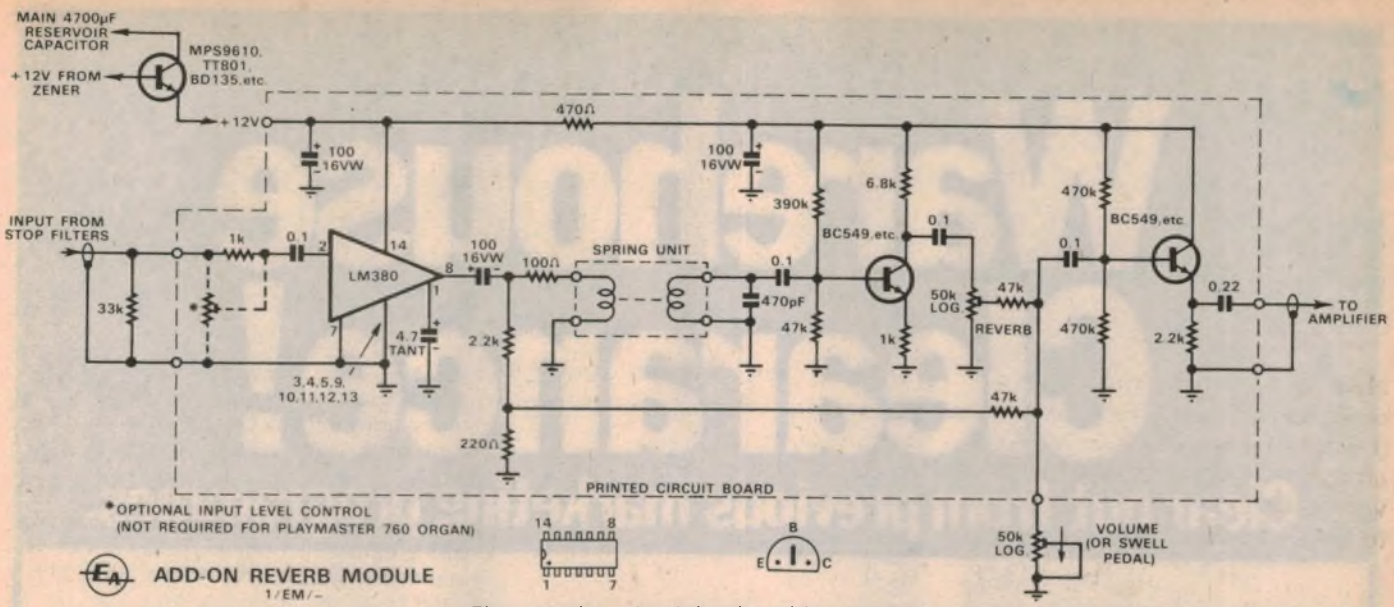
The output from the amplifier is fed to a 50k log pot, which forms the reverb level control. As noted earlier, this pot may be either a preset or a front-panel control. The output from the pot is then mixed with the "direct" signal from the divider across the LM380 output, via 47k mixing resistors, to produce the composite output signal.

The signal produced at the junction of the two 47k resistors is controlled in volume by a 50k pot connected as a shunt rheostat. This may be either the original volume control pot fitted to the front panel of the 760 organ, or a similar pot in a swell pedal assembly.

Although the signal across the pot may



The reverb module PCB and a delay line unit mounted inside the Playmaster 760 organ case.



The complete circuit for the add-on reverb module, as added to the basic Playmaster 760 organ. The dashed line indicates the circuitry mounted on the PCB.

be fed directly to the original amplifier input point of the 760 organ, we have made provision on the reverb module for an output emitter follower using a second BC549 or similar. This has been done mainly to make the module more flexible, so that it may be used in other applications where a low impedance output may be required—perhaps to feed through a long cable, or to ensure low pickup from note generator wiring.

In fact the low output impedance of the emitter follower does tend to be worthwhile even in the 760 organ, helping to minimise the faint background "singing" caused by capacitive coupling from the keyboard wiring into the amplifier input circuitry. As the emitter follower only involves three resistors, two capacitors and a low cost transistor, I therefore suggest that you leave it in—unless the cost must be kept to the absolute minimum.

There are a few components whose purpose may not be immediately apparent. The 470pF capacitor across the sensing transducer coil of the delay line is to minimise RF pickup. The 1k resistor in series with the LM380 input is a stopper, again to attenuate any RF or other spurious signals which may be picked up by the tone colour filter circuitry.

The 33k resistor shown across the input is to act as a load for the tone colour filter output mixing resistors. The resistor also adjusts the signal level fed to the LM380, to a value which provides adequate output level and signal-to-noise ratio, while not causing overload of the LM380 when multi-note chords are played.

As you can see, the circuit also provides for an optional input level pot, in place of the 33k and 1k fixed resistors. This is to make the reverb module suitable for applications other than the Playmaster 760 organ. In our present design the two fixed resistors are quite adequate.

If you use the reverb module in an-

Why add reverb to an electronic organ?

Traditionally, organs are associated with relatively large enclosed spaces—the interiors of cathedrals, large churches, concert halls or theatres. Perhaps because of this, most people have come to expect organ music to contain the reverberation components introduced by the acoustics of a large auditorium. An organ played in a small room or a very "dead" environment such as a recording studio thus tends to sound unnatural, and lacking in musical interest.

While this is true even with pipe organs, it tends to be much more evident with electronic organs. The sound from an electronic organ tends to sound rather "bland" and unsatisfying to start with, so that without reverberation it can be particularly unappealing.

There are two basic reasons why the sound from an electronic organ tends to be bland. One is that the notes from an electronic organ tend to cease abruptly, rather than die away gradually like the notes from most acoustic instruments. The other reason is that the notes tend to be locked together in fixed frequency and phase relationships, in contrast with a pipe organ where all notes are produced by substantially independent oscillators—the pipes.

To be sure, some electronic organs are intrinsically better than others in this latter respect, at least before any compensating techniques are applied. Those which use independent oscillators for each note of the keyboards tend to be better than the single master oscillator type, for example, although they still cannot approach the note randomness of a traditional "straight" pipe organ because of the impracticality of using a separate oscillator to correspond to every pipe of every stop rank. And the advantage they do achieve in this respect tends to be at the expense of additional circuit complexity, cost and lower reliability —at least in theory.

In order to produce an instrument capable of generating musically satisfying sounds, the electronic organ designer or builder thus has two obstacles to overcome—the inherent blandness of the basic instrument, and the fact that in the majority of cases it will be used in a situation where there will be virtually no assistance from the acoustic environment by way of reverberation.

All sorts of techniques have been developed to overcome these obstacles. Some involve low-speed vibrato modulation of the signals from the organ, either cyclically or randomly and using either electronic or mechanical means. But whether such methods are used or not, it is almost universal to incorporate synthetic reverberation, or "reverb".

The reason for this is that reverb gives a very significant improvement in the sound, for a relatively modest increment in cost and complexity. It produces not only some of the effects of reverberation in a large hall, but also causes the notes to "hang" and die away gradually after the keys are released. And at the same time it tends to introduce a measure of "randomness" into the various notes, breaking down their locked phase relationships.

Various techniques have been evolved to produce reverb, but the most successful method devised to date is based on a spiral-spring delay line, of the type first developed by the Hammond Organ Company. The unit described in this article uses a delay line of this type.

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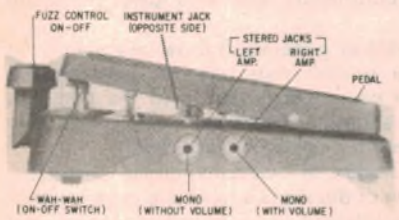

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ADD-ON REVERB

other organ, or in some other application, the preset pot should be used if the signal level available to drive the LM380 is more than about 100mV peak-to-peak. The pot value is not critical, and may be any value up to about 150k depending upon the requirements of the external circuitry.

The 100 ohm resistor in series with the exciter transducer coil of the delay line is primarily to ensure current-type drive in the case of transducers having a low impedance winding.

There are two spiral-spring delay lines currently available, and both appear to operate well with the new module. The line for which it was initially designed is the Piezo type RE-4, a low cost unit of Japanese manufacture which measures 230 x 55 x 30 mm, and weighs 210 gms. It has two parallel springs, and gives a reverberation time of around 2.5 seconds at 1kHz. It is currently available from Dick Smith Electronics Pty Ltd, of 162 Pacific Highway, Gore Hill 2065.

The other delay line unit currently available is the O.C. Electronics type 51, made in the USA under licence to the Hammond Organ Company. This unit has been available for some time, being the most modern version of the original Hammond delay line. It is physically a little larger than the other unit, measuring 283 x 111 x 33 mm. It uses a single spring line, but the line is folded twice into a "Z" shape. The reverberation time appears to be very close to that of the other unit. The O.C. line does feature a sprung sub-frame, to minimise microphony.

The O.C. Electronics line is apparently available from a number of suppliers. We obtained a sample for testing from ACE Radio Pty Ltd, of 136 Victoria Rd, Marrickville, NSW 2204.

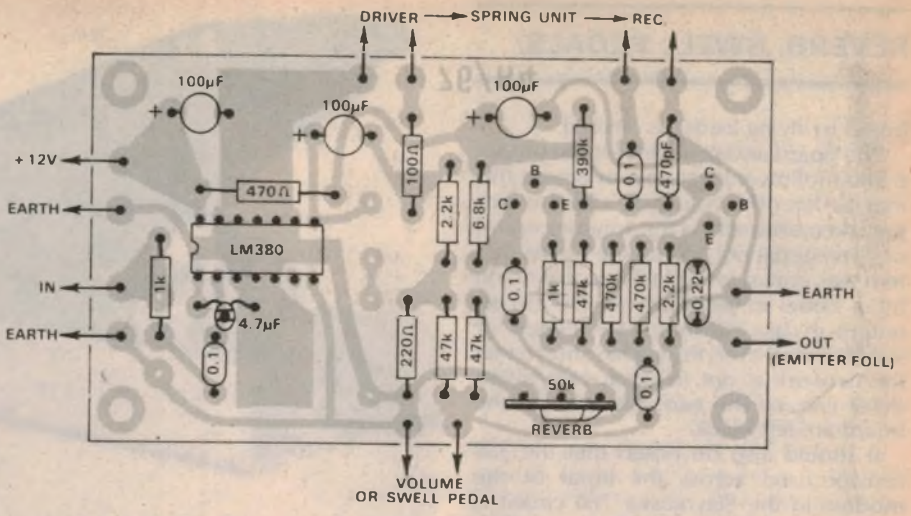
Although the O.C. Electronics line has a somewhat higher impedance exciter transducer coil than the Piezo unit, it is fairly sensitive and operates quite satisfactorily from the drive supplied by the LM380 amplifier in our module. Although the 100 ohm series resistor does not produce current drive with this line, due to the high coil impedance, it also makes negligible difference to the drive level and may thus be left in circuit. In fact even though there is substantially voltage-type drive with the O.C. Electronics line, it gives a quite smooth response—very similar to that of the Piezo line.

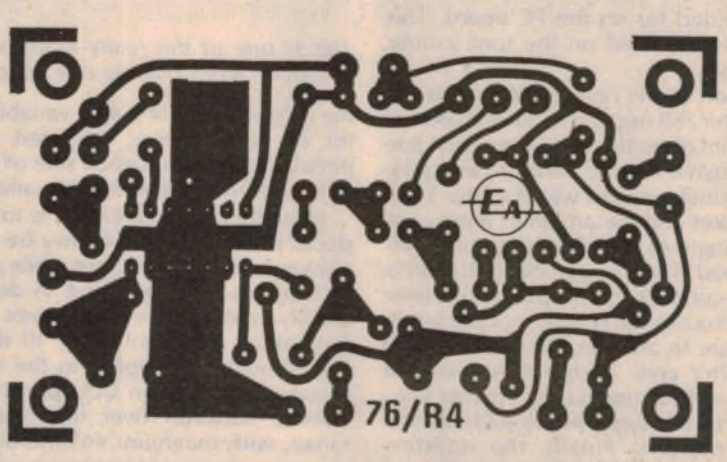
In short, then, both delay lines give good results with the module, and either may be used with it without any circuit modifications.

As you can see from the circuit, the module is designed to work from a nominal 12V supply. It is provided with its own decoupling components. However as the module can draw up to about 30mA of quiescent current, I suggest that you do not run it directly from the 12V zener-regulated supply line in the Playmaster 760 organ. Instead it is better supplied by an emitter-follower, fed from the main supply output and using the zener line purely as its reference. This is shown in the main circuit. The transistor is an MPS9610, a BD135, a TT801 or similar, and is mounted on the power supply component panel.

Virtually all of the circuitry for the basic reverb module is mounted on a small PC board, except the volume or swell pedal pot and of course the delay spring unit. The PC board measures only 51 x 90mm, and is coded 76/R4. The pattern is reproduced actual size on these pages, to allow tracing if you wish.

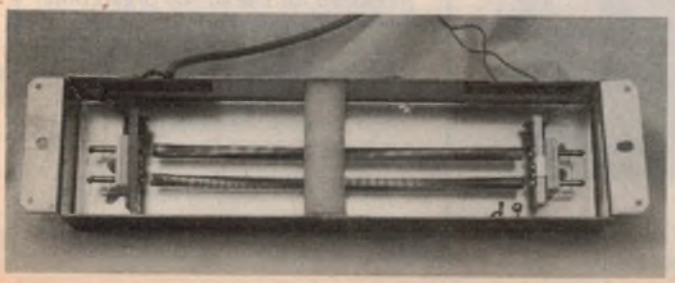
Wiring the board should be fairly straightforward, as we have prepared a wiring diagram to guide you. Note that the board provides for preset pots to be used for both input level adjustment to the LM380 input amplifier, and reverb level, but the former may be left out while the latter may be replaced by a front panel control connected to the

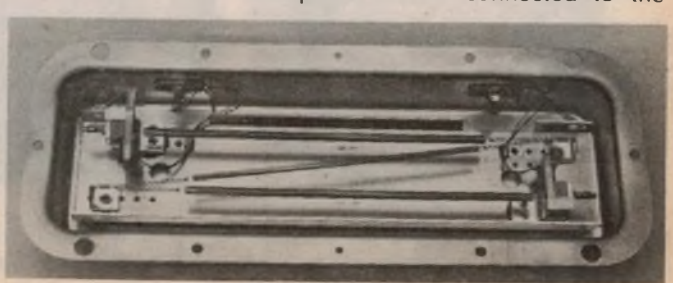




At top is a wiring overlay for the reverb module PCB, while below this is the actual PCB pattern, actual size to allow tracing.

Below are the two spring delay lines currently available. At left is the Piezo type RE-4; at right the OC Electronics type 51.





board by flying leads, as desired.

The board also provides for the output emitter follower stage, but of course this may be left off if you wish, with the output taken from across the volume control or swell pedal pot. When the board pattern was drawn provision was also made for a Zobel network across the LM380 output, in case this should be needed for stability. However, testing has shown that the network is not needed, with either delay line, so the two positions on the board are left blank.

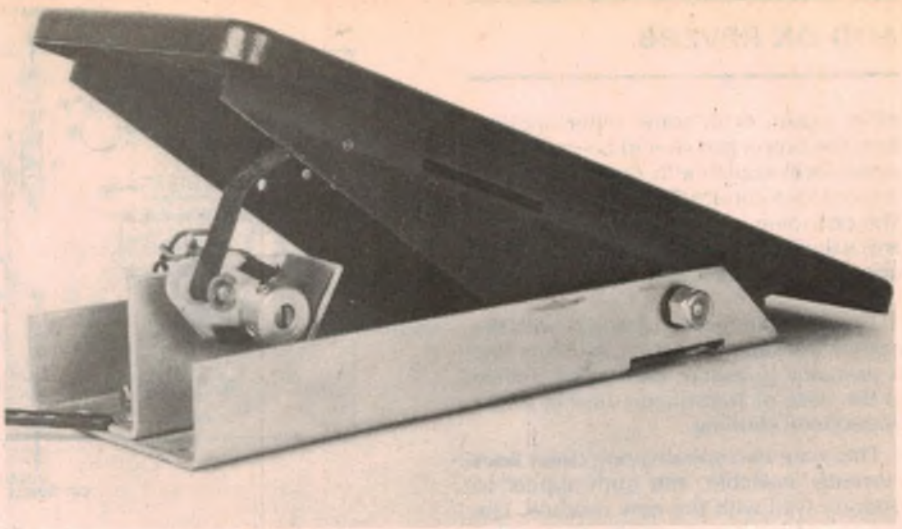
It should also be noted that the 33k resistor used across the input of the module in the Playmaster 760 circuit is not provided for on the PC board. This resistor is mounted on the tone colour filter panel.

Addition of the reverb module to the Playmaster 760 organ is quite straightforward. It involves breaking the signal line at the original volume control, taking the original shielded lead wired to the 5-pin DIN socket and the amplifier input, and connecting it to the reverb module output instead. Then a new shielded lead is used to connect the output of the tone colour filters to the reverb module input, taking care to add the 33k shunt resistor at the filter end. Then a third shielded lead is used to connect the volume control pot to the appropriate pads on the reverb module. Finally the emitter-follower transistor is added to the power supply, and used to provide the module with its 12V power.

This is all that is required if you propose to leave the 760 organ with its manual volume control. It is simply a matter of adjusting the reverb level pot to give a pleasing amount of reverb and "life", and you're all set.

Understandably, however, many will find the manual volume control rather unsatisfying, and will want to replace it with a swell pedal control to permit more convenient "expression".

Electrically, this is fairly straightforward—merely a matter of replacing the existing 50k pot with a variable resistor of similar value, operated by the pedal. It is the mechanical side of the job which involves the most time and effort.



This is one of the ready-made swell pedal units available from Electronic Arts, if you don't fancy making one yourself. It is solidly made.

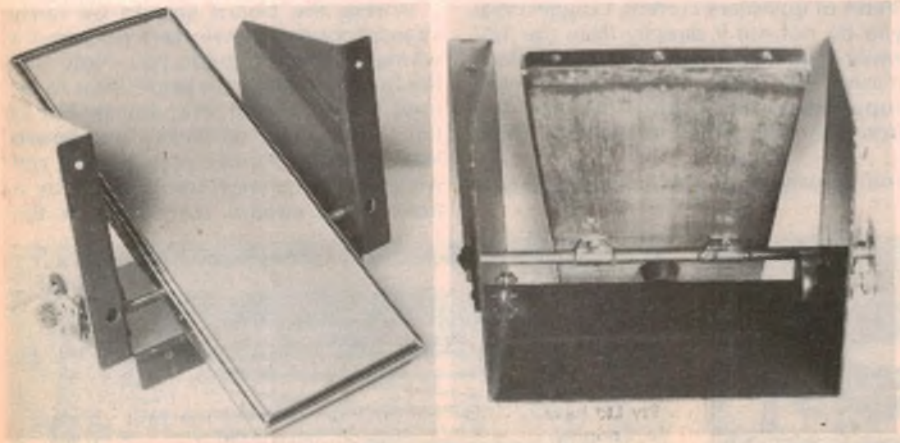
Basically the requirement is to have a pedal pivoted so that it may be moved conveniently by one's foot while playing, through an angle of about 35 degrees—usually from about 45 degrees to the horizontal, down to about 10 degrees. This should be coupled to the variable resistor to give an acceptably large volume variation over this movement range, with minimum volume at the 45 degree extreme and maximum volume at the 10 degree extreme, so that the pedal operates in the same sense as the accelerator of a car.

However, unlike an accelerator pedal the swell pedal should not be spring loaded. It should remain in any desired position, if your foot is removed. Apart from this the main requirement is for the action to be smooth, and the resistor able to vary the organ volume reliably and quietly.

Although various techniques have been used to produce swell pedal controls for electronic organs, the simplest approach and the one most often used is a rugged moulded-track carbon potentiometer directly varying audio level, and the pedal via either gears or a lever and crank arrangement. The lever and crank approach tends to be easier from a constructional point of view, while the gears approach can provide a somewhat greater resistance change between the minimum and maximum pedal positions.

If you don't fancy the mechanical work involved in making your own swell pedal assembly, it will no doubt be welcome news to learn that there is a ready-made unit available commercially. It is available from Electronic Arts, of 126 Bombay Street, Lidcombe, NSW 2141. Designated the type EP-1, it will cost you around $35 but it is a solidly made unit which comes complete with a 100k moulded-track carbon pot and a rubber mat on the swell pedal itself.

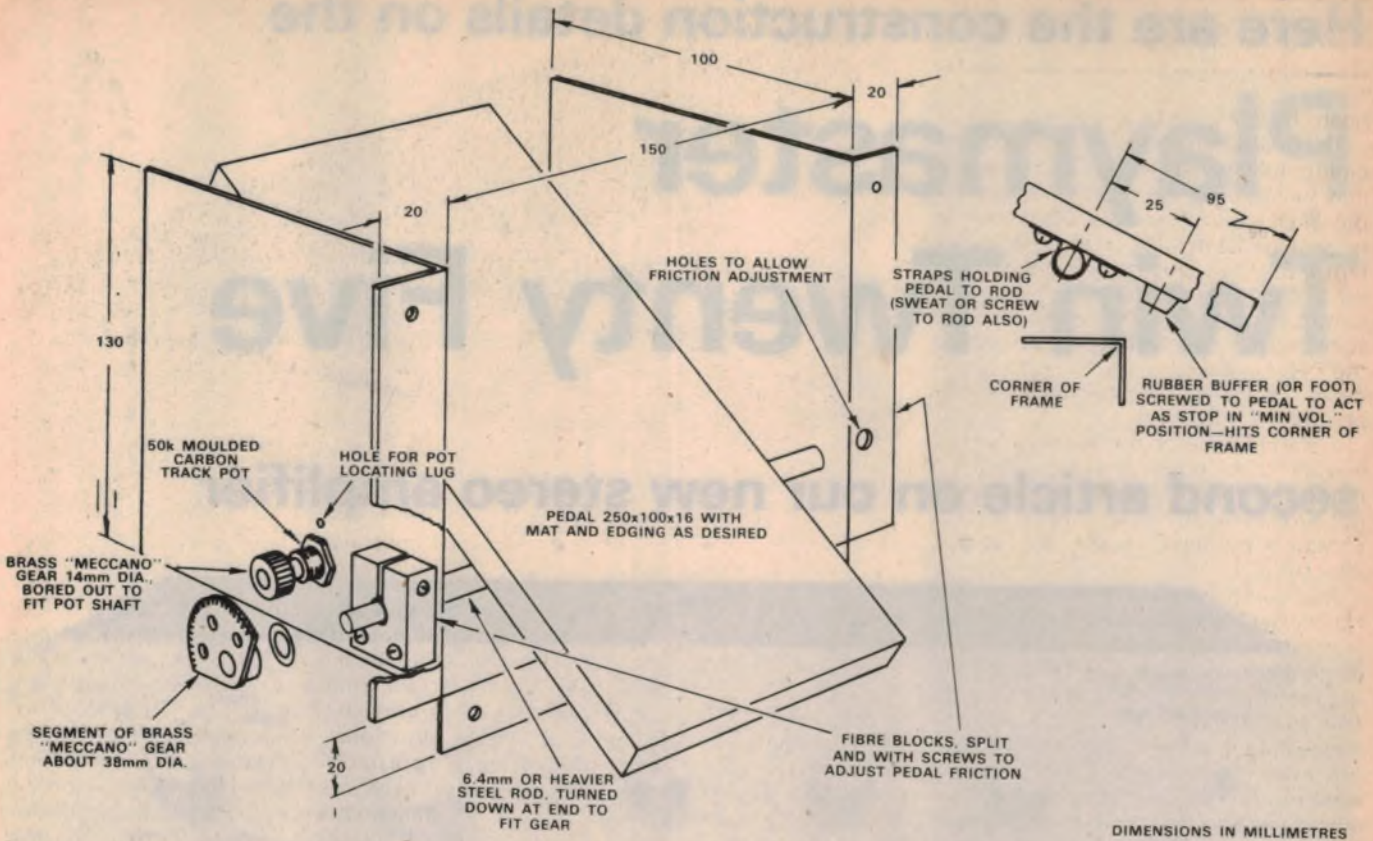
Although the pot fitted to the EP-1 assembly has a value of 100k, it is coupled to the pedal via a lever and crank system which gives a rotation of only about half the full track. Thus the effective resistance range is quite close to that required in the Playmaster 760 organ circuit, either before or after the reverb module is added.



Two views of the home-made swell pedal assembly, which could serve as a guide if you are going to build up one from scratch (see drawing on next page).

REVERB UNIT—PARTS

1 PC board, with pattern coded 76/R4, 51 x 90mm
1 Spring delay line—see text
1 LM380 audio amplifier IC
2 BC549 or similar NPN transistors
1 MPS9610, BD135, TT801 or similar (required for use in 760 organ only)
½W or ¼W Resistors: 100 ohms, 220 ohms, 470 ohms, 2 x 1k, 2 x 2.2k, 6.8k, 33k, 3 x 47k, 390k, 2 x 470k
1 50k pot, PC vertical preset type
1 470pF ceramic or polystyrene
4 0.1uF LV greencap
1 0.22uF LV greencap
1 4.7uF 16VW tantalum electrolytic
3 100uF 16VW PC-type electrolytic



Here is a dimensioned drawing of the do-it-yourself swell pedal, designed to mount in a spinet-type organ cabinet.

Of course if you're fairly adept at mechanical construction, you may choose to have a go at building up a swell pedal assembly yourself. There's not a great deal of work involved, although it calls for a bit of care. Some of the materials required may also be a little difficult to obtain, so that you may have to "shop around" unless you are endowed with a well-stocked junk box.

To illustrate one quite practical type of construction which you could use, we have taken pictures and prepared a drawing showing assembly built by our Editor-in-Chief Neville Williams for a small organ he has been rebuilding privately.

As you can see, it uses a pedal made out of 16mm particle board, measuring 250 x 100mm. This is mounted on a ¼-in diameter steel rod, which passes through ¼-in holes drilled in the sides of a simple U-shaped chassis measuring 150mm wide by 130mm high by 100mm deep. The chassis has flanges to enable it to be mounted inside a spinet organ cabinet, but it would not be difficult to adapt the basic idea if you wish to have a free-standing unit to sit on the floor.

A fibre block is mounted at each end of the chassis, directly over the two main bearing holes. Each block is similarly drilled to allow the rod to pass through, but is also slotted and provided with a tensioning screw and nut so that it can be adjusted to apply a suitable amount of frictional force opposing the rod's rotation. This makes for smooth pedal action, and also ensures that the pedal remains put when your foot is removed.

One end of the rod is turned down to receive a large brass "Meccano" gear, about 38mm in diameter. This meshes with a similar gear about 14mm in diameter, which is drilled out to mount on the shaft of a 50k log moulded-track carbon pot. The pot is mounted the correct distance away from the pedal spindle rod to ensure that the gears mesh properly, and a small hole is drilled in the chassis to mate with the pot locating spigot, to prevent the pot from rotating. The large gear is cut away to clear the front flange of the chassis; about 120 degrees of its periphery are left, which is more than adequate to cope with the pedal movement.

A small rubber buffer or "foot" of the type used on small instrument cases is screwed to the underside of the pedal itself, to act as a stop in the "minimum volume" position. The gearing is arranged so that the pedal movement is halted by the buffer just before the pot reaches its minimum resistance—so that the pot cannot be damaged by strain on its internal stop, yet can still be brought to a very low value.

The top surface of the pedal is covered by a small piece of rubber or plastic mat, of the type sold in department stores to prevent slipping in baths. This is cut to size and attached with contact cement. A small strip of decorative plastic beading around the edge then gives the pedal a neat and tidy appearance.

More about keyboards:

Since publication of the first two articles on the Playmaster 760 electronic organ project, we have received further advice from a number of firms regarding availability of keyboards:

Maxwellectronics, of PO Box 140, Tongala, Victoria 3621, advise that they have stocks of 49-note (C-C) Kimber-Allen keyboards, less switches at $79.50 each. A complete set of SPDT gold switch contacts to suit will be available shortly at $25.00 the set.

Jaycar Pty Ltd, of PO Box K39, Haymarket, NSW 2000, advise that they have stocks of both 49-note and 61-note Kimber-Allen keyboards. A 49-note keyboard less switches costs $79.00, or $98.00 with 49 SPDT or DPST switches suitable for mounting thereon.

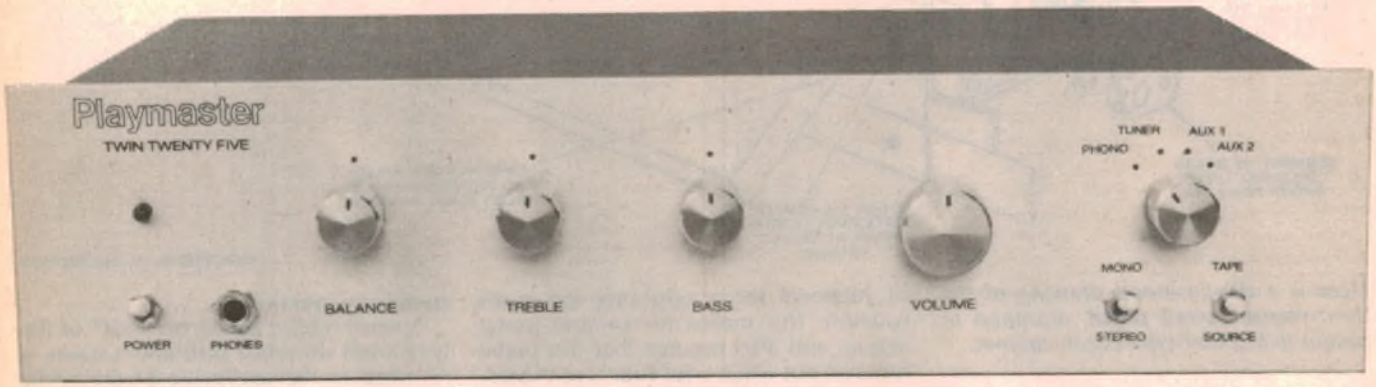
Baber Nominees Pty Ltd, of 2 Monomeeth Drive, Mitcham, Vic 3132, advise that they will shortly have available 49-note (F-F) keyboards made by Pratt, Read & Co Inc. These will be less contacts, and will cost $60.00. A 13-note pedalboard with SPST switches will be available also at the same price.

Dick Smith Electronics Pty Ltd have advised that, due to an unforeseen export licensing problem in Japan, their original keyboards have been delayed. However alternative keyboards will be available.

Here are the construction details on the

Playmaster Twin Twenty Five

second article on our new stereo amplifier



In this article on the Playmaster Twin Twenty Five we continue the circuit description, give details of performance measurements on the prototype and describe the assembly procedure.

by LEO SIMPSON

Having completed the description of the power amplifier circuitry last month we now move to the input stages and describe features therein. Refer to the complete circuit diagram.

The phono preamplifier is similar to that featured in the November 1973 issue of "Electronics Australia, and is a well-proven design. T1 and T2 form a differential amplifier with balanced output to drive the 741 operational amplifier. The sole purpose of using the transistors is to improve the otherwise inadequate noise performance of the 741.

Collector current of the two input transistors is set at about 87uA by the common 82k emitter load resistor. This value of current is not as low as we have used in past designs but is intended to give better noise performance with the complex source impedance presented by a magnetic cartridge. As another measure to minimise noise output, the collectors of T1 and T2 run at the quite low voltage of about 2.4V.

Five components are used in the equalisation network (560k, 56k, .0056uF, .0012uF and 150pF) to give an RIAA response within 1dB. Even closer adherence to the RIAA curve can be obtained by using 2% or even 1% tolerance components.

Low frequency response of the preamplifier is rolled off below 30Hz to minimise rumble reproduction. The roll-off is determined by the ratio of the reactance of the 10uF capacitor to the 1k resistor in the feedback network.

A 47pF capacitor and 1k resistor are used at the phono inputs as an RF attenuation network. This network causes a slight degradation to the signal/noise ratio of the preamplifier but is a necessary measure (along with others in the circuit) to ensure that the amplifier is not prone to RF breakthrough.

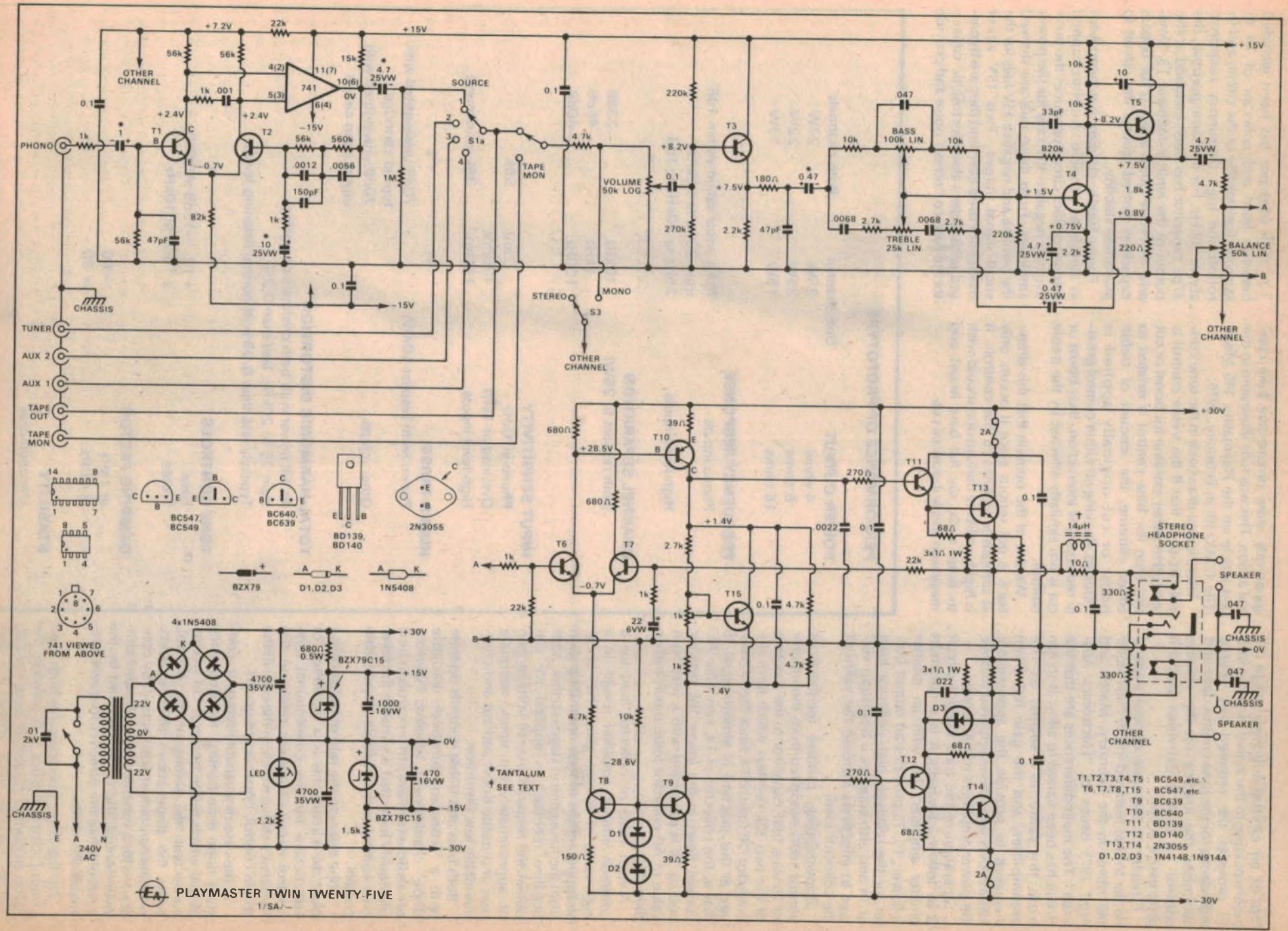
The series network consisting of the 1k resistor and .001uF capacitor between the collectors of T1 and T2 ensures stability of the preamplifier at high frequencies. At the same time, the 15k resistor connected from the output terminal of the op amp to the positive 15V rail provides a standing current of 1mA to minimise cross-over distortion from the class-B output stage of the 741.

It may be thought that the combination of exceedingly high open-loop gain in the preamplifier together with the internal 6dB/octave high frequency compensation (roll off) of the 741 operational amplifier makes the circuit a "sitter" for the occurrence of transient intermodulation distortion. However, the RIAA equalisation means that the negative feedback around the circuit also decreases at the rate of 6dB/octave (albeit with an inflection at about 1kHz), so that the overall negative feedback is essentially constant over the audio spectrum.

Output signals from the preamplifier are coupled via a 4.7uF capacitor to the Selector switch. The negative electrode of the capacitor is connected to the zero supply rail via a 1M resistor to ensure that there are no clicks from the loudspeakers when the phono source is selected.

Supply rails for the preamplifier are plus and minus 15V. This enables the preamplifier output signal to exceed 9V RMS, which means that it has more than adequate input overload margin.

Signals from the volume control are



PLAYMASTER TWIN TWENTY-FIVE

1/SA/—

fed to an emitter-follower stage T3 before passing to the active tone control. T3 provides the required low source impedance for the tone control stage and minimises the loading on the volume control so that it provides smooth progressive action.

Circuitry of the tone control stage is similar to that featured in the Playmaster 145 Mixer in the February, March and April 1975 issues of "Electronics Australia". The main differences are that the circuit has been varied to allow it to run from the same 15V supply as the preamplifier, and the gain has been increased to provide the approximate 700mV RMS signal level required to drive the power amplifiers to full power.

Operation of the tone control circuit is as follows. Basically it is a common emitter amplifier, T4, with an emitter follower, T5. T5 provides an output buffer for the relatively high collector load of T4 and also supplies a bootstrap voltage to effectively increase the value of the collector load.

Bootstrapping, positive feedback of almost 100% is applied from the emitter of T5 via a 10uF capacitor to the junction of the two 10k resistors which form the collector DC load of T4. Since the AC voltage at this junction is almost equal to that at the collector of T4, very little AC current flows in the lower 10k resistor and so T4 is presented with a very high value of AC collector load, much higher than 20k.

A high value of collector load for a common emitter amplifier results in a high value of voltage gain. Thus bootstrapping results in high open-loop gain from the tone control stages so that, after negative feedback is applied we can obtain the required overall voltage gain of approximately ten times, adequate bass and treble boost and cut and commendably low distortion.

Both bass and treble controls operate with a "constant turnover, variable slope" characteristic, whereas Playmaster solid-state amplifiers published previously have had a variable turnover bass control and a variable slope treble control.

Slope refers to the rate of boost or cut from the circuit; this is a maximum of 6dB/octave for any conventional tone control circuit. Turnover refers to the frequency above which, in the case of the treble control, boost or cut occurs.

In the case of a variable turnover, constant slope tone control, the frequency above which treble boost or cut occurs varies with the setting of the control, while the slope above this frequency remains constant at 6dB/octave. By contrast, with a variable slope constant turnover control, the slope is altered by the control while the turnover frequency remains the same.

For the same time constants both tone control characteristics will provide the same amount of maximum boost or cut, but the variable slope system will give apparently more progressive tone control action. This was fully illustrated in the first article on the Playmaster 145 Mixer (File 1/MX/10) in February, 1975.

There is one drawback in the tone control circuit in that if the treble control is rotated to either extreme for boost or cut and then the bass control is rotated to either extreme, the amount of treble boost or cut originally applied is reduced. Backing off either control greatly reduces this interaction. Bass boost or cut is not similarly affected by the treble control.

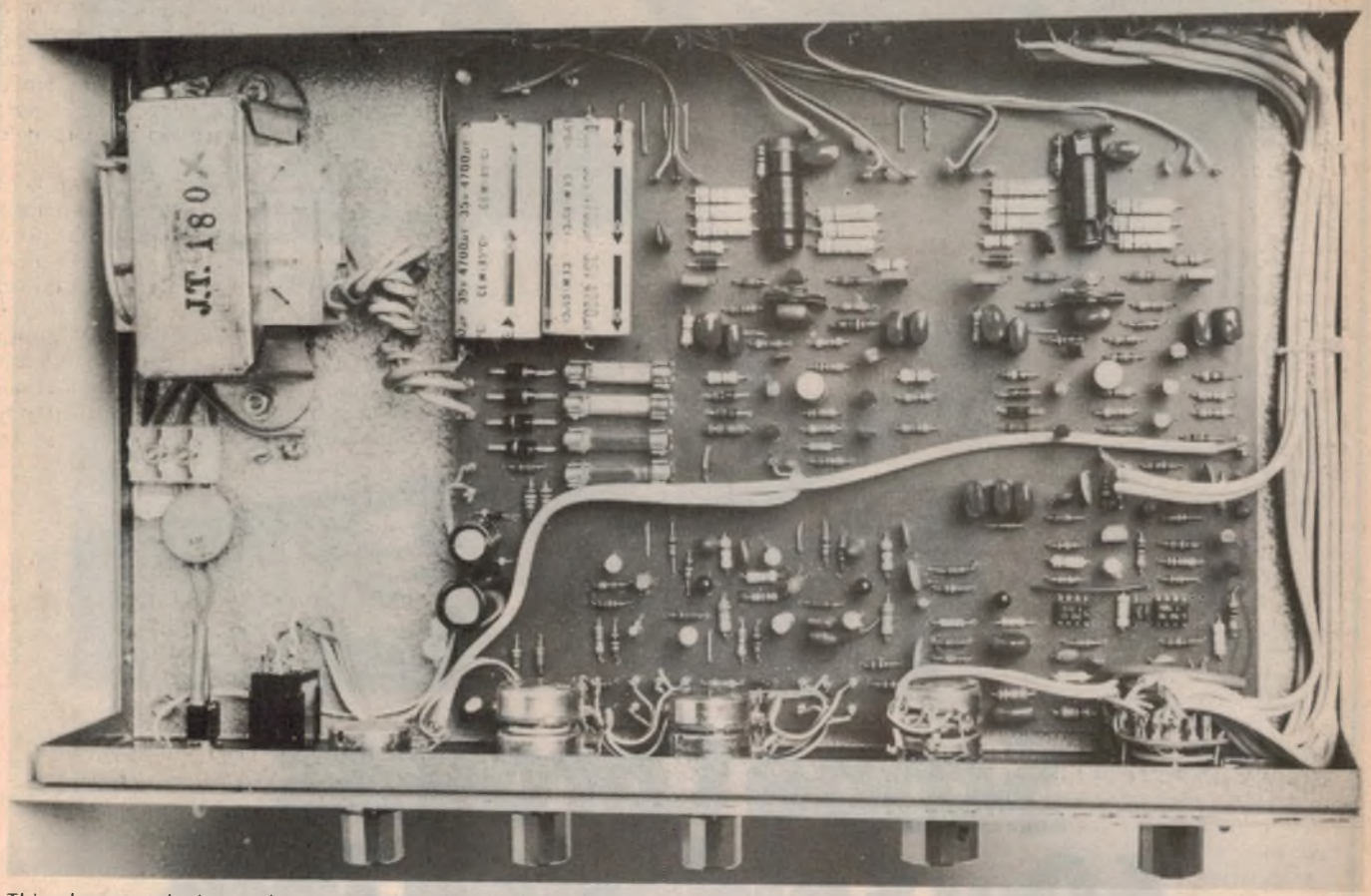
We are of the opinion that this drawback is not serious since it occurs only at unrealistic settings of the controls. It is highly unlikely that anyone would wish to listen with, say full bass boost and maximum treble boost or cut.

A 33pF capacitor has been included between base and collector of T4 to improve the stability of the circuit and to rolloff the high frequency response above 30kHz. For the same purpose, the 47pF capacitor has been included at the output of the emitter-follower T3. Similarly, there are quite a few 0.1uF bypass capacitors dotted around the circuit to guarantee stability.

Power supply circuitry has been kept as simple as possible. A centre-tapped bridge rectifier circuit produces the positive and negative 30V rails for the power amplifiers. From these rails are derived the positive and negative 15V rails for the small-signal stages. Two 15V zener diodes are used here and they are bypassed with large value electrolytic capacitors to reduce "zener" noise and provide

PERFORMANCE OF PROTOTYPE

POWER OUTPUT	One channel	Both channels
4 ohms	35W	27W
8 ohms	25W	22W
16 ohms	15W	13W
FREQUENCY RESPONSE		
Phono inputs	RIAA equalisation within 1dB from 30Hz to 20kHz	
High level inputs	25Hz to 20kHz ± 1dB	
CHANNEL SEPARATION		
(with respect to 25W)	10kHz	—33dB
	1kHz	—46dB
	100Hz	—40dB
INPUT SENSITIVITY		
Phono at 1kHz	2mV	56k
Overload at 1kHz	120mV	
High level inputs	150mV	36k (minimum)
HUM & NOISE		
Phono (with respect 10mV)	70dB unweighted with typical cartridge	
Other inputs	70dB unweighted with inputs open circuit	
TOTAL HARMONIC DISTORTION		
At full power with both channels operating from 25 to 20kHz: less than 0.2%		
Typically less than 0.05% at normal listening levels		
TONE CONTROLS		
Bass	+12, —13dB at 50Hz	
Treble	± 10dB at 10kHz	
DAMPING FACTOR		
at 1kHz	> 60	
at 30Hz	> 30	
STABILITY		
Unconditional		



This photograph shows the prototype amplifier with wiring completed.

a further degree of hum filtering. The pilot light is a LED run from the negative 30V rail via a 2.2k resistor.

This completes the description of the circuit apart from the optional loudspeaker protector facility which will be described next month. Now a brief discussion of the performance measurements on the new amplifier.

Notice that the title "Twin Twenty Five" is only an approximate guide to the power output. The maximum power figures we give are for continuous sine wave output at 1kHz, at just before the onset of clipping with a mains voltage of 240VAC. Altering any of these parameters slightly, i.e., load impedance, mains voltage or degree of clipping (say to 1% THD) can alter the figures quite markedly. Music power output is of the order of 40 watts per channel into 8 ohm loads.

All specifications refer to the whole amplifier from input to output, not just the power amplifiers. The distortion ratings apply to all inputs, including the phono input. The square wave response photographs are for the high level inputs with tone controls set for flat response.

Assembly can begin with the PC board. Proceed carefully and double check all components as many mistakes can be made here. Refer to the circuit diagram and PC board layout diagram as assembly progresses. No particular order of component installation need be followed other than to insert the long links of hook-up wire before adjacent components.

Transistor designation on the board is the same as on the circuit, i.e., T1, T2, etc., while the duplicate channel is T101, T102, etc.

PC stakes are optional and any type may be used provided they are a tight fit in the PC board holes before soldering. If PC stakes are used they have the advantage that all connections to the board can be quickly broken to allow the board to be completely removed from the chassis.

Low noise cracked carbon or metal film resistors of ¼W or ½W rating may be used throughout except where we have noted otherwise, on the circuit diagram. Insert all the resistors so that their colour code bands run in the same direction. This makes component checking easier.

Ensure that tantalum and aluminium electrolytic capacitors are correctly inserted, otherwise they will be reverse polarised and rendered ineffective. Tantalum capacitors are coded with a dot (as shown on the PC layout diagram) or plus sign to indicate polarity.

Quite a diverse range of transistors may be used on the board apart from those in the output Stages. TO-92 transistors are preferable to those in metal encapsulation both from the cost angle and the fact that transistors with collectors connected to the metal can are more prone to parasitic oscillation. If you are supplied with substitute transistors not listed in our parts list make sure of the following:

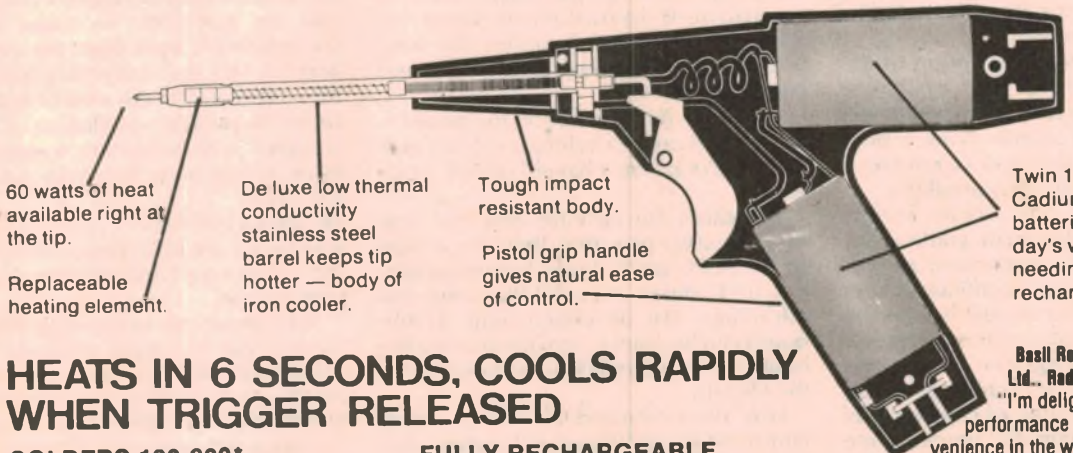
(a) obtain the dealer's assurance that the substitutes are in fact equivalent and
(b) obtain from him a diagram of the lead connections.

Take great care in inserting transistors. Notice that the base diagram for the BC639 and BC640 is different from that for BC549 etc. Notice also that the BD139 and BD140 are differently orientated—the metal flat on the BD139's faces to the rear of the chassis while on the BD140's it faces to the front.

While we have designed the copper pattern around 14-pin ICs for the 741's, the PC board is also compatible with both the 8-lead "mini-dip" and 8-lead metal can versions of the 741. This is by virtue of the fact that pins 1, 2, 7, 8, 12, 13 and 14 have no internal connection (on the 14-lead IC), while the remaining pins have the same orientation as in the smaller packages.

For both 8-lead packages, pins 1 to 4 connect to pins 3 to 6 of the socket pattern and similarly, pins 5 to 8 should con-

Scope Cordless 60w Soldering Tool



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*Light electrical connections. Capacity will vary for lighter or heavier joints.
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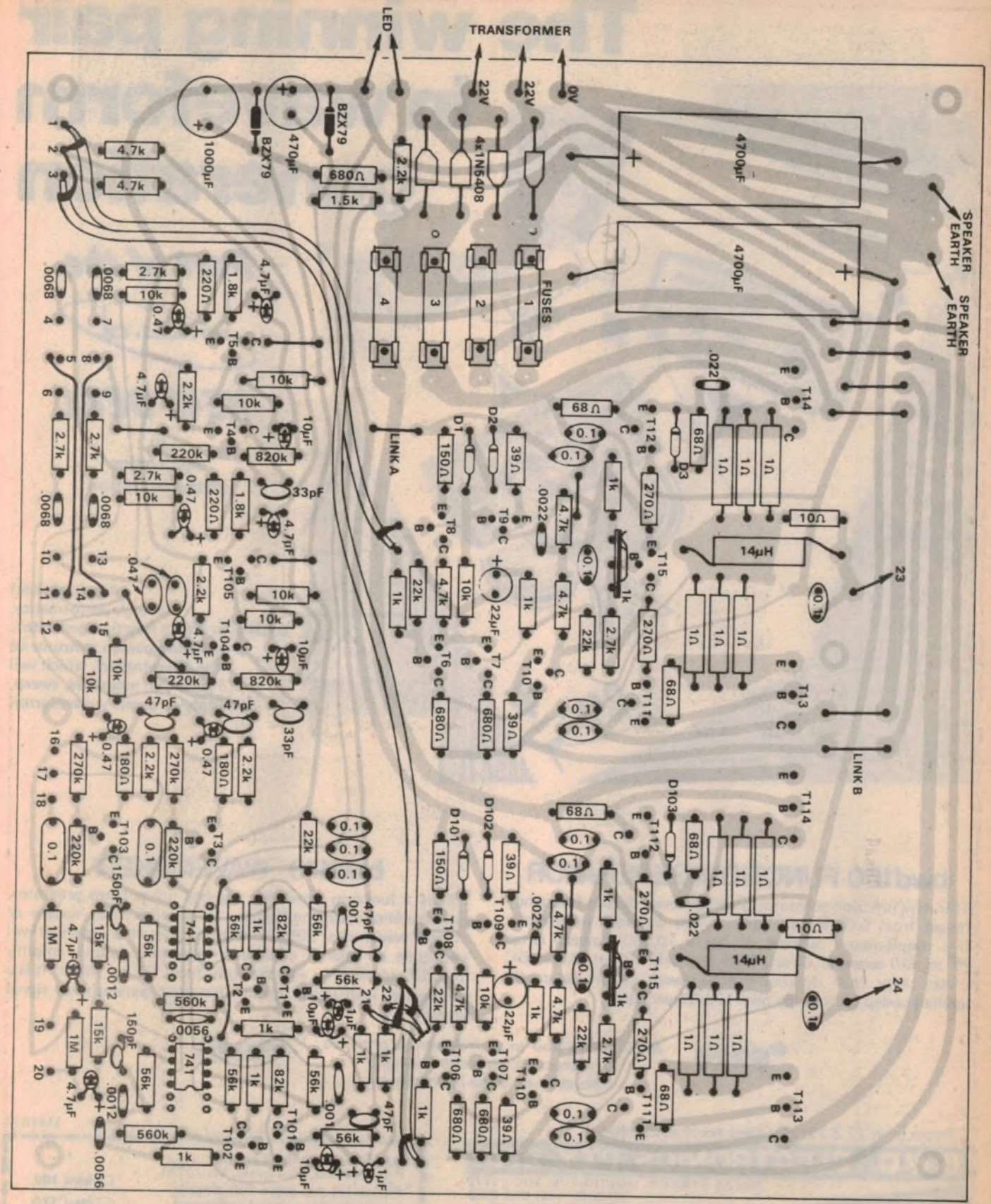
SCOPE

Distributors to the Electrical Trade:
NATRONICS PTY. LTD. The Crescent, Kingsgrove, N.S.W. 2208

Manufactured by: SCOPE LABORATORIES, MELBOURNE.



nect to pins 9 to 12 of the socket pattern. The PC board layout diagram shows mini-dip IC's in position.

IC sockets have not been specified as we regard them as a mixed blessing. In many cases the socket may cost more than the IC, while some of the cheaper sockets can give problems with intermittent contacts.

Ensure that the 1k preset potentiometers are clear of T15 and T115, especially if these transistors have metal encapsulation.

We used 1N5408 rectifier diodes as supplied by Dick Smith Electronics. These have the advantage of economy, but if they cannot be obtained any power diodes with a rating of at least 2 amps

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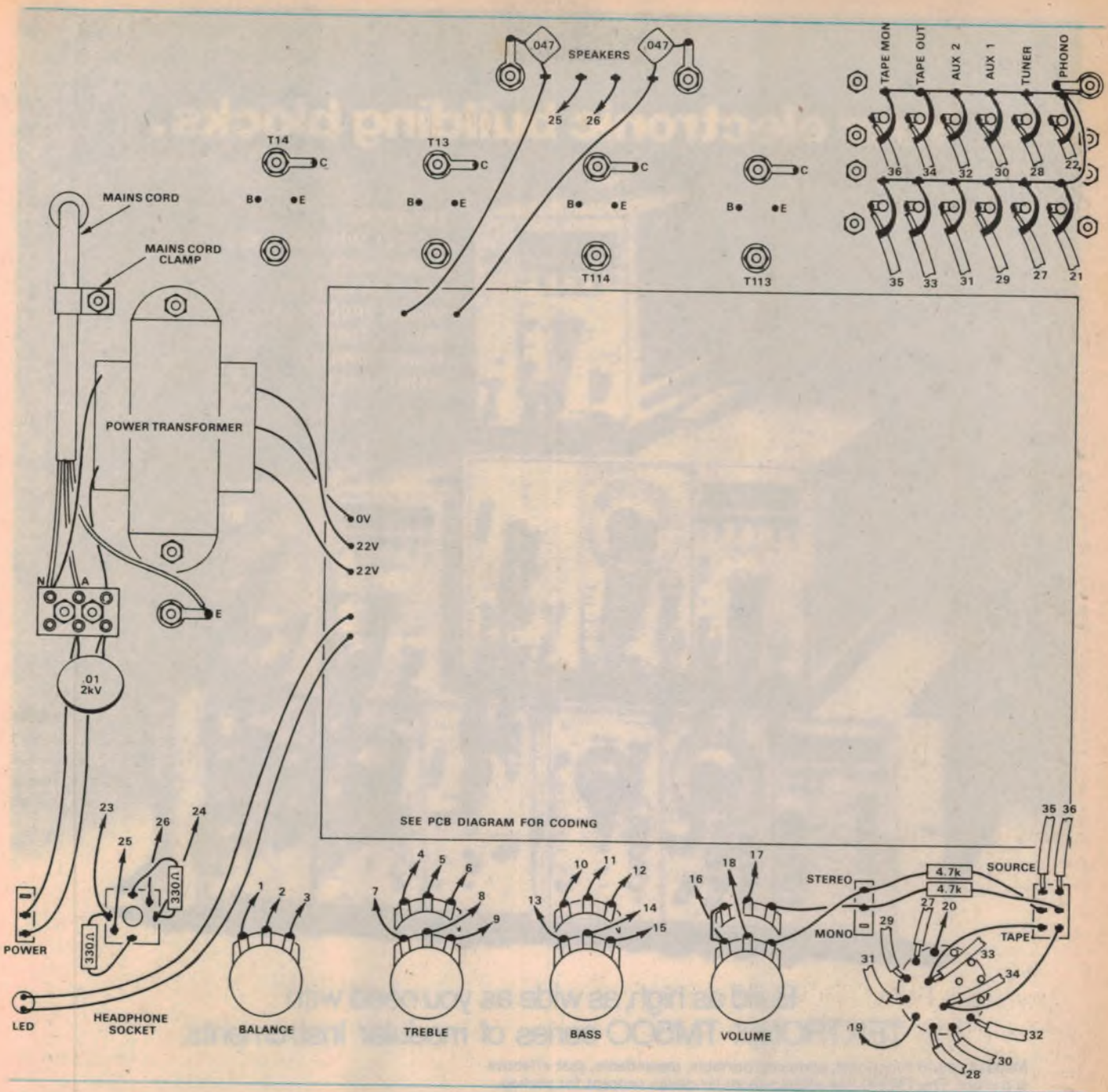

Use this diagram in conjunction with the PCB layout on page 61 to complete the amplifier wiring.

at 100PIV will suffice.

Notice that diodes D3 and D103 point in opposite directions on the PC layout diagram.

8 Swann (McMurdo) FC1 fuseclips are used on the PC board. These are inserted and the solder tags crimped on the copper side before soldering to ensure that they are mechanically secure. But do not insert the four fuses until after the setting-up procedure has been successfully completed.

Six 1 ohm/1W resistors are used in each power amplifier output stage. These are used instead of equivalent resistors of higher rating, because they are cheaper and often more freely available. However, if the 1 ohm/1W resistors cannot be obtained, two 0.33 ohm/5W resistors can be used for each power amplifier.

The 14uH chokes were kindly supplied by Paradio Electronics, 7a Burton Street, Darlinghurst, NSW, who can supply trade requirements. Designated VPC14A, the chokes are wound with eighteen turns of 20 B&S enamelled copper wire on a special grade of ferrite rod 30mm long and 10mm diameter. Ordinary ferrite rod used for AM radio antennas is not suitable. We understand that at least one kit retailer will be supplying ferrite rods of correct grade and dimensions plus wire, instead of the completed chokes.

A length of shielded cable is required to connect both of the amplifier inputs to the balance control terminals. This is to tie the power amplifier input earth points to the rest of the board earth network. Leave the inner conductors of the shielded cable disconnected from the amplifier inputs for the time being.

This completes assembly of the PC board so that attention can now be turned to installation of hardware in the chassis.

Mount the transformer so that it is spaced off the chassis by at least 3mm using brass nuts or washers. This is to prevent hum induction into the chassis.

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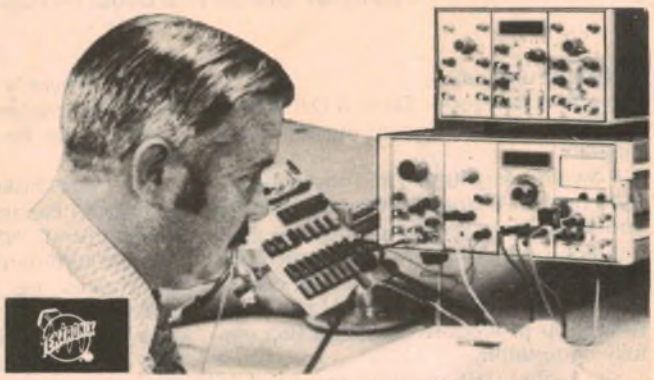

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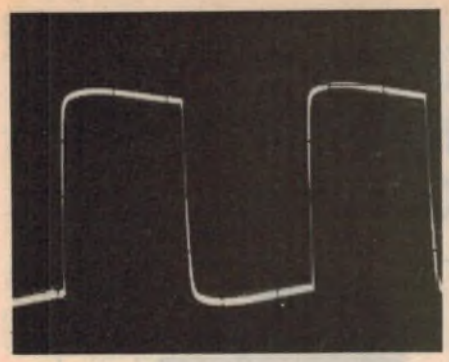
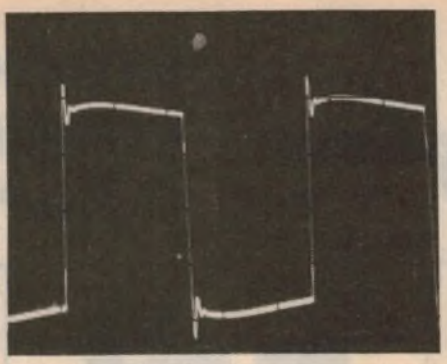
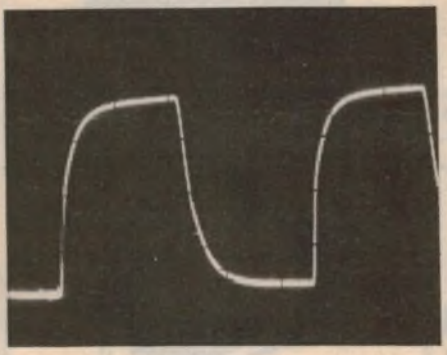
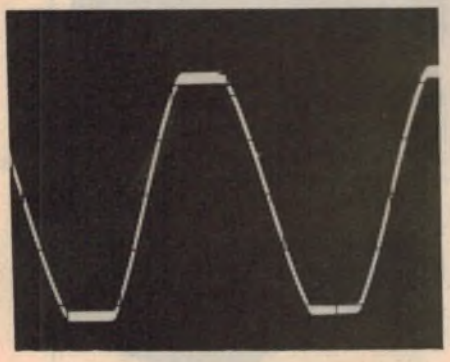
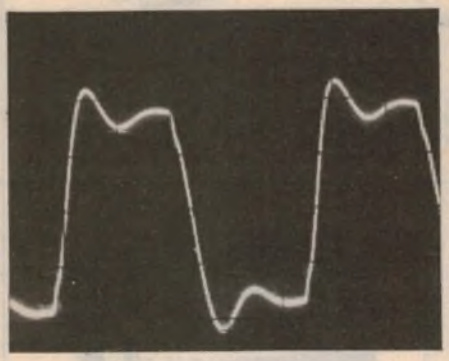










Clockwise from top, these square wave oscillograms show the transient performance of the complete amplifier at 20V P-P: 1kHz into 8 ohms; 1kHz into 8 ohms shunted by 1uF; 10kHz into 8 ohms; 10kHz into 8 ohms shunted by 1uF. Immediately below is the overload performance of the amplifier at 10kHz into 8 ohms shunted by 1uF at approximately 45V P-P.

The secondary leads should be closest to the board. Twist the secondary wires together and cut them to a length of about 10cm. Similarly, twist the primary wires together and cut to a suitable length for termination at the insulated terminal block.

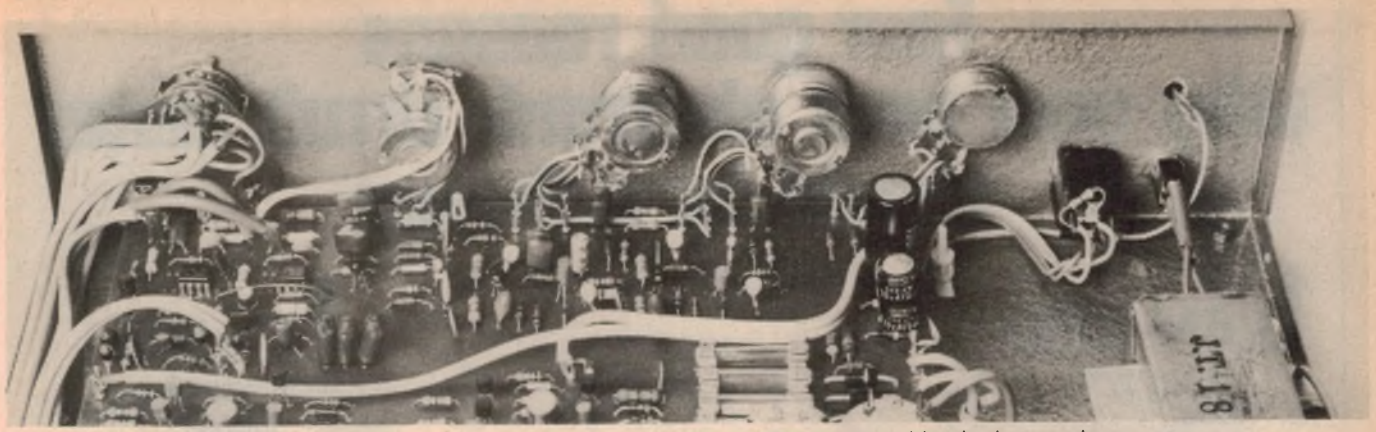
Cut all potentiometer shafts and the rotary switch shaft to a length of 15mm, taking care that metal shavings do not fall inside the pots. Loosen the clicker plate of the rotary switch, if necessary, so that it is reasonably easy to turn using the selected knob. Mount all the switches and pots, but leave the escutcheon plate off at this stage to avoid scratching. It can be installed after the amplifier is fully checked out and operational.

The 6-way banks of input-sockets and the loudspeaker sockets may also be mounted now. The loudspeaker terminals we used are spring-loaded and are more convenient than the cheaper screw-terminal panels. Swap one pair of the red and black terminal covers so that the two red terminals are in the centre of the panel. Do not omit the solder lugs associated with input and loudspeaker sockets.

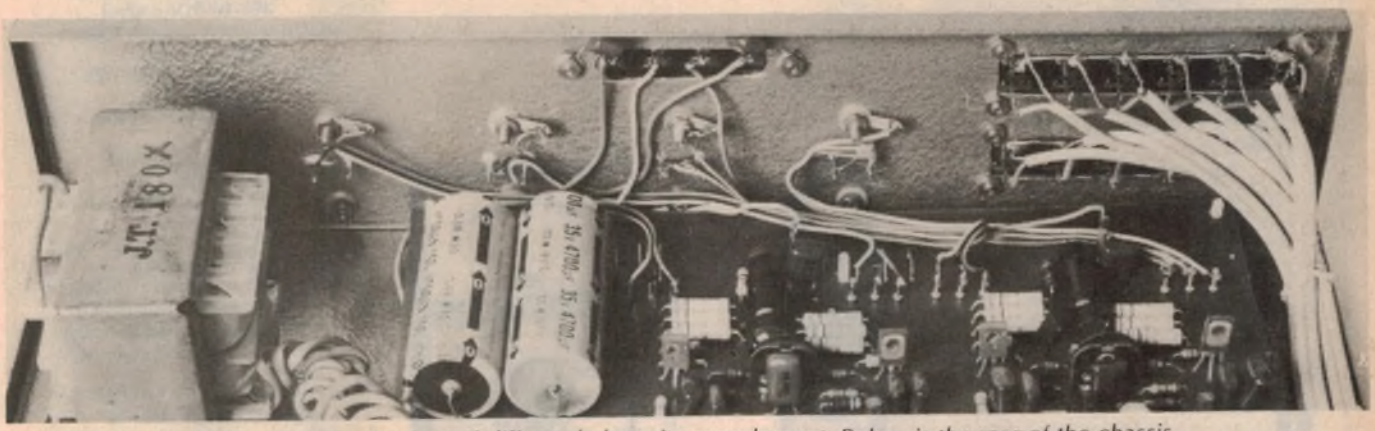
Before mounting the transistors, ensure that the contact area is completely smooth and free of burrs and swarf. Smear the contact surface and the underside of the transistors with silicone grease or heatsink compound. A mica washer and insulating bushes must be used to isolate each transistor from the chassis. Attach a solder lug to one of the retaining screws of each transistor. As an alternative to insulating bushes, TO-3 sockets may be used, provided the chassis has been suitably drilled.

The mains cord should be passed through a grommetted hole in the rear of the chassis and anchored with a cord clamp. Terminate the mains active and neutral to the terminal block and solder the earth wire to a solder lug near the transformer. Run two wires from the terminal block to the mains terminal switch.

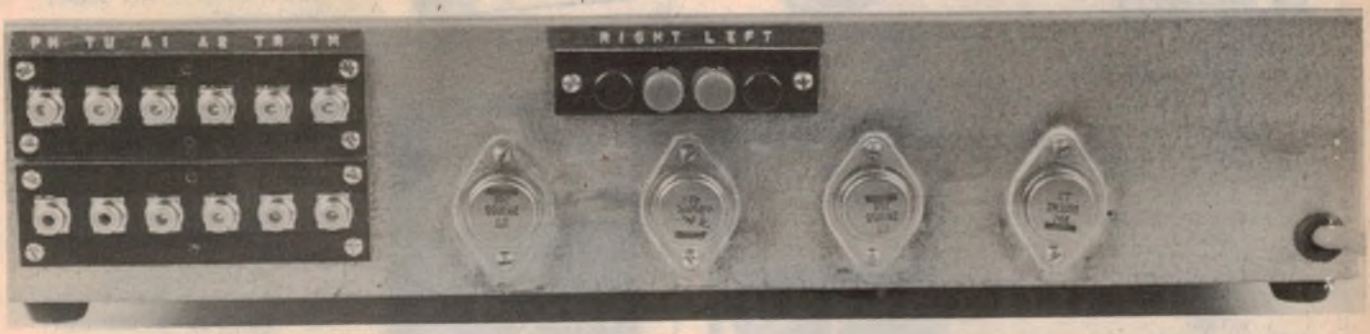
The mains switch has a .01uF/2kV ceramic capacitor wired across it, at the insulated terminal block. Keep the leads to this capacitor short to prevent them touching the chassis. Before soldering the wires to the mains switch, push a length of suitable plastic sleeving over



Notice that the bass, treble and balance controls are oriented to keep the associated leads short and neat.



Notice that each driver transistor is oriented differently from its complement. Below is the rear of the chassis.



the wires and after soldering, push the sleeving over the terminals of the switch. This is to make it as shock proof as possible, in case you are foolish enough to dangle your fingers near it while the power is applied.

Wiring from the input sockets to the Selector switch and associated switches can now be installed. Use figure-8 shielded cable, with the shields all terminated to the common "bus" around the input sockets. This bus is soldered to a solder lug retained by one of the input panel mounting screws to become the sole earth point for the amplifier circuitry. The cable shields are not terminated at the Selector switch. Cut them off to avoid shorts with the inner conductors. The cable shields for the phono input are terminated on the PC board, when installed.

Cut the cables so that they lie together neatly as in the photographs. Use a couple of cable ties if necessary.

There are two 4.7k resistors strung between the tape monitor switch S2 and the stereo/mono switch S3. These resistors should be sleeved in plastic tubing.

Flat ribbon cable (three wires) can now be run from each power transistor and potentiometer. Each length of cable should be about 15cm long and stripped and tinned at the free end ready for terminating to the PC board. Note that if PC stakes are not used, this process will have to be reversed—terminate the cable to the PC board first.

By way of explanation, the flat ribbon cable usually comes in ten strand form—just peel off as many strands as needed and cut to length.

Two .047uF capacitors connect the earth connections of the loudspeaker terminals to the chassis. This is a measure to eliminate mains radiated interference.

The PC board can now be dropped into place in the chassis and mounted using Richco plastic supports. Both board and chassis should be drilled for these supports. Make all connections exactly as indicated in the chassis wiring diagram.

Double check all wiring against the circuit, PC layout and chassis wiring diagrams. You are now ready for the setting up procedure.

Cut link A and link B. Solder 100 ohm/1W resistors across fuseholders 2 and 4. When looking from the front of chassis, rotate the 1k preset pots fully clockwise. Do not connect any loads to the amplifier outputs. The input cables to the power amplifiers should be disconnected as noted earlier but the shields of this cable must be connected to tie the power amplifier input earths to the rest of the circuit.

Apply power and check voltages in the right hand power amplifier. There should be less than 1 volt DC across each

(Continued on page 125)

Four good reasons why your next electronic circuit tester should be a Sanwa

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30k (w/HV probe)
±DCA 0-30μA 0-3-30-300mA (300mV) ±3%
ACV 0-6-30-120-300-1.2k (8kΩ/V) ±4%
Freq. 20Hz to 20kHz at 6V
Ω x1 x10 x1k x10k (max. 50M)
Batt. 1.5Vx2 & 22.5Vx1
dB −10 to +63
μF 0.0001 to 10 in 2 ranges
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- Push-button capacitor tester with built-in solid state oscillator
- Polarity reversal switch for negative measurements
- Series capacitor terminal (OUTPUT+) — AF output level check

3. N-501

±DCV 0-60mV
0-0.3-1.2-3-12-30V (500kΩ/V)
0-120-300-1.2k (50kΩ/V) ±2%
0-30k (w/HV probe)
±DCA 0-2μA 0-0.03-0.3-1.2-3-12-30mA
0-0.12-0.3-1.2-12 (300mV) ±2%
ACV 0-3-12-30-120-300-1.2k (1MΩ)+2.5%
Freq. 20Hz to 50kHz (±1dB)
ACA 0-1.2-12A
Ω x1 x10 x100 x1k x10k x100k (max. 200M)
Batt. 1.5VX1 & 9VX1
dB −20 to +63
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- Multifarious application — as circuit analyser

4. 460-ED

±DCV 0-0.3-3-12-30-120-300 (100k/Ω)
1.2k (16.6kΩ/V) ±2%
30k (w/HV probe)
±DCA 0-12μA
0-0.3-3-30-300mA
0-1.2-12A (300mV) ±2%
ACV 0-3-12-30-120-300-1.2k (5kΩ/V) ±3%
Freq. 20Hz to 1MHz at 3V
ACA 0-1.2-12 (300mV) ±3%
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Batt. 1.5Vx1 & 9Vx1
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Simple circuit converts calculator to stopwatch

This article describes probably the simplest conversion kit yet developed to allow a low-cost Novus 650 or National NS600 calculator to be used as a stopwatch. The unit is accurate to 1/50 of a second, and can be made small enough to fit inside the calculator case. Two alternative versions, one crystal controlled and one mains controlled, are given.

by DR P. C. BURY*

Although less sophisticated than the version described by Mr N. Campbell in the December 1975 issue, the stopwatch conversion kit described here is considerably cheaper to build and much more compact. Only one transistor, a quad AND gate and a handful of peripheral components are used in the interface and control circuitry. Readers are referred to the December 1975 article for information on the workings of the calculator and the principles of converting it to a stopwatch.

As mentioned above, two alternative versions are described. Version 1 assumes that a 50Hz square wave is available. I used Dick Smith's QC-8 crystal kit as described in the September 1975 issue, but in a miniaturised form.

The 50Hz output from the clock circuit is gated by a control gate (IC2/4) and then used to gate pin 1 of the calculator chip to pin 3 (which performs the add function) every 1/50 second. If there is a two in the arithmetic register of the calculator, the elapsed time in seconds is accumulated and displayed by the calculator. The two can be entered manually after the calculator/clock has been stopped and cleared, in which case the rest of the circuit is unnecessary.

However, this latter function is more conveniently performed by pressing a single reset button. In the circuit shown, the reset button initiates the following events:

(1) It places a high on pin 3 of the calculator chip, which clears the chip (asynchronously);
(2) It turns TR1 on, causing diode D4 to conduct to place a low onto the control latch. This turns the control latch off; and
(3) It discharges capacitor C1, and charges capacitor C2.

When the reset button is released, C2 will discharge through its associated time constant resistor R4 (47k). After a delay of approximately 25ms, the collector of TR1 goes high and the gate of IC4/4 is held high until C1 is charged again. This allows IC4/4 to gate pin 16 of the calculator chip to pin 4, which enters a two in the arithmetic register. The calculator is now ready to count.

The second version is mains controlled and incorporates a power supply to run both the calculator and the conversion circuitry, eliminating the need for internal batteries. Although the mains frequency is not as accurate as a quartz crystal, it is still considerably better than most conventional stopwatches.

The unit is designed to run off 9-12V RMS from a small mains transformer, or from a 12V 50Hz square wave. Current requirement is approximately 50mA.

In operation IC1/4 is now used to square the 50Hz input, and IC2/4 gates this to IC3/4 which again performs the add function. There are insufficient gates for a control latch, so the stop/start switch cannot be a momentary contact switch. A toggle switch or a push-on push-off switch should be employed instead. However, if desired the gate can

Physics Dept., Victorian College of Pharmacy, 381 Royal Pde, Parkville, Vic 3052.

PARTS LIST

Both versions:
- *1 Novus 650 or NS600 calculator*
- *1 PC board, 24 x 44mm, code 76sw4*
- *1 normally open, momentary contact push-button switch*
- *1 MM74C08 quad AND gate*
- *1 BC108 or equivalent silicon NPN transistor*
- *3 1N914 or similar silicon diodes*
- *1 x 220k, 2 x 47k, 1 x 470k resistors, ¼ or ½W*
- *2 0.47/12VW PC electrolytic*

Crystal version only:
- *1 22k resistor, ¼ or ½W*
- *2 normally open, momentary contact pushbutton switches*
- *1 1N914 or similar silicon diode*

Mains version only:
- *1 x 470k, 1 x 150k, 1 x 33 ohms, 1 x 47 ohms, 1 x 100k, 1 x 10k resistors, ¼ or ½W*
- *1 miniature toggle SPST, or push on push off SPST*
- *1 BZY88/C12 12V zener diode*
- *1 10uF/12VW electrolytic*
- *1 100uF/16VW PC electrolytic*
- *4 EM401 silicon rectifier diodes*

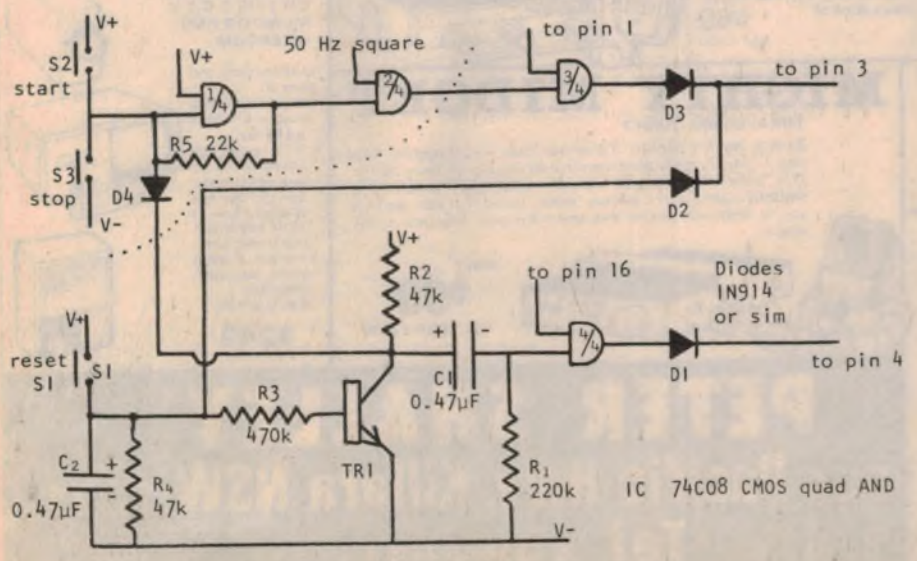

Fig. 1: the circuit for the battery-powered, crystal controlled version.

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36 Ranges With OFF Position
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0 5 10 50 250 1K (15KΩ 1½ V)
0 10u 500u 5m 50m 500m
0 10K 1M 10M 100M (30 Mid Scale)
20 to +62
165H x 110W x 65D
625g
1.5V (UM3) x 1 — 15V (W10) x 1
4Φ x 4

$30 P.P. $3

MODEL Y —50HN

Meter 8uA
25 Ranges With OFF Position
0 2.5 10 50 250 1K (100KΩ ½ V)
0 5 25 100 500 1K (10KΩ ½ V)
0 10u 5m 50m 500m
0 10K 100K 1M 10M (120 Mid Scale)
20 to +62
142H x 97W x 45D
445g
1.5V (UM3) x 1
2Φ x 3

$24 P.P. $3

MODEL FM —10FM

Meter 25uA
19 Ranges With OFF Position
0 3 15 60 300 600 1.2K (30Ω ½ V)
0 6 30 120 600 1.2K (15KΩ ½ V)
0 30u 3m 300mA
0 60R 6M (45 Mid Scale)
0.0001 0.01
0.001 0.1
20 to +16
125H x 88W x 38D
215g
1.5V (UM3) x 1
2Φ x 1

$14 P.P. $3

MODEL FM—20YN

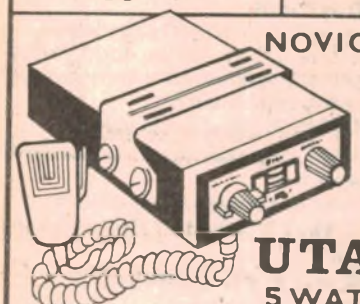
Meter 25uA
24 Ranges With OFF Position
0 5 25 125 250 500 1K (40KΩ ½ V)
0 10 50 250 500 1K (20KΩ ½ V)
0 25u 5m 50m 500m
0 10K 100K 1M 10M (48 Mid Scale)
20 to +62
142H x 98W x 40D
290g
1.5V (UM3) x 1
2Φ x 6

$20 P.P. $3

MODEL Y—60FM

Meter 25uA
23 Ranges With OFF Position
0 0.6 3 15 60 300 600
1.2K (30KΩ ½ V)
0 6 30 120 600 1.2K (15KΩ V)
0 30u 3m 300m
0.6K 600K 6M (45 Mid Scale)
20 to +63
132H x 88W x 38D
260g
1.5V (UM3) x 1
2Φ x 6

$17 P.P. $3



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27MC GPV BASE LOADED

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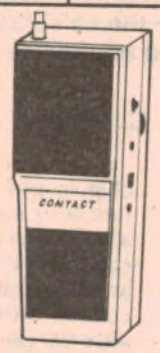

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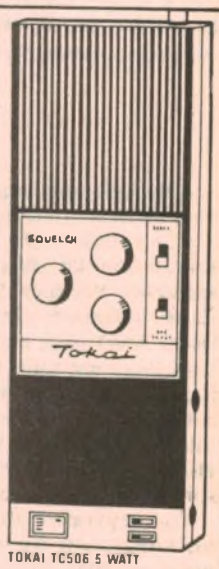
$97 P&P $3.00



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This great 6 channel 27 Mc mobile has been slashed to sell the last few of the model. It is complete with 1 set of xtals, p/t/t mike, cradle, etc. Was great value at $99. Twenty only left now at give away price of

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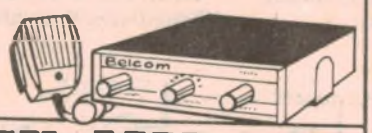

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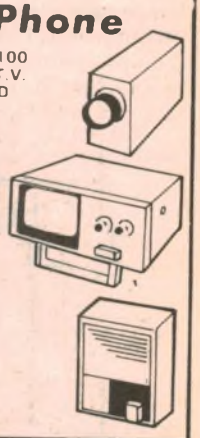

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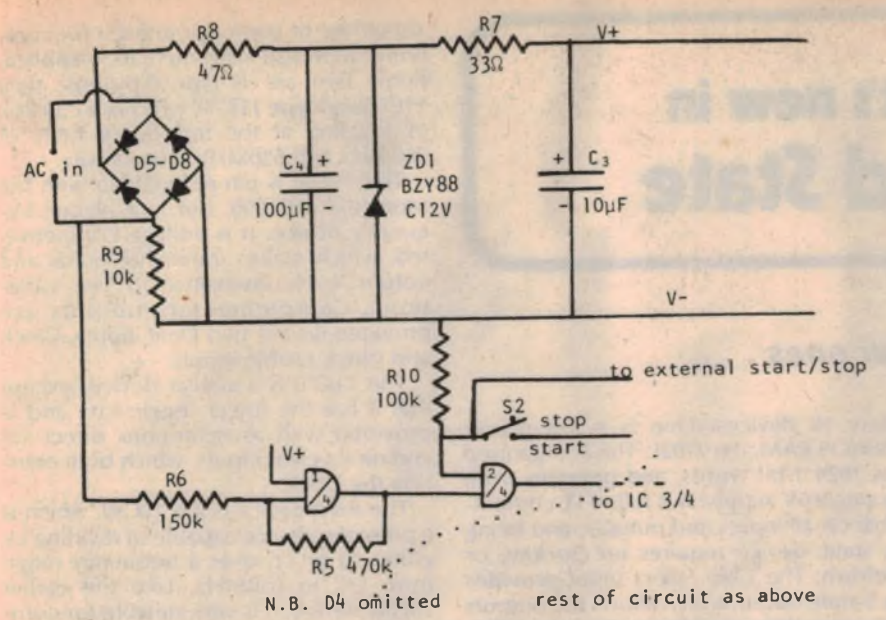


Fig. 2: additional circuitry for the mains controlled version. Replace those components above the dotted line in Fig. 1 with the circuit shown above.

still be controlled by voltage levels such as those from an external flip-flop. Switch S2 has to be in the stop position for resetting to occur.

A small printed circuit board is used to facilitate construction, the same board being used for both versions. The board measures just 24 x 44mm, and is coded 76/sw/4. Note that for space reasons some components are end mounted.

The crystal controlled version uses only those parts shown on the PCB below the dotted line. The board, together with the crystal driver, can be fitted into the space under the keyboard of the Novus 650, although it is a tight fit. Fitting this version into the NS600 case was beyond me.

The mains controlled version includes all those components above the dotted line, in addition to the parts used for the crystal version. The exception here is diode D4, which should be omitted. This version has an advantage in that it can be easily fitted into the battery compartment of the calculator, since internal batteries are eliminated.

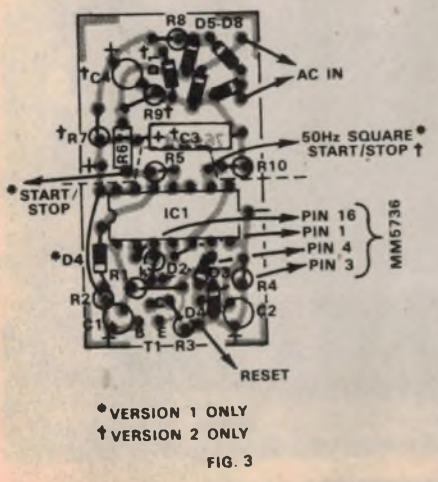


Fig. 3: the component overlay pattern on the PCB. Board is actual size.

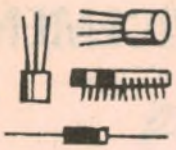
Opening the Novus 650 case is fairly straightforward. Simply remove the battery cover and the battery from the calculator, slacken the nut on the AC input, and undo the four securing screws. The back can then be removed.

However, the manner in which the older NS600 is opened is not as obvious. The latter is held together by eight plastic studs, four behind the stick-on back label and four in the back of the battery compartment. To undo them, simply touch the end with a not-too-hot soldering iron while gently prising that part of the case apart. The rear flap of the battery compartment may be cut off.

After assembling the small PC board, connections to the calculator can be made by soldering the leads directly onto the pins of the MM5736 calculator IC. Note that it is necessary to modify the calculator board by cutting the copper track on both sides of pin 1 of the MM5736 chip. The tracks on both sides of pin 1 should then be rejoined with a single strand of insulated wire, leaving pin 1 isolated. This modification was detailed in Mr Campbell's article.

The plus and minus supply leads can be taken directly off the wires to the battery plug. There is room for the reset and stop/start switches to be mounted through the calculator case on either side of the circuit board. When re-assembling the calculator, take care to ensure that the leads do not foul and that the calculator fits together without needing to be forced.

Operation of the unit requires that the calculator switch be turned on only after the 50Hz drive has been turned on. This is to ensure proper start-up of the MM5736 calculator IC. The stopwatch is then controlled in the normal manner by using the start, stop and reset buttons.



What's new in Solid State

Memories—big ones, smaller ones . . .

We have a rather mixed bag of new devices to talk about this month, although all of them are digital ICs, and most are fairly obviously intended for use with microprocessors and other computers. As you may have gathered from the emphasis in this column over the last few months, this seems to be the semiconductor product area getting most attention at the moment by the big US and Japanese manufacturers.

The first item is in fact from Hitachi Ltd in Japan, a firm which seems to be very active in the microprocessor and memory area. It is a prototype 16k RAM chip, fabricated using N-channel MOS technology, which Hitachi announced at the 1976 International Solid State Circuit Conference held a few weeks ago in Philadelphia.

Most of the major semiconductor makers in the world have been hard at work on developing a practical 16k RAM device using NMOS technology, as such devices are expected to replace 4k devices as the main memory elements in the next generation of computers. Hitachi looks to be well in the forefront of this activity, motivated in part by their commitment to the "Pattern Information Processing System" project initiated and funded by the Japanese Government.

In their release announcing the prototype of the new device, Hitachi reveal that it is a dynamic device using single-transistor memory cells. There are apparently difficult problems associated with this approach, if one is to achieve high speed and stable operation. Layout and compatible peripheral circuitry were very critical, but Hitachi say they now have these problems under control. New sense amplifiers have been used also, to balance stray capacitances and suppress noise injection from adjacent data lines.

The high packing density required for a practical 16k device has been achieved by local oxidation techniques, photolithography capable of 5um resolution, and ion implantation for channel doping.

The device is organised as 16,384 1-bit words. It has an access time of 200ns, with a refresh time of 2ms. The chip is packaged in a 22-pin ceramic DIP, and dissipates 6mW in standby mode rising to 500mW when operating.

While we are talking about memory chips, Fairchild have just released three new 1k devices. One is a low-power NMOS RAM, the 2102L. This is organised as 1024 1-bit words, and operates from a single 5V supply. It is fully TTL compatible on all inputs and outputs, and being a static device requires no clocking or refresh. The Chip Select input provides a 3-state output which allows the outputs of a number of chips to be wired-OR. Manufactured using Fairchild Isoplanar process, the 2102L dissipates only 131mW maximum at 350ns access time. It is available in a 16-pin ceramic DIL package, in the commercial temperature range.

The other two devices are high speed field-programmable ROMs, the 93417 and 93427, which are both organised as 256 4-bit words. The devices are identical except that the 93417 has open collector outputs, while the 93427 has 3-state outputs. Both have two ANDed low active Chip Select inputs, and both are supplied with all bits stored as 1's. Any bit can be programmed to a 0 by following the field programming procedure. The devices use Isoplanar Schottky TTL technology.

Fairchild have also released three new very high-speed ECL devices, which should be of particular interest for communication and instrumentation applications. Two are D-type flip-flops, type 11C06 and type 11C70, which are capable of toggling at the impressive rates of 750MHz and 650MHz respectively.

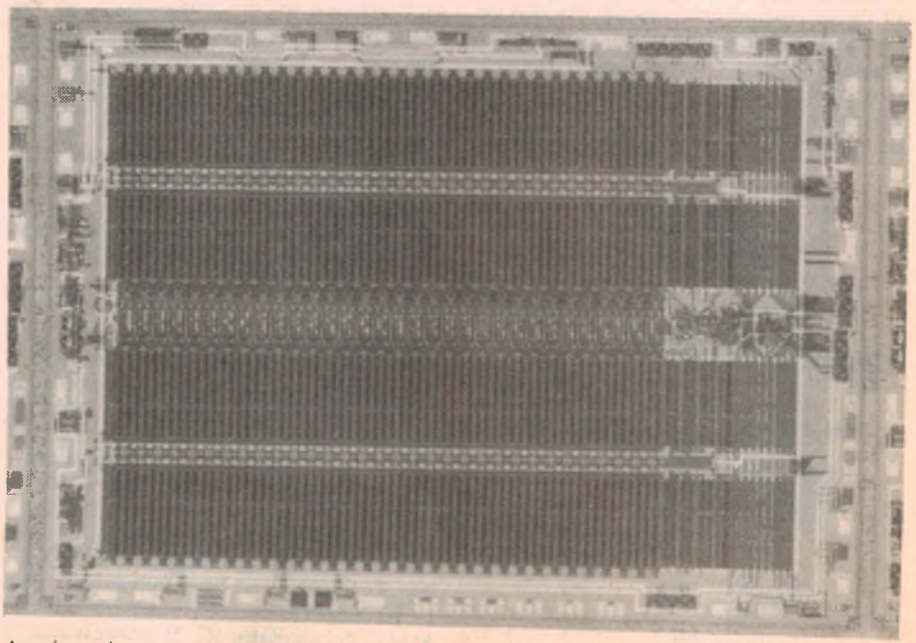
The 11C06 is pin compatible with the Motorola MC1690, but is a higher frequency device. It is voltage compensated, which makes input thresholds and output levels insensitive to Vee variations. Complementary outputs are provided, as are two Data inputs, Clock and Clock Enable inputs.

The 11C70 is a similar device, except that it has the lower toggle rate and is provided with asynchronous direct set and direct clear inputs, which both override the clock.

The third device is the 11C90, which is a prescaler device capable of dividing by either 10 or 11, over a frequency range from DC to 650MHz. Like the earlier 95H90 device, it is very suitable for communication and instrumentation applications. It will operate from either TTL or ECL power supplies and has high speed totem-pole TTL output with 20mA fanout, as well as complementary ECL outputs capable of driving 50-ohm lines.

Further details may be obtained from Fairchild distributors, or from Fairchild Australia on Sydney 929-6711 or Melbourne 81-0592.

National Semiconductor have also released some interesting new devices. Of particular interest for use with microprocessors are four new octal buffer ICs, which provide no less than eight two-input buffers in a single package. Designated DM81LS95, DM81LS96, DM81LS97 and DM81LS98, the new devices use low-power Schottky TTL technology, and thus have very good speed/power performance: propagation delay is typically 14ns, while power con-



A microphotograph of Hitachi's new 16k NMOS RAM memory chip, which they announced recently. It has a 200ns access time, and 2ms refresh time.

sumption is typically around 80mW.

Essentially they are low power, octal versions of the familiar DM8095,8096,8097 and 8098 hex buffers. One of the two inputs to each buffer is used as a control line to gate the output into the high impedance state—the devices are Tri-state. The --95 and --97 devices present true data at their outputs, while the --96 and --98 devices invert the data. In the --95 and --96, all eight buffers share a common Tri-state enable line, controlled by a 2-input NOR gate. In the --97 and --98, the buffers are split into two groups of four, each with its own control line.

All four devices are currently in stock.

The other interesting new devices from National are a family of CMOS multi-decade counters, complete with latches and buffer-drivers, and intended for general use in digital display systems and instruments. There are four devices in all, with type numbers MM74C925, MM74C926, MM74C927 and MM74C928. As you can see from this, they are part of the "74C" family of CMOS devices originated by National.

The --925 device contains a 4-decade counter, four 4-bit latches, and a multiplexed 7-segment output section which needs only 7 resistors and four digit selector transistors to drive a 4-digit LED display. The multiplexer has its own free-running oscillator, and needs no external clock.

The ---926 is like the first device except that it has a carry-out connection to allow cascading beyond four decades, also a display select line which allows either the data in the latches or the data in the counter to be displayed. The ---927 retains these features, but has a divide-by-six counter in the second most significant position, so that by making the count input frequency 10Hz the display reads in tenths of seconds, seconds, tens of seconds and minutes—e.g., 9:59.9. This makes it very suitable for use in a stopwatch.

The ---928 is also like the ---926, except that the most significant stage has a divide-by-two counter, and the carry-out is an overflow indicator. This makes it very suitable in 3½-digit counters for instrumentation.

All four devices are designed for a supply voltage range from 3 to 6V. The display segment drivers deliver 80mA typical into LEDs with 1.6V drop, with a nominal 5V supply. The ---925 device comes in a 16-pin DIL Epoxy-B package, while the other three come in a similar 18-pin (0.3in spacing) package.

Further information on these National Semiconductor devices would be available from NS Electronics Pty Ltd, PO Box 89, Bayswater, Victoria 3153. (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.

Forum

Conducted by Neville Williams

Bringing hifi gear down to earth!

An abrasive problem which is currently facing the Australian hifi industry has to do with the 2-wire flex and the 2-pin plugs which are fitted as standard to much of the imported equipment. We can't offer an immediate solution to the problem, but we can discuss it in terms which may encourage debate rather than invective.

It may seem a rather strange way to introduce the subject but I'd like to turn the clock back 40 or 50 years, to a time when electrical standards and wiring practices in Australia were anything but uniform.

At the time, I was living in a house in the country—one of a small group of homes and shops which had the electric light on, as distinct from kerosene lamps. It was a real do-it-yourself installation: an 80V DC generating set, with a battery bank, set up by a local handyman and wired by the same handyman—neatly but to his own standards of workmanship.

When the 240V mains came through the village, the said wiring was checked and passed, more or less as was; fuses, meters and lamps were changed, and the 240V AC fed straight in. I couldn't imagine that happening today!

Shortly afterwards, when I came to Sydney to my first job, it was to work in a radio factory in the heart of the city, connected to 240V DC mains. A rotary converter provided the AC for sets under test but everything else—lights, iron, water heaters, etc—were run from the DC mains as often as not from bayonet sockets! And pity help the unwary person who was careless enough to unplug anything substantial without first switching off; it would often start an arc which would run up through the socket to the cord and then start burning its way to the ceiling rose!

The other half of the story was that the receivers emerging from the said factory were normally fitted with a length of cotton lamp cord, knotted where it passed through the outlet grommet, but simply bare at the far end. The men who delivered them carried a box of fittings to meet any occasion—bayonet (lamp) plugs, 2-way adaptors, American and English style 2-pin power plugs, and even Australian style 3-pin plugs!

That was a measure of the then consumer market.

Subsequently, I took a job in a relatively new Sydney skyscraper (1930 vintage) which was wired completely in accordance with British practice—presumably because the company's chief electrician was a dour Scot of the old school. Power points, no more than originally needed, were all of the 3-pin round variety and his way of controlling what was connected to the mains was to strictly control the issue of matching plugs!

Older readers could undoubtedly match such recollections but enough has been said to make the point.

Reacting to what was then an obviously chaotic situation, authorities in all states of Australia have been working progressively towards better and more uniform standards covering virtually every aspect of electric power reticulation.

Undoubtedly, one could raise many arguments about their ideas and administration, etc., but the fact is that the original chaos has gradually given way to uniform standards, fittings, procedures and so on. Rarely now does one come across radio sets, irons and toasters running from 2-way adaptors plugged into the light socket. If there's still a way to go, at least it can be said that we've made considerable progress since 1930.

"I'd have taken this too but it's got the wrong kind of power cord . . ." (With acknowledgements to "BASF Newsletter").

All through, there has been a strong emphasis on safety and, from the user's point of view, it depends heavily on two requirements:

(1) The exposed metallic structure of all mains-operated appliances should be effectively earthed through a third wire in the mains cord and a third circuit in the plug and socket. Should an electrical breakdown occur in the appliance, the earthing provision should prevent the structure of the appliance from becoming "live" and therefore a danger to the user. Instead, the fuses should blow or an isolating cut-out should operate, effectively opening the active mains supply lead.

Either that or:

(2) The appliance may be "double insulated". The term has formal implications but the basic idea is that there must be two distinct and acceptable insulation barriers between the mains circuitry and the outside environment. Both have to be breached before the appliance becomes unsafe. Double insulated appliances are fed via an approved 2-wire flex, with no earth lead. Possibly the most familiar example of the practice in Australia is electric shavers, which are obviously much easier to handle with a lighter, 2-wire lead rather than the usual heavier 3-way flex.

The long and short of it is that Australian supply authorities, with Government cooperation, have largely sorted out the early chaos and instituted standards, methods and procedures covering most facets of electric power reticulation and use. At the consumer level, it gets down to the details of appliances, flexes, plugs, sockets, house wiring, earthing, fuses, etc.

There is no shortage of critics ready to denigrate the measures themselves, "bureaucratic" attitudes and complexities of gaining design approval, but that is another argument.

Much more to the point is that the hifi industry is a stone out of place in the edifice and, the more everything else is brought into line, the more attention tends to focus on the odd bit!

This comes about largely because most of the hifi equipment currently being imported into Australia is manufactured in—or for—countries which have 117V AC mains, and a convention of 2-wire mains cords without earth and with not more than conventional insulation procedures. As a convenience, many of the amplifiers have a row of 2-pin mains sockets along the back into which other items of equipment can be plugged.

The discrepancy in mains voltage is no great worry in itself. It is now com-

monplace for the mains transformers to have two primaries, which are connected in parallel for 117V AC and in series for 240V AC. By changing the power plug to an Australian 3-pin, or simply twisting the original parallel pins so that they will fit into an Australian socket, the system can operate from Australian mains, supplementary sockets and all.

The trouble is that such adaptation does not conform to Australian wiring rules for a number of reasons.

1. Parallel 2-pin power plugs are not approved for Australian power mains, whether used as is, or twisted so that they will fit the sockets. Apart from the physical implications of forcibly twisting the pins, they may be too long, allowing tiny fingers to stray between plug and socket before the circuit is broken.
2. The 2-wire flex which comes with the equipment may or may not be approved or acceptable for connection to Australian 240V AC mains.
3. The connection as a whole is unacceptable for another reason in that, while the equipment is not earthed, it probably does not employ double insulation techniques either.

Superficially, the immediate problems should be overcome by the manufacturer or his distributor fitting an approved 3-pin power cord and plug to the equipment, making sure that the earth wire is suitably connected to the chassis. If the 2-pin outlets at the rear cannot be replaced by approved 3-pin outlets (there is often a physical problem here) they could be disconnected internally, so that ancillary equipment has to be plugged into a wall outlet.

This is being done in some cases, but under protest and without enthusiasm. To quote one acquaintance concerned with installing hifi gear: "Instead of being able to tuck the flexes out of sight, you end up with an ugly bunch of them converging on the power point. The customers are definitely not happy!"

Unfortunately, there is another dimension to this which is no less serious: the problem of hum in the output caused by earth loops, resulting from the multiple earth leads.

Here I can quote another hifi dealer: "Following an article in a consumer magazine, several of my customers brought back gear with the request that we fit a 3-wire flex. We did so without charge but, next day, they were back with the complaint that the equipment now had a noticeable hum. We told them that they could overcome it by disconnecting the earth wire, which they did. The whole exercise left them wiser and us poorer!"

To understand how hum can enter a hifi system via the earth wiring, consider the following proposition:

50Hz magnetic fields exist randomly in space around street and house wiring, so that any hifi gear we purchase and set up is fated to operate in a 50Hz field, some environmental, some due to its own transformer and wiring.

Now let's say that we have an amplifier and a separate cassette deck interconnected by normal shielded signal leads. Both plug into a power point, and each has a separate earth lead running to the point (or points). It is now possible to trace a continuous earth path from the power point to the chassis of the amplifier, along the signal earth leads to the chassis of the cassette deck, then back along its earth lead to the power point—a complete loop.

Since this loop exists in an alternating magnetic field, it is highly likely that cur-

An enthusiast has his say!

Dear sir,

I would like to suggest a topic for your Forum section, namely the use of three-conductor mains cords for electronic equipment with the third conductor used to earth the equipment.

This has caused me trouble in quite a few installations due to earth loops when the signal braids are also connected to the frame of the equipment. In this case there is a continuous path via mains earth to socket, back to the amplifier and via signal braids to the ancillary equipment.

I have corrected the problem in one of two ways, either by isolating the signal source from the rest of the "machinery" and using the mains earth, or by plugging it into an earth-isolated power outlet.

In some machines it is easy to isolate the signal source, for example in a turntable but, in a taperecorder, a non-earth is a much easier way out.

It means that, when purchasing a piece of equipment, it must usually be modified before it can be used correctly—a problem where a non-technical buyer lives away from the shop where it was purchased.

I accept that machines operating from mains supply should be earthed for safety reasons and shielding purposes; also, if the signal braids are relied on for earthing, that they may not be able to carry enough current to open the fuse if a breakdown did occur.

However, in view of the stringent requirements for mains transformer insulation required by Australian Electricity Commissions, I feel that they should waive the 3-conductor mains leads for equipments which provide drive for an earthed main amplifier and instead require the earth braids of signal carrying leads to be capable of carrying at least 10 amps for a specified time.

I must stress that I am not qualified to write on this subject, but I have been plagued by earth loops to the point where I have "a thing" about them. I sat down to write this letter when I found an acquaintance, happily listening to his hifi hum without realising that it was not included in the price!

R. B. (Seymour, Vic)

FORUM: Bringing hifi gear down to earth!

rent will be induced in it and voltage drop will occur along it, depending on the relative length and resistance of the various segments. One of the segments is, of course, the earth return of the signal leads—which simply means that a hum voltage has appeared in the signal circuit. It will be a very small voltage but, in a high gain circuit, that's all it needs to produce a perceptible hum!

The hum may or may not be evident in the cassette record/play function, depending on the level at which the signals are interchanged. Curiously, however, it may show up in a seemingly unrelated function where the signal level is very low: when operating from a magnetic phono cartridge.

> *I read your "Forum" with interest each month.*
> *I would be grateful if you would write an article on the subject: Should electricity supply authorities use the "earth" system?*
> *It seems to me that, in most cases of electric shock, the victim has come into contact with active and earth. I believe that, in the USA, no earth is used and it would be interesting to compare fatalities on a per capita basis, hopefully allowing for the lower supply voltages used there.*
> *I asked one electrician and, for a while, he seemed stuck for an answer. He finally came up with: "er . . . what if one line was accidentally earthed, say next door?"*
> *T.H. (Liverpool, NSW).*

This comes about because the earth loop current resulting from other equipment—cassette deck, tuner, etc—may flow through the phono preamp earth pattern on its way to the chassis earth point in the amplifier. In so doing, it can set up an AC voltage drop too small to affect the cassette player or tuner, but large enough to produce a hum in the phono system.

Two suggestions might flow from this: If a mains earth is a legal requirement, and if the closed earth loop is the problem, why not open or omit the signal earth paths?

In terms of hum, the idea may work in some cases but it is certainly not to be relied upon. As often as not there is some reactively generated current from the device itself flowing in the earth lead and, if this appears directly in the signal return path, the cure can be worse than the complaint.

Much more urgent is the fact that, if one has a signal lead connected to an amplifier input, with the volume control advanced, and the earth return is accidentally opened by removing the power plug . . .!

The result is likely to be a "blurt" sufficient to wreck the loudspeakers or the output transistors. You just don't tolerate that kind of situation.

The second suggestion is to position the signal and power leads so that they are substantially parallel instead of forming a large open loop in space.

This can have some effect as evidenced by the fact that, when one has a hum loop situation, moving leads around can change the level of the hum. However, it's a "fiddle" rather than a cure and, as often as not, pushing power and signal leads close together can increase direct induction as the price of closing the loop—a rather pointless exercise!

It becomes even more pointless if the equipment has to be plugged into physically separated power points, with the added possibility of small but extraneous current flowing in the household earth circuit.

It is for reasons such as this that representatives of the hifi industry tend to react somewhat emotionally to suggestions that their equipment may one day need to be "prescribed"—subjected to tests and type approval like other devices intended for connection to the power mains; like irons, toasters, shavers, electric drills, etc.

With some heat, they ask whether the pressure to conform to Australian electrical standards flows from a real user-hazard or from mere bureaucratic motives.

To be sure, hazardous situations can be dreamed up:

A young child pulls a non-approved 2-pin plug partly from a power socket; its tiny fingers can stray into the intervening space and find a live pin because, being too long, the pin is still touching the live contact inside the socket.

Again, John Citizen may not be aware that his prize cassette deck has developed a mains-to-chassis short and has fused the thin signal earth braid that previously linked the two chassis. He puts one hand on the live cassette deck and the other on the earthed amplifier chassis, and Mrs. John Citizen becomes an instant widow!

So runs the scenario but—say the industry buffs—has it ever happened? Is it ever likely to happen, considering the quality of the gear we sell? Is the risk anything like as great as when the same John Citizen goes for a drive in the family car?

And that's about where matters rest at the moment, with the involved parties variously edgy and variously vocal.

There's no question of existing equipment being suddenly banned and no reason not to buy off-the-shelf equipment, if it's what you want. But, around the corner is a situation that will have to be sorted out in the not-too-distant future.

It seems inevitable that hifi gear will have to come into line with local electrical standards and, because there is more to it than merely changing a cord and socket, it is equally inevitable that the overseas manufacturers will have to provide the ultimate solution. They will have to select the common earth point in their amplifiers, "float" the internal circuitry in some cases, and attend to other relevant details to achieve maximum hum immunity with earthed rather than floating peripherals.

One can well imagine that not all equipment manufacturers will be urgently gripped by the need to do something for a secondary market—a place "down under" where they use 240V mains and get all up-tight about user safety! It may well be, however, that if they do not face up to the problem, they may ultimately have to vacate their place under the southern cross.

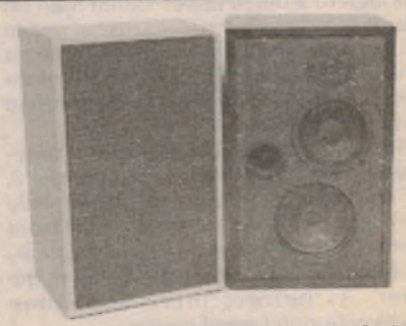
And it may not end there. There's a little place called Britain where they also use 240V mains where they are similarly touchy about insulation, earthing and all that!

In short, it's not a problem that's going to get up and go away. It's going to become more and more significant as electricity supply authorities around the world gradually tighten up their safety standards.

If this article helps to promote a solution to the problem sooner rather than later, it will have served its purpose.

NEXT MONTH . . .

- We tell you how to build our new Playmaster 3-41L loudspeaker system, ideal for use with the "Twin Twenty-Five" or other high quality amplifiers. Not unduly expensive but it really performs!
- Playmaster "Twin Twenty-Five" amplifier: finishing touches.
- Synchronise your slide projector with a tape recorded commentary.
- Simple audio output voltage indicator using a miniature LED array.
- Plus many other articles and all our regular departments and features.



Above: The new Playmaster 3-41L loudspeaker system.

(Please note: contents of an issue can change due to unforeseen circumstances.)

The Serviceman

When the neighbour's set goes on the blink

The problems of television reception in home unit blocks do not end with inadequate aerial systems, at least not if a friend's recent experience is anything to go on! A neighbour's transgressions were to set him back the cost of a service call, for a set that was functioning perfectly.

It all began when my friend bought a colour TV set, one of the most popular locally made brands. Included in the deal was a service contract covering the set for twelve months from date of purcahse. The set was duly delivered and installed, and he settled back to enjoy the colour.

For the first few months the set functioned normally and, apparently, to his complete satisfaction. Then, two weeks after the expiry of the initial free service period stipulated in the service contract (Murphy's Law), it began to "play up".

The trouble started one night when my friend was sitting quietly at home watching a program on Channel 2, Sydney's ABC station. About half way through the program, the picture suddenly began to roll, the colour killer cut in, and several vertical "bands" each about a centimetre thick, appeared on the screen. The sound was also affected, there being a fair amount of noise and quite noticeable distortion.

Although the symptoms were unusual to say the least, my friend's first reaction was to suspect a technical hitch at the station. But the fault persisted, eventually prompting him to check reception on the three commercial channels.

But no joy! Switching to channels 10, 9 and 7 in turn revealed that the problem was evident on these channels as well, although to a much lesser extent than on Channel 2. In all three cases, a stable colour picture could be obtained, but the vertical bands remained. And in colour these looked even more spectacular than those on Channel 2.

However, instead of the two, sometimes four, vertical bands on Channel 2, the commercial stations displayed only one each. This band scanned slowly from right to left across the screen, disappearing at one edge before reappearing at the other. As before, there was some deterioration in sound quality.

By this stage, the problem was beginning to look much more serious, and my friend began considering the possibilities. He has, by the way, a general knowledge of matters electronic, although more at an enthusiast's level than at a professional level.

Living in a home unit, he first considered the possibility that some form of external interference was reaching his set through the community aerial system. So he unplugged the aerial lead from the wall socket and substituted a small indoor aerial. Although the indoor aerial was inadequate for normal viewing, it would hopefully prove or disprove his theory.

Unfortunately, his efforts were in vain, the problem remaining very much in evidence regardless of the aerial system in use. Seemingly, this eliminated the possibility of interference through the community aerial system. Then, as suddenly as it had appeared, the problem disappeared, and the set began functioning normally.

This pattern was to be repeated over the next few nights. The problem would suddenly appear to interrupt perfect reception, and just as suddenly disappear, apparently at random. Once in evidence though, the problem usually persisted for some hours, and was occasionally present at switch-on.

Convinced by now that his set had developed some strange kind of intermittent fault, my friend decided to call the service company. As far as he was concerned at this stage, it would be well worth the cost of a service call for a qualified serviceman to deal with the problem.

"Hummm." (Radio-Electronics.)

The service call necessitated that my friend take an afternoon off from work. At first, things didn't go so well: Arriving home, he switched the TV set on, hoping that the problem would show up by the time the serviceman arrived.

But the problem didn't show and neither, for that matter, did the serviceman—at least not until 7.30 pm! By that time my friend had given the service company up as a lost cause and had turned the set off. I gather that he was feeling thoroughly "liverish", both with the set and with the service company.

As it turned out, the serviceman's late arrival proved rather fortunate. This time when the set was switched on the fault chose to appear, much to my friend's relief. At least the serviceman would have something to get his teeth into.

However, things didn't work out quite the way my friend expected. The serviceman took only a moment to check reception on all channels before commenting: "There's nothing wrong with your set, you've got some kind of interference problem."

"What kind of interference," asked my friend, somewhat unconvinced of this diagnosis.

"I'm afraid I don't know," was the reply. "It could be one of the FM stations; or someone close by could be operating a transmitter. It might even be welding equipment. Anyway, I'm positive that there's nothing wrong with your set."

"Can't be the FM stations," my friend protested. "They've been in operation for sometime now; and I've never had any trouble before."

But by now he was beginning to realise that the serviceman was right—that it was some kind of interference problem. But interference from what? Certainly judging by the strength of the interfering signal the source had to be quite close by, probably within the same building.

Then, just as the serviceman was preparing to leave, my friend suddenly came up with an idea.

"Listen," he said, "I've got some new neighbours in the unit downstairs; only just moved in as a matter of fact. Could their set be causing the interference?"

"It's possible," the serviceman agreed. "Why not go down and ask them to turn their set off?"

It was worth a try, so my friend disappeared down the stairs to find that the new neighbour did have his TV set turned on and that, yes, he was willing to help. The set was turned off, and my friend hurried back up the stairs to check the results. The interference had completely disappeared!

It took only a few repeat observations to confirm beyond doubt that the neighbour's set, apparently faulty, was indeed the cause of the interference. The neighbour, by now somewhat puzzled by the operation, was invited up to see for him-

self the problems his set was causing. A great deal of tact and diplomacy would be required if the problem was to be solved, and my friend knew it!

I gather that what followed was a brief discussion between my friend and the serviceman on means of stopping the interference, when the neighbour suddenly volunteered the information that his set was "hissing". And as far as he was concerned, the serviceman was quite welcome "to come and have a look at it".

Despite the hour, the serviceman readily agreed. The "hissing" noise was probably due to some kind of EHT fault, and could hopefully be fixed without too much trouble. At the very least, he was prepared to take a quick look and see what could be done.

The set concerned was a vintage Kriesler 22-inch model. It took only a moment to confirm that it did indeed have an EHT fault, arcing obviously taking place inside the EHT cage. And this was what was causing the interference to my friend's set, apparently either as mains-borne RF energy or direct radiation, or as a combination of both. It is also interesting to note that the offending set was suffering from self-interference, there being a quite discernible interference band running up the face of the picture tube.

What followed was something of an anti-climax. The EHT cage was removed and the problem quickly traced to a faulty EHT rectifier, a 1S2. The anode cap had come adrift and was merely sitting in position on top of the valve body. Arcing was taking place between the body of the cap and the anode lead that emerged from the top of the valve.

Not having a suitable replacement on hand (after all, he had come equipped to deal with a modern solid-state colour set), the serviceman simply soldered the anode cap back on. A few other minor adjustments to control settings and the set was back in operation, this time minus the interference effects.

And that solved both my friend's problems and his neighbour's problems. Not that my friend was completely happy. It had just cost him a service fee to find a fault in his neighbour's set, not to mention a great deal of time and inconvenience.

But he was able to derive some satisfaction from the fact that his neighbour was also "stung" (and unexpectedly stung at that) for a service fee. Having fixed the fault, the serviceman felt he was entitled to a second service fee. After all, he had been under no obligation to service the neighbour's set.

The view was supported by my friend, by now feeling thoroughly uncharitable towards his new neighbour. In fact, I suspect that he sensed that some form of poetic justice was at hand. The result was that the neighbour "coughed up". And to quote my friend, "that service technician charged like a wounded bull".

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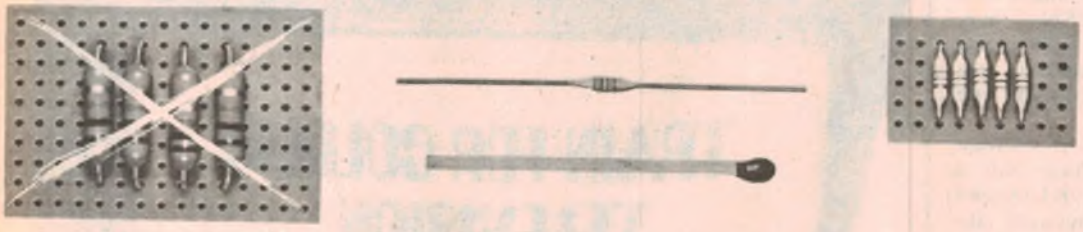

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Circuit & Design Ideas

Conducted by Ian Pogson

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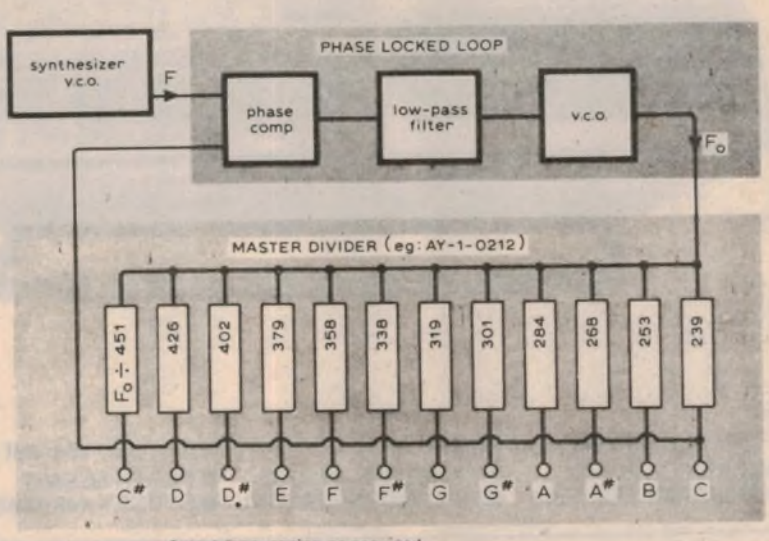
Producing chords on a synthesiser

To play chords on a synthesizer, VCOs are normally run from a common voltage source with the appropriate offsets to each oscillator. To do this all the oscillators must be matched to the same voltage/frequency curve. A more satisfactory solution is to use a configuration similar to that shown in the diagram. The advantages are that only a single VCO is necessary in order to get an octave of notes. The circuit is basically a phase-locked loop frequency multiplier with the divide by N section a master divider. Unfortunately the range is limited by the phase-locked loop locking range.

(By H. A. Thomas, in "Wireless World".)

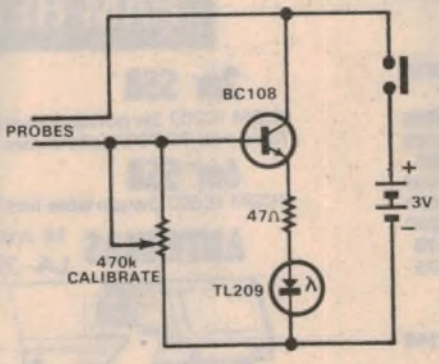
Editorial Note: The same basic idea could be used to make switchable transposing from one key to another, on electronic organs.



Select frequencies as required

Simplified plant moisture checker

This is a variation on the Water Warbler which was published in December, 1975. It uses a LED rather than an audible signal to indicate the moisture content of soil. It also offers such features as simplicity, low cost, small size and very low current drain permitting the use of penlite size dry cells. One disadvantage is that the unit needs re-calibration as the battery voltage falls. However, this operation should only need to be done infrequently. A reference resistor of about 47k is useful for checking calibration. Another disadvantage is that the difference between full brightness of the LED and partly on is a little hard to judge at first but experience soon overcomes this difficulty.



I mounted the probes on a separate piece of plastic to the main unit which was built into a small box. The LED was glued into the cap of a green felt pen, to shield it from background light. A push-button switch is also used because the unit could easily be left on if a conventional toggle switch were used.

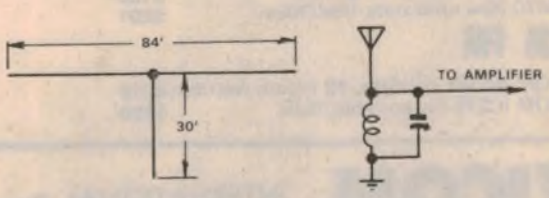
(By Mr P. Schubert, P.O. Box 90, Cadell, SA 5321.)

Aerial for LF & VLF reception

Some years ago I made myself a rather crude VLF converter which tuned from about 15kHz to 70kHz. I used it in conjunction with my BC348 receiver. With this arrangement I had no difficulty in picking up a large number of stations, including NAA on 17.8kHz in Cutler, Maine, U.S.A.

My attention was drawn to the article describing an LF and VLF converter in March, 1976. This converter normally uses a ferrite rod loopstick aerial but it was also mentioned in the article that there was some room for experimenting with aerials for this specialised field.

As an alternative to the loopstick, a large external aerial can give good results. It is necessary to extract as much energy as possible from the aerial, as well as being able to tune it to some extent. The simplest way that I know of doing this is to use a parallel tuned circuit connected directly to the aerial as shown in the diagram. Although this may look a little primitive, it is effective. Since the aerial capacitance is shunted directly across the tuning coil, it becomes part of the tuned circuit, with maximum energy transfer, as well as being tunable at the same time.



(By Mr J. A. Adcock, PO Box 106, Preston, Victoria 3072.)

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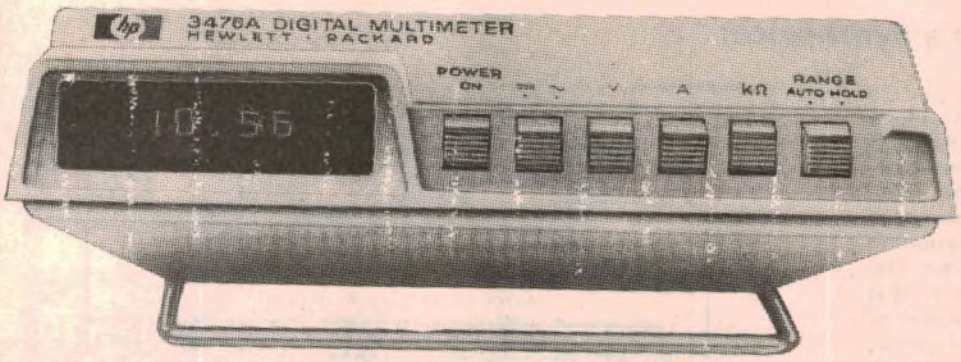

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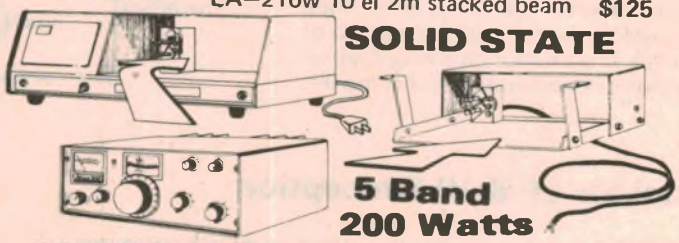

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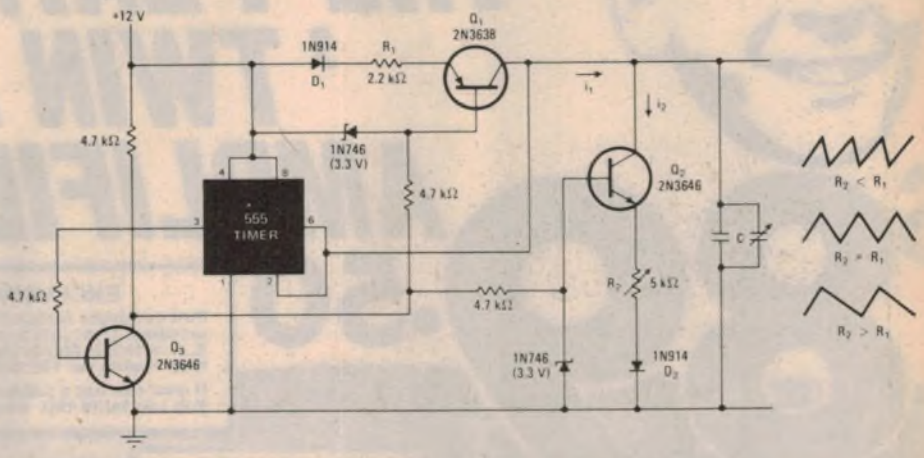
Adjustable symmetry triangular waves from 555 chip

The fixed frequency triangular waveform often required in pulse-duration modulators or sweep generators often turns out to be rather costly. However, an inexpensive 555 timer and some transistors can generate triangular waves at frequencies up to about 100kHz.

The circuit shown generates a triangular waveform by alternately charging and discharging a capacitor. The transistors Q1 and Q2 with their zeners act as a switched-current source and a switched-current sink that are activated by Q3. When Q3 is on so that its collector is low, the Q1 current source is switched on and a current i1 charges capacitor C. The linear voltage ramp that appears across C corresponds to the charging law $dV/dt = i1/C$.

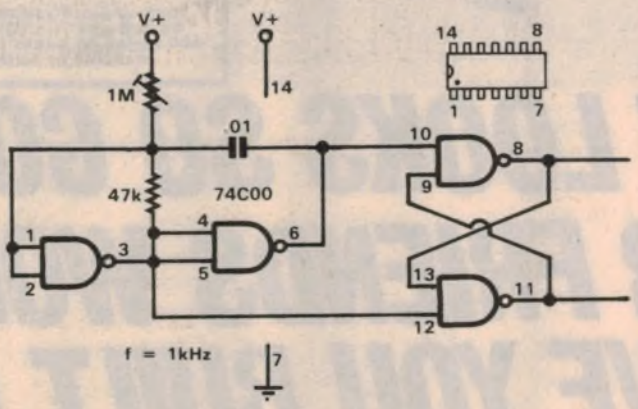


Voltage V across the capacitor increases until it reaches a level that is ⅔ of the supply voltage, which is the upper trip point of the 555 timer. The voltage at pin 3 of the timer then goes low, turning off Q3. Since the collector of Q3 is thus made high, the Q1 current source is deactivated and the Q2 current sink is switched on. The capacitor is discharged by i2 until the lower trip point of the 555 timer is reached, at ⅓ of the supply voltage. At this point the 555 changes state and the cycle repeats. Thus the output voltage varies from 4V to 8V if the supply is 12V.

Q1 and Q2 may be any high-gain PNP and NPN transistors, such as 2N3638 and 2N3646. Q3 may be any NPN switching transistor, such as 2N3646. The forward voltage drops of D1 and D2 ensure turn-off of Q1 and Q2. Resistor R2 is a symmetry adjustment, controlling the discharge rate of C by varying i2. For the values shown, the frequency in hertz of the symmetrical triangular wave form is roughly 75/C, where C is in microfarads. Thus C determines the frequency.

(By Devlin M. Gualtieri, in "Electronics".)

2-phase CMOS clock oscillator



Here is a simple oscillator, based on a CMOS quad gate. The first two sections are wired as inverters, and connected to form an RC oscillator. With the values as shown, the frequency is approximately 1kHz. The waveforms at pins 3 and 6 are somewhat rounded complementary squarewaves. If required, a 1M trimpot can be connected between the positive supply rail and pins 1 and 2. This can then be adjusted to give a unity mark/space ratio.

The remaining two gates are used as a flip-flop, to "square up" the waveform. The rise and fall times are less than 1us. The oscillator will operate with supply voltages between about 3V and 15V, with some variation in frequency. The oscillator has been bread-boarded with a 74COO quad gate, and performed satisfactorily. Other suitable ICs would be the 74CO2 quad gate, and the 4000 series CMOS quad NAND and NOR gates. Note, however, that pin configurations will be different.

Construction is not critical, and the unit can be assembled on a small piece of Veroboard. The oscillator has applications wherever complementary outputs are required. One possible application is in driving MOS bucket brigade devices.

(By David Edwards, "Electronics Australia".)

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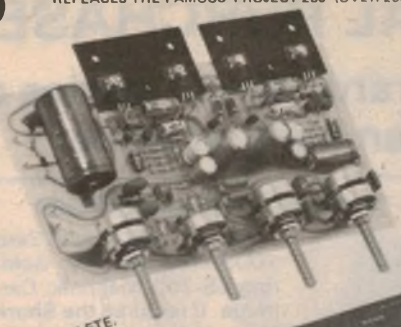

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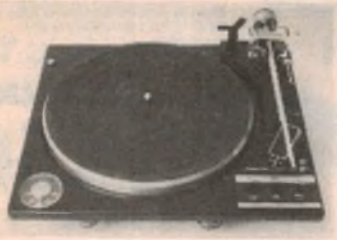

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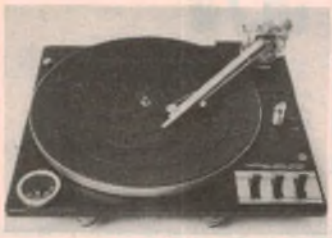

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Twin T oscillators for workshop experiments

During experimental work, the circuit designer often requires a stable oscillator capable of delivering a single frequency in the range 2Hz to 20kHz. Here the author describes two simple circuits that should fulfil this requirement. Each is based on the well known twin T configuration and is easy to build and get going.

by VIJAY A. PRADHAN*

When a stable oscillator is required for frequencies from 2Hz to 20kHz, the choice normally goes to RC oscillators rather than LC oscillators. This choice lies in RC primarily because of the size of components, particularly the size of the inductor required for an LC oscillator at this lower spectrum of frequencies. To reduce the size of the inductor, toroidal cores of high permeability material could be used, but this is more expensive compared to the price normally paid for resistors.

Apart from these two reasons, there are other reasons such as the temperature stability that could be controlled on a production basis, and the variations in value of the inductance due to vibrations and shocks. Due to these basic limitations, RC oscillators are normally preferred over LC oscillators for the lower range of frequencies.

Most RC oscillators can be categorised into one of two different groups[1]: (1) Single phase oscillators employing a passive network and a single amplifier unit; and (2) Polyphase oscillators with several active stages.

Due to their simplicity and ease of design, oscillators in group 1 are used more often than oscillators in group 2. The latter are used for special applications due to several design advantages offered by them.

There are three main types of oscillators which are commonly used from group 1. These are: RC phase shift, Wien bridge, and the bridge T or twin T oscillator.

It has been shown[2] that for a given amplifier configuration, the twin T network gives the lowest distortion. The twin T configuration also offers the following advantages over the Wien bridge and phase shift networks:

- Input and output have a common terminal which can be grounded;
- Due to its configuration, it can be used for biasing active network components;
- Inputs and outputs are less sensitive to loading; and
- Characteristics at the resonant frequency are very well defined.

*Project Head, Research and Development Department, The Tata Power Company Ltd, Bombay, India.

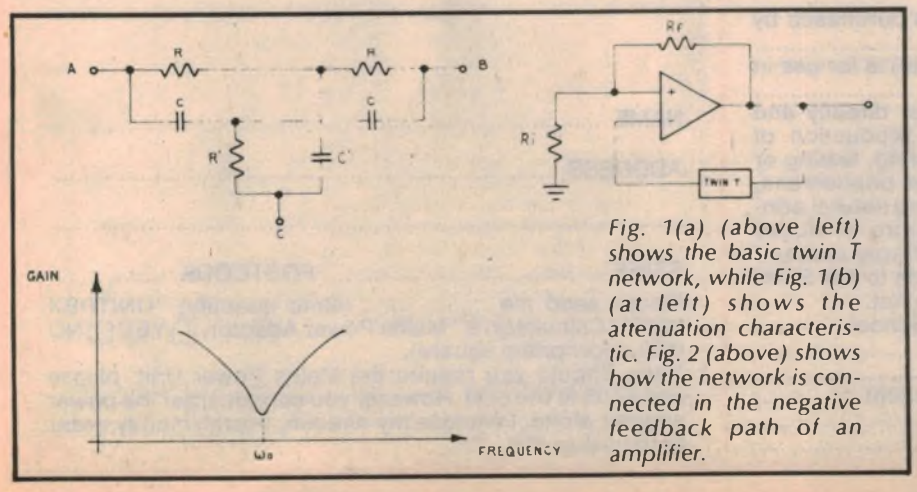

Fig. 1(a) (above left) shows the basic twin T network, while Fig. 1(b) (at left) shows the attenuation characteristic. Fig. 2 (above) shows how the network is connected in the negative feedback path of an amplifier.

Due to the advantages mentioned above, for a single frequency oscillator, the twin T configuration is normally used. Two circuits are described in this article, one using transistors and the other an integrated circuit operational amplifier.

OSCILLATOR THEORY: The twin T network, shown in Fig. 1(a), is a three terminal network. Terminal C is a common terminal used for input and output, and is generally grounded. The input signal is connected at terminal A and output is taken from terminal B. The two resistors R and the two capacitors C are of equal value. Capacitor C' is twice the value of capacitor C, and resistor R' is normally taken as half the value of resistor R. Under this condition of $C' = 2C$ and $R' = R/2$, the network is in a balanced condition and gives maximum attenuation.

The attenuation characteristic of the twin T network is shown in Fig. 1(b). Maximum attenuation is obtained at the frequency $fo = 1/2\pi RC$, and the phase shift of the signal from input to output is 180°.

When the twin T network is used in oscillators, it is included in the negative feedback path of an amplifier, as shown in Fig. 2. At DC, the network has practically zero attenuation and this gives the amplifier unity DC gain, and hence high stability. At the centre frequency, fo, the phase inversion in the network and the phase inversion in the amplifier results in positive feedback. The gain and phase characteristics[4] of the entire circuit of Fig. 2 now changes, as shown in Fig. 3.

When the AC gain of the amplifier is adjusted to compensate for the attenuation in the network, the circuit will oscillate at the frequency fo. As the gain increases, the sine wave will turn into a distorted square wave, the amplitude of which is limited by the saturation of the amplifier. For a distortionless sine wave the gain of the amplifier must be properly controlled.

The twin T network needs to be driven from a low impedance source and has to be connected to a high impedance circuit. The frequency of oscillation is given by the twin T network, the active elements having no effect on the frequency stability.

CIRCUITS: The transistorised twin T oscillator is shown in Fig. 4. Q1, Q2 and Q3 form a low distortion amplifier with very high input impedance and low out-

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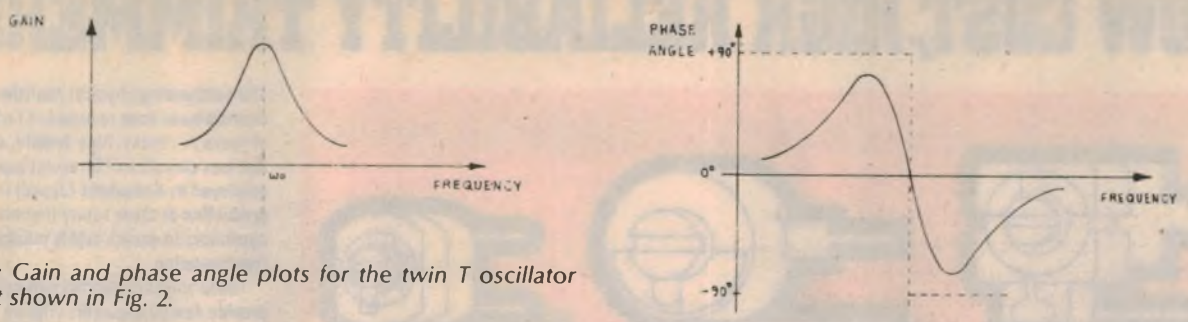

Fig. 3: Gain and phase angle plots for the twin T oscillator circuit shown in Fig. 2.

put impedance. Because of the high frequency response of the amplifier, there is very little phase shift at the desired frequency of oscillation.

The twin T network is shown in the dotted block with its resistors R providing negative feedback and at the same time DC biasing the amplifier. The DC gain of the amplifier from the base of transistor Q1 to the emitter of transistor Q3 is unity, giving good stability. The twin T is driven from the emitter of transistor Q3 and is connected to the base of a Darlington pair formed by transistors Q1 and Q2.

The emitter of transistor pair Q1 and Q2 is connected to the 4.7k preset (R2) whose wiper is taken to ground through electrolytic capacitor C1. This gives variable gain for the amplifier formed by Q1 and Q2. R3 has been added to ensure that even with the wiper of resistor R2 fully towards the emitter of Q2, the impedance presented to the twin T network is very high.

Transistor Q3 performs two functions. It acts as a driver for the twin T network, and it amplifies the signal at the output point by a factor of approximately four.

For this circuit, the frequency of oscillation is given by fo = 0.26/RC. This formula differs slightly from the one given above due to the fact that a resistance of 0.1R has been used in the lower leg of the twin T, in place of the normal value of 0.5R.

The value of the capacitor C can be chosen from the experimenter's available stock, and the value of R then calculated from the formula to get the desired frequency. However, a very low value of capacitance should not be selected, as this will excessively increase the value of R, especially at low frequencies. For the range of operation specified (2Hz-20kHz) any value between 1uF and 1000pF could be selected, with higher values of capacitance for low frequencies and vice versa.

Due to component tolerances and variations, the experimental frequency of oscillation may differ slightly from the calculated frequency. The frequency may be trimmed to the desired value by varying the value of the centre leg resistor 0.1R.

Biasing of the amplifier can be checked by ungrounding the centre leg of the twin T configuration. This will stop the circuit from oscillating, enabling bias voltages to be checked. The distortion of the sine wave is adjusted by varying potentiometer R2. The circuit is self-starting.

This circuit has been assembled and used a number of times by the author, and gives an undistorted output signal of nearly 12Vpp. Distortion is approximately 1% or less, using standard 5% resistors and 10% capacitors. The output impedance of the circuit is approximately 600 ohms.

Although the above circuit works well and gives a good sinusoidal output waveform, it cannot be used to get a stable, very low distortion sine wave that is sometimes required for precision work. This is because of 0.1R used in the lower leg of twin T, rather than normal value of 0.5R. The value 0.1R was chosen as the resistor values are easier to obtain, and the gain required for oscillation is not of a very high order.

The circuit of a twin T oscillator using an IC operational amplifier is shown in Fig. 5. The amplifier is the readily available uA709, used here in an inverting mode. Transistors Q2 and Q3 form a complementary Darlington emitter follower to provide low impedance drive to the twin T network.

On the other side of the twin T network, the operational amplifier is connected to give a very high input impedance. Field effect transistor Q1 is used here as a voltage controlled resistor to vary the gain of the operational amplifier. Circuit operation is as follows.

Initially, before the circuit is turned on, capacitors C3 and C4 have no charge on

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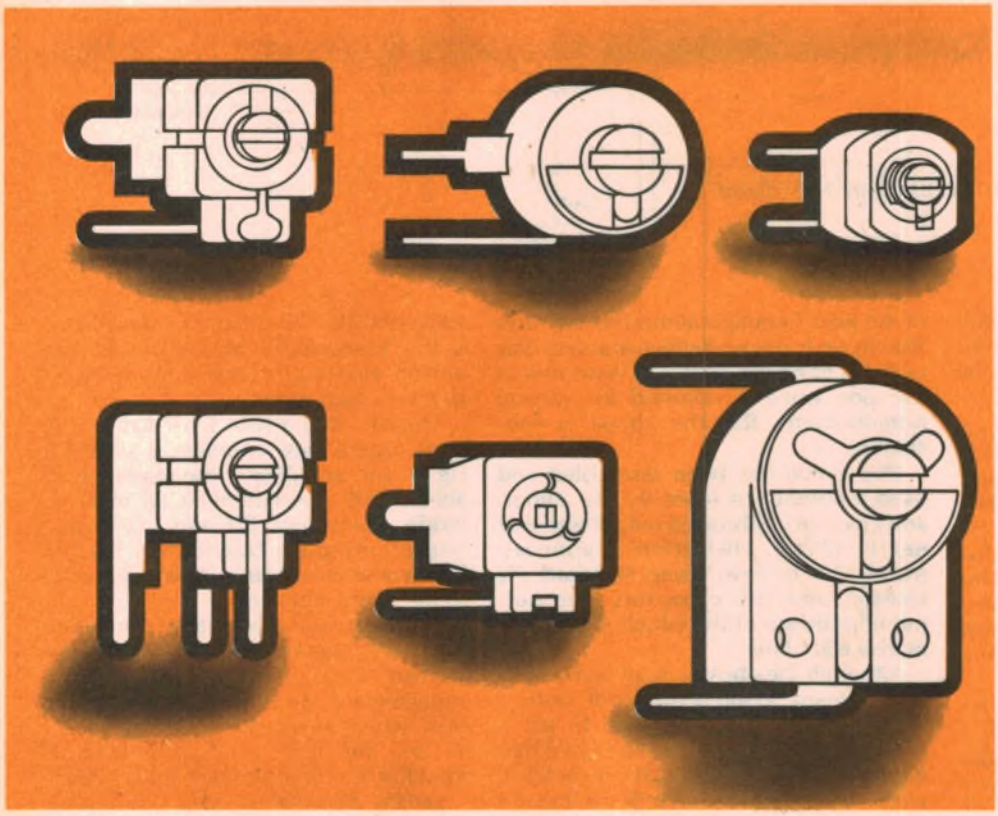

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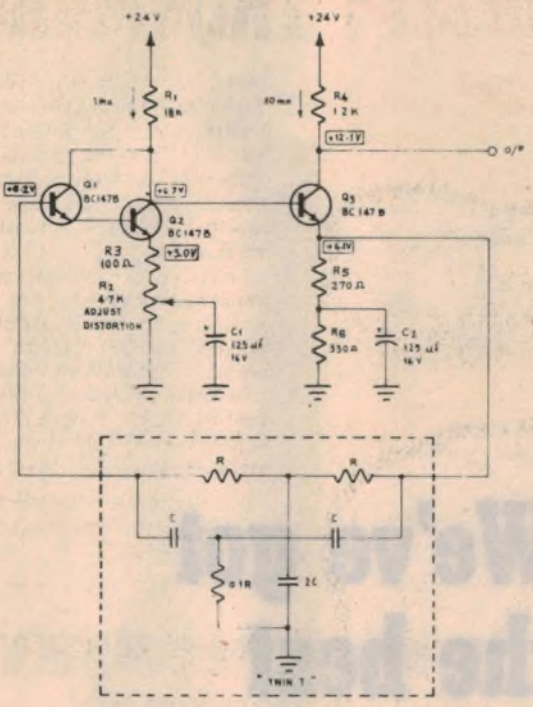

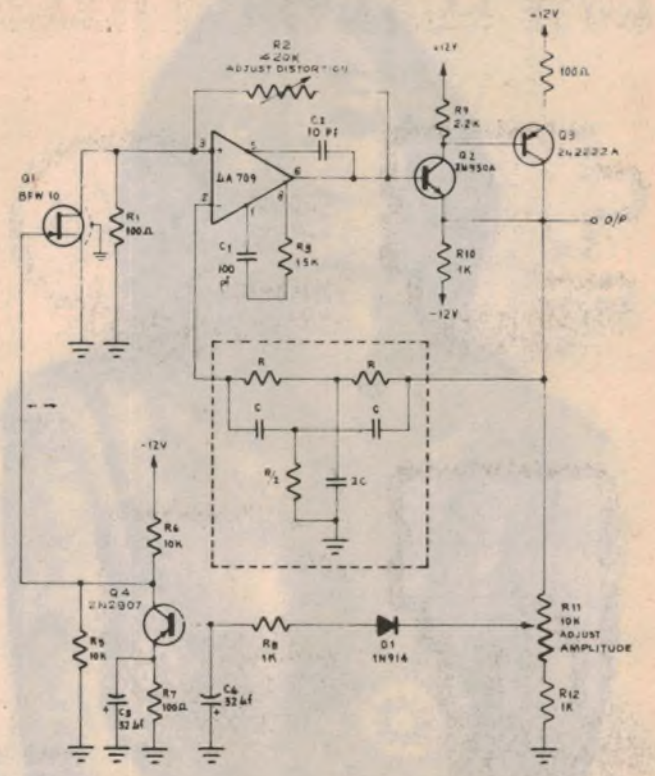

Fig. 4 (above): discrete transistor twin T oscillator. Fig. 5 (right): twin T oscillator based on an IC op amp.

them. Immediately after switch on there is no output signal at the emitter of Q2, and there is no bias to transistor Q4. The collector of this transistor is at −6V which keeps the FET completely off. When the centre leg of the twin T resistor is exactly R/2, the phase shift of the network is exactly 180°, so that the total phase shift, including the 180° phase shift in the amplifier, is 360° and the circuit is zero damped.

In order for the circuit to commence oscillation, an extremely high initial gain is required. The gain must then be reduced immediately, otherwise the circuit will saturate and the output will be highly distorted. This is achieved by means of FET Q1 which acts as a variable resistor and reduces the gain of the operational amplifier by reducing the amount of positive feedback.

DC control voltage is applied to the gate of FET Q1 by transistor Q4, according to the amplitude of the sine wave output. As the amplitude increases, capacitor C4 is charged to the negative peak amplitude through diode D1. Transistor Q4 is now forward biased and conducts, reducing the negative bias at the gate of FET Q1 and taking it into conduction.

Resistors R5 and R6 are selected so that the gate of FET Q1 does not go more than −6V, to prevent the reverse breakdown of the gate-source diode junction. Variable resistor R2 is adjusted to give as low as possible distortion, whilst at the same time sustaining oscillation. After this, whenever the circuit is turned on, it will automatically adjust itself to give a low distortion sine wave. Potentiometer R11 is used to adjust the output level.

The prototype circuit was designed to give a sine wave of frequency 3.6kHz. Power supply voltages used were ±12V, giving a measured output amplitude of 15Vpp with a distortion of 0.02%. The output impedance was 300 ohms.

Components used in the twin T network were of 1% tolerance, with resistors having the opposite temperature coefficient to that of the capacitors in order to give the required temperature stability. The frequency drift observed over a temperature range from −5°C to +60°C was only 2Hz, this change occurring only at the high end of the range due to the characteristics of the capacitors above 55°C.

ACKNOWLEDGEMENT: The author acknowledges with thanks the discussion and suggestions given by Mr Kanchan A. Mahashur while writing this article. The circuits were tested by Mr C. P. Rede. Thanks are also due to the management of Tata Electric Companies for permission to publish this article.

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Logic design: theory

When it is necessary to design a circuit to perform a required logic function, part of the exercise involves simplifying the logic function itself down into its most basic form—a process known as "minimalisation". This chapter gives you a broad idea of the techniques generally used to perform minimalisation.

by JAMIESON ROWE

Let us now look at what is involved in designing practical circuits to perform required logic functions. This is often called "realisation" of the logic, or "translation into hardware".

As you might expect, the aim in designing practical logic circuitry is to arrive at circuits which perform the required logic function with the least expenditure—not just in terms of initial hardware costs, but also in terms of running costs. Broadly speaking we want to produce hardware which may be manufactured as cheaply as possible, yet which will work as reliably as possible and use the least possible amount of energy.

The initial approach of logic circuit designers was to assume that this goal would be automatically achieved if the required logic function were first to be simplified down into its most basic logical form, and then merely implemented by suitable logic modules. Traditional textbooks on digital electronics have therefore treated logic design as if it consisted almost entirely of techniques to simplify or "minimalise" the required logic functions.

Unfortunately while this approach may have been reasonably valid in the early days of logic design, it has become less valid with each advance in technology since then. Soon after the first integrated circuit logic modules were developed, it became clear that these devices imposed practical constraints which could often make it difficult, clumsy and unattractive to implement a theoretically "minimal" logic function.

In short, it became necessary to temper the "ivory tower" theoretical approach with practical considerations such as module availability and cost, and the economic advantages of having a minimum parts inventory rather than merely "minimum gates count".

More recent developments such as the evolution of programmable logic arrays (PLA's) and microprocessors (uP's) have tended to reduce the significance of logic function minimalisation still further, by making it increasingly less necessary (and/or less attractive) to design custom logic circuits at all. We will look at these developments in more detail later on.

The implication of these developments is that nowadays it is neither necessary nor desirable to place heavy emphasis on logic minimalisation, in a course of this type. We therefore propose to look at this subject only in a broad and general way, sufficient to give you enough knowledge of the principles involved to allow further study if this ever proves necessary. This treatment will be followed in the next chapter by a discussion of the more practical aspects of logic design, including a look at the implications of PLA's and uP's.

To begin, then: Logically the idea behind minimalisation is to boil the required complex logic function down into its barest essentials—the minimum number of logic terms still sufficient to perform the required job. These logic terms are sometimes called the "prime implicants" of the function.

Not surprisingly, this can be achieved in a number of ways. Perhaps the most obvious way is to use the time-honoured "cut and try" approach with the logic diagram of the function, re-arranging and modifying it until no further simplification can be envisaged. While superficially attractive, this approach tends to be rather inefficient where complex functions are involved, and it is difficult to recognise when one has really arrived at the simplest form.

A somewhat more scientific approach is to manipulate the logic expression of the required function, using the various axioms of Boolean algebra. This can not only be more efficient, but the concise nature of the resulting symbolic expression can make it somewhat easier to verify that you have indeed found the most basic form.

Unfortunately when there are more than about four input terms or variables, the expression for the required logic function can become quite unwieldy, and hard to manipulate. Because of this, various graphical and topological methods have been evolved. Undoubtedly the most popular of these is the Karnaugh map method, developed by G. Karnaugh in 1953 from earlier topological map techniques used by Veitch, Venn and Euler.

A Karnaugh map is basically a multi-compartment grid or matrix diagram, in which each compartment or "cell" is made to correspond to a specific possible truth value combination of the input terms concerned. There is a cell for every possible truth value combination of the terms, so that a map for functions involving 4 terms has 16 cells and so on.

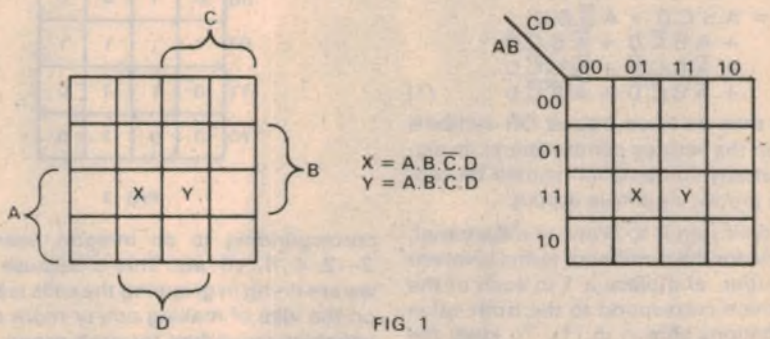

FIG. 1

A Karnaugh map for 4 terms is shown in Fig. 1, which also shows two alternative ways of labelling the rows and columns in terms of the truth values of the terms. One way uses brackets to indicate the rows or columns corresponding to the truth of each term, while the other way labels each row or column with combinations of 0's and 1's to indicate the same thing.

Note that the two adjacent cells X and Y have truth value combinations which differ only in respect to the truth value of one term—term C, in this case. This relationship applies with all adjacent cells in a Karnaugh map, as a result of the way

in which the truth values of the the terms are assigned to the various rows and columns, and it is this property which makes the Karnaugh map so useful in simplifying logic functions.

Fig. 2 shows basic Karnaugh map formats for functions involving 2 and 5 functions. The 2-term map is shown purely for illustration, because a function involving only two terms could be minimalised quite easily without a Karnaugh map. Note that the 5-term map is actually drawn as two grids, one corresponding to the truth of the fifth term "E", and the other to its falsity.

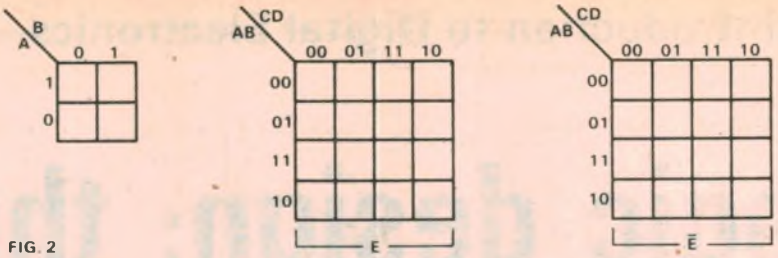

FIG. 2

To use a Karnaugh map, we mark in each cell of the grid or grids the required truth value of the output of our logic circuit, for that particular combination of truth values for the input terms. If the output should be true, we put a 1; if it should be false, we put a 0; and if we don't care (perhaps because the combination can't occur anyway), we put an "X".

When this is done, the map becomes a highly concise and easily visualised representation of the function we want to implement. It becomes relatively easy to separate the logical "wood" from the "trees", as it were, and to try various ways of defining the required result in terms of the smallest number of basic logic relationships.

This is probably best shown by an example. Let's say that we want a logic circuit whose output Z must be true for the following truth value combinations of its four input terms A,B,C and D:

$$Z = A.B.C.D + A.\overline{B}.C.D + A.B.\overline{C}.D + \overline{A}.B.C.D + \overline{A}.B.C.\overline{D} + \overline{A}.B.\overline{C}.D + \overline{A}.\overline{B}.C.D \quad \ldots (1)$$

Notice that we have placed OR symbols between the various combinations, to signify that any combination should be capable of producing a true output.

Our next step is to draw up a Karnaugh map grid for the number of terms involved —here four, and place a 1 in each of the cells which correspond to the truth value combinations shown in (1). To keep the example simple, let us assume that the output of the circuit should be false for all remaining combinations, so that we can place a 0 in all of the other cells. We thus end up with a map of the required function, as shown in Fig. 3.

Having produced the map, we are now in a position to try finding the most concise way of describing the required function. This is done by attempting to group all of the cells containing a 1 into a minimum number of sub-groups, with each of these having as many terms redundant as possible.

You may perhaps recall from the preceding chapter that a term is logically redundant in a function or expression if it may be either true or false without affecting the overall truth value.

The way this grouping is tackled on the Karnaugh map is to first try isolating any cells which cannot be grouped with any others. Then "loops of two cells" are made wherever there are pairs of adjacent cells which will not obviously form part of larger groups. Then "loops of four cells" are attempted, if there are any four-cell groups which do not seem likely to lend themselves to amalgamation into larger groups. And so on.

Note that it is only possible to group cells in loops enclosing a number of cells

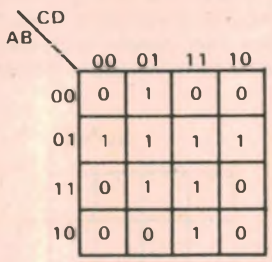

FIG. 3

corresponding to an integral power of 2—2, 4, 8, 16, etc. This is because what we are doing in grouping the cells is based on the idea of making one or more of the variables redundant for each group. That term or terms must therefore be represented in the group by an equal number of "true" and "false" cells.

In doing our grouping, we can have intersecting loops—in other words, a cell can be included in more than one group. Strictly speaking this is inefficient, but at the same time it may allow us to cover the overall function with a smaller number of groups than otherwise, or the groups may be simpler in that they may involve fewer terms.

If we happen to have cells on the grid containing "don't care" X's, these can be included in loops or left out as convenient. Including them may enable us to form the cells which do contain 1's into fewer but larger loops than otherwise, which is desirable. On other occasions, regarding the cells with X's as if they contained 0's may again allow us to group the 1 cells into a smaller number of larger loops. In other words, cells with X's may generally be treated as if they contained either a 1 or a 0, whichever helps in forming the

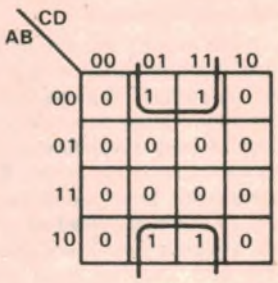

FIG. 4

smallest number of loops enclosing as many cells as possible.

It is also quite legitimate to make loops which group cells on opposite sides of the map, as shown in Fig. 4. This is because strictly speaking a Karnaugh map has no "sides", being a topological surface equivalent to the surface of a sphere. The cells which appear to be on opposite sides are thus really adjacent to each other, so that if required they may be grouped together by a single loop. The loop shown in the example of Fig. 4 corresponds to the function:

$$Z = \overline{B}.D \quad \ldots (2)$$

This is because the loop has two cells where term A is true, and two cells where it is false, making term A redundant. The same applies for term C, which is therefore also redundant, leaving only terms B and D.

As it happens, our example of Fig. 3 does not involve this type of loop. However it does have a number of possible "correct answers", which is a situation that often occurs. In other words, a complex function may not have just a single "minimal" form, but may have a number of minimalised forms which from the logical point of view may be equally basic. Which of these may be most desirable from a practical point of view will usually depend upon considerations other than

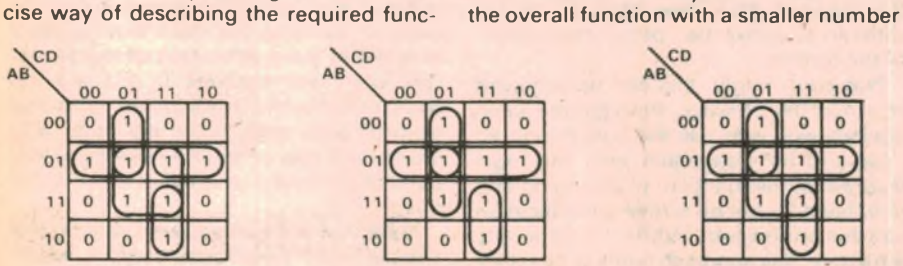

FIG. 5

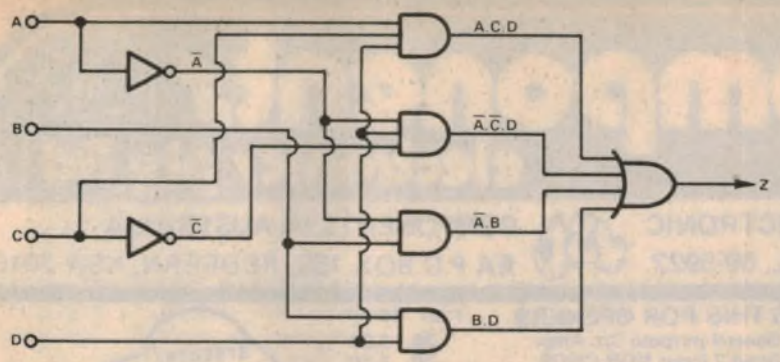

FIG. 6 $Z = A.C.D + \bar{A}.\bar{C}.D + \bar{A}.B + B.D$

sheer logic simplicity, elegance or what might be called "efficiency".

Three of the possible groupings for the example of Fig. 3 are shown in Fig. 5, together with the corresponding simplified logic expressions. Of the three probably the solution in (c) would be the most attractive from a practical point of view, because it results in an expression containing only four main terms, two of which contain only two of the original input terms.

By the way, note that the terms containing only two of the original input terms correspond to the loops on the map enclosing groups of four cells, while those with three original terms correspond to loops enclosing groups of two cells. This sort of relationship holds for all Karnaugh maps, in that the larger the number of cells enclosed by a loop, the smaller the number of original terms in the corresponding term of the final logic expression. So that the idea is to end up with as few loops as possible, with each loop enclosing as many cells as possible.

The direct logic diagram equivalent to the map looping and symbolic expression of Fig. 5(c) is shown in Fig. 6. As you can see, it would call for seven logic elements in all: a single 4-input OR gate, two 3-input and two 2-input AND gates, and two inverters.

It should be stressed, however, that this would not necessarily be the most effective or economical way of implementing the logic function we set out to turn into hardware. It is merely a logic configuration based on (hopefully) the simplest and most elegant logical expression of the job to be done. As we noted earlier, this may or may not correspond to the best answer from a practical point of view.

In the next chapter, we will look at the various practical considerations which must be taken into account in arriving at the final logic design, after one has gone through the process of logic minimalisation we have just described. We will also look briefly at the implications of recent developments in technology, which are making it less and less attractive or economic to embark upon this whole process of custom logic circuit design, at least in the traditional way.

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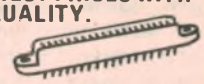

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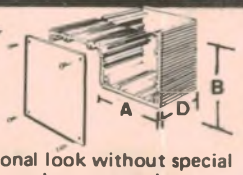

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EVB/F/50-50/75	75.0	58.0	58.0	2.25	.75
EVB/F/50-100/25	25.0	58.0	108.0	2.25	.75
EVB/F/50-100/50	50.0	58.0	108.0	2.60	1.00
EVB/F/50-100/75	75.0	58.0	108.0	2.95	1.00
EVB/F/50-100/150	150.0	58.0	108.0	5.25	1.25
EVB/F/50-150/25	25.0	58.0	158.0	3.25	1.25
EVB/F/50-150/75	75.0	58.0	158.0	4.25	1.25
EVB/F/50-150/100	100.0	58.0	158.0	4.85	1.25
EVB/F/50-150/150	150.0	58.0	158.0	5.75	1.50
EVB/F/50-200/25	25.0	58.0	208.0	4.15	.85
EVB/F/50-200/50	50.0	58.0	208.0	4.50	1.00
EVB/F/50-200/75	75.0	58.0	208.0	4.75	1.00
EVB/F/50-200/100	100.0	58.0	208.0	5.50	1.25
EVB/F/100-100/25	25.0	108.0	108.0	2.95	1.00
EVB/F/100-100/50	50.0	108.0	108.0	3.55	1.00
EVB/F/100-100/75	75.0	108.0	108.0	4.50	1.25
EVB/F/100-100/100	100.0	108.0	108.0	5.50	1.25
EVB/F/100-150/25	25.0	108.0	158.0	3.75	.90
EVB/F/100-150/50	50.0	108.0	158.0	4.25	1.00
EVB/F/100-150/75	75.0	108.0	158.0	4.85	1.25
EVB/F/100-150/150	150.0	108.0	158.0	7.25	1.50
EVB/F/100-200/25	25.0	108.0	208.0	4.25	1.00
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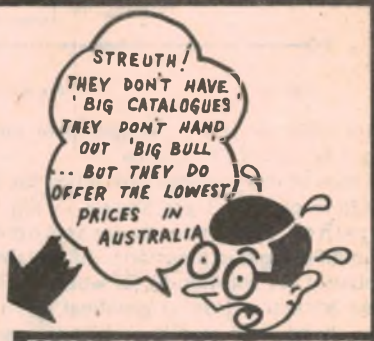

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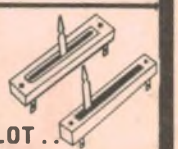

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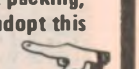

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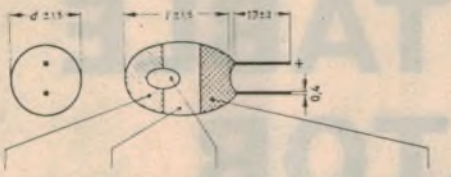

Capacity in µF				Rated d.c. voltage	
Colour	Dome 1. digit	Ring 2. digit	Dot multiplier marking of polarity	Colour	Voltage
black	–	0	x 1	white	3 V
brown	1	1	x 10	yellow	6,3 V
red	2	2	x 100	black	10 V
orange	3	3	–	green	16 V
yellow	4	4	–	blue	20 V
green	5	5	–	grey	25 V
blue	6	6	–	pink	35 V
violet	7	7	–		
grey	8	8	x 0,01		
white	9	9	x 0,1		

Marking of capacity: colour dot indicates the polarity orientation according to drawing.

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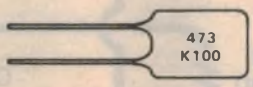

second significant figures of the value in pF, while the third digit is the multiplier in terms of powers of 10. Any alphabetic letters following indicate tolerance, i.e., M is 20%, K is 10%, J is 5%, C is +/– 0.25pF. Further figures indicate working voltage.

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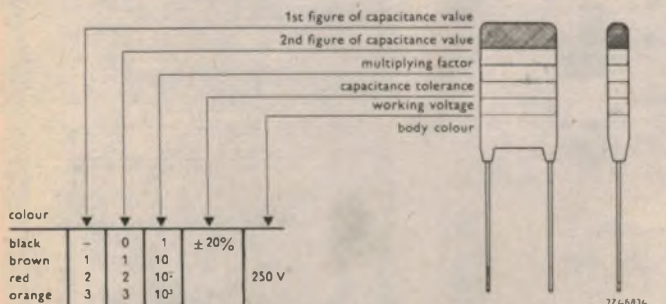

colour					
black	–	0	1	±20%	
brown	1	1	10		
red	2	2	10^2		250 V
orange	3	3	10^3		
yellow	4	4	10^4		400 V
green	5	5	10^5		
blue	6	6			630 V
violet	7	7			
grey	8	8			
white	9	9		±10%	

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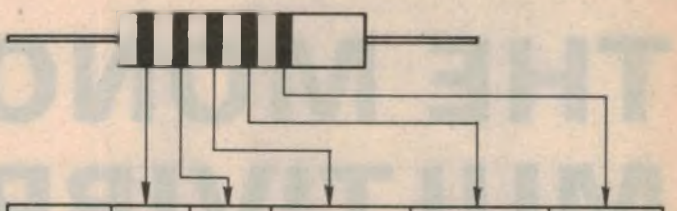
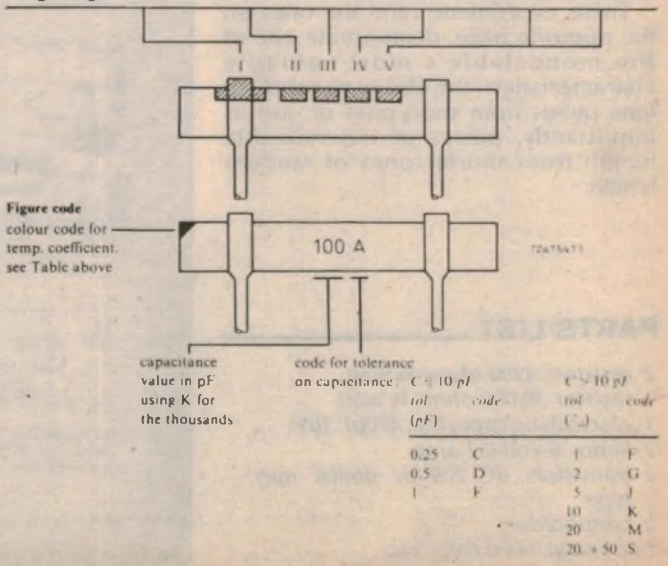


COLOUR	TENS	UNITS	MULTIPLIER	TOLERANCE	VOLTAGE
BLACK	0	0	1	20% (M)	–
BROWN	1	1	10	1% (F)	100
RED	2	2	100	2% (G)	200
ORANGE	3	3	1000	–	300
YELLOW	4	4	10000	-0 +100%	400
GREEN	5	5	100000	–	500
BLUE	6	6	1000000	–	600
VIOLET	7	7	–	–	700
GREY	8	8	–	–	800
WHITE	9	9	–	–	900
GOLD	–	–	0.1	5% (J)	1000
SILVER	–	–	0.01	10% (K)	2000

The international colour code is used to indicate the value and other characteristics of resistors, capacitors, and other components. Various arrangements, differing slightly from that shown, are used by individual manufacturers. (The letters in the tolerance column are sometimes used in place of colours.) Resistance values are in ohms and, unless otherwise specified, capacitor values in pF. As indicated in the ceramic code (below) the tolerance on capacitance values equal to or less than 10pF are often quoted in pF rather than percentage. Values greater than 10pF are quoted in percentage.

Ceramic colour code

	temperature coefficient	*first digit*	*second digit*	*multiplier for the capacitance*	*tolerance on capacitance* $C \leq 10$ pF (pF)	$C > 10$ pF (%)
red/violet	P100					
black	NP0		0	1		± 20
brown	N033	1	1	10	± 0.1	± 1
red	N075	2	2	10^2	± 0.25	± 2
orange	N150	3	3	10^3		
yellow	N220	4	4	10^4		
green	N330	5	5		± 0.5	± 5
blue	N470	6	6			
violet	N750	7	7			
grey		8	8	10^{-2}		
white		9	9	10^{-1}	± 1	± 10
orange/orange	N1500					



$C \leq 10$ pF tol (pF)	code	$C > 10$ pF tol (%)	code
0.25	C	1	F
0.5	D	2	G
1	F	5	J
		10	K
		20	M
		20 + 50	S

THE MONOSTABLE MULTIVIBRATOR

by A. J. LOWE

A third type of multivibrator, not so common as the bistable and astable, is the monostable multivibrator. It is the subject of this month's Teach Yourself Board. The photograph and circuit show the details. Construction is to the same size and standards used in earlier boards in this series.

There are no difficulties in following the circuit but the value of resistors R1 and R3 should be selected to ensure that the transistors turn on fully.

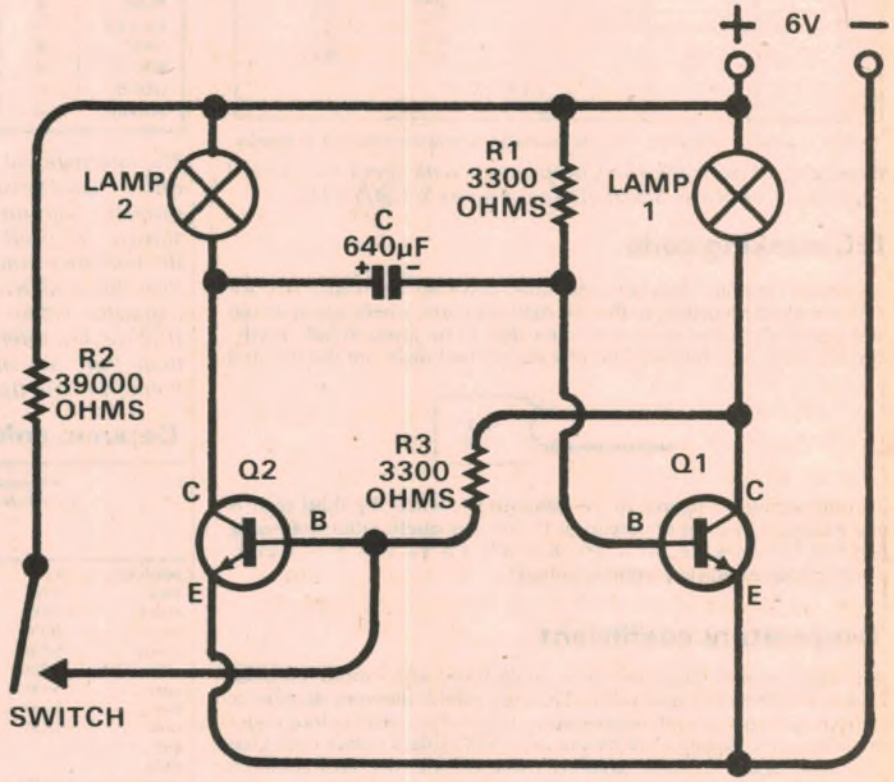
As well as the experiments described in the panel opposite there are some other simple checks which can be made, all of which add to the understanding of how the circuit works.

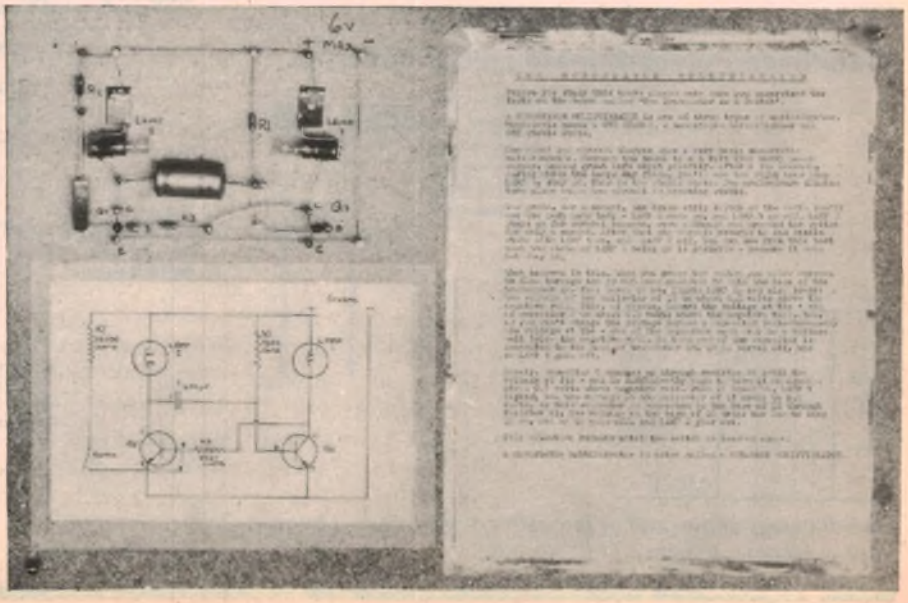
1. Measure voltages around the circuit.

2. Check that the voltage on the base of Q1 goes negative, ie, below that of the negative rail, but the voltage at the base of Q2 does NOT go negative.

3. Connect a large capacitor, say 470 µF, in parallel with C by means of two leads with clips. Before switching on make sure that the added capacitor has its + terminal connected to the + terminal of the capacitor already on the board. You'll find that the "on" time of LAMP 2 is increased.

These experiments, and the ones on the opposite page, demonstrate one of the monostable's most valuable characteristics—the ability to produce long pulses from short ones or, just as importantly, pulses of determinable length from shorter ones of random length.





PARTS LIST

2 resistors 3300 ohms ¼ watt
1 resistor 39,000 ohms ¼ watt
1 electrolytic capacitor 470µF 10V
2 lamps 6 volt 0.1 amp
2 transistors BC 209 or similar npn type
2 lampholders
brass strip, wire nails, etc.

HOW THE MONOSTABLE WORKS

Before you study this board please make sure you understand the facts on the board called 'The Transistor As A Switch'.

A MONOSTABLE MULTIVIBRATOR is one of the three types of multivibrator. Monostable means—ONE STABLE. A monostable multivibrator has ONE stable state. It is often called a ONE-SHOT MULTIVIBRATOR.

The model and circuit diagram show a basic monostable multivibrator. Connect the model to a 6 volt (not more) power supply, taking care to ensure correct polarity. After a few seconds, during which the lamps may flash, the right hand lamp—LAMP 1—will stay on. This is the stable state. The preliminary flashes occur while the circuit is stabilising.

Briefly press the brass strip switch. LAMP 2 will come on and LAMP 1 will go off. LAMP 2 stays on for several seconds, even though you pressed the switch only briefly. Then the circuit reverts to its stable state with LAMP 1 on, and LAMP 2 off. This test shows that the state of LAMP 2 being on is unstable.

This is what happens: When you press the switch you allow current to flow through 39,000 ohm resistor R2 into the base of the transistor Q2. This turns Q2 on, lights LAMP 2, and lowers the Q2 collector to about 0.2 volt above the negative rail. This lowers the voltage at the positive end of the capacitor C to the same value.

As the voltage across a capacitor cannot change instantaneously, the voltage at the negative end must drop to a voltage well below the negative rail. As this end of the capacitor is connected to the base of transistor Q1, Q1 is turned off and LAMP 1 goes off.

Slowly, capacitor C charges through resistor R1 until the voltage at its negative end is high enough to turn Q1 on again—about 0.7 volt above the negative rail. When Q1 comes on, LAMP 1 lights, and the voltage at the Q1 collector drops to 0.2 volt. As this collector is connected to the base of Q2 through resistor R3, the voltage at the base of Q2 drops too low to keep Q2 on, so Q2 goes off and LAMP 2 goes out.

This situation remains until the switch is touched again.

FURTHER SUGGESTIONS

Try coupling the monostable to "The Transistor As A Switch" board:

(a) Connect the negative rails of both boards together. (b) Connect Q2 collector to the left hand end of R on the other board. (c) Connect the batteries. The lamp on the "Transistor As A Switch" board will come on, because Q2 is off, and its collector voltage is high. (d) Briefly press the monostable switch. The lamp on the other board goes off as Q2 comes on because its collector voltage goes low. (e) After the time set by components on the monostable board, the lamp on the other board will turn on.

Repeat this experiment but connect the lead from R to the collector of Q1. The lamp on the "Switch" board will remain off, because Q1 is on and its collector is low. Under these conditions there is not enough voltage to drive current through the base of the transistor on the "Switch" board. Press the monostable switch briefly and the lamp on the "Switch" board comes on for the time set by the components on the monostable board.

Classical Recordings

Reviewed by Julian Russell

Idylls of England: "enchanting music"

IDYLLS OF ENGLAND—Pieces for small orchestra by Walter Leigh, John Ireland, George Butterworth, Peter Warlock and E. J. Moeran. The English Sinfonia conducted by Neville Dykes who also plays the harpsichord part in the Leigh Concertina. World Record Club Stereo S/5755.

I am reluctant not to appear insular but I cannot refrain from pointing out that to enjoy this recital as much as I did you must be able to appreciate music as it was written during the first half—most of it in the first quarter—of this century. This despite the extremely high quality of the whole production. Each of the items is a gem in its own right and each of the composers speak with a different voice but an unmistakable English accent. I use English instead of British because all were born into the culture of that country, including Moeran who, despite his Irish sounding name, was the son of an Ipswich clergyman.

If I had to choose a favourite it would be the opening piece, Leigh's Concertina for Harpsichord and Strings. It has a surface innocence but is really of very complex rhythmic construction. In view of the fact that it is a harpsichord concerto I have no objection to the forward recording of that fragile sounding instrument. As it is here every change of registration can be enjoyed and, even when joined by the strings playing at full tone, can still be comfortably audible. It is a brief work of three well contrasted movements, two fast ones astride an Andante which, even if taken a little on the slow side to do the lovely flow of melody justice, is nevertheless eminently graceful and mellifluoss. That it just fails to really take wing and soar is more the pity. Indeed a few bars of this movement seem to hint at a despair alien to its context. The Finale, like the first movement is full of rhythmic novelties and the playing and recording of it is as perfect as I can imagine. It is a heart-lifting little piece.

Ireland's Holy Boy is perhaps better known as a piano solo, although the work is a three chorus carol. Its melody, most beautifully shaped, is treated with subtle differences each time it recurs. And here there is no dragging of the tempo. It flows as smoothly as cream and is filled with quiet but joyous piety.

Butterworth, too, is better known by another piece. A Shropshire Lad, nowadays unjustly neglected in recordings and live performances alike, at any rate in Australia, he is represented here by English Idylls Nos. 1 and 2. Both are richly scored and played with glowing tone and manifest affection.

The Capriol Suite was the best known and most often played work of Warlock if one excepts a few of his songs. It still remains too well known to be commented on here except to mention the magnificently high quality of its performance, and once again, recording, the latter quality existing throughout the entire whole enchanting music.

E. J. Moeran contributes two pieces for small orchestra, Lonely Waters and Wythorne's Shadow. Moeran lived for some time with Warlock at Eynsford in Kent where I was a frequent visitor during the late 1920s. By the way both died tragically some years later, Warlock by his own hand, Moeran by drowning.

Lonely Waters has an alluring pastoral air. So does Whythorne's Shadow, though in this Moeran shows, for him, an unusual influence from Delius. The prevailing atmosphere, however, is predominantly Elizabethan, conceived perhaps under Warlock's influence. Whythorne was one of the lesser known Elizabethan composers. I am full of admiration for the oboe player in both these pieces; indeed throughout the whole concert he plays with the utmost delicacy and refinement, even in the distinguished company of the English Sinfonia. A disc to be cherished by all English music lovers.

Ravel—Piano Concertos in G & D Major

RAVEL—Piano Concerto in G Major. Piano Concerto for Left Hand in D Major. Hanae Nakajima (piano) and the Nuremburg Symphony Orchestra conducted by Gunter Neidlinger. Colosseum Stereo SM538.

This is the first Colosseum disc to come my way and I didn't find the engineering impressive. The surface crackles like a newly lit fire and the sound is often much too reverberant. The orchestra deals sensitively with delicate effects but elsewhere is too heavy-handed for Ravel. And the dynamic range is so wide that it's uncomfortable to listen to even in my big music room. More's the pity because Hanae Nakajima reveals herself as a good deal more than a competent pianist. You get this impression right away in the first movement of the G Major.

But I always think that the supreme test of the soloist is the second movement with its long, rhapsodic Bach-like melody at the beginning and in this Ms Nakajima is very good indeed. It is elegant and classical and makes a fine contrast to the bustle of the first movement. It is unfortunate that the orchestral background and recording doesn't match her undoubted talent.

Ms Nakajima makes the finale brisk and exhilirating right up to tempo without a single stumble. By contrast, though keeping the same tempo the orchestra has a tendency to lumber a little.

In the D Major, for left hand alone, much crackling makes the low, quiet bass opening almost inaudible and what sound does emerge is often smudgy, while the long period of reverberation doesn't help matters at all. But in this work, too, Ms Nakajima encourages one to hope to hear her better served. I am afraid I cannot recommend this disc with any enthusiasm. It faces much to much excellent competition on other labels.

It was an inspiration to decorate the record sleeve with a charming painting of a blue Persian cat. During his lifetime Ravel surrounded himself with cats and blue china.

★ ★ ★

CHOPIN—The Four Scherzos, in B Minor, B-Flat Minor, C-Sharp Minor and E Major. Artur Rubinstein (piano). RCA Mono LM 2358.

Rubinstein, who celebrated his 90th birthday a few months ago recorded these pieces when he was in his 70s. But even at that age his technique was unimpaired and his taste as faultless as ever. And from what I hear his conversation still sparkles with all its old wit.

His is truly aristocratic Chopin playing. There are no mannerisms and to say that in his 70s he was still in his prime is no exaggeration. The music flows with an enchanting gradation of sonorities. Every note, no matter how fast he plays, is admirably clear. The tone of his piano is a little sharp but you can overcome this to a great extent by reducing the high frequencies. His performance of all four Scherzos, none of them easy, is so enchanting that I have no hesitation in recommending this disc with the greatest enthusiasm.

DVORAK—Symphony No. 2 in B Flat. Op. 4. London Symphony Orchestra conducted by Istvan Kertesz. World Stereo Cassette 6257.

This young work—the composer was only 24 when he finished it—has never been popular although it has much going for it. Although Dvorak's name was already well known it was not played till 15 years after its completion, and then in a revised, shortened form. Stranger still is the fact that despite Dvorak's world wide popularity it remained unpublished, in manuscript form, for nearly a hundred years until as recently as 1959. Although it will never achieve the popularity of the later symphonies it has considerable merit and is also, not that it matters, the composer's longest symphony even after Dvorak's revision. It is, in a word, eminently listenable, and if there isn't such a word there ought to be.

Kertesz understanding sympathy is now well known since he recorded the complete series not many years ago. This series, in my mind, established Kertesz as the world's best Dvorak interpreter of his day—and I am not forgetting the late, great George Szell. Kertesz, by the way, was drowned while swimming off Israel a couple of years ago. Although the cassette is not Dolbyised it has been successfully transferred from disc with a minimum of background noise. In fact you have to listen very carefully to hear any at all. It lacks a little of the spaciousness of a Dolby cassette but is nevertheless quite acceptable. Although the work does not show Dvorak at the height of his powers it offers some fine music and has plenty of surprises, harmonically and formally. It is admirably played by Kertesz and the London Symphony and the whole production is very worthy indeed.

★ ★ ★

MOZART—16 Sonatas for Violin and Piano and 2 Sets of Variations for the same instruments. Ingrid Haebler (piano) and Henryk Szering (violin). Philips Stereo 6747125 (Six Discs).

Haebler and Szering make an ideal combination in this massive issue of six discs. It contains 16 Piano and Violin Sonatas and two sets of Variations for Piano and Violins; too many, alas, to review individually here. All I have space to say is that most of the playing can be described as quite ravishing. Szering's violin has a sweet but vital tone and Haebler's piano has peerless clarity.

Both performers have an Apollonian approach to the music, some of it early, some of Mozart's most mature. Here is no tick-tock Mozart but playing of the utmost subtlety. This is a set to treasure. In it you will find something to suit your every mood.

Some hypercritical listeners might find a rare movement in which either the piano or violin seems to dominate just a shade too much. But don't let that put you off. You'll have to wait a long time to hear anything better, or indeed as good. If you want to hear a fair sample before you invest in such a large outlay for the boxed set, I recommend you play the Sonata in B-Flat which you'll find on Side 1 of Disc Three.

★ ★ ★

BRAHMS—Symphony No. 2 in D. Variations on a Theme by Haydn. Philips. Cassette Dolby Stereo 7300375. Symphony No. 3 in F. Tragic Overture. Philips Cassette Dolby Stereo 7330139.

Haitink takes the opening passages of the first movement a little on the slow side though this tends to make it sound charmingly rustic. This is a mood that persists more or less throughout the entire movement. There are however climatic sequences in which the orchestral tone sounds unnecessarily coarse. But in these, just as one starts to think "This is not for me," there come some bars of endearing sensitivity. And if you are like me you will begin to feel that this is echt-Brahms, never overstated, its tempo solid but never stodgy.

I cannot recall having heard the end of the movement played with more tenderness since a live performance I attended, also by a Dutch Orchestra, the Hague, at Scheveningen during the Holland Festival some years ago. On this occasion the conductor was the late Carl Scguricht, then a very old man who was led on to the stage at the Kursall using two elbow-length crutches and delivered a performance I have never forgotten. It more than compensated for the bitterly cold wind and rain that was blowing in from the North Sea—in midsummer.

Some listeners might object that in Haitink's reading there is not enough contrast between the first and second movements and they may well be right. But in my case it was sensuous enjoyment of the beautiful playing of the Concertgebouw Orchestra, beautifully recorded with—important with Brahms—plenty of space between the instruments. Again some might think Haitink's interpretation a trifle too placid despite its occasional fierce conflicts, but one must still agree that Haitink's is a most carefully considered performance. Personally I like it because it gives one something fresh to think about every hearing.

On this cassette there is a generous bonus in the form of a splendid account of the St. Anthony Variations, again as fine a performance as I've ever heard. It is full of the most subtle nuancing and enchanting contrasts. And this, too, is excellently recorded. There is chaste perfection in the whole work, even in the exciting variations which feature swaggering horn passages.

In the first movement of the Third Symphony the tempo is again unhurried, almost in the Klemperer manner. Yet there are times, especially after a slightly faster change and some bewitching daintiness, that he sounds a shade on the slow side. And in this symphony, too, there is the same perfection of playing and recording. Taken as a whole the performance is much too good to knock despite any personal objections to some of the tempos.

In the second movement Haitink starts off all right but soon slows down. I don't mind this in the lovely ascending and descending passage towards the end of the movement—one of Brahms' most beautiful—though even here I missed a little of the passion it demands. However it is still very beautiful to hear.

The Third Movement starts gracefully but with Pavane-like stateliness not altogether in character with the music. But the Finale is another thing altogether. On Haitink's playing of this there can be no questions. It is full of contained vigour and the orchestra plays it with enormous vitality and, needless to add, accuracy.

The fill is the Tragic Overture, not one of my favourite Brahms pieces. Moreover unless you hurry to stop your machine the loud opening chords ruin the effect of the quiet ending to the symphony.

By the way something must have gone wrong with the program notes. After two paragraphs about Brahms' Third Symphony it goes on to talk about Beethoven's Pastoral Symphony.

Lighter Side

Reviews of other recordings

Devotional Records

THE MORMON TABERNACLE CHOIR SINGS, Conducted by Richard P. Condie. Stereo, Reader's Digest 5-record set.

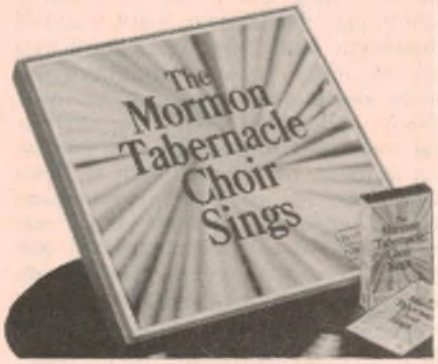
The Mormon Tabernacle Choir is undoubtedly one of the best known choirs in the World today and, for anyone who has a liking for their traditional kind of music, this new 5-record set from Reader's Digest must hold a high interest. The choir is 375-strong, the World's largest permanent choir, with a repertoire of 1500 pieces and a history dating back to before the American Civil War.

The accompanying notes do not have a great deal to say about the recordings themselves but I would judge that they have been hand-picked from the mass of recorded material the choir must have accumulated during decades of broadcasting, television, touring and recording sessions in their huge 8000-seat Tabernacle in Salt Lake City. Certainly, a few of the tracks are identified as mono, reprocessed to simulated stereo.

Some of the tracks feature accompaniments by the Tabernacle organists, presumably on the Tabernacle's huge classical 10,000-pipe instrument. On other tracks they feature with the Philadelphia Brass Ensemble and Percussion, and with the Philadelphia Orchestra conducted by Eugene Ormandy. Also featured on one program segment is the Columbia Symphony Orchestra under Arthur Harris.

Record 1 opens with theme "This Land Is Your Land", five American patriotic songs and anthems, of which only "The Battle Hymn" is regularly played and sung in this country. Side 2, however, is devoted to "Faith Of Our Fathers", great hymns which know no barriers of creed or country.

Record 2 introduces program segments "Bless This House" and "Praise To The Lord", all well known and all interdenominational hymns. A slightly folksy atmosphere appears on record three with "Church In The Wildwood" and similar titles, but the reverse side contrasts with more classically orientated themes grouped as "Land Of Hope And Glory".



Much the same contrast appears on record 4 with negro themes on side 1 ("He's Got The Whole World In His Hands") and psalms and anthems on the other ("The Lord Is My Shepherd").

And, if your guests are not too keen on all this strongly devotional fare, you can turn to record 5 side 1 for some American folk songs (Camptown Races, Dixie, Laura Lee, etc.) or to side 2 for evergreens like The Sound Of Music, Over The Rainbow, Climb Every Mountain, You'll Never Walk Alone, etc.

The sound of a massed choir is notably difficult to record but the quality is well up to normal standards and the surfaces quiet. As we observed earlier, those who appreciate the music of the Mormon Tabernacle Choir, the purchase price of $21.99 will be money well spent. (W.N.W.)

★ ★ ★

DOGWOOD. After The Flood, Before The Fire. Stereo, Lamb & Lion LL-1020. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals).

I had to resort to the notes to discover that "Dogwood" was the name of a vocal musical group of three talented young people: Ron Elder, Annie Chapman and Steve Chapman. The word itself is the name of the legendary tree from which crosses were once fashioned. "After The Flood, Before The Fire" is the title of the final track.

With that word of explanation over, this album from Pat Boone's Gospel recording organisation has a mild C & W flavour and should appeal to those who are on the lookout for Gospel recordings of a non-traditional kind but easier on the ear than the usual "rock" style Gospel.

I doubt that the titles will be familiar to many but, while diction is not outstanding, it is enough to sustain the title themes: The News – I Don't Want To Be Deceived – Remember Whose Child You Are – One Lane Road – Sometime, Someplace – If I Forget The Ones – Jesus Is Passing By – Journey Music – It's The Truth – All Of You – Watergrave – After The Flood, Before The Fire.

The quality is good and, if the contents appeal, you can buy with confidence. (W.N.W.)

★ ★ ★

SOUNDS OF SILENCE. Father Jim McClaren. Stereo, Festival L-35731.

Those who are regular radio listeners will probably know Father Jim McClaren much better than J. A member of the team that makes up the Catholic Communications Centre of the Archdiocese of Sydney, Father Jim has featured on radio and television and has even stood in for John Laws during his daytime radio sessions.

In keeping with what I judge to be the approach of the centre, there is no hard-sell religion anywhere on this disc, just a subtle, gentle reminder of human values. There are tracks for children (What Is A Boy, What Is A Girl, The Unicorn); the sanctity of life (Ballad Of The Unborn); a thought for the environment (Tar And Cement); thoughtfulness (Love Me Now); an appeal for understanding (The Desperate Ones); the climax message (You've Got A Friend), and so on.

Most of the tracks are a monologue by Father Jim, with whisps of backing vocals and musical phrases which owe much to a synthesiser. But they are as good an example of musical support as I've ever heard—sparse, pregnant with atmosphere and flawlessly executed.

And the recording, made in Festival's studio 24, is notable for its intimacy, expecially as heard on phones. Perhaps only obliquely devotional, but that's probably what it's all about. (W.N.W.)

Instrumental, Vocal and Humour

SIR ADRIAN CONDUCTS WAGNER: VOLUME 4. London Philharmonic Orchestra conducted by Sir Adrian Boult. His Master's Voice stereo OASD 3071.

This is a collection of what might be loosely termed "theme music" by Wagner. There are two pieces from operas while the other three are overtures. Such a collection is quite listenable and satisfying in the sequence on the album. Recording quality is good.

The five tracks are: Overture: The Flying Dutchman – Entrance of the Gods

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

into Valhalla; from "Das Rheingold" – Grand March; from "Tannhauser" – A Faust Overture – Overture: Rienzi. (L.D.S.)

★ ★ ★

A NIGHT WITH IRVING BERLIN. Tommy Tycho & The Good Music Orchestra. Festival L 45637-8.

Here is another musical treat from a collection of great local talent, recorded at the Sydney Opera House. Among the artists are Mary Jane Boyd, David Gray, Peter Brandon, Neville Marshall and the Claire Poole Singers.

Each of the four sides has a medley, together with three or four items from the orchestra or one of the vocal tracks, including: Top Hat, White Tie and Tails – A Couple Of Swells – Blue Skies – How Deep Is The Ocean – It Only Happens When I Dance With You – Count Your Blessings (from Alan Light).

The quality is really pleasing with a very lively sound. If you are a Berlin fan don't pass up this two record set without a hearing. (N.J.M.)

★ ★ ★

AUSTRALIAN SONGS GO CONTINENTAL. Dance Party Minstrel Records. LPMB 2005.

You could be excused for not recognising the titles on this enjoyable record from the way they have been arranged, but don't let that put you off. A lot of imagination has been used, with a generous helping of electronic music thrown in for good measure.

Some of the fourteen titles are: The Mexican Bug – Sixteen Summers – The Happy Burro – The Bus Don't Stop There Anymore – Misty Morning Dew – Listenin' To The Wind – And He Used To Be A Preacher Man – I Really Love You – Who'll Light A Candle In The Morning.

The name of J. Ashcroft crops up frequently in the credits, together with J. Halford. The quality is good, an ideal addition to your party musical "ammunition". (N.J.M.)

★ ★ ★

RODGERS, HAMMERSTEIN & HART. Tommy Tycho and his Good Music Orchestra. Stereo, M7, 2-record set MLX/2 108.

This interesting 2-record album was recorded live at a 2CH Good Music Concert in the Sydney Opera House. It features Tommy Tycho's orchestra, Greg Bonham, Julie Amiet, David Gray, Joe Andre, Michel Martel, and the Claire Poole Singers – a line-up of talent indeed, familiar on concert platforms and television.

Music on the four sides includes: No Other Love I Have – Love Duet (medley) – The Lady Is A Tramp – My Heart Stood Still – Oklahoma (medley) – Blue Moon – Mimi – Where And When – March Of The Siamese Children – My Funny Valentine – Lover – South Pacific (medley) – Bewitched – Keyboard Medley (Tommy Tycho) – With A Song In My Heart – Little Girl Blue – Slaughter On Tenth Avenue.

Musically, the orchestra and orchestrations are outstanding with Tommy Tycho rating a special mention. The vocalists are generally good, apart from some big-voice stanzas by Michel Martel which, to my ears anyway, sounded somewhat insecure in terms of pitch.

The sound is typically that of a live performance recording, with the voices just a trifle more remote, a trifle more merged into the background than one would expect in a studio recording. Apart from the first track, which sounded vaguely fuzzy, the quality is clean and an adequate memento of a concert that many hundreds will have enjoyed in person. (W.N.W.)

★ ★ ★

KINGS OF JAZZ. Louis Armstrong, Benny Goodman and many others. Joker mono SM 3428.

If you once had a collection of old 78's with jazz artists predominating, but you threw them out in the bright and brassy 1960's, here is a way to recover some of them. The ten tracks are all taken from 78's and they make a satisfying interlude on a wet Saturday afternoon or as an accompaniment to a late night supper. The sound ranges from fair to awful which really makes the album the more satisfying, as it is presented "warts and all".

Tracks are: Tea For Two (Duke Ellington) – Air Mail Special (Benny Goodman quintet) – I Love My Man (Billie Holliday) – Ain't Misbehavin' ("Fats" Waller) – Basin Street Blues (Louis Armstrong and Jack Teagarden) – Jazz Me Blues (Earl Hines Dixieland Band) – My Melancholy Baby (Mildred Bailey) – Flying Home – Lady Be Good (Count Basie) – Blues (Art Tatum and Jack Teagarden). (L.D.S.)

★ ★ ★

SOON OVER BABALUMA. Can. United Artists L 35590. Festival Release.

Can is a German rock band, which has been in existence since 1968. Their style of music is best described as extremely modern. They make fairly extensive use of electronic instruments of various sorts, and tend to play longer tracks than are normally acceptable on commercial radio.

I was rather astounded to discover that most of the members of the band are approaching forty. However, this does not affect the music, which shows traces of Eastern influences, as well as more expected similarities with bands like the Stones, the Beatles and Santana.

While the vocals are not very clear, possibly because they are only intended as background, the album is extremely clean otherwise, with the percussive instruments being particularly so. Technically, my pressing is a credit to the local Festival people. (D.W.E.)

LIGHTER SIDE—continued

STRUNG UP. Sweet. RCA Victor 2-record set. CPL2-7084.

"Sweet" are one of the up and coming groups (or up and gone, depending on how much in with the scene you are!). Seriously, this is now style rock'n'roll. Sweet have had quite a degree of success in the singles field lately, and these two records give a representative view of their style.

The first record is a live recording, while the second one consists of studio cuts. Seventeen tracks are featured in all, the ones most likely to be known to you being: Hellraiser – Fox On The Run – Ballroom Blitz – Blockbuster.

If you are young, or young at heart, then this record will appeal to you. Of course, this set should be played loudly! As usual with this label, record quality is excellent. (D.W.E.)

★ ★ ★

DYN-O-MITE GUITAR. Billy Strange. Harlequin L 25251. Festival Release.

Billy Strange is a record producer, song writer, guitar player, discoverer, publisher, singer, scorer and conductor, according to the cover notes. One may well ask where he finds time to do all these things! Such things aside, this $3.99 record is a collection of eleven film, TV and hit songs, played by the "best 'studio' " musicians, and aided by Billy's "Dyn-o-mite" guitar.

Tracks included are: Jaws – Love Will Keep Us Together – The Rockford Files – Star Trek – I Believe I'm Gonna Love You – Dynomite – The Hustle – Samantha – Good, Bad & Ugly – Durango – James Bond Theme.

Overall, this record makes pleasant background music. Recording quality is adequate. (D.W.E.)

★ ★ ★

THE TONY BENNETT/BILL EVANS ALBUM. Fantasy Records stereo L35696 (Distributed by Festival Records Pty Ltd).

Let me state at the outset that I do not respond to singers like Tony Bennett and his ilk, but I am prepared to concede that some people find his style satisfying. However, I cannot conceive that the caterwauling on this particular album could be satisfying to anybody except those that are tone-deaf, drunk or maybe both. Almost unfortunately for Tony, the recording quality is very good!

As if to admit that the musical experience of the album is rather meagre, the producer has tempted to lighten the presentation of the album sleeve with an "on the spot sketch" of Bill Evans done by Tony Bennett. Is this adequate compensation?

There are nine tracks in all: Young And Foolish – The Touch Of Your Lips – Some Other Time – When In Rome – We'll Be Together Again – My Foolish Heart – Waltz For Debby – But Beautiful – Days Of Wine And Roses. (L.D.S.)

★ ★ ★

THE COUNTRY SIDE OF GENE PITNEY. Gene Pitney. Musicor Records L 35604. Festival Release.

Unlike wine, this Gene Pitney album has not improved with age. The ten year old record appears to have been re-released to cash in on the publicity generated by the then coming Gene Pitney tour. If you're a fan, it may interest you but, to me, it sounds dated.

The twelve featured tracks are: For Me This Is Happy – I'm Gonna Listen To Me – She Thinks I Still Care – I'm Up To My Neck In I.O.U.'s – The More I Saw Of Her – If I Were – A Thousand Arms – Drinking From The Well Of Your Love – Life To Go – I'd Like To See Me Stop You – Won't Take Long – June Is As Cold As December. Recording quality is average. (D.W.E.)

★ ★ ★

FOLKSONGS OF AUSTRALIA. Denis Gibbons W&G Stereo WG 2BS/5652.

This enjoyable two record set has a nice balance between explanatory narrative and folk-song that gives a good insight to the struggles of the early pioneers.

Some of the titles are: Botany Bay – Moreton Bay – The Old Bark Hut – Bullocky O – With Me Swag All On My Shoulder – Travelling Down The Castlereagh – My Old Black Billy – Andy's Gone With Cattle – Click Go The Shears – Ballad Of The Shearer – Waltzing Matilda.

Effective use is made of the stereo image in the background sounds and the quality is very good. In short an excellent record as a gift to give someone not familiar with some of Australia's pioneer past. (N.J.M.)

★ ★ ★

FEELIN'S. Loretta Lynn/Conway Twitty. MCA Records MAPS 8017. Astor Release.

This joint effort by two of the leading Country singers from America does not seem to bring out the best in either of them. That is not to say that this album is entirely without merit; far from it. It's just that a complete record of duets, all about love tends to be a bit much for anyone playing through both sides.

The tracks which I did enjoy were "Back Home Again", the John Denver song, which has an exceptional start (when Conway puts his mind to it, he is "The High Priest of Country Music") and "Let Me Be There", made famous by Olivia Newton-John.

The remaining tracks may, of course, have their own special appeal to others. Recording quality is quite good, with negligible surface noise. (D.W.E.)

DRUMMIN' THE HITS. Sandy Nelson. United Artists stereo L45617/8 2-record set at $7.95.

The title accurately conjures up the musical presentation this two-record set – a competent and lively band backed by a frenetic drummer. Provided you listen to just one side at a sitting, it is okay for livening the atmosphere but it is certainly not suitable as a background for relaxation. Recording quality is good throughout.

A total of twenty tracks are featured, some as follows: Put A Little Love In Your Heart – Sugar Sugar – The Stripper – Rock Around The Clock – Shake, Rattle And Roll – My World Is Empty Without You. (L.D.S.)

★ ★ ★

HERE WE GO ROUND THE MULBERRY BUSH. Stereo, Dynmic WWLP-01. (From Crest Record Co, 122 Chapel Rd, St Kilda 3182. $2.55.)

If you have a family at the age when they might appreciate their very own record of nursery rhymes, the modest outlay for this album could be money well spent.

"Here We Go Round The Looby Loo" is a kiddies' version of the party dance "hokey pokey". The "Pied Piper Of Hamlyn" and "The Shoemaker And The Elves" are recounted by an un-named storyteller, but I'm prepared to bet that it is Bruce Menzies, formerly of 2CH and TV Channel 9 Sydney, and now an ABC announcer.

The remaining thirteen tracks are traditional nursery rhymes – "Little Pussy", "Miss Muffet", "Jack Sprat", etc – recited or sung by un-named female, who I can't pick. But, like Bruce Menzies, she does them very well, with excellent diction.

So, if you have a young family, or if you're in a nursery situation, it could be a very useful album. (W.N.W.)

★ ★ ★

CANTATA "EASY LISTENING" CASSETTES

MOTORING MUSIC 2. The Gil Vermont and Albert Lizzio Orchestra and the Cornel Singers. Stereo Dolby cassette, Cantata A-106. (Distributed by Goldring Sales & Service.)

As one would expect from a cassette expressly entitled "Motoring Music" there are no dynamic extremes, either likely to distract or to get lost in the general background of vehicle and traffic noise. However, the producers have taken precautions against a too repetitive sound, the successive tracks varying from orchestral to instrumental, to choral, and on to vocal, while all the time maintaining a bright rhythmic beat.

The titles: Wonderland By Night – Stranger In The Night – What Have They Done To My Song – Thank You – And We Are At This Again – She's A Lady – Limbo Jimbo – Once To Laugh, Once To Cry – Love and Shadow – O'Cangaceiro – Bossa In Pastels – Shuffle Master – Gotta Travel On – Azurita.

Quality is good, playing time is 30 minutes or more, and the cassette would obviously double for domestic listening if the music appeals. (W.N.W.)

★ ★ ★

COUNTRY & WESTERN. The Original Texas Boys. Stereo, Dolby cassette, Cantata A-116. (Distributed by Goldring Sales and Service.)

If you have a stereo cassette player in your car and you plan a country trip in the near future, I can't imagine a more suitable cassette to plug in as you head down the far side of the divide!

It opens with "Home On The Range", followed by a giggle number "Sow Song". Then come: Miller's Cave – Timba I'm Falling – Maypole On The Hill – Big Rock Candy Mountain – Blue – Fennario – Blue Tail Fly – Golden Slipper – Big Corral Railroad Corral – Banks Of The Ohio – Brahma Bull – You Don't Have To Be A Baby To Cry – Run Come See – This World Is Not My Home.

As you might judge from the foregoing, it's typical C&W fare, predominantly vocal featuring various of the Texas Boys, and backed with banjo, mandolin, accordion and such like.

Quality is fine and, despite the Texas touch, it's near enough if you want to be reminded of the open spaces here where the flies are a-buzzin! (W.N.W.)

★ ★ ★

YOUNG LOVERS. The Jacques Romain Orchestra with Leonardo and Frank Larosa. Dolby stereo cassette, Cantata A-115. (Distributed by Goldring Sales and Service in all states.)

"Young Lovers" is a pretty safe theme for an easy-listening music tape, especially when it's supported by a string of appropriate track titles:

Love Story – La Paloma – Lara's Theme – You Were Only Fooling – Romance In Beat – Somewhere In New Orleans – A Silent Summer Night – Miracles Always Happen Again – Greensleeves – La Golondrina – You Are Different – Mare Tranquilitatis – Thank You And Goodbye.

Recorded on TDK tape and using Dolby encoding, the quality is excellent, if played back on a Dolby equipped deck, or with a touch of treble cut. Good music for motoring or for that small dinner party. (W.N.W.)

BLANKET ON THE GROUND. Billie Jo Spears. United Artists L35716. (Festival Release.)

Billy Jo gets off to a good start with the title track on this album, but in my opinion, she never quite reaches the same heights again. Born in Beaumont, Texas, she has been singing professionally for quite a number of years now, although she is new to me. Country music is (naturally) her forte, and she does sing quite a pleasant song.

Tracks featured are: Blanket On The Ground – I Can Only Judge Your Future By His Past – Then Give Him Back To Me – Permanently Lonely – Since I Fell For You – See The Funny Little Clown – Come On Home – All I Want Is You – Before Your Time – I've Never Loved Anyone More.

If country music is to your taste, then this record would be worth an audition. Record quality is excellent, with little trace of bacground noise. (D.W.E.)

New Products

BWD 539C 20MHz Dual Trace CRO

BWD Electronics Pty Ltd have recently released a modified version of their well proven 539 dual trace oscilloscope. Designated the 539C, it has bandwidth from DC to 20MHz and maximum sensitivity of 10mV/cm. It has all solid-state circuitry and low power consumption.

Most people are not aware that BWD Electronics is a long established Australian company which is very successful on the international market. In fact, it makes major sales in Switzerland and Canada, countries which must already be well served by European and US suppliers.

You can be sure that BWD is also fully competitive in its home market. BWD sales offices can offer 24-hour turnaround on instrument service which is reassuring in the event of a breakdown.

Nineteen ranges in a 1-2-5 sequence are provided for the timebase, giving sweep rates from 0.5uS to 0.5sec/cm. A 5 to 1 vernier extends the sweep down to 2.5sec/cm. In addition, the horizontal trace position control can be pulled out to provide 5 times magnification of the sweep signal.

Control layout on the front panel is neat and logical and easy to follow. All controls and knobs are positive in operation and are of convenient size—the controls on some competitive equipment are often too small and fiddly, giving the impression of a toy rather than a worthwhile instrument.

Good control layout is a feature of the BWD 539C. It has bandwidth of 20MHz and maximum sensitivity of 10mV/cm.

Overall dimensions of the new model 539C are 190 x 249 x 430mm (W x H x D) including handle, knobs and feet. Mass is 7.2kg. A tilting bail is fitted.

Vertical deflection sensitivity is variable in 12 ranges from 10mV/cm to 50V/cm. In addition, the vertical deflection amplifiers can be cascaded to give a sensitivity of 1mV/cm at a bandwidth of 10Hz to 100kHz (−3dB).

The timebase may be switched off and the two vertical amplifiers used for X-Y operation and Lissajous display.

One feature we did miss was the facility to add or subtract the two vertical amplifier signals to give a composite waveform. In the minus mode, this facility is very handy as it is equivalent to an oscilloscope with differential input.

While the exterior of the unit looks relatively conventional it is the internal layout that has been changed so much in all CROs in recent years. Whereas the interiors used to be closely packed with componentry, nowadays much of the interior is free space. And this is the case with the BWD 539C.

One large PC board plus three small PCBs accommodate the major part of the circuitry, apart from that associated with two vertical amplifier attenuators and timebase range switch assemblies. All the PCBs have pin connectors so that they can be quickly removed from the chassis for service.

An active sync separator is employed to enable TV waveform displays with line or frame lock. In addition, the sync separator can be used as an AM demodulator enabling double or single sideband displays to be locked to the modulation envelope.

The calibrator waveform is referred to zero crossover of the mains voltage waveform. When the calibrator waveform is used for external triggering of the timebase, it enables accurate phase measurements on line operated equipment. An example is the measurement of thyristor and triac firing angles.

Space does not permit a fully detailed description of the circuit. Most of the circuitry is discrete except for one IC op amp. The circuit design would appear to be relatively conservative in spite of its acknowledged high performance.

A very comprehensive and well-written manual is supplied with the unit. In addition, there is an individual certificate or performance which indicates the major parameters.

Since the response of any amplifier begins to roll/off at about 30% of its stated bandwidth, calibration accuracy only applies for a limited frequency range. In the case of the 539C calibration accuracy is only applicable to about 7MHz. A chart included in the manual gives approximate calibration correction up to 40MHz and thus extends the useful measurement range up to this limit. There is also a nomograph for estimating the true rise time of waveforms as observed on the 539C.

Another useful nomograph is shown for measuring phase angle using Lissajous display.

Overall impressions of the 539C are good. It is a well proven design which has been refined over the past four years and it is backed by good service facilities. A big feature of the unit is the comprehensive instruction manual.

There is a complete range of accessories available to suit the BWD 539C. These include probes, polaroid cameras, viewing hood, dust cover and carrying case.

Price of the BWD 539C is $399 plus sales tax where applicable. Further information on the 539C and its accessories can be obtained from electronic components retailers or from BWD Electronics Pty Ltd, Miles Street, Mulgrave, Victoria, 3170 (L.D.S.)

Toshiba C-812 43cm Colour Receiver has UHF tuner

Under a recent agreement, the Tokyo Shibaura Electric Company Ltd and EMI (Australia) Pty Ltd have formed a new company to market Toshiba electronic equipment and appliances. One of the latest models in the Toshiba range is the C-812 43cm colour receiver which conforms to Australian standards in all respects and includes a UHF tuner.

For many colour television receivers, particularly those of European origin, styling has not been one of the strong features. However, on this technically up-to-the-minute Toshiba receiver the styling is very good. It has a well-finished cabinet with walnut veneer and the control panel, loudspeaker grille and picture surround finished in satin chrome.

Size of the picture tube at 43cm is probably ideal for many viewers with relatively small living rooms. Even so, the overall dimensions of the set seem to give an impression of bulkiness which is certainly not dispelled when the set has to be lifted. Overall dimensions are 622 x 429 x 416mm (W x H x D) and mass is 28.5kg.

Semiconductor complement of the all solid-state circuit is 8 integrated circuits, 25 transistors and 55 diodes. The picture tube is Toshiba's "Black Stripe" unit which is a variation of the newer vertical stripe tubes with in-line guns and a black matrix. Power consumption is 120W and audio power output is a maximum of 1.7W. Size of the oval loudspeaker is 80 x 130mm.

A conventional double-wound power transformer and bridge rectifier is employed in the power supply. This will please those who are wary of switch-mode power supplies.

Internal construction uses a U-shaped chassis surrounding the picture tube. A large mother board accommodates modules for Picture IF, Sound, Chrominance, Video output and Vertical Output. Other PC boards are used for the Horizontal drive circuitry and Power supply.

While the various modules are easily removable for service or replacement, accessibility to other boards is not so easy and would require removal of the chassis for any but the most minor servicing.

Good quality components are used throughout the circuits and this is another area where big improvements are noticeable over the older B&W sets. As a consequence, reliability should be greatly improved especially when all the solid-state operation is considered.

VHF coverage is channel 0 to 10 inclusive, with channel 11 being the selection position to make the UHF tuner operable. If channel 11 reception is required this can be easily modified by the dealer. UHF coverage is channels 21 to 68.

Antenna connections are either 75 ohm coax or 300 ohm ribbon for the VHF tuner, and 300 ohm ribbon for the UHF tuner.

Controls on the front panel are VHF Channel Selector plus fine tuning, UHF tuning, Contrast (pull out for AFC), Brightness, Colour Saturation and Volume (pull out to switch the set on).

All variable controls are smooth to operate while the channel selector and switches have a good snap action.

The push-to-engage fine tuning control concentric with the VHF channel selector was very difficult to operate as was the rear-mounted Vertical Hold control which had a shaft of inadequate length. Fortunately, these latter two controls are rarely used.

A worthwhile refinement to the set would be to have the AFC switched out when the fine tuning control is engaged, instead of having to manually switch it off.

The receiver submitted to us was used in the reviewer's home in the Northern beach suburbs of Sydney. No set-up adjustments were made apart from slight variation to the AGC Delay control (internal preset) to minimise picture noise on the weaker signals. Convergence was well within accepted standards, as was picture geometry, purity and masking. No doubt subtle improvements might have been possible if the various adjustments were tweaked. But, as it was, we felt that the picture quality was entirely acceptable.

In fact, with any normally adjusted colour receiver the biggest bugbear will not lie with the set but in the variations in colour quality from program to program. After a while though, all but the most pernickety viewers are not bothered by these presently inevitable variations.

The receiver appeared to have high gain and low front-end noise. I was able to obtain excellent colour reception from the four Sydney channels and adequate colour from Newcastle but there was insufficient signal from Wollongong to obtain colour. An antenna rotator to give optimum orientation for each channel would probably improve the DX performance. On one night only, during freak reception conditions, good colour reception was obtained from Tamworth!

All controls had adequate range, with the exception of the Contrast control which was almost to one extreme to obtain good grey scale tracking. Again, an internal adjustment may have been able to improve this.

Sound quality from the modest loudspeaker was good with the complete freedom from "frame buzz". A 3.5mm jack socket disconnects the loudspeaker for earphone listening.

Overall, the C-812 appears to be a well engineered and attractively styled set. At the recommended retail price of $569 it is a good buy in comparison with bigger sets. For those who do not require the UHF facility, the C-810 is the set to consider. Contact your dealer for further information. Trade enquiries should be directed to Toshiba-EMI (Australia) Pty Ltd, 301 Castlereagh Street, Sydney, 2000 or interstate offices. (L.D.S.)

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Front Mounting	28 cm (11.0")
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H077

NEW PRODUCTS

Clip-on V-A meter

Latest additions to the Kyoritsu range of meters are the Kewsnap series of clip-on volt-amp meters featuring swivelling heads for convenient and accurate reading in confined and awkward conditions. Five different models are available, with AC ranges covering up to 150A. All come with probes and a sturdy carrying case.

Further information from Jacoby Mitchell Ltd, 215 North Rocks Road, North Rocks, NSW.

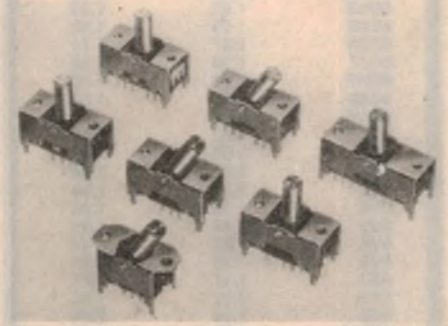
Videomaster games

The range of home video games made and marketed by Videomaster Ltd in the UK is being imported and distributed in Australia by Videomaster Sales, of 521 Burke Road, Camberwell, Vic. 3124. Included in the range is the "Olympic" a basic single box unit which offers a choice of six game variations and a novel manual scoring scheme. Also the "Mk1", a more elaborate unit with three games involving two-axis player control and scoring indication by sound "pips". All games are fitted with RF modulators for TV antenna connection.

Economy PC switches

A new family of low cost PC-type toggle switches offers a choice of two or four poles, with or without a centre-off position. The switches feature a baton type operating lever, and also offer the choice of make-before-break or break-before-make. Four corner tabs ensure rigid and reliable PCB mounting. Terminals are epoxy sealed to prevent ingress of solder flux or cleaning agents.

Operating pressure is 3oz. Contacts are rated at 0.3A/125VAC, 0.2A/12VDC, for a life of 10,000 operations. Further data on the CST series switches from Namco Electronics, 239 Bay St, Nth Brighton, Vic.



Direct transfers for one-off PCBs

Printed circuit board transfer sheets made by P.M.S. Nameplates in the United Kingdom are now being distributed in Australia by Enrite Electronics, as sole agents.

These transfers are designed specifically for making "one off" PCBs. They are packed in sets of ten sheets, covering most the symbols and lines likely to be needed to make up the copper tracks on printed boards. Once a set has been purchased, any individual sheet may be replaced as required.

Recognising that although the transfers are relatively easy to use, some guidance may be necessary, a comprehensive set of guidelines and instructions have been prepared by Enrite Electronics to ensure success. Anyone following carefully these instructions can be assured that the finished product will be comparable with professional products.

At the time of writing, the suggested price for a set of transfers is $6.98 plus 50c for packing and postage. Replacement sheets are expected to be 71c each. Further information may be obtained from Enrite Electronics, 67 Clarke Street, Peakhurst, NSW 2210.

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6BQ5	1.52	1.38
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6CA7	3.47	3.17
6CM5	1.67	1.52
6DQ6A	2.69	1.44
6DX8	1.52	1.38
6EA8	1.53	1.39
6EB8	1.87	1.71
6EJ7	1.30	1.18
6EH7	1.30	1.18
6ES8	1.76	1.60
6GV8	1.65	1.51
6GW8	1.63	1.49
6M5	2.00	1.82
6N3	2.57	2.44
6N8	2.20	2.00
6U8	1.52	1.38
6U9	2.03	1.85
6V4	1.22	1.12
6V9	3.28	2.99
6X4	1.17	.97
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Letters to the editor

LM3900 mixer

I write concerning the article you published in the November 1975 issue on page 46-47, on using the LM3900 op amp. This very useful article puzzles me in its analysis of the audio mixer in Fig. 8. In accordance with the earlier description of the input current and voltage conditions, opening the muting switches S1, 2 and 3 will cause the outputs of the buffer amplifiers to approximate V+, the muted condition. However closing these switches to earth the + inputs would seem to produce outputs of approximately zero potential, which I would call "saturated", and the amplifiers would STILL be muted. This follows from the statement on p.46 that, for the linear operation "the two inputs of each amplifier are kept at one diode voltage (0.5V) above the potential of pin 7."

The logical design would surely be to bias the + inputs through 10M resistors fed from the same decoupled V+/2 point as that used for biasing the summing stage. Closing the switches and thus earthing the + inputs should then mute the amps. Incidentally the text on page 47 indicates that closing a switch will UNMUTE that amplifier; which I cannot see.

My other comment is non-technical. If the LM3900 is available from most suppliers as you state, why does the article contain a free advertisement for Dick Smith only? I have no personal objections as Dick is a personal friend; in fact I use his mail order service exclusively, living here in Kathmandu. But I wonder how I would feel if I were another competing supplier.

P. H. Mathieson,
Kathmandu, Nepal.

COMMENT: We agree that on close examination, the diagram does seem to have an error. Your suggested scheme would appear to be quite in order, bearing in mind the need to equalise input bias currents for correct operation of the LM3900. The article came from a contributor in Britain, and was based on the manufacturer's data sheet—which also appears to have the same error. The reference to Dick Smith was included by the contributor because this was the only firm from whom he was able to determine local availability. Because he had verified that at least this firm had stocks, we left in the reference, but in fairness we added the suggestion that the device should also be available from other firms.

RFI from colour TV

Whilst on holidays I purchased a copy of your 1975 Year Book and found the articles on colour TV and amateur radio very interesting. Over the same period, I visited some friends in Wauchope, NSW, who have a Philips 26" colour television. By accident a transistor portable was brought into the room while the television was operating and there was tremendous interference to the portable's reception up to ten feet radius from the set.

Out of curiosity, I switched on the HMV stereogram, radio section: the same interference, right across the dial, but the stereogram is out twenty feet from the TV. What is the cause of this interference and how can we get rid of it?

My black and white set does not do it. I am on the verge of purchasing a colour set, and I have just started building your 1967 All-Wave-Four to do some short wave listening, and I would not appreciate this interference whilst listening.

C. Viner
Campbelltown, NSW

COMMENT: We imagine that the interference was caused by transients generated in the switching-mode power supply. A number of colour TV sets use supplies of this type, and the Philips 26in models are among them. However sets using this type of supply are almost invariably fitted with circuitry to suppress interference; we understand from Philips that this is certainly the case with their receivers. Your friends' set would thus appear to be faulty, and in need of attention.

Bouquet, suggestions

I am a school teacher at Mildura Technical School and have been buying EA back from the days when it was Radio & Hobbies then Radio TV & Hobbies. Congratulations on a well presented magazine which is used in at least three departments in the school and which is bought by at least five other teachers to my knowledge.

Perhaps I could make a few suggestions which would perhaps assist younger readers:

(a) A section devoted to model trains, where the merits or otherwise of different brands and types could be discussed; electronics controls etc could be designed and discussed. Remember some of us older members haven't grown up and still like to play trains. The same remarks also apply to model aircraft and boats.

(b) Your articles on science, particularly on astronomy and ecology (the ecology house, for example) have provided good discussion in my science classes. I already have a number of teachers interested in the use of solar cells, as here in Mildura we have plenty of sunlight.

Personally the section I read first is "The Serviceman". Over the years I have picked up quite a few clues and had many a chuckle at his anecdotes. Back in the days when I had the time to make sets, I made just about every mistake in the book, often with most unusual side effects. Believe it or not I even read your editorials! Keep up the good work.

E. W. Rudge
Mildura, NSW

COMMENT: Many thanks for the kind words about the magazine, and it's nice to know that there's at least one reader of the editorials! We have run articles on projects for model train enthusiasts from time to time, of course, but we'll see if we can do more along these lines. Your other suggestions will be borne in mind also.

Amateur exams

I refer to my letter on A.O.C.P. examinations published in the March issue of Electronics Australia.

Since writing that letter we have all sat for our examinations and in fairness I must report I found the paper very fair and quite capable of being answered in the alloted time by any reasonably well prepared candidate.

In any event congratulations to the examiner for a good paper.

Ian Purdie
Toongabbie, NSW

Help appreciated

Recently I wrote to your magazine to ask if any readers could help with the circuit diagram of a particular TV set. I have had many replies, and would like to thank all of the people who went to so much trouble to help me. Most people did not give their addresses, and this is why I wish to pass my thanks on to them through your magazine.

Kym Kavanagh
Tea Tree Gully, SA

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.

Books & Literature

Amateur radio

HAM NOTEBOOK Volume 2, Edited by James R. Fisk, W1DTY, Published by Communications Technology, Greenville, New Hampshire 03048, 1975. Soft covers, 175pp, 152mm x 228mm, many circuits, drawings and pictures. Recommended price $5.30 plus 80c postage to all States.

In line with Volume 1, this second volume contains many short items dealing with small projects, design information, methods of construction, etc., of interest to the radio amateur in particular. It is published by the publishers "Ham Radio Magazine". A perusal of this book gives me the impression that it is rather like our Circuit & Design Ideas column, except that some items are somewhat longer and that there is a book full of them.

In addition to an index at the back, there are 11 chapters. To give some idea of the contents, here is a list of the chapter headings. Antennas and transmission lines – FM and repeaters – Keying and control – Measurements and test equipment – Oscillators – Power supplies – Receivers and converters – RTTY – Transmitters – VHF and UHF – Station and workshop.

Although the Ham Notebook is directed primarily to amateurs, there is a wealth of interesting information for many other readers whose interest is in the field of radio communications. Although the price reflects current increasing trends, I think that it still offers good value and I can confidently recommend it.

The review copy came from Technical Book and Magazine Company Pty Ltd, 289-299 Swanston Street, Melbourne 3000. (I.L.P.)

Broadcasting

'1976' WORLD RADIO AND TELEVISION HANDBOOK, 30th anniversary edition published in Denmark by Jens Frost, for the World Radio TV Handbook Company Limited.

This 30th edition of the World Radio Handbook is an expanded one, for not only does it contain the Handbook as we know it, and all its excellent features, but it incorporates 'How to Listen to the World' with 90 pages of special articles for radio listeners. These two books are combined in the one volume, and offer the buyer not only the details on frequency, power, schedule, language information, addresses, and other relevant details on every radio and television station in the world, both listed by country and by frequency, but the How to Listen to the World supplement with its wide coverage of articles. These include, twenty best shortwave receivers on the world market, tips on tapes, new antenna developments, pirate or clandestine stations, relay stations, frequency selections, as well as many more interesting subjects.

Last year the edition of 40,000 copies were sold out soon after publication, and the extended edition this year is sure to create record sales.

The Handbook is without doubt the most authoritative publication of its kind, and the preface of this anniversary edition contains praise from the world's leading broadcasters and administrators.

The review copy was an advance sample received by airmail. Stocks by sea mail should be on sale by bookstores in Australia and New Zealand by the time this notice is published. Readers requiring further details, including a brochure and other information can write to the sole New Zealand agent, Arthur Cushen, 212 Earn Street, Invercargill, New Zealand. (A.T.C.)

Editor's Note: In previous years, copies of this handbook have been available from Technical Book and Magazine Company, of 289-299 Swanston Street, Melbourne 3000.

Hifi stereo

STEREO SOUND by H. W. Hellyer. Published 1974 by Fountain Press, Kings Langley, England. Stiff covers, 224 pages 220 x 140 mm. Price in Australia $10.50.

H. W. Hellyer is well known as an author of books on audio/hifi, of magazine articles on the same subject, and a reviewer of current equipment. One scarcely needs to be told that he is very much an enthusiast; one who delights in recounting the efforts of pioneers as a background to the present day scene.

This much is plainly evident in the early chapters on "Background Story", "Stereo and Films", "Stereo on Disc", "Stereo Radio". Other chapters cover "Aural Principles", "Stereoacoustics", "Microphones, Pickups and Tape" and "Stereo and HiFi".

A chapter on "Quadraphonics", one on "Servicing Stereo Equipment" and a general index round out the book.

While it contains a fair amount of factual information—tables, figures and graphs—the book impresses most by its pictures, diagrams and descriptive prose. As such, it can be highly recommended to the hifi enthusiast who wants to gain a better grasp of the technology behind the knobs and the gadgetry.

Our review copy came from Thomas C. Lothian Pty Ltd, 4-12 Tattersall's Lane, Melbourne, 3000. (W.N.W.)

In brief

NEW ORGAN MAGAZINE: Well known and established on the American continent, "The Organist Magazine" is now available in an Australian edition. The first local edition, dated March, '76, is a quality 48-page glossy production edited by Les Flanagan, well known in Sydney organ circles. It contains articles and advertising centred on organ people, organ playing, organ music, organ records, etc—all told, an interesting mag. For information: The Organist Magazine, P.O. Box 2104, North Parramatta, N.S.W. 2151.

NOTE: In the December, 1975 issue, we reviewed the book "Electronic Circuits and Systems" by Robert King, published by Thomas Nelson & Sons Ltd. We have now been advised by Thomas Nelson (Aust) Ltd that copies of the book are available locally, at a price of $15.85.

Special offer:

The Unitrex 901SN Scientific Calculator

The Unitrex model 901SN calculator, which is currently the subject of a special offer to "Electronics Australia" readers, dramatises the way in which calculator prices have fallen during the past year or so. A true scientific instrument, with impressive specifications, the 901SN is virtually pocket size, operates from two standard cells and costs a mere $29.95.

The 901SN has a 9-digit display—8 for characters and the 9th for indicating functional status, error conditions, etc. The figures are easy to read—blue-green in colour and visually about 5mm high.

As indicated in the accompanying photograph, the 901SN has twenty keys, all double function, plus a radian/degree slider and an off/on switch.

Used in normal "lower case" mode, the keys provide a basic four-function calculator suitable for use by relatively unskilled operators. It provides full chain calculation in any function sequence, with the distinction that, instead of overloading on excessive numbers, it flips automatically into and out of scientific notation. However, no "constant" key is available in the simple mode, this role being taken over by the memory facility and accessible via the "F" key and the "upper case" mode—along with the remainder of the scientific functions.

Features which are not apparent from the photo include a display which blacks out after about 30 seconds, leaving only a tiny dash in the function display to indicate that the calculator is still operating and that it retains the calculation in progress. Pressing the equals key or progressing the calculation in any way regenerates the display for a further 30-second period.

Another feature, mentioned earlier, has hitherto been found only on much more expensive calculators: an automatic resource to scientific display to forestall overload.

If being operated in normal floating point mode and the result exceeds the capacity of the display, the calculator automatically goes into scientific notation. Thus, it will display down to 10^{-7} or up to $10^{8}-1$ in floating point; after that it changes to scientific notation and will display a mantissa of either sign and up to 5 digits, and an exponent of either sign up to 99. If progressive calculation brings the result back within the previously stated limits, the display automatically reverts to the floating point decimal. The chance of overload with ordinary procedures would therefore seem to be quite remote, although it can be induced deliberately by squaring (doubling) the exponent to beyond 99.

Another interesting point is that, although the display can only handle a mantissa of 5 characters, the internal circuitry still keeps track of 8 characters which reappear automatically when the display reverts to floating decimal point. Alternatively, the 8-character mantissa can be inspected at any time by using the F/EE keys (not 8/5 as stated in the manual). Repeating the operation restores the original mantissa/exponent display.

Explaining the more exotic uses of the calculator, the accompanying data has this to say:

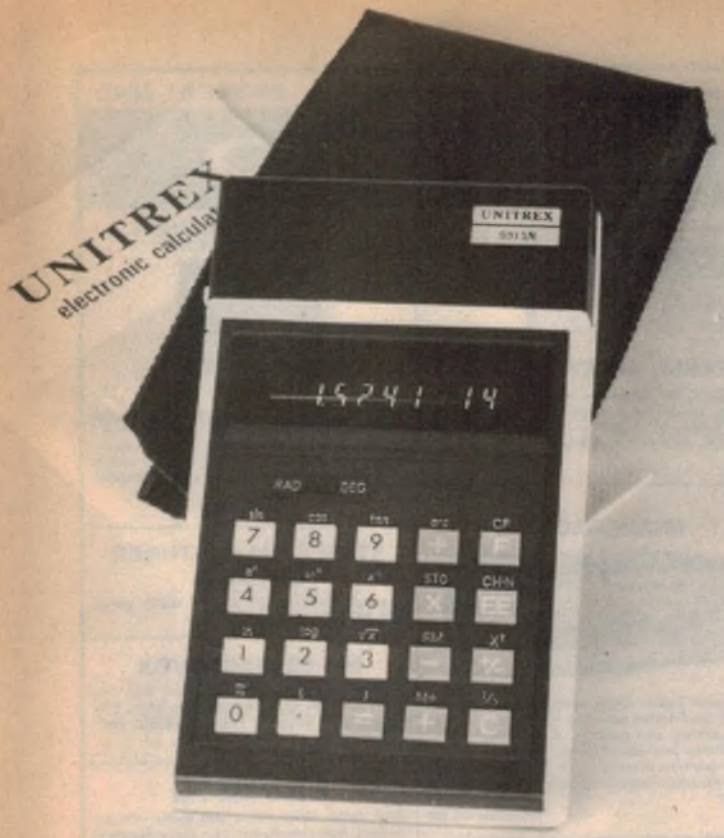
"In scientific functions, this calculator will have the capability of computing trignometric, inverse trignometric, logarithmic, exponential and convenience functions (1/x, x^2, root x, pi) etc, in a time period which shall not exceed 3 sec under the worst case conditions. The keyboard consists of momentary keys and a static mode select switch for choosing angle values in degrees or radians. For its size, it has tremendous calculating capability . . ."

Packaged with the Unitrex 901SN is a 21-page instruction booklet which should serve to introduce the uninitiated purchaser to the potential of the particular calculator. The first six pages include an index, a general introduction, explanation of the display and entry procedures and a definition of all key functions.

Pages 7 and 8 contain simple arithmetic exercises using the basic 4-function facilities, while page 9 introduces the memory function, which can be used in lieu of the usual "constant" feature. The reader may notice a few spelling literals, not unusual in Asian sourced manuals, but they are fortunately sufficiently obvious not to cause any great problems.

Following an explanation of the parenthesis facility, the reader is then introduced to various trignometrical exercises involving basic ratios, radians and degrees, inverse functions, etc.

Page 14 moves into an area familiar to electronics orientated readers



with problems to do with parallel resistors, resonant circuits, and exponential functions. This is followed by sections on natural and common logarithms and by a final listing of the error conditions and displays.

While such a book can give the user some idea of how the 901SN calculator can be used, it by no means exhausts its possibilities. For example, we put it to use early with some calculations involving the tempered musical scale and the following is typical of how it can be used to solve problems that hitherto would have been much more formidable:

DEPRESS KEY	DISPLAY SHOWS	MEMORY
2	2	0
F , x^y	2	0
F, (	2	0
1	1	0
Divide by 12	12	0
=	1.0594631	0
F, STO	1.0594631	1.0594631
440	440	1.0594631
X F RM	1.0594631	1.0594631
=	466.16376	1.0594631
X F RM	1.0594631	1.0594631
=	493.88331	1.0594631

The calculation can proceed for as many semitones as desired by simply repeating the procedure: "multiplied by read memory equals".

Similarly, by starting again at 440Hz and following the procedure: "divide by read memory equals", semitones below 440Hz can be displayed progressively.

For purely casual use, the 901SN can be operated from two type AA "penlight" cells, their life depending largely on whether the "on" time is concentrated or scattered in brief periods with long recovery intervals.

As an alternative, alkaline cells should offer about the same overall economy of cost/life, with the convenience of less frequent replacement.

In fact, the mains power supply which forms part of the offer is an excellent overall investment, in that it can often be left in the situation where the calculator finds its most prolonged use, avoiding any worry about leaving it on for lengthy periods. The internal batteries, of whatever kind fitted, need only power the calculator in its "pocket" role.

Unitrex of Australia Pty Ltd are backing the 901SN with a full 12 months warranty against faulty parts and workmanship and service is available from their Melbourne headquarters. The Company is fast emerging as one of the most active in the field in Australia. Their principals, Unitrex of America, claim that they rank number 3 in the world of companies marketing calculators.

(See advertisement, page 88.)

The Amateur Bands

by Pierce Healy, VK2APQ

World Telecommunication Day

The anniversary of the signing of the first International Telegraphic Convention in Paris, which established the International Telecommunication Union on the 17th May, 1865, has been chosen as the appropriate day to recall the technical advances in communication services.

The theme this year for World Telecommunication Day is "Telecommunication and the Mass Media"; being developed by the ITU and the United Nations Educational, Scientific and Cultural Organisation (UNESCO). It is interesting to note that the poster to publicise the day was designed by 16 year old Mohammed Ali Davarpanah of Iran, one of the winners of the ITU competition "Youth in the Electronic Age" in which over 200,000 young people participated.

In a special article on the theme, released by the ITU, some interesting facts are given. A point made is that the mass media—newspapers and broadcasting—are entirely dependent on telecommunications. Reference is made to various techniques used including teletype and facsimile. To illustrate the use of the latter the following example is given.

"In the United States, pages of the Wall Street Journal are being transmitted by communication satellite from the Dow Jones regional composition plant in Chicopee, Massachusetts, to the company's production facility in South Brunswick, New Jersey. There the reproduced facsimile is used to produce press plates for printing the pages."

The article also deals with the sociological effects that present day telecommunication services has on people.

Amateur radio has contributed much towards the advances achieved, particularly during this century.

Although no details are yet to hand it seemed probable that some form of amateur participation will take place, similar to previous years, and 4U1ITU will be operating. Amateur participation in this international event would achieve good publicity for the amateur service.

TOWNSVILLE PACIFIC FESTIVAL CONTEST

This contest is fostered by the Townsville Amateur Radio Club—VK4WIT Certificate Hunters Club No 6568, in conjunction with the Townsville city festival committee.

The aim is to promote an interest in the Townsville Pacific Festival, and to increase activity on the amateur bands by stations in Australia, New Zealand, Pacific Ocean islands and all countries bounding the Pacific Ocean.

1. Contest period: The contest will be over a period of eight days, from 0001GMT on Saturday 5th June, 1976, until 2359GMT on Sunday 13th June, 1976.
2. Sections: a. Transmitting all bands—Phone only.
b. Transmitting all bands—CW only.
c. Transmitting all bands—Open.
d. Transmitting—VHF and UHF—VK only.
e. Receiving all bands—Open.
3. Logs: These are to show the section entered and points claimed for each contact. This is most important; if points claim is not completed only one point per contact will be allowed.

VHF and UHF logs must show distance in kilometres between stations.

4. Contacts: a. CW contacts count as double score (CW to CW).
b. Stations may contact once only each day per band or mode for scoring purposes.
c. No points allowed for cross-band contacts.
d. No points allowed for contacts through repeaters.
5. Awards: A perpetual trophy is held by the TARC and it will be inscribed with the name of the winner, who will receive a smaller trophy.

Overseas stations, excluding those in VK, P29 and ZL call areas, with the highest score will receive a Pacific Festival medallion.

Section winners will be awarded a certificate.

Bonus points—except VK4 stations:
15 points for contact with VK4WIT.
9 points for contacts with other Townsville stations.

VK4 stations:
1 point per contact for working VK4WIT or other Townsville stations. Intrastate contacts not otherwise permitted for scoring purposes.

Overseas stations—excluding ZL and P29 call areas:
3 points for contact with any VK station.
5 points for contact with any VK club station.
9 points for contact with any Townsville station.
15 points for contact with VK4WIT.

All stations:
160 metres—5 bonus points per contact.
RTTY & ATV—10 bonus points per contact.
CW/CW—double points per contact.

VHF/UHF stations—scoring table:
0-50km—1 point
50-100km—2 points
100-200km—3 points
200-400km—4 points
400km and over—5 points

Bonus points VHF/UHF stations only—other than Townsville stations:— Contacts with your local club station add 15 points only if your club station has contacted VK4WIT in the preceding 24 hours (contact number must be recorded).

Townsville stations receive one point per contact only.

7. Identification: All stations identify for ease of scoring e.g. Phone VK4WIT Townsville CW VK4WIT/TVL.

Send logs to: Townsville Pacific Festival Contest VK4WIT—CHC No. 6568, PO Box 946, Townsville 4810, Australia.

Closing date for entries: 30th September, 1976.

Details of the contest were received from Hugh Barlow, VK4AM, Queensland Contest Manager.

HF scoring table for the Townsville Pacific Festival Contest. Bonus points will be awarded as listed in the text.

6. Scoring - HF stations:

Scoring table - VK; ZL; P29 stations

	VK1	VK2	VK3	VK4	VK5	VK6	VK7	VK8	VK9/P29	ZL	VKØ
VKØ	7	7	7	7	7	7	7	7	7	7	-
VK1	-	1	1	2	3	4	2	4	5	3	7
VK2	1	-	2	1	2	4	3	4	5	3	7
VK3	1	2	-	3	2	4	1	6	4	3	7
VK4	2	1	3	-	4	6	5	2	1	4	7
VK5	3	2	2	4	-	1	3	4	5	4	7
VK6	4	4	4	6	1	-	4	1	5	6	7
VK7	2	3	1	5	3	4	-	6	5	3	7
VK8	4	4	6	2	4	1	6	-	2	3	7
VK9/P29	5	5	4	1	5	5	5	2	-	6	7
ZL	3	3	3	4	4	6	3	5	6	-	7

VK; ZL; P29 stations to Pacific seaboard countries and islands - 1 pt.

MOBILE EXPLOSION HAZARDS

The above heading is from an article in the February 1976 RSBG publication "Radio Communication".

The article deals with two papers: "The possibility of ignition in flammable atmostphere due to mobile radio transmitters" and "The ignition hazard due to radiation from radio transmitters" written following experimental work carried out at the Postgraduate School of Electrical and Electronic Engineering, University of Bradford.

The papers explain that ignition of explosive mixtures can be due to any sparks which may be produced by wires or metallic structures forming resonant aerials; this is most likely to occur at frequencies from 3.5MHz upwards; and that as frequency increases there will be a tendency for any sparks to be maintained over a longer period, reducing the power needed for ignition to occur.

The authors stress the absolute importance of never operating a transmitter while a car is being refueled, "and additional hazard which we have discovered in practical tests concern the fueling of a vehicle containing an operating transmitter, or parked close to another vehicle containing one. With HF mobile transmitters there is a substantial ground return current which is coupled normally through the vehicle-ground capacitance. If however, a metallic route for this is provided (all petrol pump nozzles are required to be bonded to ground to eliminate electrostatic hazards) a spark can be drawn, the probability being that this will occur at the most hazardous point, viz., between the fuel nozzle and the tank inlet."

Comments were also made in relation to radiated power from one watt to 400W PEP transmitters, both commercial and amateur. One opinion expressed that will not appeal to amateurs is; "There is a case for restricting the power of vehicle-borne amateur transmitter to a lower level". However, the danger of operating any transmitter in or near the forecourt of a garage seems important and sensible safety precautions essential.

ROYAL VISITOR

Messages of welcome from Australian amateurs were conveyed to the distinguished amateur JY1, King Hussein of Jordan, during his visit to Australia in March, 1976.

Unfortunately, a very busy schedule did not allow a personal welcome to be extended by Australian

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.

AMATEUR BANDS

amateurs. However, the WIA was extended the priviledge of being represented at state dinners in Sydney and Melbourne, where his Royal Highness was guest of honour.

MID-WINTER FIELD DAY CONTEST

The New South Wales Division WIA, VHF and TV group is conducting a field day contest over the weekend, 12th to 14th June, 1976.

The contest will commence at 1200 hours EST, Saturday 12th June and concludes at 1400 hours EST, Sunday 14th June.

RULES:

1. All bands 52MHz and above may be used.
2. Only one scoring contact with a station per band each clock hour is permitted.
3. Serial numbers consisting of a signal report followed by three digits commencing with 001 and increasing by one for each contact.
4. The minimum contact distance is 1kM.
5. Cross-band, HF, and operation through repeaters may be used to set up contacts but not for scoring purposes.
6. All FM channels classed as nets and OSCAR 6 and 7 are not classed as repeaters.

Sections: field stations; home stations; mobile stations. Best six consecutive clock hours and best overall score in each section.

ENTRIES: Logs may be handed to a VHF and TV group committee member or posted to the VHF and TV Group, 14 Atchison Street, Crows Nest, 2065.

Logs must give the following details:— date, locations, time, call signs and locations of station worked, serial numbers, points claimed, bands and modes used.

OSCAR:
2-10 metre translator:— VK and ZL call areas—20 points
Other call areas—50 points
70cm—2 metre translator:—
VK and ZL call areas—50 points
Other call areas—100 points
ATV:
Serial numbers must be exchanged on vision and sound.

Scoring table for the Mid-winter Field Day, June 12 to 14. See text for details.

SCORING TABLE - POINTS

Distance km	6 metres FM net	6 metres Tunable	2 metres FM net	2 metres Tunable	70cm	ATV	576Mhz & up
1-50	1	2	1	5	4	20	10
51-100	2	4	2	6	10	50	50
101-150	5	10	5	15	30	150	100
151-300	10	20	10	30	50	250	200
301-500	25	50	15	45	100	500	500
501-800	20	40	25	75	200	1000	600
801-1200	15	30	35	105	400	2000	700
1201-2000	10	20	75	225	500	2500	800
2001-above	25	50	105	325	600	3000	1000

NOVICE AOCP STUDY PACKAGE

As part of a general restructuring of education services offered by the Queensland Division of the WIA to its affiliated radio clubs and associate members, the Novice AOCP Study Package has been developed.

The package is designed to suit students who have to study by themselves as well as members of radio clubs. Each student in a class is issued with his own copy of the complete package. The course was tried out in Brisbane in 1974, and the results were highly successful.

The Queensland Division WIA and the Windsor YMCA Radio Club have joined forces to enable this package to be offered to all persons and to clubs in quantities for resale to members. To assist clubs a discount on bulk purchase of five or more is being currently offered. Only recognised clubs will be quoted discount rates.

The package contains course notes, a study guide, project sheets and a cassette tape Morse code lesson. Using the study guide students can work through the sixteen sections of theory notes each with self test questions and sample answers. No prior knowledge of the Morse code is necessary and can be learnt from the the cassette tape lesson, which uses the sound only method.

The package is available at the special price of $10.00 plus $2.00 pack/post.

Write for further details or send orders to—
Novice Package, WIA, Box 638, GPO,
Brisbane, Qld. 4001.

NOVICE EXAM

Following the novice examination held in March, 1976, there has been serious criticism from some quarters concerning both the standard of the questions asked and the manner in which they were presented. Next month we plan to take a closer look at the whole concept of multiple answer type examinations and, in particular, those questions in this examination which experienced educators consider fall short of the accepted guidelines for this type of examination.

RADIO CLUB NEWS

WINDSOR YMCA RADIO CLUB: The club was formed in February, 1975, and the membership has grown to more than 60 in the year. Meetings are held at the Windsor YMCA Centre, 387 Lutwyche Road, Windsor, NSW, each Friday night from 7.00 pm-9.00 pm. Radio theory and Morse code instruction classes are held.

For full information telephone the secretary, Geoff Adcock on 59 7332 or Roger Davis on 356 9228.

GOLD COAST RADIO CLUB: The Gold Coast repeater has been performing very well and some long distance contacts have been made through it. These range from Port Macquarie 375km and Coffs Harbour to the south, Gympie 225km to the north, Dalby 225km northwest and Warwick 150km west.

A UHF repeater, in the 432MHz band, has also been temporarily installed for tests.

The GARC has been actively represented by Guy Minter at the State Disaster Organisation meetings. Although there have been some anxious times fortunately no cyclones have hit the Gold Coast.

A note from John Williams, VK4UI reports that there is a fair amount of SSB two metre activity on the Gold Coast and beams are pointed south quite often, 144.1MHz is the most used frequency. There is also some activity on eleven metres. John is trying to get others to "fire up their FT101's etc into a dipole antenna and work Sydney and Melbourne on 27.125MHz and 27.155MHz". There is a small group operating around midday on Sundays and sometimes on Saturday.

GEELONG AMATEUR RADIO—TV CLUB: An enthusiastic group of GARC members participated in the John Moyle Memorial Field Day Contest in February, 1976. The party was organised by Haydin Chittock, VK3BFL and Harold Selman, VK3CM and all amateur bands from 3.5HMz to 144MHz were used. The greatest amount of activity was on 15 metres where 280 contacts were made.

The equipment used included an FT200 on HF, FT60 for 6 metres SSB; FT221—2 metres SSB and an 1C-22 for 2 metre FM.

It is thought that the score will place the club in a leading place in the contest.

CENTRAL COAST AMATEUR RADIO CLUB: In case you have not caught up with the news and providing things have gone as planned, the Gosford two metre FM repeater should now be on channel 5. The repeater will receive on 146.15MHz and transmit on 146.75MHz. The change over was due to take place at the beginning of April.

The annual general meeting of the CCARC will be held at the club rooms Dandaloo Street, Kariong on Friday evening 7th May, 1976.

A new constitution is to be drawn up for the CCARC. This is necessary to meet the Lands Board's requirements, in respect to the occupancy of the land at Kariong, that the club is a non-profit organisation in the legal sense.

Congratulations to Ed Dyring, VK2BED who has for some time been editor of the CCARC "NEWSHEET". Ed has been appointed president of the Gosford Rotary Club, and will take over from 1st July, 1976.

WAVERLEY AMATEUR RADIO SOCIETY: During recent months WARS has been reactivated and at present are endeavouring to gather material about the early days of the club which appears to have been formed in 1911. Over the years records have been lost or lay forgotten among the possessions of former members. Glen Molloy, VK2AGM would like to hear from anybody who may have old documents or photographs that may help to reconstruct the past history of WARS.

The club repeater operating on channel 3, 146.3MHz input and 146.9MHz out, has been installed at the club's premises at Bondi Junction. The call sign is VK2RBV.

For full information contact public relations officer Ivan Repin, VK2ZOQ, telephone 30 4312.

MOORABBIN AND DISTRICT RADIO CLUB: Honorary membership may be obtained of the MDRC by DX stations working five club members. For Australian stations it is necessary to work 14 club members. The MDRC call sign is VK3APC.

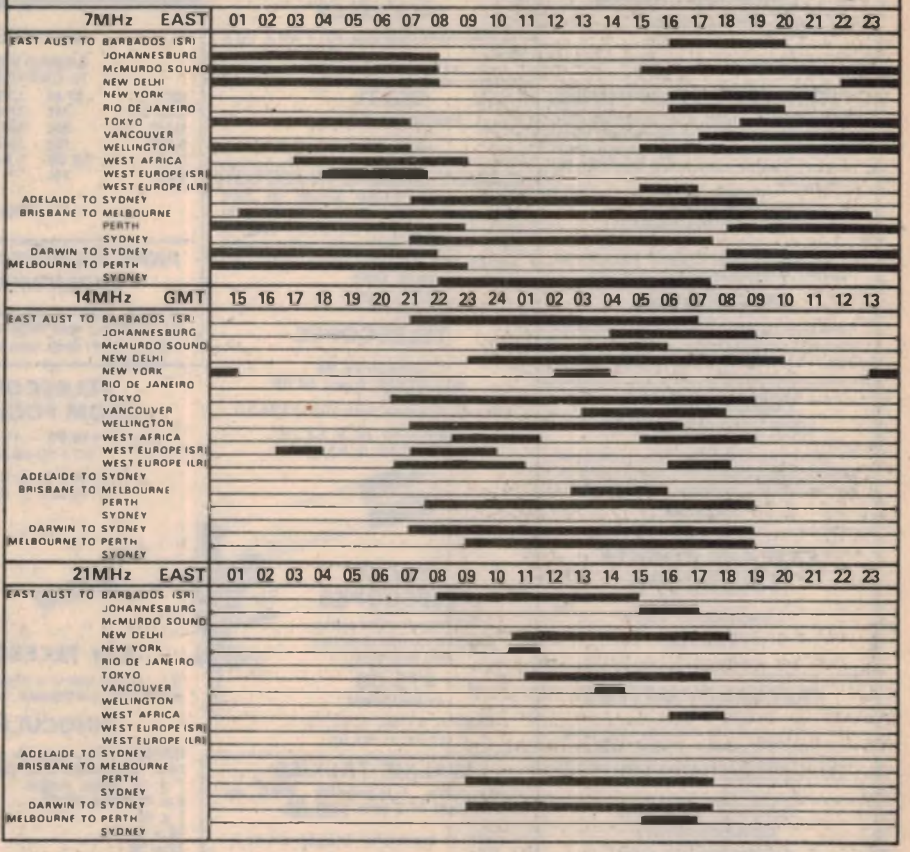
Good progress is being made with the Moorabbin council's building project to provide accommodation for several local sporting bodies. The MDRC are hopeful of occupying their rooms in the building in the near future.

ILLAWARRA AMATEUR RADIO SOCIETY: In the annual report, the first since changing from being a branch of the NSW Division WIA, retiring president Keith Curle, VK2ZYI, indicated that the society had made good progress. Financially the society is in a sound position and the prospects for the coming year are good. It was also stated that the society's repeater installation is highly regarded by its users.

The February moonbounce tests were carried out with some difficulty due to the lack of experienced personnel to operate VK2AMW. Lyle Pattison, VK2ALU, moonbounce project co-ordinator, has suffered a spinal injury requiring surgery and was unable to participate in the first W/VE test period. However, Charlie Proctor, VK2ZEN, did a good job and during the test period heard VE4JX, but a contact could not be completed.

IONOSPHERIC PREDICTIONS FOR MAY

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. 5.76



MUIRHEAD

Decadade oscillator. Type DG 38A
$100.00

LANDING LIGHTS

24 volts. Ex R.A.A.F. $9.50

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$35.00
(2 TELEPHONE SETS)

$1 cartage to rail. Freight payable at nearest attended railway station.

ALTIMETERS

Sensitive type ex Air Force, made by Pioneer USA. $37.50.
Post A $1.70, B $2.25, C $2.40, D $2.65

TEN CHANNELS VHF TRANSCEIVER

TR 1936 125-150 MHz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator

$33.00

CLIP-ON POCKET TELESCOPE

15 magnification. $3.75
P & P 60c

FREQUENCY METERS

AN/URM 32 A 120 KHz to 1000 MHz, with two 40V power supply. $125.00.
$1.00 cartage to rail, freight payable at nearest attended railway station.

ILFORD 17.5 mm SPROCKETED MAGNETIC TAPE

1000 ft reels brand new original packing
$4.00 ea. quantity available
Post A $1.30, B $2.00, C $2.30, D $2.80

No. 62 TRANSCEIVER

With headphones, accessories etc
$60

TELEPHONE WIRE

1 mile twin (2 miles) genuine ex-Army. Don 8 perfect condition $35 per drum
$1 cartage to rail freight payable at destination

PRISMATIC COMPASSES

Genuine ex-army Mk 3, liquid damped, as new $45.00 P & P A $1.70, B $2.25, C $2.40, D $2.65

MORSE KEY $1.40 Post 40c | **MORSE KEY BUZZERS** $4.25 Post 60c

DYNAMIC TRANSISTOR CHECKER

Provides a visual indication of signal output. Tests: electrode open circuits, short circuits, current gain. $14.95 ea.
P & P A $1.70, B $2.25, C $2.40, D $2.65

KAISE BATTERY TESTER

Model SK-130. Wide coverage of measure ranges 1.5 to 90 volts. $25.00.
P & P A $1.70, B $2.25, C $2.40, D $2.65

ADLER FREQUENCY METER

100KHz - 30MHz **$95**

4 DIGIT RELAY COUNTERS

50 volt DC, suit slot car Lap counters, etc.
$1.25 each. P & P 60c

NIBBLING TOOL

Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7/16inch.

ONLY **$9.95**
Post $1.10

NIFE CELLS

1.2 Volt, fully charged, 4in x 3in x 1in 4 AH
$1.50 each. P & P 60c.

BC221

Frequency Meters.
$35.00

HANDY SIGNAL INJECTOR

Produces an Audio Signal in rich harmonics. Ideal for Sig Tracing in A.F., I.F., and R.F. circuits. Powered by 4 Penlight Batteries with On-Off Switch and indicator lamp. Size 1½" Diam. 5" Long. Only
$6.50. Post $1.10.

TELESCOPES

25 x 30 $5.95
40 x 40 With Tripod $8.95
30 x 60 Prismatic With Tripod $34.50
P & P A $1.70, B $2.25, C $2.40, D $2.65

ZOOM TELESCOPES

60 magnification with a 60mm coated objective lens with tripod.

$75.00
as illustrated

P & P A $1.90, B $2.75, C $3.20, D $3.95

WALKIE TALKIES

2-way radio, 7 transistor. PMG approved, set of 2 only **$48.50**

1 watt, 11 transistor $130.00 set of 2.

P & P A $1.80, B $2.50, C $2.80, D $3.20

SMALL COMPUTER PANELS

3in x 2in containing 2 valves, qty. of resistors, etc.
ONLY 75c. P & P 60c

ELECTRONIC FREQUENCY COUNTER

Austronic type DFC-4 240V 50 cycle 0-100KHz **$150**

IMPELLER PUMPS

New gunmetal body, Stainless Steel Shaft. Neoprene Impeller. Up to 15ft Lift, suitable for almost any type of liquid. Self priming. Ideal boat bilge pump, sullage drains, etc. Approx size 8" x 5"

[illegible]"	$23.30
[illegible]"	$31.95
[illegible]"	$33.75

P & P A $1.90, B $2.75, C $3.20, D $3.95

RECEIVER No. 210

2-16 M/cs $65.
Transmitter No. 11 suits 210 $35.
24 volt Power supply to suit above $15.
Or complete station with Headphones, Mic, Morse Key, Antenna $110.

SIGNAL GENERATOR
Palec Model SG1 150 Kc/s to 30 M/cs
240 VAC $37.50.
$1.00 cartage to rail.
Freight payable at nearest attended railway station

522 Transceivers 100-150M/CS
$35.00

5" CRO TUBE

5 BPI $5.50 each.
Post A $1.40, B $2.25, C $2.70, D $3.45

POSTAGE KEY:

A: NSW.
B: Vic, Qld.
C: SA, NT, Tas, New Guinea,
D: WA.

VALVES

BRAND NEW IN CARTONS

807	$1.50	CV850	$1.50
6SN7GT	95c	1H6G	75c
5U4G	95c	832	$5.00
EF50	75c	6X4	$2.25
5Y3	$2.25	VR64	75c
2 x 2	75c		

P & P 40c

PARABOLIC REFLECTORS PYREX MIRROR

36" dia. Ideal solar radio optical experimenting also decorating purposes.
$60.00. Sorry shop sales only

TELESCOPES ZOOM FOCUSING

30 x 30 $19.95 — 45 x 40 $28.95
50 x 50 $37.50
P & P A $1.70, B $2.25, C $2.40, D $2.65

SPY TELESCOPES

8 x 17 mag size of a rifle cartridge extends to 8". Only $4.25 each. post 60c.

BINOCULARS

PRISMATIC Coated Lenses. Brand new. Complete with case.

7 x 35 Wide Angle	$35.50
8 x 40 Wide Angle	$39.50
7 x 50	$31.50
10 x 50	$32.50
12 x 50	$33.65
20 x 50	$37.95

P & P A $1.80, B $2.50, C $2.20, D $3.20

SOLENOIDS

Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio, etc.
$2.50 P & P 20c
200 MA 24 volt, ⅛in push movement.
$2.50 P & P 20c.

SELSYN MOTORS MAGSLIP

MK 11 ..... $5.25 ea.

3000 TYPE RELAYS

P.M.G. 200Ohms — 1'500Ohm
Coils $2.50 each. P & P 60c.

P.M.G. TYPE KEY SWITCHES.
45c P & P 20c

Cintel Oscillator and Electronic Counter, type 388
$250

SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2.95. We haven't got time to sort them, so you reap the benefit.
P & P A $1.80, B $2.50, C $2.80, D

RADAR TRANSCEIVER

X BAND WITH KLYSTRON ETC. **$45.00**

MULTIMETER

A compact and handy tester for workshop or lab where quick circuit checks are required
DC Voltage 5-2.5K (20,000 OHMS per volt) AC Voltage 10-1000V (10,000OHMS per volt) DC Current 0-50 UA, 0-2.5 MA, 0-250 MA. Resistance 0-6 Megohms. Capacitance 100 UUF to 1UF. Decibels — 20 to plus 22 DB. Complete with instructions.
Only $17.25 ea. Post $1.05
30,000 ohm per volt $23.75. P & P $1.05

EX ABC RECORDING TAPES TOP BRANDS

¼" x 2400' on 10½" reels $4.95
P & P A $1.70, B $2.25, C $2.40, D $2.65

Panoramic Adaptor

E.M.I. type PRA-1 455 variable Kc
Course 440-520 Kc
Centre Freq 520-440 Kc
Fine Centre Freq 20-0-20
Filter band with 50, 100, 200 L.F.
200 H.F. Sweep band width 0-200.

$75.00.

CONDENSER LENS

1½" Diam 4½" F.L. 75c 2½" Diam 2" F.L. $1.50 each. Or $2.50 per pair. P & P 40c

TRANSCEIVERS Ex Army

No C42 set. 36 to 60 MHz complete with 24V power supply, headphone, mic, leads etc $65.00.

No C45 set. 23 to 38 MHz complete with mast, headphones, mic, 24V power supply etc $95.00

$1.00 cartage to rail, freight payable at nearest railway station

Hartley double beam oscilloscope. Type 13A with probes
Working $150.00

77D x RCA STUDIO RIBBON MICROPHONES Variable pattern & response music or speech $80.00 ea. Post A $3.30 B $4.00 C $4.30 D $4.80.

Director dumpy levels optical complete with tripod and carrying case ideal for all level work also gives elevation and depression illuminated only $85.00

ANTENNA MASTS

Telescopic. 10ft extending to 27 ft. Complete with nylon rigging, stays pegs and base plate.
$45.00

MARINE COMPASS

3" floating dome. Gimbled, illuminated and compensated. In attractive strong chromed-brass housing $27.50.
P & P A $1.80 B $2.50, C $2.80, D $3.30

ANALYTICAL SCALES

Brand new. Griffin & George (London) Housed in timber & glass case 16" x 16" x 7". Weighs down to fractions of grams. (No weights supplied.) Usual price $187.50. Special $45.00 ea. Post A $2.10, B $3.25, C $4.00, D $5.25

REPERFERATOR

Genuine Siemens Type 33c $65.00

Deitch Bros.

70 OXFORD STREET, SYDNEY 2010

SORRY NO C.O.D.

Shortwave Scene

by Arthur Cushen, MBE

New transmitters mean new frequencies, making the quest for new channels a continuing affair. Recently Malta and Korea have been noted on new outlets in an attempt to find interference free channels.

The transmitters on Malta, owned by Deutsche Welle, consist on one 600kW medium-wave unit and three 250kW short-wave units located at Cyclops. The Malta transmitters are also leased to other organisations, and in recent weeks the Voice of Hope, which has in the past used the facilities of Trans Europe at Sines in Portugal, has been using the Malta transmitters.

The Gospel program of the Voice of Hope via Malta have been heard on Sundays on 9635kHz with an English program at 0700GMT, German at 0715GMT and French at 0730GMT. Sign-off is at 0800GMT. Malta on 9635kHz provides fair reception, but sideband from the BBC, London, on 9640kHz is troublesome and prevents good reception.

KOREA USING NEW CHANNELS

Radio Korea at Seoul, which has recently introduced 250kW transmitters, has been using four frequencies for its English transmission 0900-0930GMT. Four channels, 7250, 9600, 9640 and 11850kHz, were received during initial transmissions, but recently new channels have been tested.

The frequency of 7250kHz has been replaced by 7150kHz. This channel is used by the BBC up to 0915GMT with the World Service, so severe interference has been the result. The 9600kHz outlet has been replaced by 11860kHz and provides good reception. On 9640kHz Korea has co-channel interference from the BBC up to 0915GMT, while on 11850kHz the transmission at 0925GMT suffers interference from the Voice of Germany.

These frequencies are on a test basis, and following the interference caused to the established broadcasters on these outlets, Korea is expected to make further moves before finding suitable channels for its English transmissions.

BERNE USES 11950kHz

The Swiss Broadcasting Corporation at Berne is using the new frequency of 11950kHz for its service to the Far East, Australia and New Zealand 0700-0930GMT. The signals on this frequency are well received throughout the transmission which replaces 17840kHz. Reception is best on 9590kHz and this transmission includes English 0700-0730GMT and 0900-0930GMT. At the same time the transmission is radiated for listeners in Europe on 3985, 6165 and 9535kHz. In addition transmissions on 11775 and 15305kHz are beamed to the Far East.

SMITHSONIAN DISPLAY

The writer has received a request for a selection of his verifications to be shown at the Smithsonian Institute in Washington. The display of verifications is to cover those issued by the Canadian Broadcasting Corporation since it began shortwave broadcasts to the international audience some thirty years ago. Previous to that date the programs of the domestic service were carried on a 7500W transmitter located near Montreal at Vercheres.

Radio Canada International, using two 50kW transmitters at Sackville, New Brunswick, went into operation on February 25, 1945. Recently these transmitters were replaced by five 250kW units. Radio Canada broadcasts to the South Pacific 0900-1000GMT on 9625 and 5970kHz.

INDIAN RADIO EXPANSION

According to DX Digest of India, the recent Geneva Conference on the allocation of medium-wave frequencies has granted India many new stations. India has the second largest total of frequencies allocated in Asia with the most going to China. Some transmitters will be for day-time use only and the plan includes seven programs for major cities such as Delhi, Bombay, Madras and Calcutta. There will also be 352 low power transmitters one for each of the 352 districts of India.

India also has plans for four super-power 1000kW transmitters for Bangalore, Nagpur, Delhi and Greater Nicobar Islands. India's future plans for medium-wave broadcasting is for 787 day-time and 500 night-time transmitters as against the 111 of All India Radio being operated at present.

The total power radiated by All India Radio network MW transmitters is 4245kW today. This will be increased to 7089kW during daytime and 18467kW at night when the plan is implemented.

RECENT VERIFICATIONS

ESTONIA: Radio Tallinn has confirmed our reception of their shortwave broadcasts on 6085kHz with a letter and three coloured cards. The actual verification card shows the modern broadcasting centre in Tallinn. The Estonian Soviet Socialist Republic is one of the smallest republics in the Soviet Union with a population of 1.4 million. There are more than 537,000 radio sets and 300,000 TV sets, and there have been no licence fees since 1958. Estonia Radio broadcasts three programs on medium-wave and FM, while a shortwave station is used for foreign service.

MALAWI: A letter verification from the Malawi Broadcasting Corporation, PO Box 30133, Blantyre 3, gives the present schedule as: 3380kHz 0250-0520GMT and 1750-2215GMT, 5995kHz 0500-2110GMT, and 7130kHz, 0600-1715GMT. The power is 100kW, except for 5995kHz when it is 20kW.

DX WORLD RETIMED

The DX World program, which is broadcast over the External Service Division of Radio New Zealand on the first Wednesday of each month, has been retimed. The transmissions are now at 0610 and 0910GMT. The first broadcast is on 9585 and 11780kHz and the second program on 6105 and 9520kHz. There is a repeat on the following Saturday at 2330GMT on 11960 and 15380kHz.

The session is also carried on medium-wave by the Radio New Zealand National Program on the second Thursday of each month at 1230GMT. This network comprises 22 stations from Kaitaia in the north to Invercargill in the south, with 2YA Wellington on 570kHz providing the best signal for listeners in Australia. The sessions are recorded at the Radio New Zealand studios Invercargill by the writer, and are 15 minutes in length.

MEDIUM-WAVE NEWS

AUSTRALIA: The latest commercial station to open is 5AA in Adelaide on 1390kHz, which is carrying good music programs. According to Keith Barton reporting in the Southern Cross DX Post the address is: Festival City Broadcasting Limited, PO Box 1390, Norwood, South Australia 5067. 5AA operates 24 hours a day, has the power of 5kW, and was well received in New Zealand during test broadcasts before opening on March 14.

The station which formerly operated on 1390kHz, 4BH in Brisbane, is now using 880kHz with the increased power of 5kW. The station has relocated its transformer site and aerials, and is reported to be providing better coverage of the Brisbane area.

Station 4NA Nambour, Qld, has changed frequency from 940kHz to 830kHz according to Chris Martin of Sydney. The frequency change allows easier reception of 4AY Ayr on 940kHz. However, 4NA will be difficult to hear in New Zealand and southern Australia because of the strong signals of 3GI Sale and 1YX Whangarei, both of which use 830kHz.

GUAM: According to the 1976 World Radio and Television Handbook two new stations are to come into operation. These are KUAI on 720kHz using 10kW and KUFE on 940kHz, also using 10kW. The latter station is being operated by the Far East Broadcasting Company, which has its headquarters in Manilla, Philippines.

LISTENING BRIEFS

EUROPE

FRANCE: Paris continues to be heard on new frequencies, and John Mainland of Wellington, NZ, reports reception on 9790kHz at 1945GMT. At this time a program in French for Africa is broadcast with the same service on 9715 and 9740kHz.

HUNGARY: Radio Budapest is using the new frequency of 6005kHz for its service to Europe, which includes a program in German at 1730GMT. The frequency of 6110kHz also carries the same transmission.

ROMANIA: Observations by the BBC Monitoring Service has revealed that two daily 30-minute broadcasts in Russian have recently been added to the external services of Radio Bucharest. They are transmitted from 1700-1730GMT and 1830-1900GMT on 7195 and 6180kHz.

AFRICA

SEYCHELLES: The Far East Broadcasting Association on Seychelles has been heard on 11715kHz at 1730GMT. Up to this time the service is directed to Iran and at 1730GMT the signal suffers interference from Vatican Radio opening in Arabic. Another FEBA frequency, 9605kHz has been heard by John Mainland of Wellington at 0300GMT.

TUNISIA: Radio Tunis has been noted on the new frequency of 7275kHz at around 0600GMT. The station carries the normal Arabic service and provides fair reception.

CAMEROONS: Radio Garoua on 5010kHz has been heard by Harry Weatherley of Melbourne at 1713GMT. The station has confirmed reception and gives the power as 4kW.

ASIA

PHILIPPINES: Radio Veritas has a new address which is PO Box 939, Manilla, according to Mark Shiell of Nailsworth, SA. Test transmissions continue to be heard from 2230-0200GMT on 15310kHz and 1130-1500GMT on 11875kHz.

INDIA: All India Radio Broadcasts in English to Australia, New Zealand and north east Asia from 1000-1100GMT. According to Craig Tyson of Wembley, WA, the frequencies in use are 11725, 11775, 15165, 15190, 15205 and 17387kHz. A further transmission to this area, as well as to the United Kingdom and Europe, is broadcast 2045-2230GMT on 7150, 7225, 9525, 9912, 11630 and 11740kHz.

IRAN: Radio Teheran, Iran, confirms reception with a card showing the Abadan Television Studios. Reception was verified on 9680kHz at around 0730GMT. The latest observations show that this frequency has been dropped, with four other frequencies continuing to carry the program. These are: 9022, 15085, 15135 and 17735kHz. The address of the station is: Radio Iran, PO Box 22-200, Teheran, Iran.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for West, 10 hours for East and 12 hours for NZT.

SUPER SAVINGS

IN914 — 10 FOR 50c. New, Marked, Silicon signal diodes. (Limit of 10 to each customer.)

BC108 — 10 FOR $1. New, Marked, Metal can. Top Quality. (Limit of 10 to each customer.)

EM410 — 10 FOR $1. Silicon rectifier (1000V, 1A). New, Marked. (Limit of 10 to each customer.)

741 OP. AMP I.C. — 5 FOR $2.50. New, Marked, Top Quality in mDIP Package.

POLYESTER CAP. PACKS — 2 PACKS FOR $6.50. (100 Capacitors per pack.) All 10% Tol. Top Quality. Post and Pack, Interstate $1.50, N.S.W. $1.30.

RESISTOR PACK — 3 PACKS FOR $2.90. (100 Resistors in each pack). Mostly 5%, 10%, ½w and some 1w Resistors. No short lead types.

HA1322 AUDIO POWER I.C. — 4 FOR $7.50. Each Rated at 5.5 watts peak. Supply volt. 13v. You get a total of 22 watts peak for $7.50 (incl. Circuit Diagram). NEW, MARKED, GUARANTEED.

2N301 — 4 FOR $5. A Premium Power Transistor actually marked 2N301/2869. NEW, BRANDED. At this price we have a limited quantity only, so be early.

ELECTROLYTICS SINGLE ENDED — FROM 7c EACH

NEW, TOP QUALITY FOR P.C. BOARD MOUNTING
ALL 25V

4.7uf	7c
10uf	7c
22uf	9c
47uf	14c
100uf	19c
220uf	25c
470uf	30c
1000uf	40c

POLYESTER GREENCAPS FROM 10c EACH

All 10%, 100V. Rating. Fantastic Value —

.001, .0015, .0022	— 10c ea.
.0033, .0039, .0047	— 10c ea.
.0056, .0068, .0082	— 10c ea.
.001	— 10c ea.
.015, .022	— 12c ea.
.033, .039, .047	— 14c ea.
.056, .068, .082	— 17c ea.
.1	— 20c ea.
.15	— 23c ea.
.22	— 26c ea.

CARBON FILM RESISTORS — ALL 3c EACH

Top Quality, High Stability, 5%, ½ watt in E12 values. Your choice from 10 ohm to 1 MEG.

DISCOUNT FOR VOLUME BUYERS

IDEAL FOR ALL RADIO CLUBS, SERVICEMEN AND GROUP BUYERS ETC., ETC

STYROSEAL CAPACITORS

680pf/1000v	— 200 for $14
100pf/125v	— 200 for $ 6
680pf/630v	— 100 for $ 4
680pf/125v	— 100 for $ 3
270pf/125v	— 200 for $ 6
220pf/125v	— 100 for $ 3

TANTALUMS (Miniature Type)

4uf/6v	— 100 for $4.00
5uf/3v	— 100 for $3.50
7uf/3v	— 100 for $3.50

POLYESTER PACK

Super pack of polyester caps. All 10% incl. 160V, 270V, 400V types — 100 for $3.50.

CERAMIC CAP. PACK

Super pack of ceramic caps incl. low and high volt. types. Top quality — 50 for $1.

ELECTROLYTIC PACK

Super pack of electrolytics. Top quality pigtails, low and high volt. — 25 for $2.50

RESISTOR PACK

Super pack of resistors. Mostly ½ watt, 1 watt, 5% and 10% resistors. No short lead rubbish. — 100 for $1.25.

POPULAR SEMICONDUCTORS

Transistors	BC108	— 10 for $1.00
	BC548	— 10 for $1.80
	BC557(177,157)	— 10 for $1.80
	BC558(178,158)	— 10 for $1.80
	BC559(179,159)	— 10 for $1.80
	BC328	— 10 for $2.00
	BC338	— 10 for $2.00
	BF198	— 60c ea.
	2SA353(AF126)	— 60c ea.
	2SB367(AD162)	— $1.00 ea.
	2N6107	— $1.00 ea.
	40250	— $1.45 ea.
Silicon Rectifiers	EM402	— 10 for $1.00
	1N5059	— 10 for $1.00
Stick Rectifier	TV18-2MT	— $2.00 ea.
	SCR C106D(400v, 4A)	— $1.40c ea.
	RL4850 L.E.D. Red ¼" with clips	— 40c ea.

LINEAR I.C.'s

The Best Prices for Top Quality I.C.'s

741	m DIP	— 60c
709	DIP	— 70c
555	m DIP	— 85c
301	m DIP	— 70c
307	m DIP	— 70c
723	DIP	—$1.00
3900	DIP	—$1.25
CA3012	(Can)	—$1.50
CA3013	(Can)	—$1.50
CA3018	(Can)	—$1.50

COPPER CLAD BOARD

Fantastic Value

6½" x 5"	— 4 for $2.00
10" x 6"	— 3 for $2.75
9" x 12"	— 2 for $3.50

DIGITAL T.T.L. I.C.'s

New, Guaranteed, Low, Low Prices!

7400	35c
7401	35c
7402	35c
7404	35c
7408	35c
7410	35c
7413	80c
7420	35c
7430	35c
7440	35c
7441	$1.20
7442	$1.00
7447	$1.50
7473	90c
7474	90c
7475	$1.00

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INFORMATION CENTRE

WHEEL PROTECTION: Reference "Burglar Bait", Information Centre, January 1976.

To steal a wheel one must first raise the car. Therefore, surely a magnetic reed switch, mercury switch, or two micro switches, fitted to the suspension near each wheel, should provide protection. They would need to be set to operate, say, 35mm below and 20mm above an established parking norm and wired to operate the alarm if either a body axle jack was used on the car. (J.L., Luina, Tas.)

● Thank you for the suggestion J.L., which appears to have definite possibilities. Some details may have to be worked out, but we have published the idea for the benefit of any reader who feels inclined to try it out.

MOVIE STROBE: I am a relatively recent convert to Super 8 movies, including close-up nature work. Nowhere have I seen any mention of a high power strobe type of movie light with the flashes triggered by the camera's own contacts. Does such a thing exist? Surely the circuitry would not be too difficult to arrange? If you have any thoughts or information, or perhaps a reference to a previous article in E.A. I'd be very grateful.

● Frankly, we have not seen anything along these lines, at least at the amateur or ordinary commercial level. There is no question that it can be done, and has been done. The classic work of Eggerton, who pioneered the modern high speed flash technique, included extremely high speed motion pictures of such things as exploding light bulbs, drops landing on the surface of a bowl of liquid, and so on.

The main problem would be to find a strobe light which would give adequate light output at the relatively high duty cycle involved. The closest we have come to anything like this was the Stroboscope we described in September 1970 (File No. 7/SC/3). While unlikely to be suitable as it stands, the design considerations may at least provide a basis for experiment. In the ultimate, much would depend on the area to be illuminated. If small, readily available tubes may be adequate; if large, a rather more specialised approach would be required.

ORGAN FOOT PEDAL: I have a small commercial electronic organ, which I would like to fit with a volume control foot pedal. I would like this to be hinged at the bottom end, with an up and down motion controlling the volume. Has there been a back issue of Electronics Australia in which such a pedal was described? If not, would such a design be the basis of a future article? Your help would be appreciated. (L.E., Howrah, Tas. 7018.)

● The mechanical details required to construct a pedal such as you describe are given in this very issue, in the article describing the Playmaster 760 organ. This appears to be exactly what you have in mind.

CONTROL CENTRE/PATCH BAY: Have you ever published a project about a control centre/patch bay, a unit which one can plug various items of tape equipment and accessories into to give complete patching of any program source to any destination. For example, such equipment could be used to connect three tape decks, an equalizer, a Dolby NR unit, and a 4 channel decoder into a single tape input/output terminal on an amplifier.

If such a unit has not been described, would you give serious consideration to such a project? I'm sure many of your readers would appreciate such facilities. (P.M., Summer Hill, NSW.)

● We have not to date published a project such as you describe, and at present we have no plans to do so. As each hi-fi installation tends to be unique, such equipment would tend to be very specialised, and only suitable for use with a specific set of equipment. It would be very difficult to come up with a really "universal" unit capable of fitting into the majority of systems.

LSI CLOCK: I recently purchased two LSI Digital Alarm Clocks from Dick Smith Electronics, as featured in the November, 1975 issue, and would like to make the following points for the benefit of other readers.

Firstly, the 9012 transistors supplied have the same pin connections as the 9013, and not as shown in your article. If connected as shown, the AM/PM indicators will both be displayed at the same time.

Secondly, although my clock chip has the same type number as the one specified, the AM/PM indication changes at 12 noon and 12 midnight, and not at 1AM and 1PM as stated in the article.

Finally, surely the 22k resistor in note 2 should be omitted when the clock is connected for 24 hour operation without the flashing colon, but inserted for flashing colon with JP-3. When JP-4 is connected for continuous colon, this resistor is placed in parallel with R5, also of 22k. However, for 12 hour operation, only R5 is in circuit. (R.F., Melville, W.A.)

● Dick Smith Electronics advise that the pin connections for the 9012 transistors supplied with recent clock kits differ from those supplied with earlier versions. They further advise that full details of the amended pin connections for these transistors are supplied with each kit. If you did not receive this information, then this was presumably due to an oversight.

A similar situation applies to the clock chip, which has apparently been modified by the manufacturer to eliminate the problem described in the article with regard to AM and PM changeover. The

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result is that many of the Kits now being supplied (but not ALL) incorporate the modified IC, which is all to the good.

In practice, it makes no difference whether or not the 22k pull-down resistor in note 2 (R7) is left in or out of circuit for 24 hour operation with continuous colon. You are perfectly correct, though, in stating that for this mode of operation the resistor may be left out. However, if modifying the clock from the 24 hour mode with flashing colon (which is what we did), then there is no need to go to the trouble of removing the resistor.

Notes & Errata

SOLID STATE 27/3.5 TRANSVERTER (April, 1976; File No. 2/TR/59): The frequency quoted for the crystal in the parts list on p. 48 is in error. The correct frequency is 23.57MHz.

SIMPLE FUNCTION GENERATOR (March, 1976; File No. 7/AO/23). A 100k resistor has been left off the PC board overlay diagram on page 67. Its correct position is between the 1M resistor and the upper two diodes. There is also a discrepancy in the feedback network of amp 3 between the circuit diagram on page 64 and the PC board. However, the diagrams are electrically identical, and both circuits will function as intended.

Playmaster . . . from p. 67

100 ohm test resistor. There should be less than plus or minus 100mV DC at the amplifier output. If these checks are okay, the quiescent current can be set. Rotate the righthand 1k preset pot to obtain 2 volts DC across the 100 ohm resistor, i.e., each resistor should have a voltage drop of 2 volts.

If these checks are okay, the process can be repeated for the left hand channel. Connect the 100 ohm resistors across fuseholders 1 and 3. Reconnect link A and link B. Reapply power and measure voltages. Set the quiescent current as before.

If all these checks are okay, install 2A fuses, connect loudspeakers to the output and make all connections in the amplifier yet to be made. Apply power and listen for hum or other unpleasant sounds. It should be quiet. Now you are ready for a listening session. Enjoy yourself.

For those who cannot for some reason reach this happy stage, there will be a trouble-shooting procedure included in the final article next month.

(To be continued).

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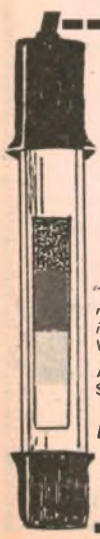

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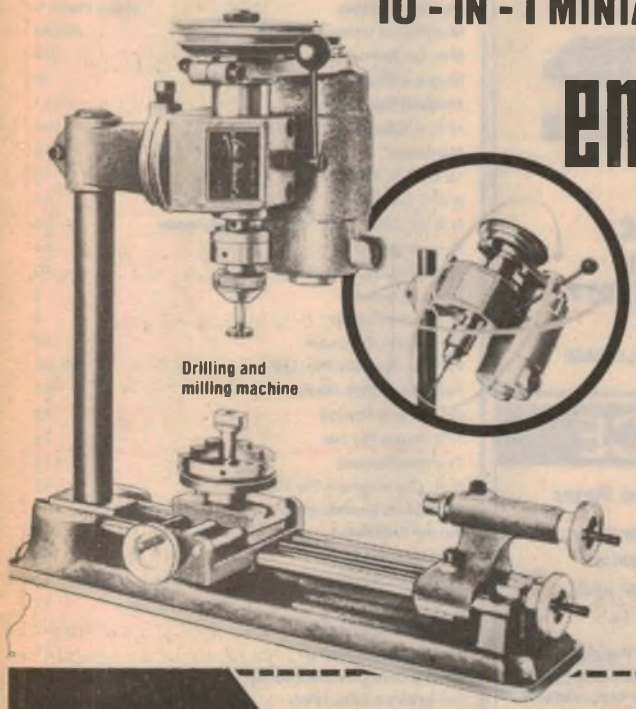

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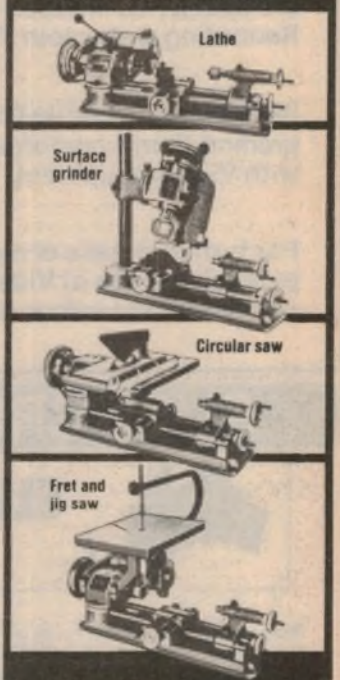

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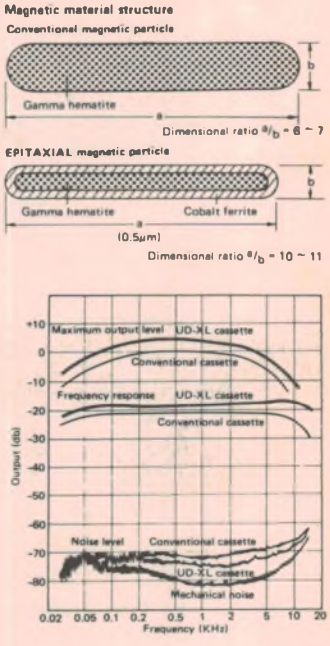

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