ELECTRONICS Australia

HIFI NEWS

APRIL, 1976
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NEW TWIN 25W STEREO AMPLIFIER

36TH BIRTHDAY ISSUE

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The Sony PS2350 is a magnificent belt-driven turntable totally new in design and materials. The plinth is made of Sony's revolutionary new material BMC (bulk moulding compound), which is almost 100% acoustically dead. The 30 cms aluminium diecast platter and 4-pole hysteresis synchronous motor significantly reduce wow and flutter to under 0.06% (wrms) S/N ratio 63dB. The PS2350 has rubber disc supports to insulate the disc from vibration (a real hassle with conventional turntables). Here are a few of the PS2350's superb features: hydraulic cueing device, auto tone-arm return, magnetic cartridge, reject mechanism and of course all the care and precision that people who understand good Hi-Fi have come to expect from Sony.

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ELECTRONICS Australia

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

VOLUME 38 No 1

This is our exciting new Playmaster Twin Twenty Five stereo amplifier. It's easy to build, all on one large PC board, has an attractive appearance, and puts out 25 watts per channel. The first article commences on page 36.

Designed especially for novices, this solid state transverter will effectively convert a 27MHz "walkie talkie" transceiver into a 10 watt output transceiver on the 3.5MHz Novice band. Details on page 42.

Free catalog!

This month's issue offers something extra. In addition to our usual range of projects and feature articles, you will find a comprehensive 84-page catalog/data manual, published by arrangement with Dick Smith Electronics Pty Ltd. It's free, offered with their compliments and ours!

On the cover

Our two principal projects are featured on this month's front cover. The main theme shows our new easy-to-build, low-cost electronic organ which can be built to suit both your requirements and your budget. The story on page 54 provides all the information necessary to complete the unit in its simplest form. Inset shows the new Playmaster Twin Twenty Five stereo amplifier, featured on page 36. See also above.

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world of electronics and hi-fi

projects and technical

regular features

SPECIAL NOTE

In the Dick Smith Electronics Catalogue 76/77 included in this issue and in the April 1976 issue of "Electronics Today International", advertisements on pages 20 and 21 use the words "Duty Free" in connection with electronic calculators. This term is not intended to imply that these products are offered at duty free prices only by Dick Smith Electronics Pty. Ltd. It was intended only to emphasise that because calculators into Australia are duty free, there is no resulting advantage in buying them overseas.

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ON SALE THE FIRST MONDAY OF EACH MONTH

Editorial Viewpoint

Ethnic radio—yes, but who pays?

It has become apparent that the experimental "ethnic radio" stations set up in Sydney and Melbourne by the former Labor Government are a huge success. In less than a year, they have gained very wide acceptance among both "new" and "old" Australians. Even by normal broadcasting criteria, they are extremely popular, with 2EA estimated to have a current listening audience of between 500,000 and 700,000.

The success of the stations is no doubt due at least in part to the efforts of the people responsible—many of whom have worked very hard, far beyond the call of duty. They have every reason to be proud of their success in realising the immediate goal.

But the other reason for the success of the stations is also quite clear: they fill a very real need. A large number of people in our community were not adequately catered for by existing stations, and they have naturally responded with great enthusiasm to the new stations designed to meet their needs.

In other words, it is clear that these stations should continue, possibly joined by others later. Yet it is also clear that there are problems.

One is legal status. At present, the stations exist almost on a month-to-month basis as "experimental stations" under the provisions of the Wireless Telegraphy Act. The Broadcasting and Television Act apparently makes no provision at present for community stations of this sort, although this may be changed shortly.

The other problem is funding. The previous Government was committed to a policy of public funding and control of community facilities of this type, and even now many of those involved in both the administration of ethnic stations seem to be very opposed to any idea that such stations could be funded by sponsorship, or run on normal commercial lines. Whether this opposition is due to commitment to socialist ideals, or alternatively to fears that commercial pressures could produce ethnic unbalances, it is hard to say.

Yet in Australia's current economic climate, to insist upon full public funding may well be to force the Government to either drop the stations altogether, or limit their operations indefinitely at the current modest level. It seems to me that a far more realistic approach would be to seek amendment of the Broadcasting and Television Act to allow operation as privately funded, sponsored or even fully commercial stations, but with suitable protection against ethnic unbalances provided by licensing regulations and administered by the Australian Broadcasting Control Board.

I'm sure the ethnic stations would be quite capable of standing on their own feet in this way. And quite apart from the saving in public funds, the stations themselves would be substantially free from public control—apart from the regulations to ensure ethnic balance.

If they were allowed to operate on a controlled commercial or sponsored basis, not only would the existing ethnic stations have an assured future, but the stage would be set for natural development of further stations and services.

—Jamieson Rowe

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*Recommended and maximum price only.

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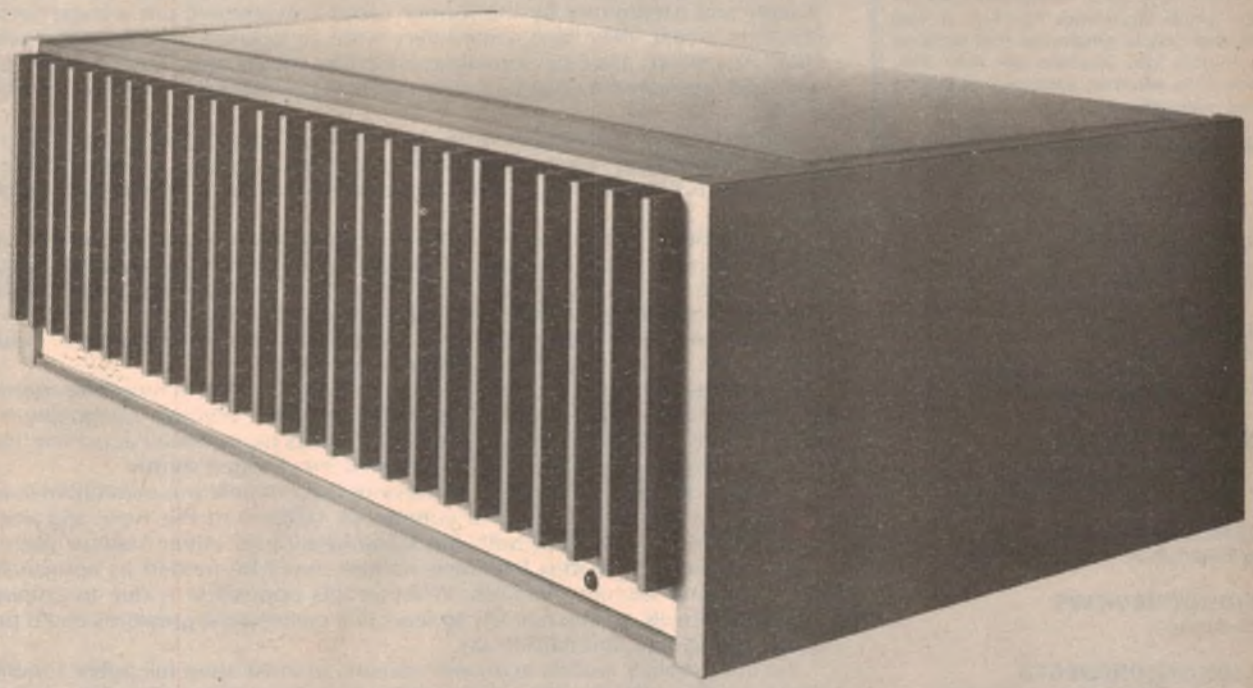
What have Quad been up to recently?



Current Dumping that's what

Current Dumping is not East Anglia's answer to the black pudding but the name given to a totally new power amplifier circuit developed by QUAD.

A current dumping amplifier basically consists of a low power amplifier of very high quality, which controls the loudspeaker at all times and a high-powered heavy-duty amplifier which provides most of the muscle.

The small amplifier is so arranged – it carries an error signal – that provided the heavy duty transistors (the dumpers) stay within the target area of the required output current, it will fill in the remainder accurately and completely.

The reproduced quality is solely dependent on the baby amplifier, which because of its low power, can be made very good indeed.

The QUAD 405 is the first amplifier to incorporate current dumping.

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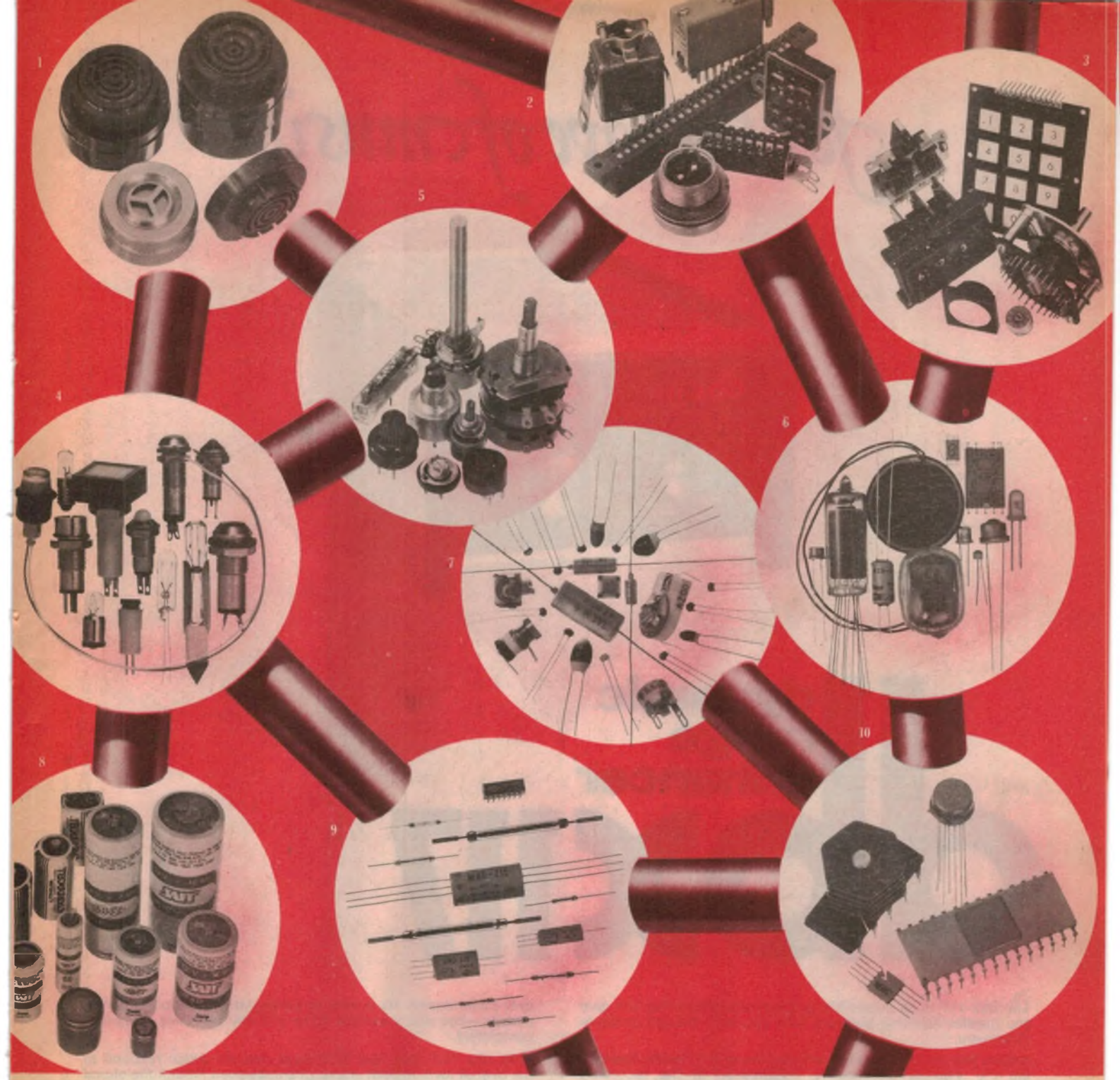

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10/ **Microelectronic I.C.'s** communication, audio and power control styles. MOS devices, high speed dividers, microwave devices (X-band etc.)

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This is what Electronics Today said. *"We first used the dbx unit by playing ordinary records with average background noise . . . and the background noise all but vanished. The music sounded far cleaner with a presence that was unquestionably better than the original unexpanded record."*

"Our next evaluation involved a piece of newly recorded orchestral music . . . when played in the normal manner, tape hiss was quite prominent . . . when played through the dbx 117 . . . the problem all but completely disappeared . . . the music had a quality which could genuinely be described as sounding comparable with the original."

Australian Hi-Fi discusses the remarkable dbx 117 in detail. Here are a few direct quotes. *"And it does work well, giving back a 'sparkle' to some recordings which have always sounded over-compressed. Its action is particularly impressive during pauses—the disc's surface noise and any tape hiss disappear completely."*

"The dbx 117 uses true RMS level sensors which respond to the overall level in **both** *stereo channels even though the signal paths themselves are separate. This technique is necessary for dynamic range enhancement or there would be a wandering of the stereo image."*

Hi-Fi Review expressed their findings of the dbx 117 this way: *"Yet another way of 'quieting' noisy records is to use a clever little device called the dbx 117, dynamic range enhancer.*

This device 'expands' the program material so it sounds more like the real thing, and reduces background noise so effectively, that it all but disappears. It's particularly effective with old or antique records."

dbx 117 restores up to 20 dB of the dynamic range missing from records, tapes and FM broadcasts.

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And, like all AKAI Hi-Fi equipment distributed by AKAI Australia, it's covered by our Complete Protection Plan*.

Which simply means 12 months full parts and labour warranty on all Tape Equipment, 2 years full parts and labour warranty on all Amplifiers, Turntables and Speakers and a lifetime warranty on all GX Tape Heads. Make sure the Complete Protection Plan Warranty Card is with your AKAI equipment. Sound good?

At a recommended retail price of $550 we think the GXC325D is quite a deal. Care to call our bluff?

The AKAI Hi-Fi Professionals are: **NEW SOUTH WALES — SYDNEY CITY AND METROPOLITAN. Sydney:** Douglas Hi-Fi, 338 George Street; Duty Free Travellers Supplies, 400 Kent Street; European Electronics, 187 Clarence Street; Instrol Hi Fi, Cnr. Pitt & King Streets; Magnetic Sound Industries, 32 York Street; Jack Stein Audio, 275 Clarence Street. **Bankstown:** Selsound Hi Fi, Cnr. North Terrace & Apian Way. **Burwood:** Electronic Enterprises, 11 Burwood Road; Edge Electrix, 31 Burwood Road. **Concord:** Sonarta Music Services, 24 Cabarita Road. **Cremorne:** Photo Art & Sound, 287 Military Road. **Crows Nest:** Allied Hi Fi, 330 Pacific Highway. **Hurstville:** Hi Fi House, 127 Forest Road. **Liverpool:** Miranda Stereo & Hi Fi Centre, 166 Macquarie Street. **Miranda Fair:** Miranda Hi Fi & Stereo Centre, Shop 67, Top Level. **Mona Vale:** Warringah Hi Fi, Shop 5, Mona Vale Court. **Parramatta:** Gramophone Shop, Shop 151, Westfield Shoppingtown; Selsound Hi Fi, 27 Darcey Street. **Roselands:** Roselands Hi Fi, Gallery Level. **South Hurstville:** Selsound Hi Fi, 803 King George's Road. **Summer Hill:** Fidela Sound Centre, 93B Liverpool Street. **Sutherland:** Sutherland Hi Fi, 5 Boyle Street. **Waitara:** Hornsby Hi Fi, 71 Pacific Highway. **Westleigh:** Sound Incorporated, 16 Westleigh Shopping Centre. **NEW SOUTH WALES COUNTRY. Albury:** Haberecht's Radio & TV, 610 Dean Street. **Bega:** Easdowns, 187-191 Carp Street. **Bowral:** Fred Hayes, 293 Bong Bong Street. **Broken Hill:** Pee Jay Sound Centre, 364 Argent Street. **Gosford:** Gosford Hi Fi, 163 Mann Street; Miranda Stereo & Hi Fi Centre, Cnr. Donnison & Baker Streets. **Moss Vale:** Bourne's Merchandising, 1 White Street. **Newcastle:** Ron Chapman Hi Fi, 880 Hunter Street; Eastern Hi Fi, 519 Hunter Street. **Nowra:** Nowra Hi Fi, Shoalhaven Arcade. **Taree:** Taree Photographics, Graphic House, 105 Victoria Street. **Wagga Wagga:** Haberecht's Radio & TV, 128 Baylis Street. **Wollongong:** Hi Fi House, 268 Keira Street; Selsound Hi Fi, 2-6 Crown Lane. **A.C.T. Civic:** Allied Hi Fi, 122 Bunda Street. **Fyshwick:** Allied Hi Fi, 3 Paragon Mall, Gladstone Street. **QUEENSLAND. Brisbane:** Chandler's, 120 Edward Street; Chandler's, 399 Montague Road, West End; Stereo Supplies, 95 Turbot Street; Tel Air Electronics, 187 George Street. **Nambour:** Custom Sound, Currie Street. **Mt. Isa:** The Sound Centre, West Street. **Rockhampton:** Chandler's, 144 Alma Street. **Southport:** Stokes Electronics, Scarborough Street. **SOUTH AUSTRALIA. Adelaide:** Ernsmiths, 48-50 King William Street; Flinders Trading Co., 55 Flinders Street; J B Electronics, 115 Gouger Street. **Blackwood:** Blackwood Sound Centre, 4 Coromandel Parade. **Glenside:** Steiner Electronics, Conygham Street. **Moana:** Bob Carmen, 185 Commercial Road. **VICTORIA. Melbourne:** Douglas Hi Fi, 191 Bourke Street; **Warrnambool:** A. G. Smith, 159 Liebig Street. **WESTERN AUSTRALIA. Perth:** The Audio Centre, 883 Wellington Street. **Calista:** Hub Hi Fi, Kwinana Hub, Gilmore Avenue. **East Victoria Park:** Japan Hi Fi, 889 Albany Highway. **Nedlands:** Audio Distributors, Broadway Shopping Centre, Broadway. **Midland:** Midland Audio, 16B Great Northern Highway. **Mosman Park:** Audio Distributors, 14 Glyde Street. **W.A. COUNTRY. Bunbury:** Aabel Music, 130 Victoria Street. **Kalgoorlie:** Hambley's Hi Fi, Shop 13, Central Arcade, Hannan Street. **TASMANIA. Burnie:** James Loughran & Sons, 29-31 Wilmot Street. **Hobart:** Quantum Electronics, 181 Collins Street. **Launceston:** Wills & Co., 7 Quadrant. **NORTHERN TERRITORY. Darwin:** Pfitzners Music House, Smith Street.

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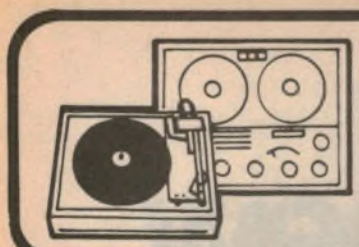


Hi Fi News

Build your own loudspeakers—JBL style

Perhaps the incentive is to save money, or maybe it is to personalise a collection of purely commercial hifi equipment—but the fact is that there is a lot of interest, these days, in assembling one's own loudspeaker systems. Of particular interest to the do-it-yourself group is an enclosure information kit for JBL loudspeakers, available from Harman Australia Pty Ltd.

The name JBL is well known for prestige built-up commercial systems but, in Australia at least, there has been less emphasis on separate JBL drivers and components for use in home-made cabinet work. The new information kit should help change that, as well as reinforcing the demand for JBL components in music system loudspeakers.

The description "kit" is suggested by the novel packaging—a cardboard tray about the size of this magazine with a plastic lid in which is moulded the shape of a loudspeaker cone, a diffuser, a tweeter and a vent. The shapes are purely decorative but they do suggest an intentionally different approach to the presentation of loudspeaker information.

Inside the kit is a 32-page finely printed brochure which introduces the reader to the concept of loudspeaker system enclosures, as distinct from other woodworking projects which a handyman may have tackled.

Sections in the book deal with: Understanding What You Are Dealing With—Understanding Enclosure Principles—High Fidelity Systems For The Home—Musical Instrument Loudspeaker Systems—Enclosure Construction—Enclosure Finishing—Tuning Procedures For Speakers Other Than JBL.

A second 12-page brochure explains and depicts the JBL range of drivers, from bass drivers to high frequency lenses and horns, and including a range of made-up cross-over networks. It adds up to quite an impressive array.

To give practical expression to all this, the kit contains a collection of dyeline sheets which illustrate the construction of systems as follows:
HOME HIFI; 3 cu ft enclosure, plus seven different speaker/baffle combinations.
HOME HIFI; 5 cu ft enclosure, plus eight different speaker/baffle combinations.
HOME HIFI; 8 cu ft enclosure, plus six different speaker/baffle combinations.

In the centre, the information carton with moulded lid. At right, one of the brochures and, at left, one of the dyeline plans.

MUSICAL INSTRUMENT SYSTEMS; 3.75 and 5.75 cu ft enclosures, with two different speaker/baffle combinations for each.

Mr. Bill Martin, manager of Harman Australia stresses that the plans do not present a collection of closed options from which the constructor must choose just one. By looking ahead, he can build up a basic system and expand it later to something more ambitious by purchasing the appropriate additional components.

While this adds up to an impressive number of options, the kit also includes a couple of sheets allowing the constructor to determine optimum porting for JBL bass drivers in enclosures of dimensional volume other than the figures specified. Some guidance is given in using speakers other than the JBL types listed but it is quite sparse and says little more than has been said many times in magazine articles. Primarily, it is a user manual for JBL products.

Using bass drivers or wide-range units ranging in diameter from 8 to 15 inches, and in power handling capacity from 30 to 150 watts, the systems envisaged range from middle- to top-market and have doubtless been selected primarily for the American scene.

The cabinet work, too, envisages working from raw materials and would be most suitable for American hobbyists (or their Australian counterparts) who—according to the glossy magazines anyway—appear to have a heated basement replete with full woodworking facilities. Either that, or they have hand tools plus an appropriate amount of time and patience.

It is, in fact, the opposite end of the spectrum from what we have seen in Australia recently, in the way of cabinet kits: precut and pre-finished and needing little more than a tube of glue and a screwdriver to complete the job.

So there it is. If you want to get involved in the realm of prestige American loudspeakers, cabinet construction from raw materials, and personalised finish and styling, the JBL enclosure construction information pack is for you. It sells for $8.00 and is available from JBL agents throughout Australia or direct from Harman Australia Pty Ltd, 271 Harbord Rd, Brookvale, NSW. Their postal address is P.O. Box 6, Brookvale 2100.

IMPORT DUTY

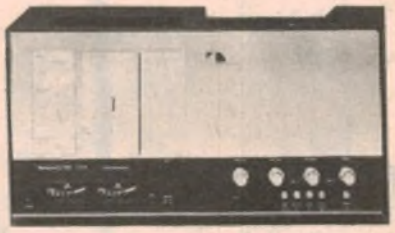
Shortly before Christmas it was widely reported that a new Customs by-law would slash import duty on consumer electronic equipment: "from 35% to zero" according to one report, which estimated price reductions of around $3 on a small transistor radio, and up to $300 on the top range of equipment.

This latter area was naturally assumed by enthusiasts to include hi-fi equipment—complete audio systems, and the tape decks, tuners, speakers and amplifiers from which they are assembled. In fact,

Nakamichi revolutionary new cassette systems

Nakamichi tapedecks' many special features take them well beyond the capabilities of other cassette decks . . . and into a range that makes possible professional applications otherwise virtually unthinkable.

NAKAMICHI 1000 TRI-TRACER The Nakamichi 1000 probably represents the most advanced cassette deck ever made. Nothing has been spared to ensure a level of performance that rivals that of professional reel-to-reel recorders. Noise has been reduced to the vanishing point. Speed stability is unconditional. Frequency response has been extended to beyond audibility. Particular emphasis has been placed on reliability and ease of operation. To achieve these goals, conventional cassette technology had to be discarded and new, innovative solutions found. Foremost among them is the use of three completely separate heads for erase, record and playback.



NAKAMICHI 700 TRI-TRACER The Nakamichi 700 was created in response to the demand for a machine that could, offer the essential performance of our highly acclaimed Model 1000 Tri-Tracer, but at a more modest cost. Since a compromise in performance was unthinkable, the alternative was to simplify the design and develop new construction techniques that would permit cost reductions while maintaining quality. The 700 employs the same advanced transport system and shares most of the features of the more expensive model. Central to both Tri-Tracers are three separate heads, erase, record and playback.

NAKAMICHI 500 DUAL-TRACER extends cassette technology to in-the-field recording. The 550 employs Nakamichi's exclusive Focused-Gap head for extended high frequency response and extremely low distortion. With its own self-contained battery power supply, the Nakamichi 550 may also be operated from a car battery, or from a standard AC line (adaptors supplied). Professional 45 dB range, peak level meters attest to the unit's extended dynamic range and are especially useful during live recording sessions. Under rigorous field conditions or in your home the Nakamichi 550 is the perfect companion.

NAKAMICHI

VICTORIA: Allans Music (Aust.) Ltd. Melbourne 63 0451 • Encel Electronics Pty. Ltd. Richmond 42 3761 • Instrol Hi-Fi, Melbourne 67 5831 • Southern Sound, Melbourne 677 7869 • Southern Sound, Moorabin 97 7245 • Tivoli Hi-Fi, Kew 80 4956
N.S.W.: Arrow Electronics, Sydney 29 8580 • Convoy Sound, Sydney 358 2088 • The Gramophone Shop, Westfield Shopping Town, Parramatta 633 2846 • Instrol Hi-Fi Pty. Ltd., Sydney 29 4258 : 290 1399 • Jock Leate Pty. Ltd. Hurstville 579 6399 Milversons Pty. Ltd. Brookvale 938 2205 • Milverson Pty. Ltd. Chatswood 412 2122 Milverson Pty. Ltd. Parramatta 635 3588 • Riverina Hi-Fi, Brookvale 938 2662 • United Radio Distributors Pty. Ltd. Sydney 232 3718 • Wests Pty. Ltd. Burwood 747 4444
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A.C.T. Pacific Stereo, Manuka 95 0695 • Duratone, Altree Court, Phillip 82 1388.

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Please send me your fully detailed brochure on
☐ Nakamichi 1000 ☐ Nakamichi 700
☐ Nakamichi 550
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this is not so.

A detailed survey was indeed conducted by the Bureau of Customs to determine the extent of local manufacture. New by-law entry was, in fact, granted for certain items of electronic equipment such as AC radios, clock radios, etc.

However, the official Customs policy states emphatically that by-law entry would not be appropriate on hi-fi equipment such as tuners, amplifiers, speakers, turntables and so on.

The early reports had suggested that the 'new (reduced) prices' would be unlikely to take effect until after Christmas. Predictably, many people who intended buying hi-fi equipment in December delayed their purchases in anticipation of the illusionary lower prices.

A spokesman Mr Nigel Cowan, Marketing Manager, from Rose Music Pty Ltd, importers of the well known Yamaha hi-fi equipment, has confirmed this.

"Our hi-fi sales in December were markedly lower," he said. "We had numerous enquiries about the 'duty-cut' prices, and despite our assurances that by-law concessions were simply not on, many people adopted a wait-and-see attitude."

According to a senior tariff consultant, the present Customs policy of "no by-law on hi-fi-equipment" is unlikely to change in the foreseeable future.

OPEN REEL RECORDERS FROM SONY

Amidst the flurry of consumer activity surrounding cassette players, Sony are still catering handsomely for users of open reel equipment. Pictured is the TC-755A, a 3-motor, 3-head deck, with closed loop capstan system, ferrite heads and a capacity for reels up to 26.7cm. It can be used for 4-track stereo / mono recording on normal, ferrichrome or CRO2 tape at either 19 or 9.5cm/sec. Normal inputs are from mic and line, outputs to line and phones, plus Rec/PB.

Very similar in style, the TC-758 offers similar facilities but with an automatic reverse provision. (Details of these are other reel-reel recorders from Sony Kemtron Pty Ltd, 453-463 Kent Street, Sydney 2000.)

FM BROADCASTING: With national and community stations now operating in several capitals, FM/stereo broadcasting on VHF is definitely on its way in Australia, even though its progress may be impeded by economics, politics and the need to clear one or more TV channels from the 88-108MHz part of the spectrum.

Events in Australia, however, have at the one time served to stimulate and to embitter FM protagonists across the Tasman, as revealed in "FM News", a circular published by the Newlands Broadcasting Society Ltd. (19 Cotswold Crescent, Newlands, Wellington 4, NZ).

The Society's claims and representations over the years have paralleled those made in Australia, with much the same frustration, right up till the Maclean report was presented to the Australian Government. This recommended abandonment of the long-term plan to develop FM broadcasting on UHF and to commence services immediately in vacant areas of the VHF band, using international standards.

The about-face here left the New Zealand Government right out on its own and it has shown no haste to follow suit.

Before the last elections in that country, the Newlands Broadcasting Society circulated parties and candidates to seek their attitudes to FM broadcasting and advised their subscribers accordingly. They also "had a go at" various N.Z. newspapers and magazines for publishing inaccurate information about FM, or otherwise "putting down" their FM system.

Mr. Les Black, Chairman, Australian Hi Fi Industry Association.

Their latest bulletin to hand ends up with a 3-line par which summarises the position:

FM PROGRESS IN NEW ZEALAND. No, we haven't run out of space to report FM progress in New Zealand. There just isn't any progress to report!

In the meantime, the Australian Broadcasting Commission is copping its share of criticism for the programs which it is offering on the FM/stereo network—predominantly classical. With 2MBS and 3MBs also offering classical programming for much of the time, it's a feast for the culture vultures, but a famine for most everyone else.

So to the following press statement:

The Chairman of the Australian Hi Fi Industry Association, Mr Les Black, said recently that the Australian Broadcasting Commission's FM programming format would only appeal to a narrow audience range.

"It appears that the Australian Broadcasting Commission aims to cater mainly for classical music buffs, especially during the peak listening times" said Mr Black.

Mr Black who is also Managing Director of Pioneer Electronics Australia Pty Ltd, said that the majority of people who prefer middle of the road and popular music were just not being catered for.

He said, "The situation appears quite ludicrous as we are already many years behind overseas countries in introducing FM and now it is being released for the benefit of only 15% of the potential listening audience. For example, the latest McNair Anderson radio audience survey shows that in Melbourne during a prime listening time such as 5.30am to 9.00am, 432,000 people listen to all commercial stations as opposed to the ABC's combined LO/AR audience of only 47,000. In Sydney during the next peak listening time of 4.00pm to 7.00pm, 263,000 people listen to commercial stations as against the ABC's 34,000 listeners."

"So if you like rock music for instance, you can only tune in to FM on Saturdays between 11.00pm and 3.00am the following morning."

"We spoke to the Australian Broadcasting Commission's programming people in Adelaide and were informed that they had already received many complaints about the lack of middle of the road type

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music. Mr Chris Symons of the ABC informed us, however, that mainly classical music would be played on ABC FM in the forseeable future."

"As Chairman of an industry, whose members are marketing excellent FM sound reproduction equipment, I suggest that people who purchase our products should be entitled to a modern balanced programming format. The superb quality of FM sound reproduction should be available to the majority of people and not only the minority."

"By catering for only a small section of the potential listening audience, the Australian Broadcasting Commission's programming format could well inhibit the growth of FM in Australia."

Mr Black said that one way to provide a choice of programming would be to allow FM licensing of present commercial broadcasting stations who currently cater for the majority of audience groups. He added, "To my knowledge the new Federal Government hasn't yet made known its policy in regard to commercial FM licensing and the general public have a right to know where the Government stands on this issue. The outgoing Federal Labour Government's policy of course, was to deny commercial stations access to FM. This week we contacted the Prime Minister's Office and received quite a hush-hush no comment reception on this point."

"I think its about time a positive statement was made on the future of FM broadcasting in Australia."

EPICURE LOUDSPEAKERS: Auriema (A'asia) Pty Ltd has announced a new range of loudspeaker systems, some of which are pictured above, under the brand name "Epicure". According to John Farrow, Auriema Marketing Manager, the systems have a notably flat frequency response and "produce a very musical sound". They carry a 10-year warranty on parts and labour—probably an industry first.

The Epicure Five, at the front of the group, is a sealed "bookshelf" system, using a 6-inch woofer and a 1-inch tweeter which Epicure describe as "air spring". Recommended retail price is $258 per pair.

The Epicure Ten system (left) is somewhat larger at 9 x 11 x 21 inches, and is intended to operate within the RMS power range of 12 to 50W. It has a specially designed cross-work network centred at 1800Hz and a rated response from 45Hz to 20kHz within ± 3dB. Recommended retail price is $398 per pair.

Slightly larger again, the Epicure Eleven employs a 1-inch tweeter and a special 6-inch bass driver, operating in a bass reflex cabinet. It extends the rated bass response down to 38Hz and pushes the maximum power rating to 80W RMS. Price is $498 per pair.

Largest of the systems illustrated is the Epicure Twenty, which is virtually two systems in one. One pair of speakers—a 1-inch tweeter and an 8-inch woofer—fires through the normal front grille, the other pair through the angled top grille. Price is $778 per pair.

For further information on Epicure systems: Auriema (A'asia) Pty Ltd, PO Box 604, Brookvale 2100.

HIFI PIONEER DEAD: A. K. Box 1905-1976

Arthur Kingston Box, a well known identity during the early days of broadcasting and hifi, died in Melbourne in mid-February. His passing severs yet another vital link with the fascinating history of radio in Australia.

Born in 1905, Arthur Box took up technical journalism at the age of 25 and, in 1926, joined the technical staff of the Melbourne program/technical paper "Listener In". In those days, operation and maintenance of a radio receiver required some technical ability and most "wireless" publications combined the "what's on" information with "how to receive it".

In 1930, Arthur Box left the "Listener In" to become editor of such publications as "Popular Hobbies", "Radio Trader" and "Modern Sets", but he rejoined the "Listener In" in 1933.

Subsequently "Boxey", as he came to be known, joined the Rola Company and became advertising manager—a position that he held until his retirement a few years back.

His association with Rola, which centred for the most part around loudspeakers, led him to promote what is claimed to have been the first public stereo broadcast in Australia, when left and right channels were broadcast separately by two Melbourne commercial stations. To receive the broadcast in stereo, listeners had to use two receivers, on opposite sides of the room, tuned to the respective stations.

The experiment typified his technical approach to the promotion of Rola products and, while he was never short of the superlatives, beloved of an advertising executive, he was never happier than when arguing the technical merits of Rola systems with magazine editors like the late John Moyle.

It is by rather sad coincidence that the passing of Arthur Box coincided, within a few days, with the announcement that the Rola Company, Australia's oldest functioning loudspeaker manufacturer, was closing down its Richmond (Vic) factory. Like Arthur Box, Rola Australia has become a memory, just one more segment of industry nostalgia.

How good are the new cassette "super" tapes?

The laboratory tests detailed in this article indicate clearly that there is more to the latest generation of "super" cassette tapes than superlatives and slick advertising copy; they are good. The tests also confirm what we have often said elsewhere: the best type of cassette for a recording enthusiast to use is the one which is most compatible with his own particular machine.

by JULIAN D. HIRSCH, Hirsch-Houck Laboratories

New cassette tapes are introduced with almost clockwork regularity. Most are claimed to have significantly improved characteristics in such important areas as frequency response, noise, distortion, coating uniformity, etc.

Some tapes, notably the "ferrichrome" types available from Sony and 3M (Scotch), require special recording bias and equalization to obtain their full potential. Most tapes, however, are designed to be compatible with the "normal" or "chrome" operating modes of any good cassette deck.

In past tests of cassette tapes, we used an Advent 201 deck to achieve uniformity of results for reference purposes. This deck has a single switch to set both bias and equalization for either "regular" ferric-oxide or chromium-dioxide tapes. In testing the new tapes, however, we used the Advent as well as a Nakamichi 500 deck which has separate three-position switches for independently setting bias and equalization. This permitted us to get a better overall picture of modern cassette performance. We would have liked to use other decks also but the number of measurements required made this impractical.

Some inconsistent or difficult-to-explain results were expected from our tests, and we were not disappointed in this respect. However, we did find some significant differences between some tapes. Note, though, that many of the apparent differences between some tapes are a result of recorder characteristics. Quite possibly, the relative standing of the tapes in some performance areas would be different with other decks.

Some of the differences are so clearly a function of the tapes themselves, however, that they leave little room for doubt.

The new tapes tested were: Capitol Music Tape, Fuji FX, Maxell UD-XL, Memorex MRX$_2$, Nakamichi EX, Scotch Low Noise/High Density (LN/HD); Scotch Chrome, Scotch Classic, Sony Ferrichrome (FeCr), and TDK SA(Super Avilyn). As a reference, we also included TDK SD, a familiar high-quality tape whose properties are compatible with the regular bias for which the Advent and other decks are specially set. The Scotch Chrome tape, which is similar to other CrO_2 tapes, was used primarily to establish a basis for comparison against the new TDK SA tape. The latter is a unique ferric-oxide tape intended to perform with CrO_2 bias and equalization.

TAPE DETAILS. One way to improve tape is to manufacture smaller ferric-oxide particles whose shape ideally is that of a rod about 10 times longer than it is wide. Particle distribution must be even throughout the binding material that anchors them to the plastic backing to reduce tape noise and output fluctuations and maximize the playback output level.

It appears that all tape manufacturers have devoted considerable effort to achieving a uniform distribution of correctly formed and proportioned oxide particles.

High-frequency performance can be enhanced by "doping" the ferric-oxide with cobalt. Again, the problem of homogeneity exists, with "clumping" of the cobalt portion of the mix being undesirable.

TDK and Maxell have attacked the problem with what appears to have been a similar approach, but by different techniques.

According to TDK, the SA tape has a ferric-oxide base, with cobalt ions added to each fine oxide particle. This tape is unique among ferric-oxide tapes in requiring chrome bias and equalization and a 70μs playback characteristic. (The back of the cassette even has the special notch that automatically switches some decks to the CrO_2 mode.) TDK states that the SA's characteristics are in some ways superior to those of CrO_2 tape.

Maxell's UD-XL tape is offered as a "very high performance ferric-oxide tape" that can operate with normal ferric-oxide bias. However, the slightly higher level offered on some decks with an EX, LN, etc., switch is preferable. It should be used with a 120μs playback equalization. Maxell has developed a smaller magnetic particle coated with cobalt ferrite, which takes care of the clumping problem. Claimed for the UD-XL tape are a higher output level at all frequencies and a lower noise level when compared to conventional ferric-oxide tape.

The other ferric-oxide tapes—Capitol Music Tape, Memorex MRX$_2$, Nakamichi EX, and Scotch LN/HD—appear to offer an overall refinement in performance rather than any specific technological breakthroughs. They all lay claim to finely dispersed coatings, compatibility with normal bias and equalization, and the precise mechanical construction needed for a smoothly operating, jam-free cassette.

Two ferrichrome tapes (Sony FeCr and Scotch Classic) were included in our tests. Both have a layer of ferric oxide coated with a thin layer of chromium dioxide. The low and middle frequencies penetrate to the oxide layer that has superior characteristics in these ranges, while the surface coating brings the superiority of chromium dioxide into effect for the highest frequencies.

Operating at normal ferric-oxide bias settings (or the higher settings of decks designed for high-energy tapes), a ferrichrome tape can have a high-frequency reponse that surpasses conventional ferric-oxide and chromium-dioxide tapes. The catch is that special recording equalization is also required. On a standard recorder not designed for it, a ferrichrome tape has an exaggerated high-end response.

Further complicating matters is the fact that the Sony and Scotch tapes are so different in their characteristics that they are

not interchangeable. The Scotch tape has a thinner chrome layer and does not have as extreme a high-end boost as the Sony tape. Hence, a Scotch tape performs best on a 3M Wollensak deck, and a Sony deck is needed for best performance from a Sony tape. (This situation is expected to change shortly and may have done so by the time this report is in print.)

THE TESTS. We used both the Advent Model 201 and Nakamichi Model 500 cassette decks throughout our testing. We tested: record/playback frequency response at 0 and -20dB recording levels; IM distortion in playback from recordings made at 0, -5, and -10dB input level required at 1000Hz to produce 3% THD on playback; playback output level from a 0dB, 1000Hz recording; output noise (IEC "A" weighted) referred to the playback output from a 0dB, 1000Hz recording; playback THD at 100, 1000, and 5000Hz from recordings made at a constant input level corresponding to 0dB at 1000Hz; and playback output uniformity, including the effects of dropouts in the tape coating and mechanical friction in the cassette.

The last test was accomplished by recording a 10,000Hz signal at -20dB for about three minutes and playing it back into a slow-speed chart recorder with a fast pen response. The width of the trace, ideally a straight thin line, is an indicator of the uniformity of the tape coating. A cyclic variation in output level indicates a binding or eccentricity within the cassette. In all measurements, the 0dB level was based on the deck's meter indications.

Whenever possible, we used the recommended bias/equalization switch settings. Obviously, the regular and CrO_2 positions of the Advent deck placed some of the high-energy ferric-oxide tapes, to say nothing of the ferrichrome tapes, at a disadvantage.

We set out to discover how well a "super" tape performs when used in a machine for which it was not specially designed. It soon became obvious that neither test deck could cope with the ferrichrome tapes using a single switch setting. Therefore, we settled for recording with regular or EX bias and equalization and playing back with the 70μs CrO_2 equalization. This provided an "acceptable" frequency response, although we doubt that we were utilizing the full potential of either tape.

INTERPRETING THE DATA. After accumulating more than thirty frequency response charts and hundreds of observations on various aspects of tape performance, we faced the difficult task of evaluating the data. Our hope that the degree of saturation at high frequencies revealed by the rolloff in response of the 0dB record/playback curve would indicate the relative high-frequency energy capabilities of the tapes had to be discarded. It proved to be basically a property of the tape deck. If any event, the differences between the tapes were too small to be significant.

The differences between some of the tapes in our IM tests on one deck were so great that we began to doubt our instruments. However, the same measurements repeated on the other deck yielded totally different results—in degree, not kind.

Although the tapes ranked in roughly the same order in both cases, the measured IM distortion levels reflected the internal operating conditions of the decks as much as they did the tape characteristics.

In our opinion, the four remaining parameters indicate real tape qualities. Although there were some differences between the two decks, we feel that they would generally apply to the tapes used in other good recorders. However, one must not attach too much importance to small differences between tapes, since they would not be warranted by our test conditions.

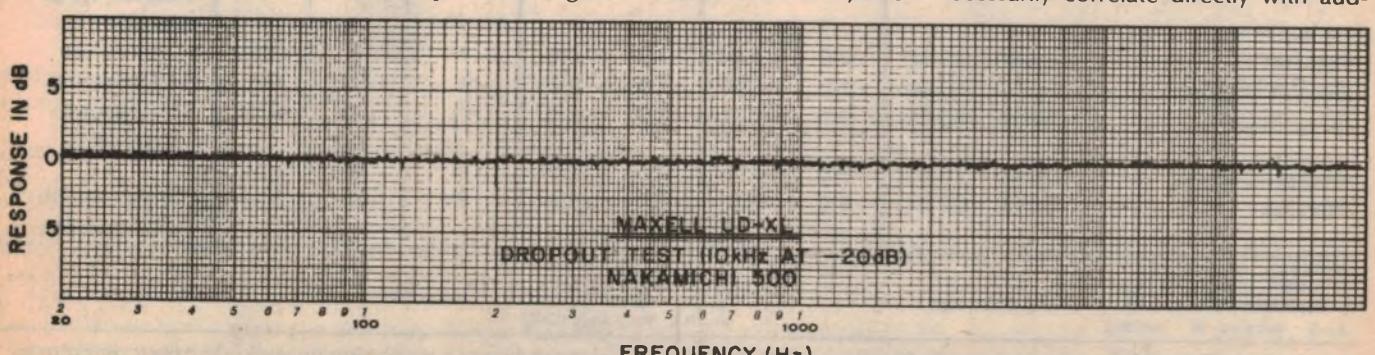
The dynamic range was separately tabulated for each tape deck. This is the decibel span between the maximum recording level, above the deck's own 0dB meter reading, that corresponded to a 3% THD at 1000Hz in playback and the weighted noise. It was taken from a section of tape exposed to the bias waveform but with no signal applied. Although much is made of the separate factors of maximum level and playback noise by the manufacturers, neither is sufficient to define the important dynamic-range parameter.

We divided the S/N measurement into 2dB intervals, assigning each tape a numerical rating based on its own performance. The overall range of the actual S/N measurements was higher (better) on the Advent than on the Nakamichi deck. This tends to obscure the comparisons between tapes unless they are made on the basis of a single deck. Nevertheless, the tapes that ranked high on one deck generally did so on the other, even if the order was slightly different.

The maximum recording level for 3% THD on either machine reveals the midrange saturation capabilities of the tapes. This is dependent on the operating bias and equalization, but it gives a clue to how close one comes to saturation by recording up to the "zero" mark. The playback output from a 0dB recording is an indicator of how much energy has been stored on the tape. All else being equal, a higher output implies a higher S/N.

The chart recorder's trace in the "dropout" test is one of the best guides we know to check the homogeneity of the tape coating. Although it does not necessarily correlate directly with aud-

. . . "This would not be a tape to use with decks that have only regular and CR02 bias and equalisation, since it doesn't fit into either category. A possible exception would be an older deck with unexceptional highs, which might well become exceptional with this tape."



Typical chart recording of dropout test—in this case for the Maxell UD-XL. Comparative results from other tapes tested are shown in the table overleaf.

ible effects, it seems obvious that, in this case at least, less is better than more. A "typical" chart obtained in this test is shown.

The relative performance of the tapes with respect to the four parameters described is shown in the table. Remember that small differences are usually not significant and that comparisons should be made in each category only on the data obtained from one deck. If both decks suggest a similar ranking of the tapes, this gives a greater credibility to the rating, but the reverse is not necessarily true.

OTHER CASSETTE FEATURES. There is more to a good cassette that the tape within it. All the makes represented in our tests have good-quality mechanical construction, and our experience with them has been uniformly satisfactory. Since we tested only one C-60 cassette of each tape type, no sweeping conclusions can be drawn regarding uniformity throughout production. However, we wouldn't expect any major departures from our findings.

The listing of test results in the table includes a column for case construction, which is nearly evenly divided between screw fastened and welded, if a case is well made, there is probably little difference between the types. Some people might prefer the screw-fastened case because it can be disassembled to permit reguiding and splicing of tapes. (A welded cassette cannot be opened without breaking the case.)

However, as 3M points out in its novel cassette-splicing kit, disassembling a case is never recommended. If a tape is broken, it can be spliced from outside the case.

Of the cassettes tested, the Memorex MRX_2 and Maxell UD-XL had larger-than-normal windows for viewing the tape, the former spanning almost the full width of the cassette housing.

TDK, Nakamichi and Maxell have timing marks on their tape leaders. Nakamichi and Maxell tapes have marks that indicate five seconds remaining before the coated tape reaches the head and arrows that indicate the direction of tape motion. Nakamichi also marks the side, A or B, on the leader. TDK tapes have four seconds of leader, with timing marks at one-second intervals.

The Maxell (and we suspect from the audible sound as it moves, the Nakamichi) has a special headcleaning tape as a leader so that the heads are cleaned every time the leader passes over them.

Recordists who have run afoul of short-length cassettes that can cause the end of a half-hour broadcast to be lost will appreciate Sony's FeCr Plus 2 cassettes. They have a full 31 minutes of tape per side.

SUMMING UP. As stated earlier, it is possible that, by optimizing a recorder for each of the tapes, we would have eliminated many of the differences observed. But this isn't an option open to most users. Thus, the question of what a user can expect from each of the tapes on his particular deck still remains.

Every tape we tested is capable of making really good hi-fi recordings with any good deck. In most cases, especially when recording FM broadcasts, we doubt that any one could tell which tape was being used. Our TDK SD control tape, once a "premium" tape, is now a "standard" tape of sorts. This says a lot for the continuing progress in tape performance.

Except for its higher dropout level, the Scotch LN/HD tape was very similar to the TDK SD tape. (On the Advent deck, they were almost identical.)

In most respects, Memorex MRX_2 and Capitol Music tape measured not too differently from the TDK SD tape, which was in the middle in our tests. On the Advent deck, the Capitol tape ranked at the top in dynamic range and maximum recording level, but it was in the middle of the group on the Nakamichi deck.

Strangely, Nakamichi EX tape was in the middle or slightly above in all characteristics, but never reached top position on either deck. In other words, it was a very fine tape among other very fine tapes.

As claimed, the Maxell UD-XL tape ranked close to the top in maximum recording and playback levels. Its dynamic range was also outstanding on the Advent deck, though average on the Nakamichi deck. Its dropout level was very low, ranking with the TDK SA and Sony FeCr tapes and better than all other

TEST RESULTS

	Dynamic Range (dB)		Rec. Level at 3% THD 1 kHz[1]		Output from 0-dB Rec.		Dropout Ranking[2]	Case Seal[3]	Price ($)[4]	Comments
Recorder[5]	N	A	N	A	N	A	N			
Tape										
TDK SD	54-56	58-60	+2.3	+5.0	0.0	0.0	5	S	3.00	4-s timed leader
Scotch LN/HD	52-54	58-60	+1.5	+4.5	−1.3	−0.7	6	W	3.00	
Memorex MRX_2	58-60	58-60	+1.5	+5.0	+1.0	−0.7	5	W	2.30	Large window
Capitol Music Tape	56-58	62-64	+3.5	+6.5	0.0	+0.8	5	S	3.00	
Nakamichi EX	52-54	58-60	+1.5	+5.0	+0.7	0.0	3	S	3.70	5-s timed leader, head cleaner
Maxell UD-XL	56-58	60-62	+2.0	+6.5	+2.2	+0.7	2	S	4.89	5-s leader, head cleaner, large window
Fuji FX	56-58	60-62	+2.0	+6.0	+2.3	+0.6	2	S	3.50	
Scotch Classic	52-54	58-60	−1.0	+2.0	0.0	+0.6	5	W	4.35	Ferrichrome
Sony FeCr[6]	56-58	60-62	0.0	+3.0	+1.0	+0.6	1	S	4.00	Ferrichrome, 31 min/side
Scotch Chrome	58-60	60-62	+2.5	+2.0	−0.5	−0.5	4	W	3.75	
TDK SA	60-62	62-64	+3.0	+3.0	+2.7	+3.1	2	S	3.60	"Super Avilyn" ferric coating

Notes:
1—0 dB meter reading at 1 kHz
2—Numbers increase with increasing dropouts
3—S screws. W welded
4—For C-60 tape
5—N Nakamichi 500. A Advent 201
6—Rec Reg Play CrO_2

A summary of the test results, as compiled by the author. He warns against reading too much significance into minor differences between the figures, since they could relate to the decks and other test conditions. Disregard the prices, which are for the US market.

ferric oxide tapes except Fuji FX.

In all out tests, the Fuji tape was so close to the Maxell UD-XL that we would not consider any differences to be significant.

Scotch Classic was something of a "maverick" in this group. Without optimum recorder adjustments, it saturated early, had a fairly low output level (lower than average S/N) and average dropout rating. Although most of the other tapes gave nearly identical frequency-response curves (on a given deck), the Classic had a strongly peaked high-end on the Advent deck. On the Nakamichi deck, with EX bias, the peak was considerably tamed. This would not be a tape for use with decks that

. . . "Every tape we tested is capable of making a really good hi-fi recording with any good deck. In most cases, especially when recording FM broadcasts, we doubt whether anyone could tell which tape was being used."

have only regular and CrO_2 bias and equalization, since it doesn't fit into either category. A possible exception might be an older deck with unexceptional highs, which might well become exceptional with this tape. Needless to say, on the Wollensak decks in their FeCr modes, this tape delivers a much better account of itself.

Everything we have said about Scotch Classic applies, to an even greater degree, to Sony's FeCr tape. On a suitably designed deck, such as some of the better Sony models, it is an excellent tape. On most other decks, however, it is unusable because of its exaggerated high-end response. A possible solution is to record with normal bias and equalization and playback with the 70µs CrO_2 equalization. This gives a not too objectionable, mildly rising high-end. This tape was outstandingly free from dropouts and other irregularities.

Both test decks were designed to deliver their flattest, widest response with CrO_2 tape, and they did just that. The Scotch Chrome ranked slightly above average in its overall performance, which we expected from a well-made cassette using chromium-dioxide tape. The real reason for including it was to set the stage for TDK SA tape, which is effectively a substitute for chrome in a cassette deck, although it is a ferric-oxide tape.

The SA placed at or just below the top in every performance category. Its S/N (dynamic range) was the best on the Nakamichi and a hair's breadth below the top-ranking Capitol Music Tape on the Advent decks. Although its maximum recording level was only slightly above average, the playback output was 2 to 3 dB better than any of the other tapes. Finally, its freedom from dropouts tied the Sony FeCr tape and was far ahead of all the others. The SA tape can be used with any deck that has a CrO_2 switch, and that includes just about every deck on which you would use a top-grade tape.

In closing, we repeat our caution: Don't read into our test results more than is justified. Most tapes perform better on some machines than they do on others. It makes good sense to experiment with different tapes to determine which is best for your needs.

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AE103/FP

Pioneer's 'top of the line' tuner

While the TX-9500 is the top-of-the-line FM tuner from Pioneer its price is in the medium range as far as the hifi market is concerned. However its performance makes it comparable with even the most expensive tuners.

While some people may not regard the Pioneer TX-9500 as beautiful, none could deny that it is very well finished. The tuning knob is one of the biggest in the business and its large flywheel helps make it one of the smoothest. Other knobs are the four position Function control and the Output level control

Three modes of reception are available via the Function control. They are AM, FM Auto, which provides automatic stereo reception, and FM mono which is used where signal conditions are too poor for noise-free stereo. The fourth position of the Function control is labelled: "Rec Level Check" and provides a pulsed 440Hz tone at a repetition of a little more than one per second. The level of the tone at the tuner outputs corresponds to 50% modulation from an FM broadcast and is intended to enable the user to correctly adjust the recording levels on a tape or cassette deck without any need for trial and error. The tone pulse repetition rate has apparently been chosen after consideration of the meter characteristics of typical tape machines. The set up procedure in the owner's manual suggests recording level adjustment so that the meter pointers indicate in the region of 0dB.

This really is an ingenious idea. While it may raise ethical and legal issues surrounding taping of broadcasts it certainly is a boon for those who wish to skirt those issues.

The output level control enables the variable outputs to be adjusted to match signal levels from other sources in the system, while fixed outputs are available for tape recording.

Three lever switches are provided for Power, MPX Noise Filter and Muting Level. The Multiplex Noise Filter could more correctly be called a High Blend switch since it performs this function. Two levels of muting threshold are provided by the Muting switch as well as switching the Muting right out if need be.

Dial calibration on the long, almost linear frequency scale is very good and certainly within 50kHz.

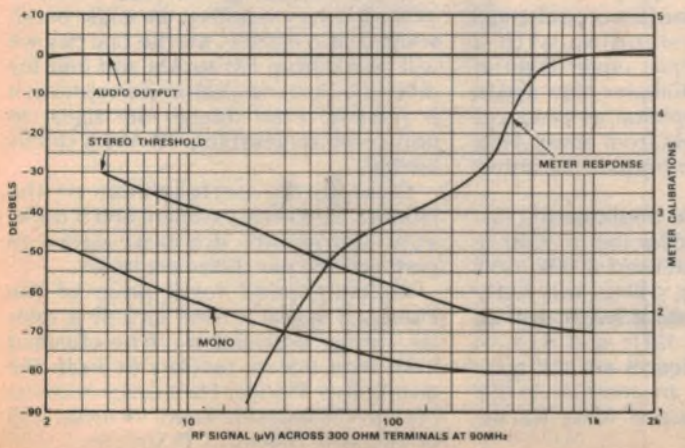
There is one problem with the front panel styling, in that the user needs to have the meters at eye level when tuning to a station, otherwise the meter pointers cannot be seen. This is because the meters are quite deeply recessed. The result is that if the TX-9500 is installed on a waist-high shelf or bench the user has to bend over to tune it. For convenience, it should be mounted at eye-level.

Dimensions of the TX-9500 are 420 x 150 x 365mm (W x H x D) including knobs, rear terminals and feet. An extra 140mm clearance at the rear of the chassis is required to enable the rod antenna to be swung out and oriented for best AM reception. Mass of the TX-9500 is 9.1kg.

Terminals are provided on the rear panel for 75 ohm coax cable and 300 ohm ribbon FM antenna as well as a long-wire AM antenna to be used in poor signal areas where the rod antenna is not adequate. RCA sockets are provided for fixed and variable audio outputs plus horizontal and vertical inputs for a multipath oscilloscope display. The horizontal output is actually the FM demodulator output which can be connected to a 4-channel or Dolby decoder if and when such broadcasts ever become a reality in Australia.

Also making the TX-9500 compatible with any future Dolby encoded broadcasts is the FM de-emphasis switch on the rear panel. It provides 75uS de-emphasis for American reception, 50uS for Australia and Europe and 25uS for Dolby encoded broadcasts.

In spite of the otherwise very good presentation of the TX-9500 there is one glaring omission. It is not fitted with an approved three-core mains flex and three-pin mains plug for Australian use—definitely a negative feature. Other Japanese manufacturers or their local distributors supply correctly wired models



Ultimate signal-to-noise ratio in the mono mode is 80dB and 70dB in stereo.

for the Australian market as a matter of course and so should Pioneer.

Of course the astute buyer can stipulate that the retailer fit a three-core flex and plug while ensuring, before purchase, that there is no earth-loop problem likely with the other equipment in his system.

Chassis layout is very similar to several other tuners we have reviewed recently but that is where the similarity ends. No less than eleven IC's, 34 transistors, 23 diodes and 3 mosfets make up the semiconductor complement.

The combined AM/FM front end uses an eight section tuning gang so that both AM and FM sections have tuned RF stages for improved performance. The 10.7MHz IF section has eight stages of limiting (yes, eight!) with seven IF amplifier IC's plus the IF stage in the front end.

As in most FM tuners these days, the multiplex decoder is a phase-lock loop integrated circuit. This gives low distortion and excellent separation between channels.

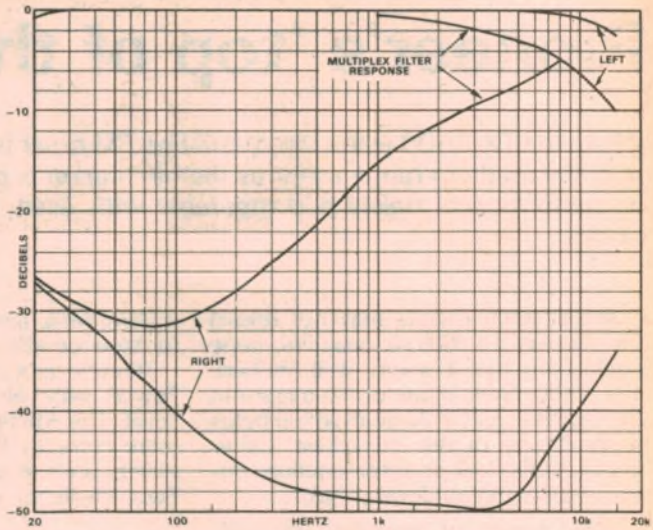
A refined muting circuit is employed which utilises reed relays to give "pop-free" unmuting when the signal is correctly tuned. There can be a slight hassle here, since the muting circuit needs quite precise tuning (ie, the centre-reading meter must be in the black region) before it will unmute and there is a slight delay between correct tuning and unmuting. This means that the receiver should be slowly tuned across the band while watching both meters otherwise it is possible to miss stations entirely.

On the positive side, we can testify that the relay muting system is the cleanest and most "pop-free" we have used. By way of explanation, many receivers give quite a loud "pop" or "thump" from the loudspeakers when they mute and/or unmute.

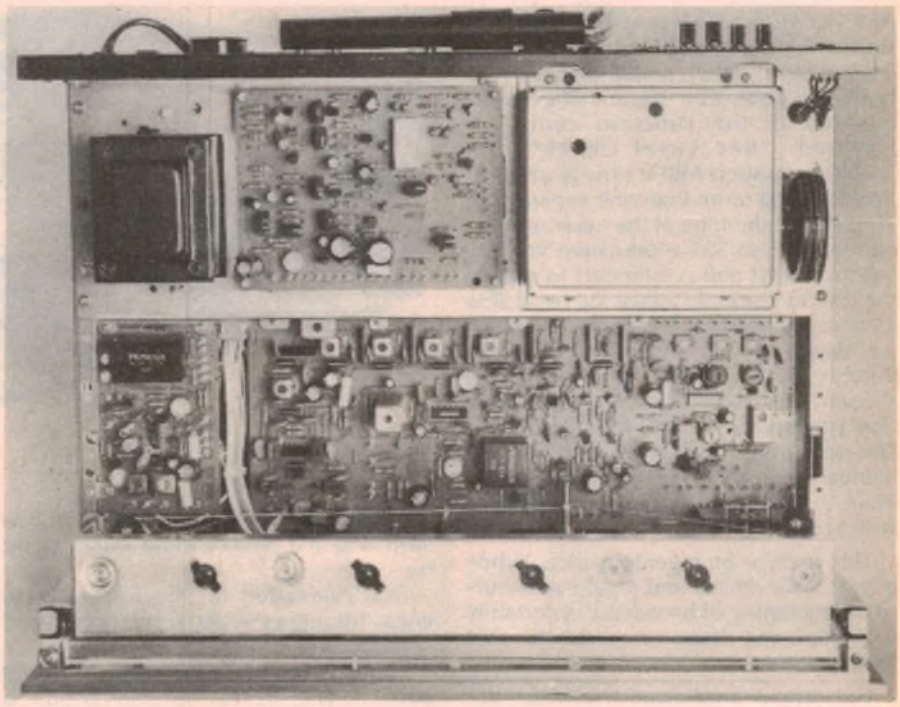
A very sharp cut-off low-pass filter is used to remove 19kHz and 38kHz residual signals from the audio output of the TX-9500. As a result, the 19kHz residual is 65dB down with respect to full output (as specified). This is the best figure we have achieved for this measurement. In fact, that comment applies to most measurements on this tuner.

Now refer to the Quieting curves. These are the best we have achieved on any tuner to date. In fact, the ultimate signal-noise ratio of 80dB in mono is better than the specification for our Sound Technology 1000A FM generator. So we were really stretching the measurement equipment to the limit.

The signal-strength meter response is shown, together with the quieting curves. The meter response is fairly linear for most of its range but saturates for signals above 1 millivolt (RF input).



Separation between channels is excellent but the Multiplex filter action is drastic.



Again, the separation between channel results were outstanding with a maximum figure of just under 50dB at around 3kHz. The Multiplex filter action is too drastic in our opinion, as it reduces the separation at 1kHz from about 49dB to 15dB and to nil for frequencies above 8kHz.

We were unable to duplicate the distortion figures quoted for the TX-9500. In mono mode, we achieved 0.15%, 0.3% and 0.8% at 100Hz, 1kHz and 6kHz respectively while in stereo we measured 0.3% at 100Hz and 1kHz and 0.6% at 6kHz. While these figures are still quite acceptable there is an anomaly in the lower distortion figure at 6kHz for the stereo mode.

Again, as with other FM/AM tuners, the AM section is the poor relation. While it is very sensitive, the audio bandwidth is also narrow. Maybe one day we will switch from FM to AM and find the difference in bandwidth imperceptible. It is feasible, even though the signal to noise ratio achievable with AM is strictly limited.

Overall, the performance of the Pioneer TX-9500 is excellent and it probably represents the best value in performance per dollar available.

Recommended retail price of the Pioneer TX-9500 is $369 including sales tax. Further information can be obtained from high fidelity retailers or from the distributors, Pioneer Electronics Australia Pty Ltd, 178 Braeside Road, Victoria, 3195 or interstate offices. (L.D.S.)

AMPLIFIERS EXPLAINED:

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From Sony research... a totally new turntable system

Sony PS-4750

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Sony achieved this in a number of ways:
First, all the belts, pulleys, idler wheels and other paraphernalia used in conventional turntables to make the turntable spin at the record's speed, instead of the motor's, have been eliminated.

The Sony PS 4750 has no need for these troublesome, noisy and fluttering parts, because its slow-revving D.C. motor is directly coupled to the platter.

Speed accuracy takes on new meaning with another Sony breakthrough, the "Magne-disc Servo Control."

Through a unique multi-gap head, this system automatically reads turntable speed through speed detective signals magnet-coated on to the turntable rim. Should there be any deviation induced by fluctuations in power supply, it immediately "instructs" the servo motor to make micro-accurate adjustments.

Another triumph of Sony research is the very material used to make the cabinet and turntable, B.M.C., developed specifically for audio use because its damping and resonance characteristics are 30 per cent better than the conventional aluminium diecast. B.M.C. is also virtually free of expansion or contraction, freeing the design of any problems arising from temperature changes.

Sony innovation didn't stop there. Look at the revolutionary rubber disc supports. These insulation mats are of a unique design which firmly grips the record, effectively insulating the disc from vibration when the turntable revolves. By preventing vibrations, these mats contribute to the stereo effect and significantly improve presence.

The precision tonearm is a universal type which accepts all quality shells and cartridges. Some of the Sony PS 4750's other advanced features are: stylus pressure adjustment (0-3 g), anti-skate compensator, viscous-damped (up and down) arm lifter, see-through stroboscope, independent pitch control (+ 4% on both 33⅓ and 45) and large insulator legs for effective prevention of audio feedback.

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Sony TA-5650 V-FET stereo amplifier

The new Sony TA-5650 stereo amplifier has two attractions: V-FETS in the power stages and very comprehensive input and output facilities. Continuous RMS power is rated at 60 watts per channel.

Generous power output and conservative ratings are features of the Sony TA-5650. Each output stage uses four V-FETS.

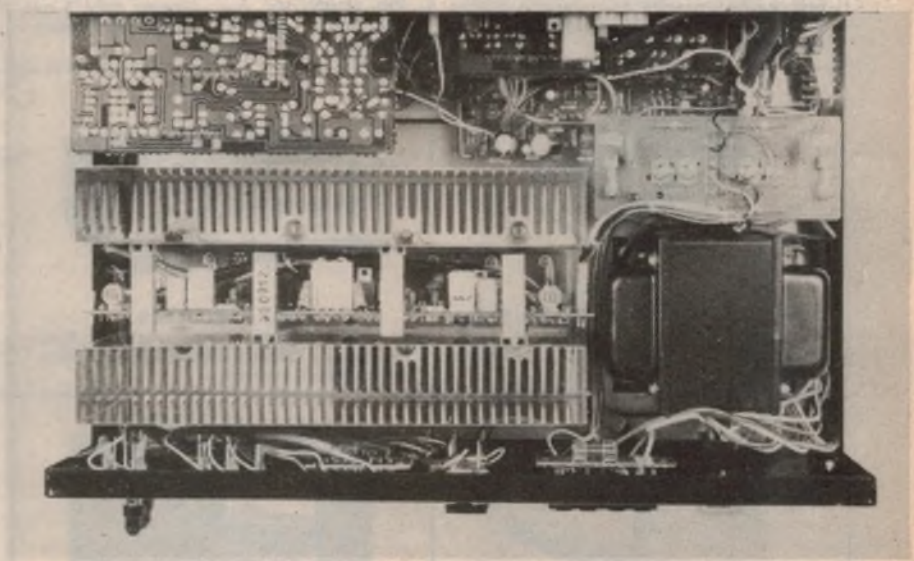
Dimensions of the TA-5650 are 462 x 168 x 331mm (W x H x D) including knobs, rear terminals and feet. Its mass is a hefty 13.4kg. The styling matches the new ST-4950 FM stereo tuner reviewed in these pages last month.

Pages could be written about the comprehensive input and output facilities. Of special note are the three toggle switches, which allow connection of two tape or cassette recorders plus two signal processors such as a compressor/expander and a graphic equaliser.

Rugged construction is readily apparent when the top cover is removed. Large finned heatsinks are mounted at the bottom of the amplifier to dissipate the considerable heat produced by the eight V-FETS in the output stages. Tinplate chimneys improve convection through the amplifier and out through its ventilated cover. The amplifier must not have anything placed on it which restricts ventilation, otherwise it will rapidly overheat.

We are unable to state that the use of V-FETS gives a clearly recognizable and audible advantage over other high quality solid state amplifiers. For this sort of statement to be made, carefully controlled listening comparison tests must be made, and we are unable to perform these tests at present. We can state, however, that the TA-5650 is a fine performer and is conservatively rated.

To quote just a few of the measurements we made: Power into 8-ohm loads was 60 watts per channel with both driven and 72 watts with one channel driven; into 4-ohm load, power was 68 watts per channel with both driven and 76 watts into one channel. Typical distortion measurements were in the region of 0.05% or less. Frequency response was 10Hz to 100kHz at the –1dB points. RIAA equalisation was within 0.5dB over the range from 50 to 15kHz.



Signal-to-noise ratio for the phono input was 70dB with respect to 10mV input and 50 watts output with a typical cartridge connected. Phono overload capability was a whopping 320mV at 1kHz.

Two pairs of loudspeakers may be connected, either singly or together. One disadvantage here is that when the two pairs of loudspeakers are in use simultaneously, they are actually connected in series across each channel output. This has been done to ensure that the minimum load on the amplifier is never less than 4 ohms.

We find it a little surprising that Sony find it necessary to limit the loading to 4 ohms in view of the generous heatsink and comprehensive protection circuitry. At any rate, we are of the opinion that Sony should have merely stipulated that loading be no less than 4 ohms, instead of opting for a connection system which results in poor damping when both sets of loudspeakers are used simultaneously.

Low and High filters are provided. The Low filter rolls off below 30Hz at 12dB/octave, while the High filter rolls off above 9kHz at a less effective 6dB/octave rather than 12dB/octave as quoted in the instruction manual.

Aside from this point about the High filter we could find no fault in our performance testing. The amplifier is overload and short-circuit proof, and performed impeccably at all times. It becomes quite hot during normal use, but this is no cause for alarm.

Recommended retail price of the Sony TA-5650 is $599 including sales tax. Further information can be obtained from high fidelity retailers or from the Australian distributors, Sony Kemtron Pty Ltd, 453 Kent Street, Sydney, NSW 2000. (L.D.S.)

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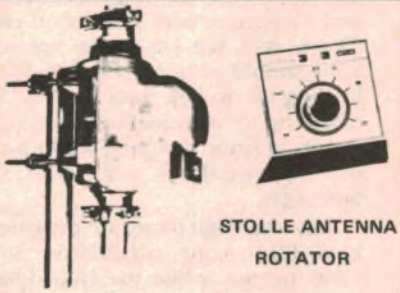

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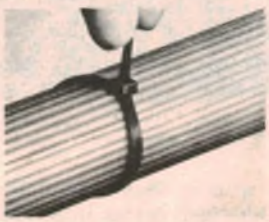

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Sennheiser infra-red headphones

The Sennheiser infra-red headphone system, featured in our February issue, is due for Australian release within the next few weeks. In the meantime, we have had the opportunity to use the original system in a home situation and can offer a first-hand reaction to its effectiveness.

To recap briefly, the infra red system offers an elegant solution to the problem of listening to television or other sound on headphones, without the problem of trailing cords.

The wanted sound is picked up from the receiver or amplifier and fed via a length of shielded cable into an infra-red transmitter, placed nearby and facing towards the listening area. In the transmitter, the wanted signal is frequency modulated on to a super-sonic carrier at about 95kHz which is, in turn, applied to a bank of light emitting diodes (LEDs) radiating in the infra red spectrum.

The listener wears a pair of headphones which are integral with, or connected to, a tiny battery-operated infra-red receiver.

Developed mainly in Europe, the infra-red system can be used to propagate sound from a variety of sources, including higher powered versions intended for installation in auditoria. Two-channel versions have also been developed.

By far the greatest interest is for use with television receivers, allowing the viewer to watch programs at any time without disturbing other members of the household. It also becomes possible for hard-of-hearing viewers to have amplified sound right at their ears, while the loudspeaker itself operates at normal volume.

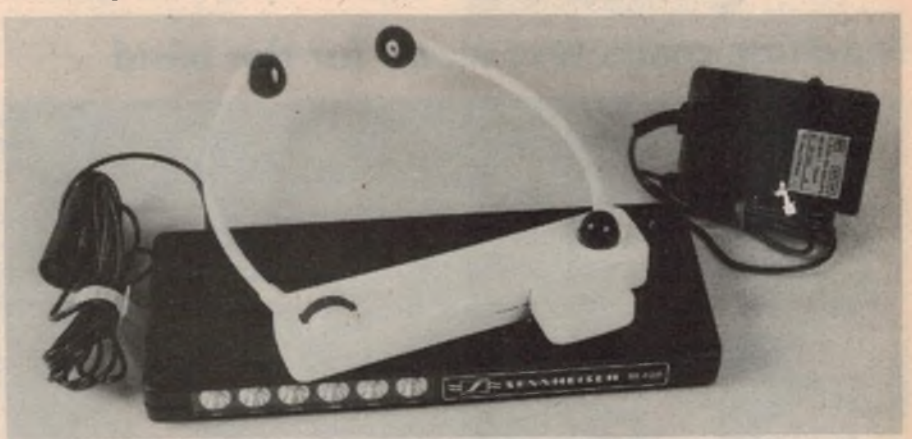
The Sennheiser transmitter type SI406, as pictured, is housed in a slim package measuring approximately 200 x 80 x 17mm. It carries six tiny infra-red LEDs on its front face which should be placed so that they radiate into the listening area. For our tests, we rested the transmitter on top of a normal 26-inch television receiver, although it would be better kept out of the way by attaching it to the underside front of the cabinet.

The transmitter is powered by a small AC supply which is intended to plug directly into—and be suspended by—the power point. The only power unit available at the time for our tests was one designed for the European market and we had to improvise by plugging it into a lead as used for irons and toasters.

The Sennheiser transmitter is particularly tolerant of the magnitude of the audio signal fed into it. According to the literature, its in-built audio AGC will cope with any input from 10mV to 1V. Tapping into the sound source could be a minor hassle, however.

Some receivers, notably European, have an output socket fitted, from which audio can be fed to an external hifi system—or to an infra-red transmitter. Many Japanese receivers, on the other hand, have headphone sockets much like those fitted to transistor sets. In a few cases, the actual loudspeaker plug/socket may be accessible externally. While the last-named schemes may be handy in one sense, they may also mean that connecting the infra-red transmitter would automatically silence the receiver speaker.

For our own purposes, we did what would otherwise have involved calling in a serviceman. We removed the back from the set and located the circuitry on the exposed DC board feeding sound to the receiver volume control. Playing safe with voltages, we clipped a 10uF bipolar electrolytic capacitor to an exposed component lead on the audio line and used a short length of shielded cable to carry the signal to the infra-red transmitter.



The additional lead did not affect operation of the TV receiver, the users being free to turn the loudspeaker volume up or down at will.

The transmitter itself was simply plugged into a power point and, to all intents, forgotten. It radiates while ever it is switched on and supplied with an audio signal. If the TV receiver only is switched off and the audio signal is thereby interrupted, the transmitter inhibits itself after a few minutes and the LEDs cease to radiate.

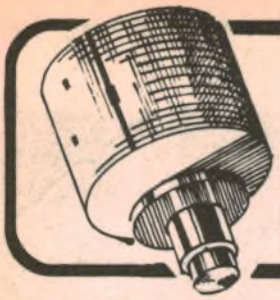
Sennheiser's HDI 406 headset, also pictured, is notable for its lightness—and its simplicity as far as the user is concerned. It simply hangs in the ears, almost unnoticed, and provides any volume level that is likely to be required at the turn of a knob. The tiny battery pack will provide power for about 5 hours of listening. Sennheiser suggests, however, that it be plugged into a live AC power socket when not in use, which will keep it topped up, without fear of over-charging.

What is amazing is the way in which six tiny LEDs can indeed illuminate a listening area. In our own case, there was ample signal for a typical but fairly large L-shaped lounge-dining area with the transmitter in the apex of the L. At about 25ft, the sound in the phones was completely clean and free of noise, despite normal overhead lighting.

We could not support some published claims of infra-red even in the shadowed areas. While we could not lose the signal in any likely viewing (or listening) situation, we could lose it by turning away from the source and facing an open (i.e. non-reflecting) doorway, or by crouching down behind a piece of furniture.

The important point is that the system behaved exactly as intended and, assuming that no problems arise with the "Australianised" transmitter power unit, the Sennheiser system should meet what is a definite need for many people. While the system pictured involves one transmitter and one receiver, as many receivers can be used as necessary. Similarly, Sennheiser headsets can be used in association with most other infra-red transmitters, some fitted as an integral part of European TV sets.

For further information: R. H. Cunningham Pty Ltd, 493-499 Victoria St, West Melbourne.



News Highlights

CSIRO develops revolutionary new hearing aid

Many of the problems of deafness aren't solved just by the use of hearing aids. In a noisy environment, turning up the hearing aid won't always help a deaf person to hear what someone else is saying—the noise is amplified with the speech.

The major disability of deafness, then, is mainly a difficulty in separating a wanted sound from unwanted sounds.

To combat this, Mr Vic Burgess at the CSIRO National Measurement Laboratory, Chippendale, NSW, has developed a new type of hearing aid that relies on radio signals. Signals are picked up by a lapel-worn microphone attached to another person, and transmitted to the deaf person's hearing aid receiver.

Mr Burgess' system uses small ferrite rod antennas to transmit and receive a magnetic 'induction field'. An induction field is present very close to a small transmitting antenna. It doesn't radiate away like a normal radio wave; instead its strength falls away very rapidly.

In addition, if this field is frequency modulated (FM), it is possible to take advantage of the "FM capture effect". This effect is a distinctive property of FM and means that if more than one FM signal is received in the same frequency channel, the strongest is heard at full strength, while the others are almost totally inaudible.

Combining these two features, induction field transmission and FM modulation, into a hearing aid was Mr Burgess' key idea. He calls it 'induction field telephony'.

The new system means that a deaf person will be able to receive speech, at a constant volume, up to about 10 metres from the transmitter. If there is another unit nearby he will need to keep just a little closer to the transmitter that he wants to hear than to the other one. If he wants to hear the other conversation he will just have to walk across; at the half-way point his reception will automatically change over.

The system was developed in response to the interest of the National Acoustic Laboratories (NAL) in the provision of wireless hearing aids for use in schools. Deaf pupils are under a great disadvantage at school. There is usually too much noise for conventional aids to be of much use and without communication education cannot take place.

Radio linked aids are produced overseas for school use but they require a separate frequency channel for every transmission in the school.

In collaboration with NAL, a number of field aids have been constructed. They have been successfully field tested, with the help of the NSW Department of Education, at Farrar Public School for the Deaf in Sydney.

Machine reads text aloud for the blind

Developed at Cambridge near Boston in the United States, this extraordinary machine allows the blind to read by a method other than Braille. Still at an experimental stage, the machine basically consists of a reading table equipped with an optical scanning device and a computer. As each word is scanned, it is transmitted to the computer and read aloud. By means of a special keyboard, the machine can be instructed to repeat a sentence or to spell a word.

VHF ship-to-shore radio telephone service

The Overseas Telecommunications Commission (Australia) has officially introduced a direct VHF ship-to-shore radio telephone service for vessels in the Sydney area. Commencing date was January 5, 1976.

The new service, utilising VHF-FM equipment will give high-quality reception for vessels within a range of approximately 50km from OTC's Sydney radio installation at LaPerouse, the operating station.

The manager of OTC's Coast Radio Service, Mr Phil Chapman, said that the service had proved highly successful during trials. "Although range is limited, the equipment required by boat owners to gain access to this service is much more economical than that needed for our longer-range HF services," Mr Chapman said.

Vessels wishing to use the new service must have equipment fitted to operate on VHF channels 16, 26, 67 and 23 (optional). Channels 16 and 67 are for correspondence with the coast station and for emergency/safety-of-life-at-sea messages. Channel 26 is connected through the coast radio station direct to a Telecom Australia telephone operator for ship-to-ship telephone calls.

US/Soviet team tests MHD power generator

A team of US and Soviet scientists and engineers working in Moscow has successfully completed a 127-hour test run on the US designed and constructed magnetohydrodynamic (MHD) channel on the Soviet U-02 MHD test facility.

The MHD method of generating electricity involves the combustion of coal or other fossil fuels to generate a combustible gas at temperatures upwards of 4,500°F. The hot gases are seeded with potassium salts to render them electrically conductive, and accelerated by a nozzle into a powerful magnetic field. Electrical energy is then directly extracted from the hot gases as they flow through the magnetic field.

The achievement of more than 100 hours of continuous operation of this small MHD test channel is a significant step in demonstrating the feasibility of a key component of this electrical power generating system.

The Soviet team was directed by Academician A.Ye.Sheyndlin, Director of the Institute of High Temperatures of the USSR Academy of Sciences, which operates the U-02 and other Soviet facilities. Design and construction of the US test channel was undertaken by the Westinghouse Research Laboratories, Pittsburgh, under contract to the Fossil Energy Program of the Energy Research and Development Administration.

Co-operation with the USSR was implemented in July 1973, and is currently an activity under the US-USSR Energy Agreement of 1974. The co-operative program in MHD with the USSR is integrated with the US MHD research effort, and is intended to obtain data using facilities not available in the US.

Nuclear powered heart pacemaker

A nuclear-powered pacemaker that could bring a new lease of life to thousands of people suffering from certain types of heart trouble has been developed in Britain. Implanted in a patient's chest it could provide the vital rhythmic stimulus that a defective heart needs for between 10 and 20 years—several times longer than conventional pacemakers powered by chemical batteries.

Power for the pacemaker is derived from the isotope 'Plutonium 238' because its power output falls by only one percent a year and its radiation requires the minimum of shielding for implantation. Internationally agreed safety standards require stringent tests on the batteries to ensure there is no radiation hazard and that they will withstand the most severe accident, fire, impact—or even cremation.

The technology for the new pacemakers has been developed over a six year period during which they have been subjected to long-term controlled trials

at recognised cardiological centres under the supervision of Britain's Department of Health. The Department has already placed the first production order for 100 of the new nuclear batteries and an order for a further 200 is following.

North Sea oilmen on the phone

Some of Britain's most isolated inhabitants—the men working on North Sea oil and gas platforms—can now be on the public telephone service, with direct dialling throughout the UK and to many places abroad.

Using a new service inaugurated last January, Mobil's Beryl platform—150km east of the Shetlands—can be linked direct to most of the UK's 20 million telephones and to more than 250 million telephones in 26 countries.

Beryl is the first North Sea platform to be provided with an automatic public telephone service and has been given Aberdeen telephone numbers. The service is intended primarily as a business link, but workers on the platform will be able to ring their homes through the platform's operator in the event of urgent personal business.

The new connection is the first part of a multi-million-pound network of offshore microwave radio links being set up by the Post Office to extend Britain's telecommunications system far out into the North Sea.

British Post Office expands Postfax service

The British Post Office has now broadened the concept of its recently introduced Postfax service to allow private firms to link into the system. At the same time, the Post Office has almost doubled the number of post offices offering the service from 12 to 22.

The move marks a major extension of Postfax, Britain's first public facsimile service. Documents handed in for transmission at any post office with the facility are normally delivered to the recipient within three hours.

The decision to extend the service—launched a year ago with 12 terminals and post office-to-post office transmission only—has been taken following approaches by some of the country's biggest businesses and by some Government departments. These approaches indicated an interest in a Postfax network with a wider geographical coverage of the country, and offering direct access to private facsimile machines.

New Braille learning system from Britain

A young blind girl uses a new do-it-yourself method of learning Braille which has been developed in Britain. Already, it is being used by hundreds of blind people to learn Braille.

Developed by Dr Michael Tobin of the Research Centre for the Education of the Visually Handicapped at the University of Birmingham, England, the system comprises two pre-recorded cassette tapes and a Braille booklet divided into 20 lessons. The learner listens to the instructions on the tape, and then carries them out using the booklet.

There is no copyright on the system, and the cassettes together with the booklet can be reproduced by blind organisations throughout the world.

For further information contact the Royal National Institute for the Blind, 224 Great Portland St, London.

We're #1—and the critics totally agree!

HIRSCH-HOUCK LABS . . . Stereo Review

"The Pickering XUV/4500-Q is obviously one of the best phono cartridges presently available. There are few stereo cartridges that can outperform it in any of its individual characteristics, and we know of none that could be said to be a better stereo/CD-4 pick-up."

B. V. PISHA . . . Audio Magazine

"The Pickering XUV/4500-Q ranks among the top cartridges for stereo, SQ, QS and CD-4. The sonic clarity is exceptionally good ,with superb transient and applause response, and good definition, particularly in the low bass region."
"To sum up, we can recommend the Pickering XUV/4500-Q cartridge without reservations, based upon our laboratory and listening tests"

MAURICE HOLTHAM . . . Canadian Stereo Guide

"In fact the reproduction of all material . . . stereo, CD-4 and matrix . . . was absolutely superb. Good recordings were reproduced with outstanding fidelity and clarity, and tracking was secure at one gram with even the most heavily modulated bands. Solo instruments and voice were rendered with exciting realism; large orchestral and choral works came through in all their magnificence."

Hi-Fi Stereo Buyers Guide

"In both stereo and CD-4 one of the most outstanding under any program conditions. Sound so clean and crisp it almost hurts."
"This pickup is a perfect example of why measurements cannot truly express the sound quality from a transducer; though the measurements are good, the sound quality was rated by the entire listening panel as superb."

The specifications of the XUV/4500-Q are so exciting that we hope you will write to

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NEWS HIGHLIGHTS

Computer study shows city pollution effects

Pollutants emitted in a metropolitan area can have a marked effect on air quality in downwind locations more than 200 miles away, according to a Bell Telephone Laboratories study of atmospheric data from eastern New York, northern New Jersey, Connecticut and Massachusetts.

Statistical analyses of data by Bell Labs scientists show that highly concentrated photochemical air pollution originating in the New York metropolitan area is frequently transported through Connecticut and into Massachusetts by prevailing winds. This pollution flow contributes to excesssive ozone concentrations (poor air quality) as far away as Fitchburg, Massachusetts, some 40 miles northwest of Boston.

Bell Laboratories conducted its study in co-operation with the New Jersey Department of Environmental Protection. For the past two years, the New Jersey agency and Bell Labs have been collaborating on computer-based analyses of pollutant chemistry and behaviour in the state and neighbouring areas. Bell Labs uses such data in its environmental research for Bell System telephone companies—primarily in assessing potential impairment of telecommunications equipment.

The scientists involved (clockwise from left): Bert Kleiner, Jean McRae, Jack Warner and William Cleveland.

In the recent study, consistent correlations were found between wind direction and daily ozone buildup at monitoring sites in Connecticut and Massachusetts. Maximum ozone concentrations were recorded at those sites on days when the air mass from metropolitan New York moved in the prevailing northeasterly direction through Connecticut and Massachusetts.

Bell Labs' study is one of the most revealing yet conducted on pollution transport because of the substantial distances and effects noted.

Radio & TV courses at University of NSW

Commencing in May 1976, the Division of Postgraduate Extension Studies, University of NSW, will offer over Radio University VL2UV and Television University VITU the course "Control Computing". This is a course of ten radio lectures, two television lectures, and two attended seminars.

The course deals with the principal features of digital mini-computers applied to real-time systems in laboratory and industrial process control. It reviews hardware organisation, instruction repertoire, and features of typical commercially available machines as seen by the systems analyst. A review of software ranging from basic utility programs to operating systems will be provided, together with discussion on the role of higher level languages for control applications.

The fee for the course is $18, which includes comprehensive notes. Upon enrolment, students receive details of a simple, inexpensive modification for domestic radio receivers, permitting excellent reception of Radio University in the Greater Sydney Area. Enrolments should be submitted by April 21, 1976.

For further information on this and other radio and television courses contact the Division of Postgraduate Extension Studies, University of NSW, PO Box 1, Kensington, 2033.

World's biggest telecom satellite

The world's biggest communications satellite, an Intelsat IVA—stationed 22,300 miles above the Atlantic—went "live" on February 1, 1976, when it began carrying communications between Europe, America, Africa and the Middle East. Britain is working to the satellite through the British Post Office's world famous satellite earth station at Goonhilly Downs, Cornwall.

Switching the satellite—launched last September from Cape Canaveral, Florida—to an operational role follows the successful launch on January 29 of a second Intelsat IVA satellite to act as a back-up. To ensure a high degree of reliability the first satellite was not made operational until the standby had been placed in orbit.

The first Intelsat IVA has taken over as the "primary" satellite over the busy Atlantic region and provides communications links to more than 40 earth stations serving over 60 countries.

Until now world communications have been served by Intelsat IV satellites located above the Atlantic, Pacific and Indian Oceans. But because of the growth in international telecommunications they are reaching the limit of their design capacity. The Intelsat IVAs have sufficient capacity to meet international satellite communications requirements until nearly the end of this decade in the Atlantic, and into the 80s in the Pacific and Indian Ocean regions.

There will eventually be six Intelsat IVAs—operational and standbys—serving the world. Each is capable of carrying about 6,000 telephone calls plus TV simultaneously—about two-thirds more than the generation of satellites they replace.

The end is near for hot metal typesetting:

Automation and

Over the next few years, one of Australia's biggest newspaper publishing companies, John Fairfax Ltd, is to make major changes to its newspaper production methods. These changes will rely heavily on the benefits of computerised automation technology, and will see the introduction of modern typesetting equipment, video terminals for advertising layouts, and computerised sorting and page make-up of classified advertising.

by GREG SWAIN

To most of us, buying newspapers is very much a part of our daily routine. In spite of the more recent availability of other forms of information dissemination, such as radio and television, newspapers have remained and, in fact, offer several inherent advantages. First, the information they contain is transportable; second, information is provided in the form of a permanent record, i.e., as a hard copy; and third, information may be scanned at the users' convenience.

It is little wonder, then, that newspapers have remained one of the most popular methods of information dissemination, and seem likely to continue to do so into the foreseeable future. They are a means by which the public is kept informed of local and foreign events, a source of interesting articles and facts, and a means of staying abreast of developments in a changing world.

But that does not mean that newspapers themselves are immune from change. Far from it. Like all industries, the newspaper industry must remain as up-to-date and as efficient as possible if it is to remain a viable enterprise. And in recent years, this has meant applying the benefits of computerised automation processes to newspaper production.

At John Fairfax Ltd, the parent company of "Electronics Australia", a $5 million program is under way to take advantage of some of the latest technological advances in newspaper production. The aim is to modernise production, to increase efficiency and profitability, and to improve working conditions for employees, many of whom will be involved in re-training programs.

A number of different newspapers are produced at the Broadway, Sydney, plant of John Fairfax Ltd, where the changes are to take place. These newspapers include "The Sydney Morning Herald", "The Sun", "The Sun-Herald", "The Australian Financial Review", and "The National Times". Most readers will be familiar with at least one, if not all, of these publications.

However, despite the fact that newspapers in general are familiar everyday objects, there are few people who have any knowledge as to how they are produced. We will therefore digress briefly and examine current newspaper production techniques, so that the impact of computerised technology may be fully appreciated.

The traditional method of printing newspapers, and the one currently in use at John Fairfax Ltd (and other major newspaper publishing houses), is the hot metal process. This involves several production stages. First, copy must be keyboarded by professional operators to produce a paper tape output which goes to a computer for justification. This produces a justified tape which is then used to control a linotype or linecaster machine, to produce lines of metal type formed from molten metal.

Alternatively, type may be set by direct keyboarding into the linotype. In fact, most of the 140 linotype machines at Broadway must be manually operated, there being no provision for tape control. Manual linotype machines are capable of setting seven or eight lines a minute with experienced keyboard operators, while tape controlled machines are capable of setting up to 15 lines a minute.

Hot metal typesetting reached the end of its technological development with the tape-operated linecaster. There's just no faster way of setting lines of metal type. The linotype, which caused a revolution in its day, is now considered slow, cumbersome and inefficient.

Furthermore, metal typesetting means

The Digiset photo-typesetter is capable of setting 40 lines of type a second.

your newspaper

that everything has to be re-keyboarded—after it has already been keyboarded by the person who creates the item, either as a story or as an ad. This is wasteful duplication of effort, and introduces errors that have to be detected and corrected.

But the inefficiency of the hot metal process does not end at the typesetting stage. Lines of type must be painstakingly assembled by hand into trays, metal blocks etched for the photographs, and the whole assembled into frames to make up the pages. A dampened sheet of papier mache is then impressed onto the page in a moulding press, and dried to form a tough semi-circular mould for the printing plates.

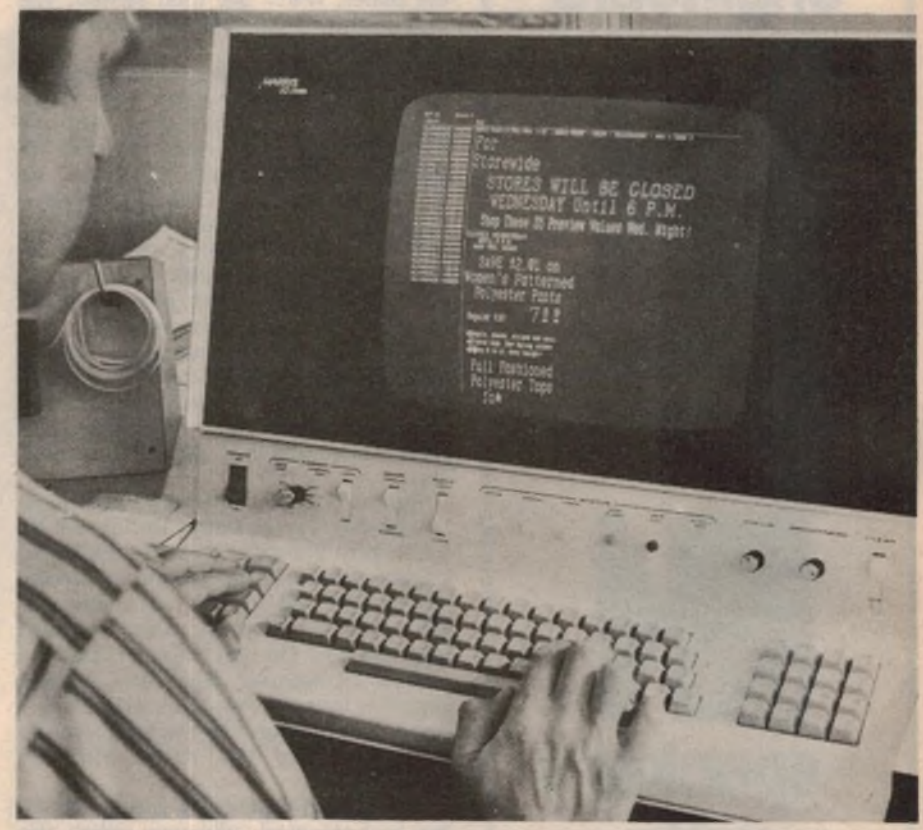
To form the printing plate, the mould is put into a casting box and molten metal pumped into it. The semi-circular plate is then cut and trimmed to fine tolerances and goes by conveyor to the presses. After printing, the plates are melted down so that the metal may be re-used.

The size and scale of the operation may be appreciated by the fact that in one day at Broadway more than 2,000 printing plates may be cast, and 50 tons of metal may be used and re-melted. More than 5 million newspapers come off the presses each week.

Although the foregoing has been only a brief summary of the overall production process, the complexity and inefficiency of traditional methods can be readily appreciated. The goal of the automation program is to speed up the typesetting process, and to eliminate several production stages. This will eventually mean the end of hot metal technology at Broadway.

A major step towards this goal will be the elimination of metal typesetting in favour of photo-typesetting, in which galleys of type are produced in photographic form. Computerised photosetting equipment has been on the market for some time now, and is in general use throughout the publishing industry. Several older machines, known as Photon typesetters, have been in use at Broadway for several years, and are used mainly for typesetting display advertisements.

The Photons are capable of setting type at a rate of approximately 100 lines per minute, or about 6½ times faster than a tape operated linotype. By today's standards, even this is considered slow. A further disadvantage of the Photons is that they are only capable of setting type which must then be laid out by hand—they cannot be used to produce complete photocomposed pages or ads.



An operator makes up a display advertisement on a Harris 2200 video terminal. Text is manipulated on the screen by typing instructions on the keyboard.

The Fairfax automation program will therefore be based on an advanced computerised photo-typesetting system known as Digiset. This machine is manufactured by Dr.-Ing Hell, GmbH, a subsidiary of Siemens Ltd, West Germany. A single unit is currently installed at the Broadway plant and two more are expected in July or August, the latter of more advanced specifications.

The Digiset is capable of setting type at the incredible rate of 40 lines per second. Compare this figure with the 15 lines per minute capability of the tape-operated linotype; or even the 100 lines per minute capability of the Photons. Translated into figures of another kind, it means that the Digiset will set the equivalent of a broadsheet page of news in less than a minute, or a page of classified advertisements in about 90 seconds, including advertisers' trade symbols.

The Digiset achieves its incredible speed by writing the characters onto the face of a cathode ray tube. These character images are then exposed through a system of lenses onto photographic paper, which is processed like a photographic print. Control input into the Digiset can either be from punched paper tape, or from data stored in a computer.

With suitable control input from a computer, the Digiset is capable of

producing complete photocomposed pages of classified ads, eliminating the need to make pages up by hand.

The Digiset typesetters thus allow pages to be made up of photographic images, or photocomposed. This, in turn, allows the plate making process to be much simplified. Film transparencies of the photocomposed pages are simply used to expose a sensitised coating on the plates, which are then etched. The result—hot metal technology is completely eliminated.

Incidentally, you may be interested to know that for many years now "Electronics Australia" has been entirely photo-typeset; since April 1971 in fact. Typesetting and composing is done on a contract basis by Dalley-Middleton-Moore Pty Ltd, Sydney, using computerised photosetting equipment. However, we can hardly claim to be unique in this regard; practically all magazines are now photo-typeset.

Why, then, has the newspaper industry been slow to change? The reason is partly because of inertia due to the scale and complexity of present operations, and partly because of the high cost of conversion.

But the changeover to modern photocomposing equipment at Fairfax will be well worth the initial cost. In addition to slashing production costs and increasing efficiency, it will provide Fairfax newspapers with a cleaner, more modern appearance. The "National Times", a weekly newspaper, has been entirely photoset for some time (except for a few headings), using the Digiset already installed and the older Photon machines.

High-speed typesetting is only one of the technological advances which the company has installed, has ordered, or is studying. In order to take full advantage of the capabilities of the Digisets, it is necessary to increase the rate at which information may be presented for photosetting.

An important step in the overall automation process, therefore, will be the introduction of a computerised advertising layout system. The system chosen is known as the Harris 2200 Video Layout System. This equipment is manufactured by the Harris Corporation, Florida, USA, and will be used at Fairfax to facilitate the layout of newspaper display advertisements.

Basically, the Harris 2200 system consists of a small computer and a number of video display terminals (VDTs), each with a paper tape reader and a paper tape punch. Up to four terminals can be connected to the computer or control unit, each terminal operating independently of the other. Input and output to and from the system can be via a paper tape, via a communications line to a computer system, or both, depending on customer requirements.

Current plans call for the installation of 6 Harris 2200 VDTs and 2 terminal control units. The computer used in the control terminals is the well-known PDP-11/45. As mentioned above, four terminals can be hooked to each terminal control, so the terminal controls will be working below capacity. This will enable future expansion, as required.

What are the capabilities of the Harris 2200 system? In a nutshell, it allows an ad layout man to manipulate text on the screen of the terminal to provide the best possible display in the space allowed. The text which is to be laid out will have been keyboarded elsewhere by someone else, and appears on the screen at first as plain run-on text, all in the one size.

Using a keyboard-directed cursor and copy fitting keys, the operator is able to manipulate text, specify type sizes for single words, sentences or lines, and change the line width, position and spacing between words and lines. The copy automatically adjusts on the screen according to the layout instructions. When the limitations of typesetting equipment are exceeded, the line in error will flash on and off as a warning.

The big advantage of the Harris 2200 system is that the operator immediately sees the result of copy fitting, movement of copy blocks, corrections and changes in type size. This compares to the present system where ads are laid out by hand, and type sizes marked up before setting. The Harris system thus permits accurate, rapid preparation for photocomposition of retail and classified display ads, and other area displays.

When the operator is satisfied with his layout, he directs the terminal to punch out a paper tape which will be used to drive a phototypesetter. The phototypesetters will, in this case be the Digisets referred to earlier in the article.

Alternatively, the 2200s can be connected directly to the Digisets, and this will be the technique used at Fairfax in the latter half of this year after initial tape operations. More precisely, the 2200s will deposit the displayed ad in a computer store (a PDP-11/45) and the Digiset operator will be able to call it up for setting.

To assist in the layout of repetitive ads, formats can be created and applied to new copy. The operator first positions the initial copy elements into a desirable layout which is defined as a format. He then directs the terminal to apply the format to following copy, and the results are immediately displayed on the screen.

The next stage of the automation

program will be the installation of computers and associated equipment to store and classify classified advertisements. This equipment is due to commence operation by the end of April.

The computers will be programmed to receive unjustified text of classified ads, to hyphenate and justify the ads (ie make all lines the same length), and sort them for production through the Digisets. Additional equipment due to arrive in July and August will enable justification of the sorted ads into vertically corrected column lengths, with crests inserted automatically.

The crests, or logos, are put in by the Digiset in the same way that characters are written, that is by writing a pattern on the face of the cathode ray tube. The pattern of the crest is carried in a magnetic disc storage, and can be retrieved simply by specifying the code number of the crest.

Another innovation at this time will be a provision for the computer to make a check during the input stages of telephone numbers in the ads against a credit checklist. If the telephone number shows up on a list of bad debts stored in the computer, a message will be printed out for the credit controller who will be able to cancel the ad at his discretion.

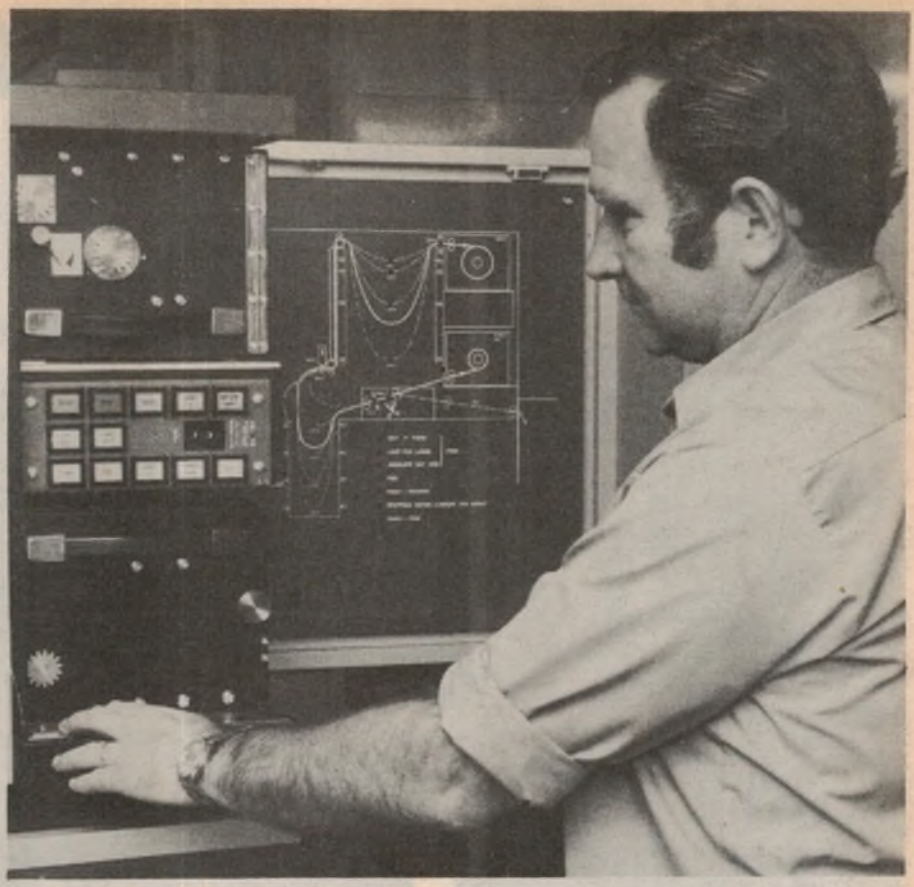
For the Accounts Department, the computer will count the lines in each ad and print out on a fast line printer a list showing the number of lines and the publishing date to enable bills to be prepared for customers.

By the end of the year, it is expected that the system will enable the two later Digisets to produce full broadsheet pages, and not just galleys of ads in a single column. This necessitates a system whereby the paper at the camera end of the photosetter is moved a number of times until the full page is covered, and the two later Digisets have provision for this. Estimated production rate is one page every 90 seconds from each machine, as mentioned previously.

As an aside, it is interesting to note that the system will have a total disc storage capacity of more than 600 million characters. This is enough to store all the ads in the Herald for well over a week, plus all the editorial matter in all publications, including every version of the original input through the various stages of correction up to the finished item.

The superiority of this system over the old method of sorting ads into classifications by hand, setting them on linotype machines, and laboriously making up pages of metal type hardly needs emphasising. There is just no comparison!

Looking further into the future, video display terminals are to be introduced into the editorial rooms early in 1977. Reporters' stories will be typed directly on the terminals and deposited in a computer store. Editors and sub-editors will be able to call these stories up on their own terminals for correction and review.



The output end of the Digiset currently in use at Broadway. The two later models will each be capable of producing a full broadsheet page every 90 seconds.

This practice is now commonplace overseas, especially in the United States.

Similarly, video terminals should appear in the classified telephone room by the end of 1977. These terminals will display to the operator a type of grid, or frame, calling for the essential billing information and reminding the operator to insert run dates and so on.

The cancellation of ads, and transfer of ads from one day to another, will be carried out by the computer, as directed by the operator. When a customer telephones a request to cancel an ad previously ordered, the operator will call up the ad on his display terminal and, according to the customers' wishes, will type in a new date for appearance or issue a "kill" instruction.

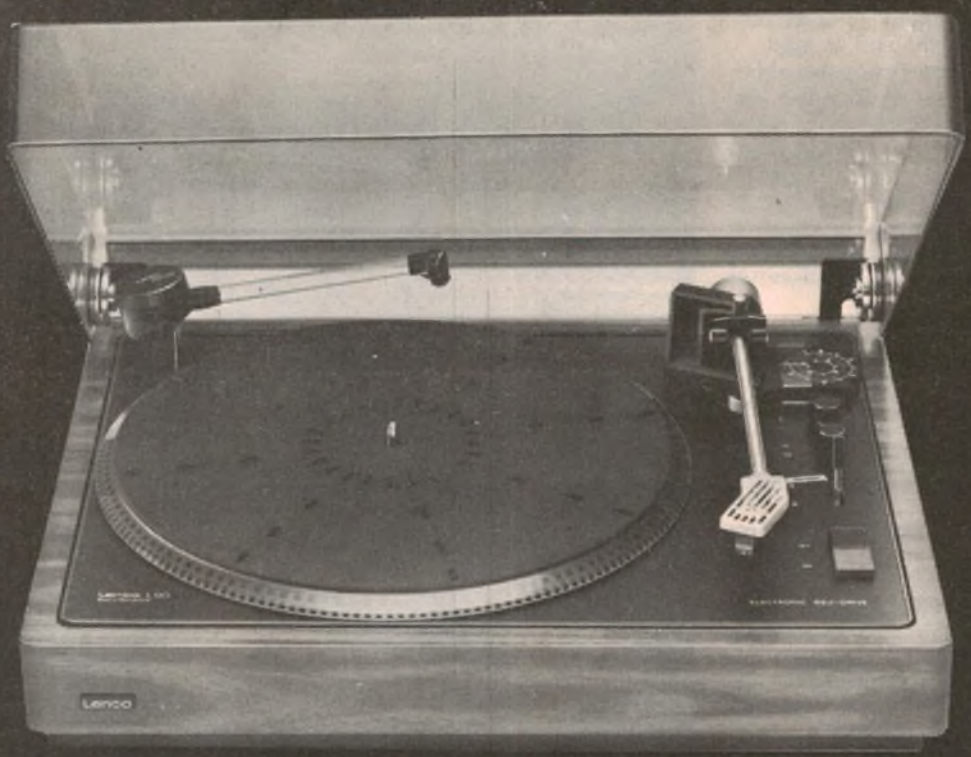
Again, if a customer decides he wants to re-run an ad which had been ordered for only one appearance, the operator will be able to call the ad up, insert a new date for it to run, and put it back in the store. Under present methods, about 80 columns of ads are reset every week, which is inefficient and wasteful. The new system should virtually eliminate the need to re-set previously run ads.

We come now to the most important aspect of automation—the people aspect. Naturally with increased automation there are fewer job opportunities, at least in the short term, and this must affect present staff levels. It is hardly unfair to ask, therefore, how a company involved with people and events treats its own people.

Fairfax management are adamant that the automation process will not occasion individual hardship. There is to be no retrenchment program. Instead, employee numbers will be allowed to diminish towards the required level by a process of natural attrition; that is by non-replacement of staff who retire or resign for personal reasons. Union representatives have been kept fully informed of the company's plans.

Indeed, the company must have the full co-operation of the various unions involved if its program is to be a complete success. For many employees it will mean job re-training, at company expense, and significant improvements in working conditions. Within the next few years, the composing rooms will be free of the clattering linotypes and occupied, instead, by white-coated staff working in air-conditioned comfort in an environment free of noise, heat and the smell of ink and molten lead.

But although automation will lead to a short-term drop in employee numbers, the long-term effect could be quite the opposite. Increased efficiency could mean increased demand for company products and services, necessitating the employment of more people, not fewer. To quote Mr T. H. Farrell, Executive Manager of John Fairfax Ltd, "the goal is to expand, not to contract".



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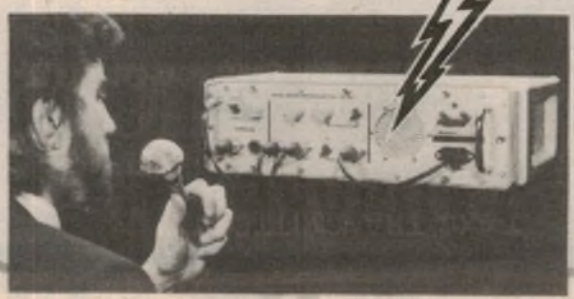
For descriptive literature and specifications send a 30 cent stamp to **Qualitron Industries Division** of Photimport at the above address.

PA 2/L

Getting rid of the "Donald Duck" effect

When operating at depths below about 400ft, divers must breathe a mixture of oxygen and helium. The result of this is a communications problem whereby the diver's voice increases in pitch, in some cases becoming completely unintelligible. Marconi Space and Defence Systems has developed a speech processor which eliminates this problem.



The DS 034 processor, which counteracts the garbling effect of helium on the speech of divers 400ft or more below the sea.

Listened to from the comfort of a cinema seat or from the depth of an armchair in front of the "telly", the grotesque utterances of Donald Duck can be quite entertaining. When similar sounds emerge from the lips of divers 400 feet or more below the sea, the matter becomes a serious problem.

Speech is produced by exciting the resonances of the vocal tract with puffs of air from the larynx during voice sounds, and by turbulence at constrictions during unvoiced sounds. In oxy-helium, which divers at great depths have to breathe, the velocity of sound increases—at 1500ft for instance, these resonant frequencies are almost trebled, making speech completely unintelligible.

To overcome this effect, Marconi Space and Defence Systems has designed a new diver speech processor, the DS 034, which supplements its successful Type 023 speech processor.

The DS 034 converts otherwise unintelligible gabble into coherent words by writing sections of the speech into temporary stores and then reading them at a lower rate. During voiced sounds, it takes sections from the most dominant part of each larynx period and rejects the rest; during unvoiced sounds, it takes sections less regularly but spaces them more closely. The frequency compression resulting from the lower replay rate is inversely proportional to the time expansion.

A section length of 2.5 milliseconds was chosen to allow operation at larynx frequencies up to 400Hz. Four temporary stores are used and at any time one is being written while the remainder are being read. This allows the expansion ratio to be varied over the range 1:1 to 3.5:1, while retaining all of the sampled sections.

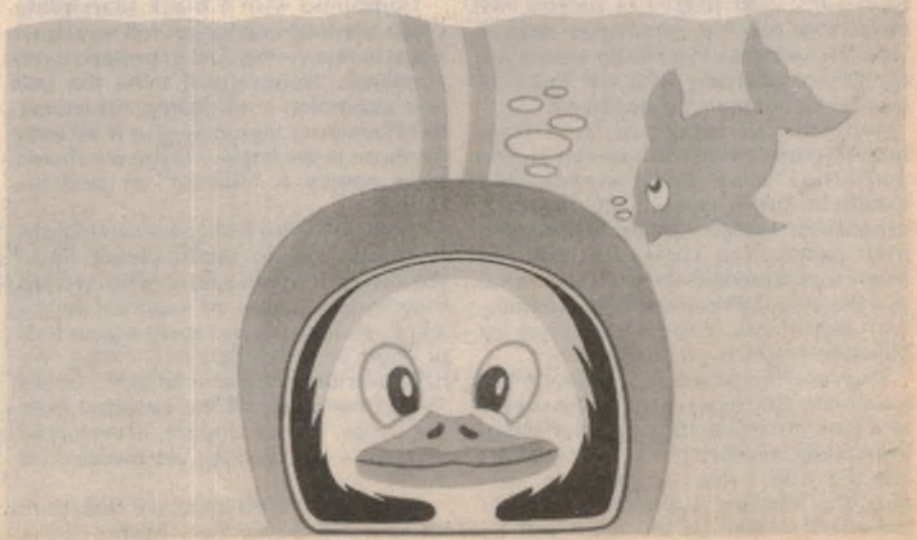
The DS 034 accepts inputs from a maximum of four divers and will allow inter-communication between them. It can be operated in either simplex or duplex modes, depending on the type of diver 'umbilical' link. An in-built loudspeaker or headset can be used for monitoring communications, and facilities are available for tape-recording.

An adjustable control, which matches the voice expansion ratio to the oxy-helium mixture, ensures maximum clarity of speech at all times, while a simple switch will return the ratio to 1:1 for normal intercom. A 'fail-safe' power supply is incorporated so that if the mains supply fails, the DS 034 will automatically switch to its internal batteries, which give up to ten hours of standby operation.

The new speech processor will be of special interest to the off-shore oil and gas market and to navies throughout the world.

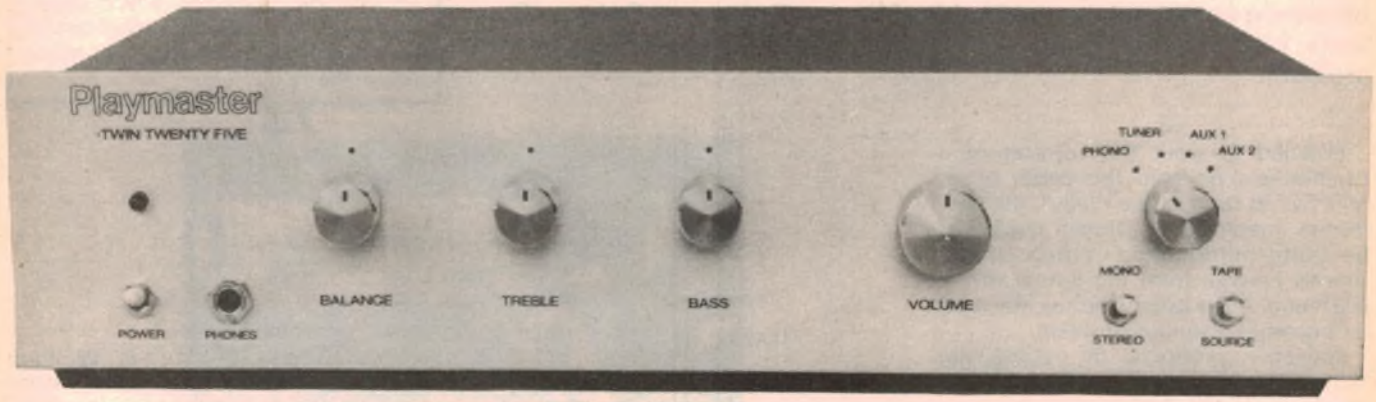
Marconi is represented in Australia by Amalgamated Wireless (Australasia) Ltd, PO Box 96, North Ryde, NSW 2113.

Reprinted from the Marconi publication "Aerial", by arrangement.



Update your system with the new

Playmaster Twin Twenty-Five



a power-packed easy-to-assemble stereo amplifier

We believe that this new Playmaster will be one of the most successful ever published. It has a most attractive 10-gauge aluminium front panel, an up-to-date circuit all on one large PC board, and it puts out 25 watts per channel.

by LEO SIMPSON

In the past few years it would appear that well over ten thousand amplifiers in the Playmaster 136/143 series have been constructed. While this doubtless represents a fair degree of success, we have often felt that even more readers would have built a Playmaster were it not for the comparison with the finish of equivalent commercial amplifiers.

With the advantage of large scale manufacture most commercial stereo amplifiers have good styling and excellent finish, especially on their expensively-tooled diecast or extruded front panels. The knobs and switches have complemented the front panels, so that the overall presentation of commercial amplifiers, especially those of Japanese origin, is very attractive.

This time the situation is different. We have been able to arrange for the supply of a very attractive 10-gauge aluminium front panel, anodised to a "champagne" tint and with a fine "scratchgrain" texture. The labelling is also anodised into the panel surface so the finish will be hardwearing and not vulnerable to fingernail scratches or similar damage. And a fine array of imported knobs complements the panel.

Combined with a black Marviplate cover, the total impression will be at least equal to many other fine imported stereo amplifiers. Nobody will think the unit was assembled in the home. Of course, the Playmaster logo may give it all away for those in the know. Maybe we should have named it "Kensui" or perhaps "Sonai".

While the fancy front panel and knobs to match will no doubt please those would-be constructors who would otherwise purchase an imported stereo amplifier, we have also spent a great deal of effort on an entirely new circuit. We have also designed one large PC board to accommodate all the circuitry. Even the large power supply electrolytic capacitors and rectifiers are installed on the PC board.

Perhaps the most attractive feature of the new Playmaster Twin Twenty Five is the kit price. At around the $89 mark it represents extremely good value in 1976 dollars. And it is about half the price of an imported amplifier with the same power output, though that is where the comparison ends. The overall performance of the new Playmaster is equal to that of many amplifiers costing up to three and four times the price.

Let us now discuss the facilities provided on the new Playmaster, and then we can proceed to a circuit description.

Front panel layout has been designed to give a logical layout, with oft-used controls grouped together. The volume control is prominent and easily recognised because it is larger than the other knobs. At the same time, the front panel was designed to keep internal wiring, especially small-signal conductors, to a minimum.

Reference to the block diagram for the complete amplifier will show how the facilities are provided. Any of four stereo sources can be selected by the two-pole switch S1. Signals from a magnetic cartridge (phono) are first fed to an RIAA equalisation preamplifier before reaching the selector switch.

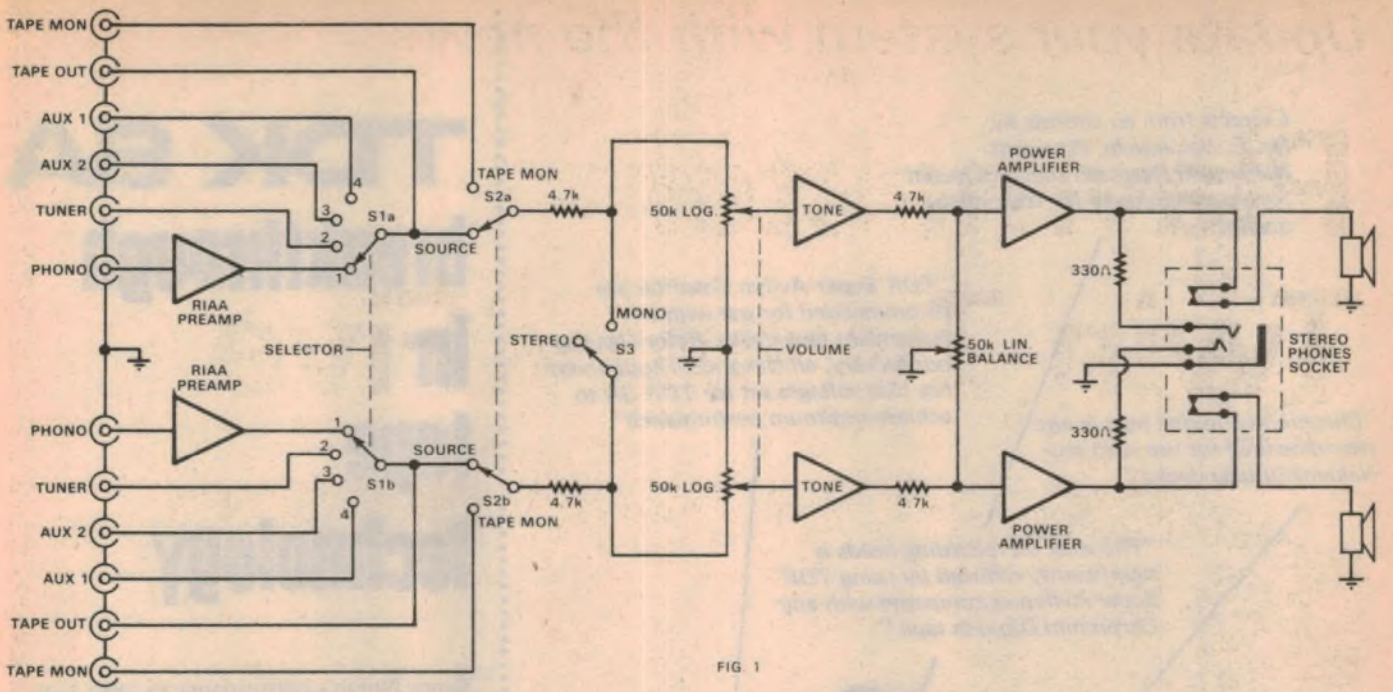


FIG. 1

This schematic illustrates the facilities provided by the new Playmaster Twin Twenty Five.

Output signals from the Selector switch, S1, are fed to the "Tape Rec." terminals for connection to any tape recorder or cassette deck. At the same time, the signals are fed to the "Tape Monitor" switch S2, which gives the user a listening choice between the signal from the Selector switch or the playback signals from the tape deck. The Tape Monitor switch also allows simultaneous monitoring of the signal being recorded when a three-head tape deck is employed.

From the Tape Monitor switch, S2, signals are fed via 4.7k resistors to the Stereo/mono switch, S3 and the 50k ganged volume control. The 4.7k resistors are inserted in the signal line to prevent distortion due to the heavy loading effects of one channel on the other if they are merely shorted together to produce the mono mode. To explain this further, consider the RIAA preamplifier which has a very low output impedance due to the considerable negative feedback in the circuit.

Now if there is an output signal from the left preamplifier and a completely dissimilar or no output signal from the right channel preamplifier, the right channel preamplifier will heavily load the output from the left preamplifier if the two outputs are merely shorted together by the stereo/mono switch. This is because the left preamplifier "sees" a heavy load presented by the very low output impedance of the right channel preamplifier. But matching a low impedance to another low impedance is not the problem—the preamplifier just cannot deliver the heavy currents which would otherwise flow. With the 4.7k resistors in circuit, each preamplifier (or any other source selected by S1) "sees" a minimum load of approximately 10k when S3 is switched to provide the mono mode.

So far then, the input facilities are no different from those on most other commercial stereo amplifiers with the exception that the stereo/mono switch is often omitted on less expensive models. We have included it for a number of reasons: It enables a mono signal to be reproduced in both channels, and also enables a noisy stereo program to be reproduced in mono which results in cancellation of the "difference" noise components. As well it enables a quick listening check for correct phase of the loudspeakers—if correct, a mono signal will appear to come from a point midway between the two loudspeakers.

Following the stereo/mono switch is the ganged volume control for both channels of the amplifier. Thus the high level signals (100mV or more) must pass via the volume control before they are fed to the active tone control stages. This ensures that the tone controls are never overloaded (unless of course the following power amplifier stages are grossly overloaded).

Output signals from the tone control stages are fed to the balance control and thence to the power amplifiers via 4.7k resistors. These resistors combine with the balance control to provide smooth control action and at the same time, ensure that neither of the tone control stages is unduly loaded when the balance control is rotated to either extreme. Without the 4.7k resistors the output of the tone controls could be completely shorted when the balance control was rotated to one extreme.

The stereo headphone socket disconnects the amplifier output to the loudspeakers when the stereo headphone jack is inserted. The headphones themselves are fed via 330 ohm resistors which are selected to give optimum signal/noise ratio for headphone listening while preventing headphone overload at high settings of the volume control.

The pilot lamp is a light emitting diode which has the advantage of high visibility while not being over-obstrusive or excessive in power consumption. It is also cheaper than a normal incandescent bezel.

The power switch is of the same type as the other two on the front panel and has a capacitor wired across it to mute any transient from the transformer at switch-off. In fact, we have been able to render the amplifier insensitive to mains-borne or directly radiated interference and there are no clicks produced when operating the various switches.

On the rear panel all small signal connections are made via RCA sockets. These are compatible with the connecting leads supplied with most turntables, tuners and tape decks and have the advantage that they are easier to wire than DIN sockets. Nor is there any problem with wiring convention as there is with DIN sockets.

Loudspeaker connections are made via spring-loaded or screw terminals which have the advantage that connections are easily made without the necessity for soldered plugs.

Also mounted on the rear panels are the rugged but cheap 2N3055 power transistors in TO-3 cases.

Now let us describe the circuit. Design of the circuit has been evolutionary rather than revolutionary and incorporates many refinements not featured in previous Playmaster amplifiers.

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

Australian Distributor
Convoy International Pty. Ltd.
4 Dowling Street,
Woolloomooloo 2011 358 2088

In keeping with recent trends in high fidelity ampilier design, the approach in this circuit is quite different to that used in previous solid state Playmaster amplifiers and for that matter, in the majority of commercial stereo amplifiers. Previously, the approach was to design for a very high value of open loop gain and then use a large degree of negative feedback to virtually eliminate the often quite drastic non-linearities contributed by each amplifier stage.

Part of the problem of applying large degrees of negative feedback is that it is not equally effective over the whole audio range. Thus while it may be possible to produce an amplifier with total harmonic distortion of less than 0.01% at 1 kHz, that same amplifier may have a THD figure of 0.5% or considerably more at high audio frequencies with the distortion products mainly high order harmonics. This indicates that excessive intermodulation at higher frequencies is very likely. More importantly, transient intermodulation is certain to occur.

To explain further, when a large degree of negative feedback is applied in an amplifier it is necessary to curtail the open-loop high frequency response to ensure that the amplifier does not oscillate at supersonic frequencies. This is because of inevitable phase-rotation effects which take place in each amplifier stage. The phase rotation present in each stage combines to render negative feedback positive at some very high frequency, and causes the amplifier to oscillate.

The designer generally solves this problem by rolling off the open-loop high frequency response at a rate of 6dB/octave and at a cut-off frequency (where the roll-off begins) determined by the open-loop band-width characteristics, the open-loop gain and the degree of negative feedback required. In a typical stereo amplifier the open-loop bandwidth after compensation may be only 100Hz or less.

Thus, while such an amplifier may have 60dB of negative feedback available at frequencies below 100Hz, the amount of feedback is reduced by 6dB/octave above 100Hz. And so at 1kHz less than 40dB of feedback will be applied, at 10kHz less than 20dB and so on. So we can see that not only is the amount of feedback reducing as the frequency rises but the ability of that feedback to nullify high order harmonics is also reduced.

While the above effect is bad enough, there is worse to come. Consider the effect of an audio-envelope with a fast rise time fed to such an amplifier (with 100Hz open-loop bandwidth). Because the feedback path around the amplifier has a slow rise time (or, to put it another way, limited bandwith) it is possible for the early stages of the amplifier to overload before the feedback can act to reduce the gain to the required level. This effect is called "transient intermodulation" and is believed to be the cause of the harsh sound emanating from some solid-state amplifiers that was previously attributed solely to cross-over distortion effects. We hope to feature an article on "transient intermodulation" and its measurement in the near future. For the time being, we have described in these few paragraphs some of the drawbacks of using negative feedback as the cure-all for basic amplifier non-linearities.

The approach which is increasingly being used in higher quality amplifiers, both in bipolar transistor and FET types, is to design the amplifier to be as distortion-free as possible, before overall negative feedback is applied.

At the same time, the open-loop bandwidth after compensation should be at least as great as the normal audio bandwidth of 20kHz. To futher prevent the possibility of transient intermodulation it is also usual to use a simple filter to roll off input frequencies above 20kHz.

Low "open-loop" distortion can be achieved by applying local negative feedback around the distortion-prone stages. The local negative feedback usually takes the form of emitter degeneration, which also has the effect of improving the open-loop frequency response.

In all, there are ten transistors and three diodes in each power amplifier circuit. This may seem quite a lot but each transistor plays a worthwhile part in obtaining the overall excellent performance of the amplifier. In fact, in some ways the performance of the power amplifiers is limited by the preceding stages.

In the new Playmaster power amplifier as shown in Fig. 2 open-loop distortion is typically less than 1%, open-loop bandwidth after compensation is 40kHz and a modest feedback figure of about 34dB is used.

Direct-coupling is used throughout and a minimum of electrolytic capacitors are employed. The exceptions are the two large reservoir/filter capacitors in the power supply and the 22uF capacitors in the feedback network. The large filter capacitors provide excellent music power capability while also helping to ensure that residual hum from the amplifier is very low. In fact, the residual noise of the power amplifier itself is better than 90dB with respect to full power.

T6 and T7 form a differential pair which enables the amplifier quiescent output voltage to be set close to 0V and thus eliminate output capacitors. Current though the differential pair is set by the constant current source T8 which uses D1 and D2 as its voltage reference. To ensure that the differential input stage remains balanced even at very high frequencies, T7 has a collector resistor of the same value as T6, ie, 680 ohms. This ensures that the voltage excursions at the collectors of T6 and T7 are always similar.

The advantage of having T8 as a constant current source instead of the cheaper zener diode network often used for these input stages is that it provides a very high degree of hum rejection. In addition, the differential input stage is able to maintain control over the output quiescent voltage even when the balanced supply rails fall to a value of only a few volts (as happens after switch-off). The net result of this is that there is no delayed "thump" from the loudspeakers after switch-off.

Signal output from the differential input stage is taken from the collector of T6 and amplified by common emitter stage T10. Local feedback in this stage is in the form of emitter degeneration provided by the 39 ohm emitter resistor. No-signal current through T10 is set by constant current source T9 which also uses as its voltage reference, D1 and D2.

Several benefits accrue from the use of constant current source T9. The first is to eliminate the more commonly-used bootstrap electrolytic capacitor employed to equalise the voltage drive to the output stages. And, in conjunction with the "Vbe multiplier" T15, it provides better stabilisation of the output stage quiescent current, which can otherwise vary markedly with variations in the supply rails.

The final advantage which often accrues when such a stage is employed we have deliberately avoided. Since a constant current source provides a very high load impedance for a common emitter stage such as T10 it can result in extremely high values of voltage gain. However there are two major drawbacks to such an arrangement. The first is that the voltage gain then becomes almost solely dependent on the product of the current gain of the output stage multiplied by the loudspeaker load.

Both of these parameters are subject to wide variations. For example, the load presented by the loudspeaker is a highly complex impedance while the beta of the output transistors varies during a signal cycle and drops to a minimum at the cross-over point—just where the necessity for feedback is greatest.

So we have effectively negated one of the apparent advantages of the constant current load by connecting 4.7k resistors from both sides of T15 to the 0V line. This makes the collector load of T10 about 2.3k and renders the voltage gain of this stage almost completely independent of the output stage.

A more important advantage gained from this arrangement is the fact that it provides voltage drive to the output stages and thus forces them to operate

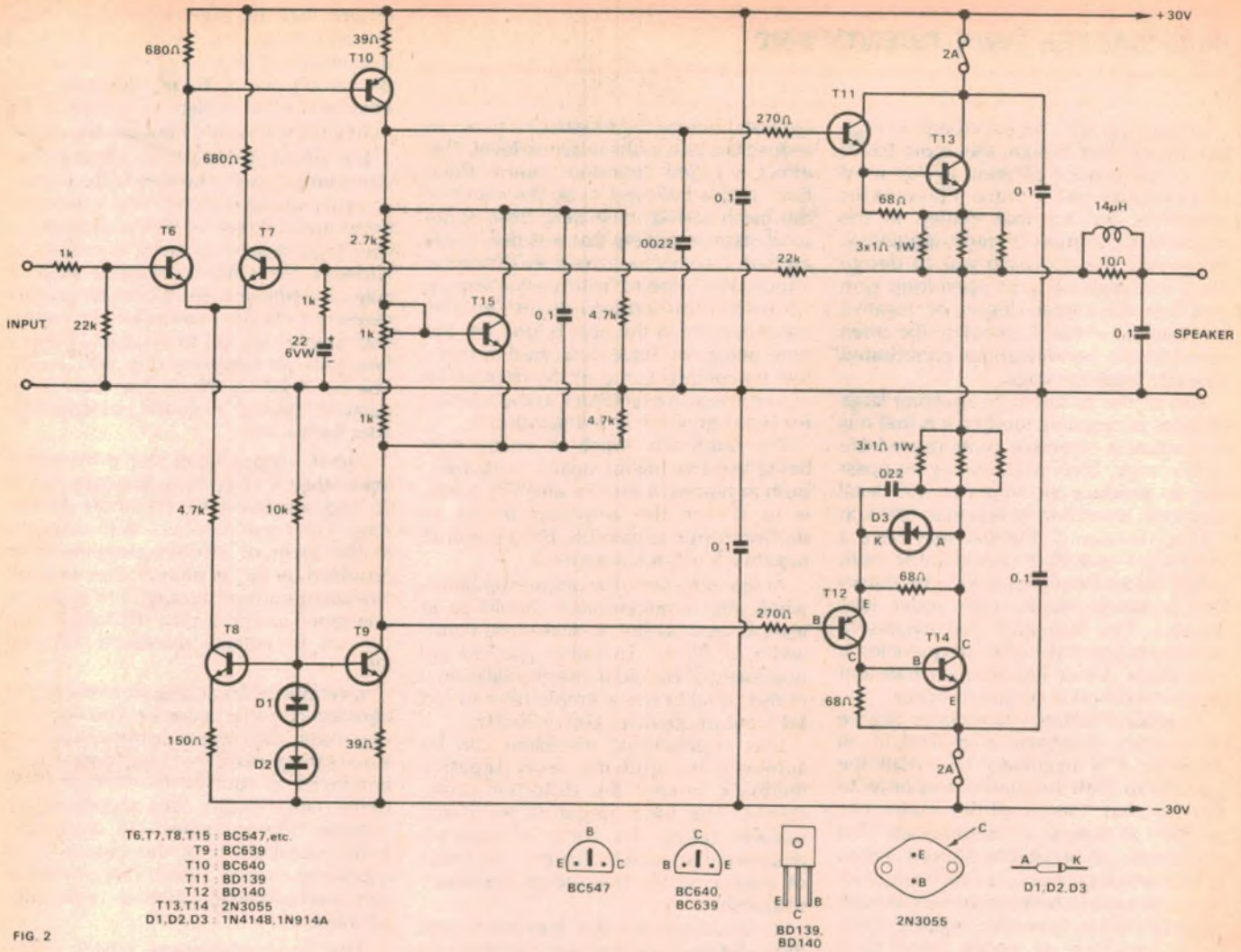


FIG. 2

PARTS LIST

CHASSIS & HARDWARE

1 plated steel chassis 370 x 80 x 245mm (W x H x D) with cover
1 front panel
5 knobs to suit front panel
2 miniature SPST toggle switches
1 miniature DPDT toggle switch
1 6.5mm stereo jack socket with switch contacts
1 LED for pilot light
2 6-way RCA socket panels, Ralmar M421 or equivalent
1 4-way spring loaded terminal panel, Ralmar ST3 or equivalent
1 rotary 2-pole, 4 position switch
1 100k (lin) dual ganged potentiometer
1 50k (log) dual ganged potentiometer
1 50k (lin) potentiometer
1 25k (lin) dual ganged potentiometer
2 1k preset potentiometers
6 Richco CBS-6N PC board supports
4 rubber feet
8 solder lugs
1 mains cord clamp and grommet
1 3-way insulated terminal block
1 three-pin mains plug and three-core mains cord
1 metre of 10-conductor rainbow cable
2 metres of figure-8 shielded cable
4 sets of mounting hardware for TO-3 power transistors, ie, mica and insulating washers plus screws and nuts
2 .047uF/25VW ceramic or metallised polyester capacitors
1 .01uF/2KV ceramic capacitor

MAIN PC BOARD

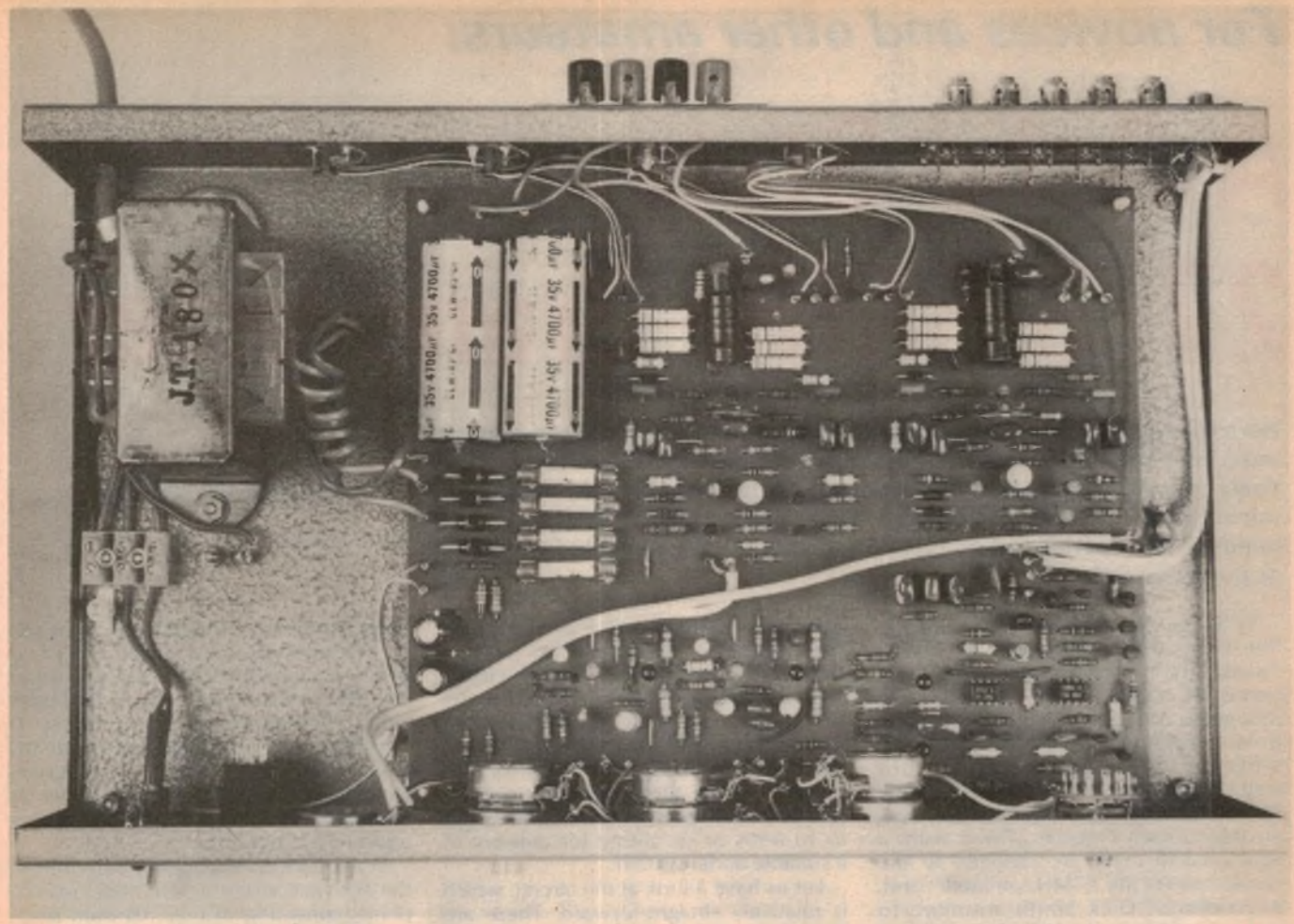
1 PC board, 76sa3
8 fuse clips, Swan (McMurdo) FC1 Part No. 1397-01-18
4 2 amp 3AG fuses
2 14uH chokes, Paradio VPC 14A or equivalent

SEMICONDUCTORS

4 1N5408 or 100PIV 2 amp silicon diodes
2 BZX79/C15 zener diodes
6 1N4148, 1N914A silicon signal diodes
4 2N3055 silicon power transistors
2 BD139 NPN silicon transistors
2 BD140 PNP silicon transistors
2 BC639 NPN silicon transistors
2 BC640 PNP silicon transistors
8 BC547, BC107, BC182 NPN silicon transistors
10 BC549, BC184 NPN low-noise transistors
2 uA741 operational amplifier integrated circuits

CAPACITORS

2 4700uF/35VW pigtail electrolytics
1 1000uF/16VW PC electrolytics
1 470uF/16VW PC electrolytics
2 22uF/6VW PC electrolytics
4 10uF/25VW tantalum electrolytics
6 4.7uf/25VW tantalum electrolytics
2 1uF/25VW tantalum electrolytics
4 0.47uF/25VW tantalum electrolytics
17 0.1uF/60VW metallised polyester (greencap) or ceramic capacitors
2 .047 metallised polyester
2 .022 metallised polyester
4 .0068uF metallised polyester or polystyrene



This internal view shows the prototype amplifier with wiring almost complete.

2 .0056uF metallised polyester or polystyrene
2 .0022 metallised polyester or polystyrene
2 .0012uF metallised polyester or polystyrene
2 150pF ceramic or polystyrene
4 47pF ceramic or polystyrene
2 33pF ceramic or polystyrene

RESISTORS
(5% tolerance, ¼W, unless otherwise noted)
2 x 1M, 2 x 820k, 2 x 560k, 2 x 270k, 4 x 220k, 2 x 82k, 8 x 56k, 5 x 22k, 2 x 15k, 10 x 10k, 8 x 4.7k, 6 x 2.7k, 5 x 2.2k, 2 x 1.8k, 1 x 1.5k, 12 x 1k, 4 x 680 ohms, 1 x 680 ohms/½W, 2 x 330 ohms, 4 x 270 ohms, 2 x 220 ohms, 2 x 180 ohms, 2 x 150 ohms, 6 x 68 ohms, 4 x 39 ohms, 2 x 10 ohms/½W, 12 x 1 ohm/1W, 2 x 100 ohms/1W (see text).

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Where voltage ratings are not quoted, they should be 50V or more. Components with higher ratings may also be used provided they are physically compatible.

with a bandwidth of almost Ft (gain-bandwidth product of a transistor), rather than being subject to the more rapid roll-off in beta at high frequencies.

Almost solely as a result of this measure, the open loop bandwidth of the whole amplifier is better than 500kHz before compensation is applied. Lag compensation to render the amplifier stable with overall feedback applied is set by the .0022uF capacitor from the collector of T10 to the OV line. This sets the open-loop bandwidth at about 40kHz, which should be adequate.

The output stage is yet another variation the quasi-complementary mode and is an adaptation of the output stage developed by J. Linsley-Hood (and others) featured in "Hifi News" in December 1972. The output stages operate essentially as Darlington emitter followers having no voltage gain but considerable current gain.

T11 and T13 combine to form a conventional Darlington emitter follower while T12 and T14 form a compound transistor also operating as an emitter follower. Diode D3 provides the same overall Vbe drop as the T11/T13 Darlington and thus helps to make the output stage more symmetrical. The .022uF capacitor across D3 compensates for the load capacitance in the collector circuit of T12 due to the Miller capacitance of the base-collector junction of T14. The capacitor thus gives another small improvement in output stage symmetry.

Voltage gain in the amplifier is set by the ratio of the 22k and 1k resistors in the base circuit of T7. Low frequency response is set by the 22uF feedback capacitor.

Another refinement which we should mention at this point in the circuit description is the RLC network connecting the load to the amplifier. This circuit was developed by A. N. Thiele and published in the September, 1975 issue of "Proceedings of the IREE". The network is a rationalisation of the LR and RC (Zobel) networks often used in amplifiers to ensure stability with hightly reactive loads.

The network is highly effective and renders the amplifier unconditionally stable. There is a proviso, of course, in that short-circuits or very large capacitances across the output will blow fuses. As a bonus, the network prevents radio interference picked up by long loudspeaker leads from being fed back to the amplifier input via the feedback network.

(To be continued).

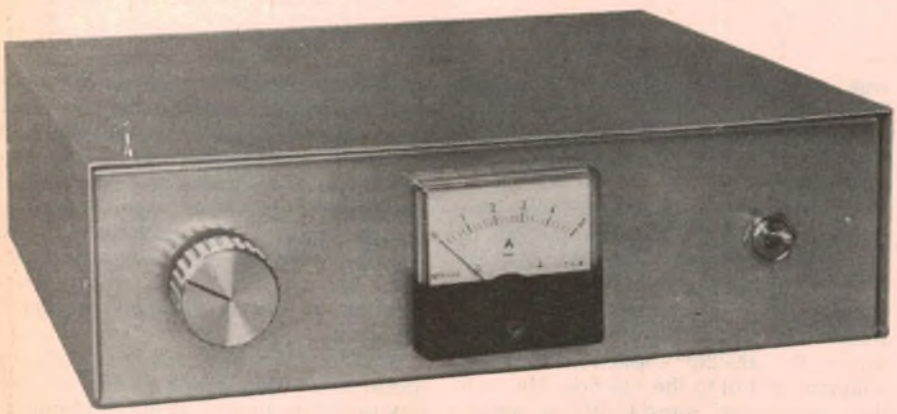
For novices and other amateurs:

A Solid State 27/3.5MHz Transverter

Here is another project for those who hope to have their Novice amateur radio licence shortly. It is a fully solid state transverter, which will effectively convert almost any of the readily available 27MHz "walkie-talkie" transceivers into a 10-watt output transceiver on the 3.5MHz Novice band. It also operates from 12-14V, making it very suitable for mobile or portable work.

by IAN POGSON

With the Amateur Novice Licence in the offing and the thousands of 27MHz "walkie-talkie" transceiver units scattered throughout the country, the thought occurred to the Dick Smith Electronics organisation that it should be possible to make good use of said walkie-talkies in the new aspect of the Amateur Service. A transverter was envisaged such that the 27MHz from a walkie-talkie could be changed to the Novice part of the 3.5MHz amateur band. Accordingly, Dick Smith arranged to have a suitable transverter designed and developed for this purpose, and very kindly offered EA the opportunity to present the design to our readers.



Above is the prototype, housed in a simple aluminium case.

In due course, a prototype was delivered to us, with full details on construction, operation, etc., and with a box full of parts to make up another one. Somehow, yours truly got the job of putting together the second unit and the following article is a joint account of my own reactions to the kit as I have found it, together with some helpful comments from the original designer.

The functions of this transverter may conveniently be divided into three parts. (1) It must convert an incoming signal on 3.5MHz, to 27MHz and feed it into the receiver part of the transceiver (walkie-talkie). (2) Conversely, it must also intercept a signal generated at 27MHz in the transmitter part of the transceiver, and convert it to 3.5MHz. (3) The converted signal to 3.5MHz for transmission is then passed through a linear power amplifier, to lift it from a level in the milliwatt range, to 10 watts or so output for delivery to a suitable aerial system.

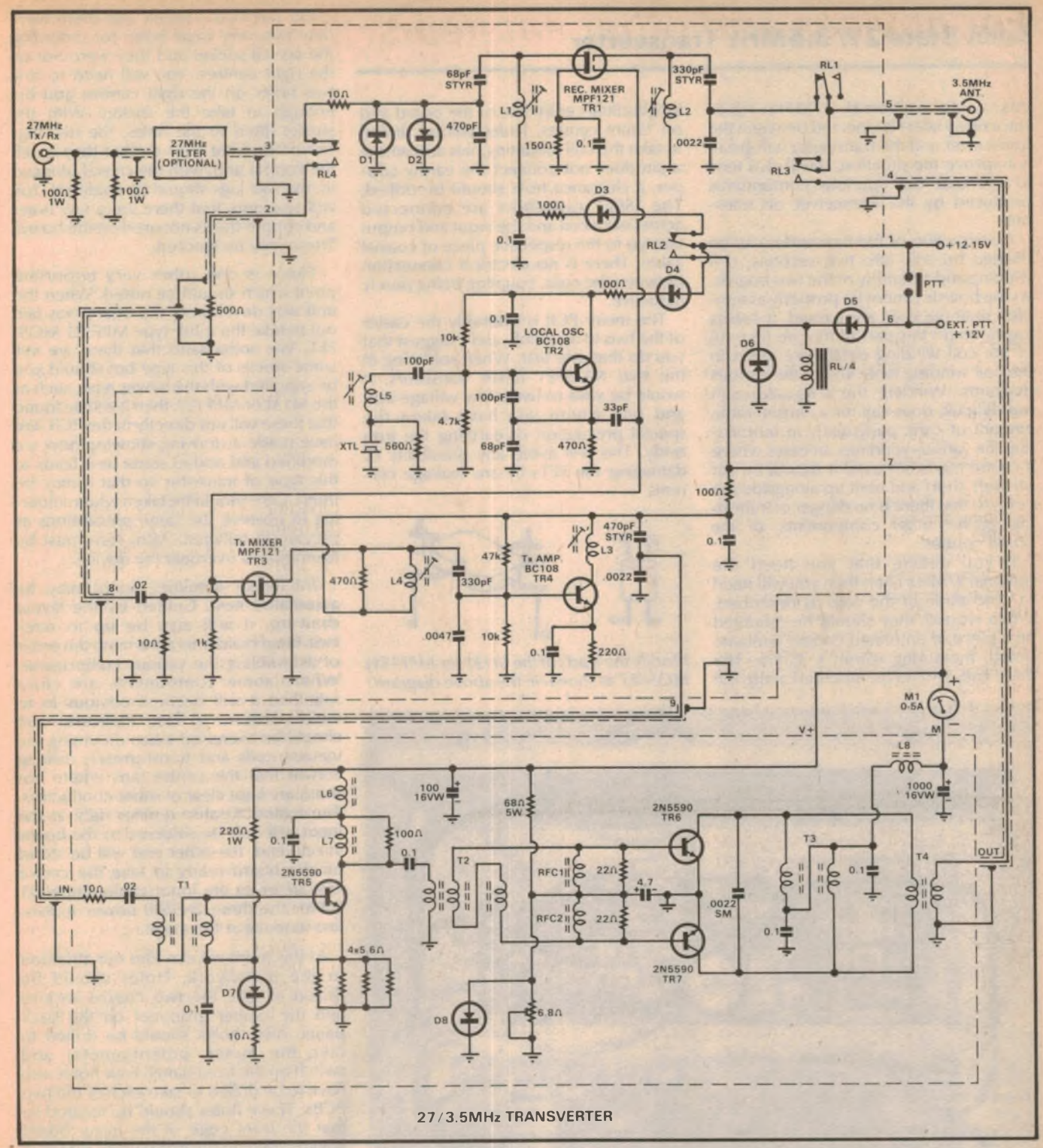
Let us have a look at the circuit, which is relatively straight-forward. There are two mixers, TR1 for receiving and TR3 for transmitting. A crystal oscillator TR2, with the crystal oscillating on its third overtone on 23.57MHz provides injection for both mixers.

Under receiving conditions, the incoming signal from the aerial on 3.5MHz passes via the set of relay contacts RL1 to the junction of the capacitive divider (330pF and .0022uF) across L2, tuned to 3.5MHz, and so to the signal gate of the dual gate MOSFET mixer. Injection from the crystal oscillator, 3.5MHz on the low side of the 27MHz transceiver frequency, is fed into the second gate of mixer TR1. In the drain of TR1 is a circuit consisting of L1 shunted by a 68pF and a 470pF capacitor in series, tuned to 27MHz. Output from the capacitor junction is fed via relay contacts RL4 to the aerial input of the 27MHz transceiver. A pair of diodes and a 10 ohm resistor also in the same circuit are provided to prevent accidental input from the transceiver from damaging the mixer should the transceiver be keyed without PTT (press-to-talk) operated on the transverter.

In the transmit mode, the output from the 27MHz transverter is terminated in 50 ohms, consisting of two 100 ohm resistors in parallel. From this point the signal is switched by relay contacts RL4 to the 500 ohm potentiometer and then to the signal gate of transmit mixer TR3. Signal from the crystal oscillator is again injected into second gate of TR3. The tuned circuit consisting of L4, 330pF and .0047uF in the drain of TR3 is tuned to 3.5MHz and is then amplified by TR4. The output of TR4 consisting of L3, 470pF and .0022uF is also tuned to 3.5MHz. The junction of the 470pF and .0022uF capacitors is the low impedance point which is used to feed the driver stage of the linear amplifier, which is on the other board.

All of the above is located on the mixer board, including the relay. Diodes D3 and D4 are used for reverse polarity protection. The transmitter is protected as the relay cannot operate on reverse polarity, due to D5. Also, D6 prevents spikes from the supply rail from operating the relay. Two sets of changeover contacts on the relay are used conjointly in the role of aerial changeover. This has been done to facilitate circuit board layout. The remaining two sets of contacts are used to change over output of the 27MHz transceiver and the supply rail for either receive or transmit.

The second board contains the linear power amplifier, consisting of TR5 as driver and TR6, TR7 and the push-pull final power amplifier. The complete power amplifier is broad banded, unlike



27/3.5MHz TRANSVERTER

the more conventional tuned approach. This does away with the usual rather large tuning components. T1, T2 and T3 are broad band transformers wound on ferrite balun cores. Diodes D7 and D8 are used to control the bias necessary for linear operation. As the power transistors have a relatively high DC current gain, some form of protection is necessary to prevent thermal runaway and so the bias supplies have been made relatively stiff.

Transformer T1 is a step down coupling from the output from the mixer board to the base of driver TR5. The 10 ohm resistor at the input of T1 has been added in the interest of driver stage stability. Inductor L6 and the 0.1uF capacitor are decoupling for TR5, whilst inductor L7 is loaded with 100 ohms to reduce the possibility of stray resonances in the collector load circuit. This circuit is then capacitively coupled to the step down transformer T2, which divides the signal to feed the bases of the output pair TR6 and TR7. RFC1 and RFC2 are similarly loaded with 22 ohms each to reduce the possibility of unwanted resonances.

T3 in the power amplifier collector circuits is the supply feed and combining transformer. The output transformer T4 transforms the low impedance output up to the desired 50 ohms. Inductor L8 and the two 0.1uF capacitors provide decoupling for the output stage.

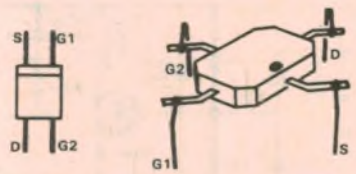
The spurious response performance of the receive side of the transverter will be dictated by the transceiver which is used with it. Some are quite good and no extra filtering is required. Some however, including some of the elaborate synthesiser type units, have very poor image and spurious responses. In such

cases, an optional 27MHz filter (described later) connected between the transceiver and the transverter will greatly improve the situation. It will also tend to attenuate any spurious components produced by the transceiver on transmit.

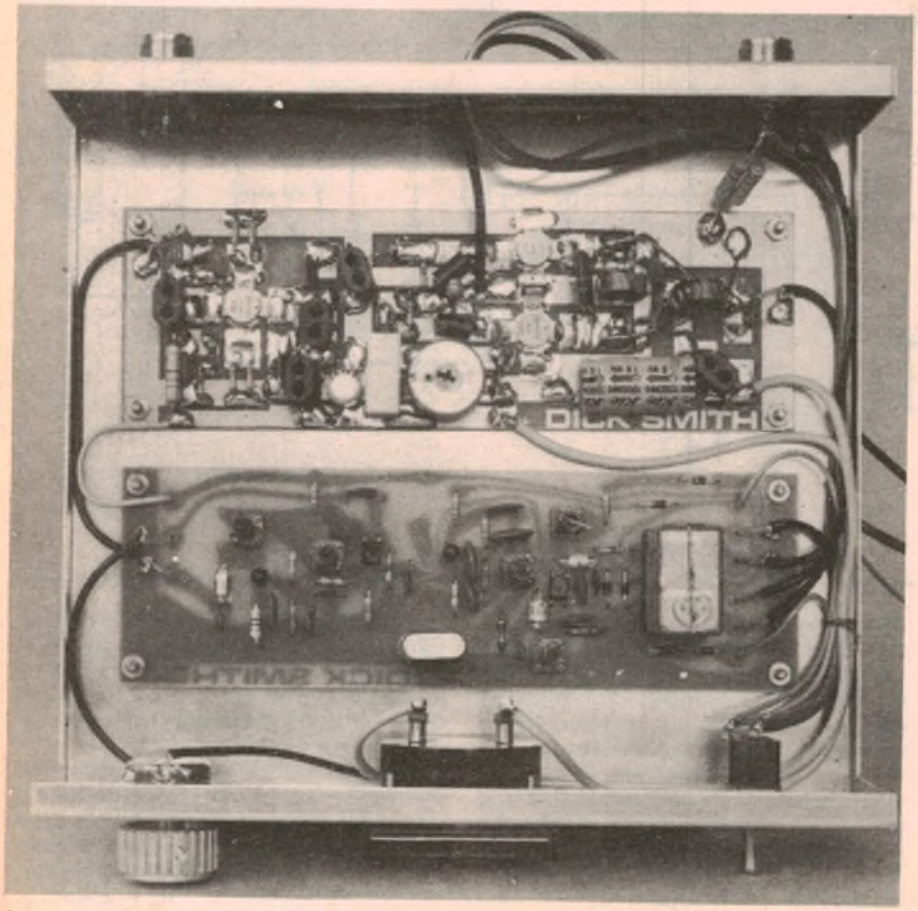
Construction of the transverter can be divided broadly into two sections, coil winding and assembly of the two boards. As the boards cannot be properly assembled until the coils are wound, it seems logical to do this part of the job first. All of the coil winding details are given in the coil winding table and in the various diagrams. Winding the coils, although not difficult, does call for a considerable amount of care, particularly in terminating the various windings. In cases where a centre tap is not used it should be cut off fairly short and bent up alongside the core, so that there is no danger of it shorting against other components, or the board copper.

If you decide that you need the optional 27MHz filter, then you will need to wind three of the coils as described. When wound, they should be mounted on a piece of untreated copper laminate board, measuring 65mm x 35mm. The three coils should be mounted along the longitudinal centre line of the board and on 15mm centres. Holes will be drilled to take the coil mounting pins and where a pin does not connect the earthy copper, a clearance hole should be drilled. The 150pF capacitors are connected across each coil and the input and output taps go to the respective piece of coaxial cable. There is no electrical connection between the coils, coupling being purely inductive.

The mixer PCB is probably the easier of the two to assemble and I suggest that you do that one first. When soldering in the two MOSFET mixer transistors, it would be wise to use a low voltage iron and one where you have taken the special precaution of earthing the iron body. This will avoid any possibility of damaging the FETs by any leakage currents.



Modify the leads of the M131 (or MPF131) MOSFET as shown in the above diagram.



Interior view of the completed prototype. The mixer board is situated directly behind the front panel, with the linear amplifier to the rear.

On our PCB, I found that there were only two very small holes for mounting the crystal socket and they were not on the right centres. You will need to drill two holes on the right centres and big enough to take the socket. With the socket fitted to the holes, the two lugs should be bent over so that they touch the copper and, with the crystal plugged in, the two lugs should be soldered. You will also note that there are a few holes and copper tracks not used on the board. These may be ignored.

There is one other very important point which should be noted. When this unit was developed, the board was laid out to take the older type MPF121 MOSFET. We understand that there are still some stocks of this type but should you be supplied with the newer type, such as the M131 or MPF131, then it will be found that these will not directly fit the PCB. We have made a drawing showing how we modified and added some new leads to this type of transistor so that it may be fitted. Care should be taken when soldering to observe the same precautions as previously outlined. Also, care must be taken not to overheat the device.

The linear amplifier board may be assembled next. Guided by the layout drawing, it will also be up to each individual builder to determine the order of assembling the various components. Where some components are close together, it will become obvious as to which ones to fit first. Particular care should be exercised when mounting the various coils and transformers, making certain that the centre taps where not used, are kept clear of other conductors. The added 10 ohm resistor right at the input will only be soldered to the board at one end, the other end will be stood off the board ready to take the centre conductor of the input cable. Do NOT solder the three 2N5590 power transistors in place at this stage.

At this point we can turn our attention to the metalwork. Holes should be drilled to take the two coaxial sockets and the rubber grommet on the back panel. Also, holes should be drilled to take the meter, potentiometer and switch on the front panel. Four holes also have to be drilled to take each of the two PCBs. These holes should be located so that the front edge of the mixer board is 30mm behind the front panel. Similarly, the back edge of the linear board should be 30mm from the back panel. This leaves a space of about 10mm between boards.

The linear amplifier board should be temporarily screwed into place and the three holes for the power transistors should be carefully marked on the bottom of the box. Clearance holes should then be drilled to take the screw thread of the transistors. These holes should be deburred.

Before mounting the PCBs permanently, the coax and other leads from the

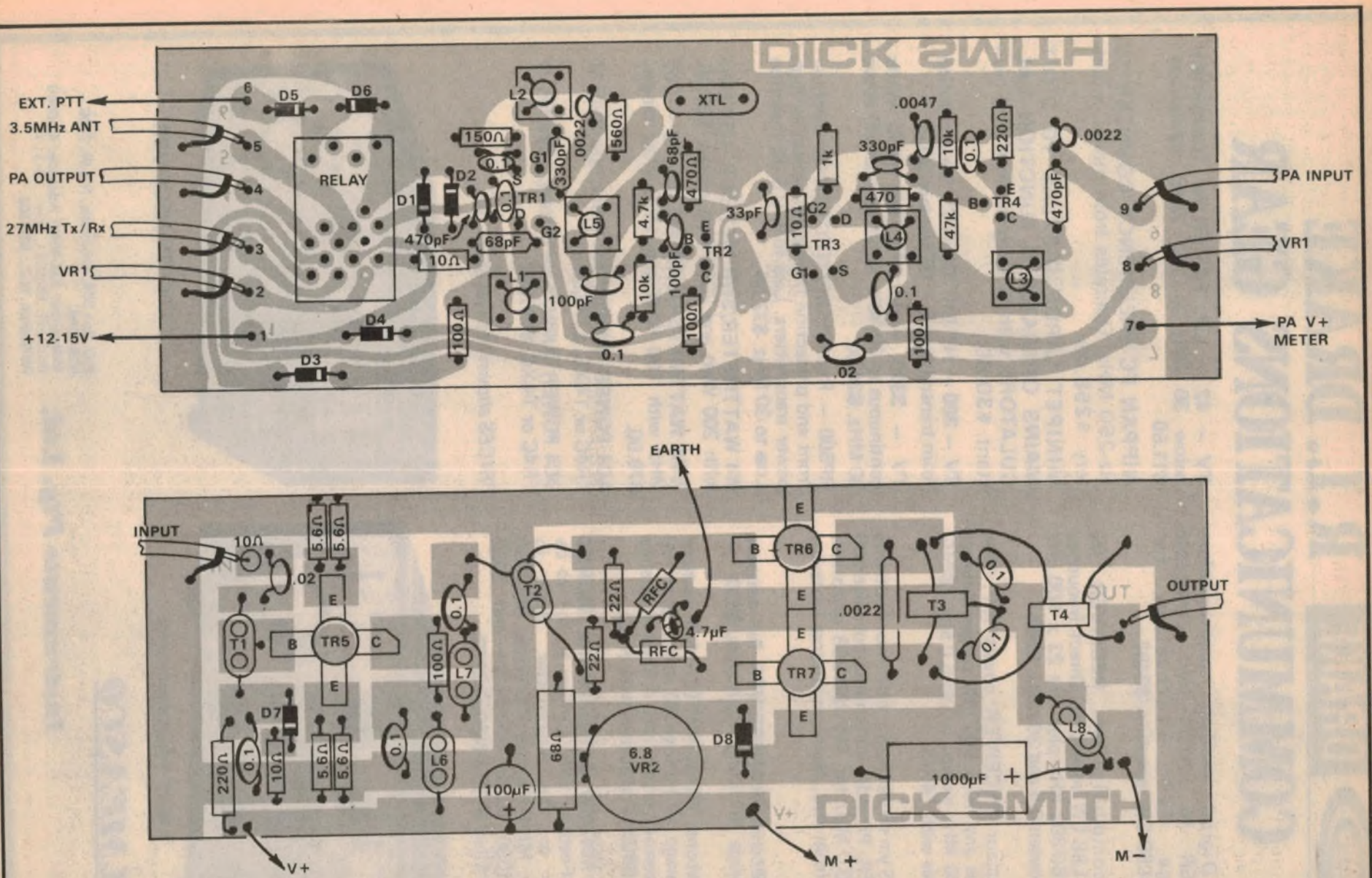


Diagram at top is the component overlay pattern for the mixer PCB, while directly above is the component layout on the linear amplifier board. Note that for the linear amplifier, components are mounted on the copper side of the board. Note also that, for drawing convenience, the linear amplifier board is depicted here upside down with respect to its chassis relationship to the mixer board. Both boards are shown actual size.

DRAKE R.L. DRAKE COMMUNICATIONS GEAR

DSR2 Digital readout communications **RECEIVER** 10 kHz-30 MHz continuous coverage, fully synthesized, for AM-USB-LSB-CW reception. **$3495.**

SPR4 communications **RECEIVER** for AM-USB-LSB-CW reception. Direct frequency dialling 150-500 kHz plus any 23 x 500 kHz ranges between 0.5 and 30 MHz. **$697**

R4C Amateur **RECEIVER** covers H.F. ham bands plus any 15 x 500 kHz ranges between 1.5 and 30 MHz except 5.0 to 6.0 MHz. **$640.** (transceives with T4XC)

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MN4 and **MN2000 MATCHING NETWORKS** — enable Feedline SWR's of up to 5:1 to be matched to the Transmitter. Built in Wattmeter. MN4 Handles 200 Watts. MN2000 Handles 1000 Watts continuous and 2000 Watts PEP MN4 **$115** MN2000 **$230.**

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RP500 — Receiver **PROTECTOR** for Receiver front end protection from close proximity high power transmitters. Less than 0.5 dB Insertion Loss to 30 MHz. **$77.00**

W4 WATTMETER/SWR METER 2 — 30 MHz with 200 Watt and 2000 Watt ranges. **$65.00.**

WV4 WATTMETER/SWR METER 20 — 200 MHz with 100 Watt and 1000 Watt ranges. **$78.00.**

AC4 POWER SUPPLY for mains operation of TR4C or T4XC. **$175.00**

DC4 POWER SUPPLY for battery operation of TR4C or T4XC. **$187.00**

PRICES shown include Sales Tax

T-4XC TRANSMITTER

TR4C TRANSCEIVER

ELMEASCO

Instruments Pty. Ltd.

P.O. Box 334, Brookvale, N.S.W. 2100 — 939-7944.
Melbourne: 233-4044; Adelaide: 42-6666
Brisbane: 36-5061; Perth: 25-3144
Wellington, N.Z.: 69-7566

mixer board should be soldered in place and each lead cut to length to reach its ultimate destination. This done, mount both boards and in the case of the mixer board, use two nuts between the board and the case to act as spacers. Only one nut spacing is used in the case of the amplifier board.

Mount the components on the front and back panels, and then all interwiring between these components and the boards may be done. The two 100 ohm 1 watt resistors are paralleled and swung between the appropriate socket and the board. Leads to and from the meter should be run in heavy cable, preferably coloured red for positive and black for negative.

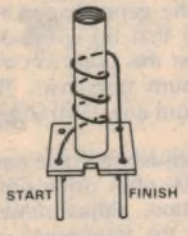
On the circuit may be seen a separate lead marked "Ext PTT +12V". It is normally intended that this lead be incorporated into your PTT system so that the relay on the transverter will be operated when the transceiver switch is operated. This must be left to the reader, as each situation must be dealt with individually. The switch on the front panel of the transverter is provided as an over-ride switch.

On the original and my unit as well, we bent up the ends of the connection lugs of the 2N5590 transistors. About 2mm or so was bent up at right angles at the end of each lug. This effectively shortens the lugs and also allows a small amount of pressure to be applied to each lug as it is soldered in place. After bending, tin each of the lugs, together with the corresponding areas on the board. Mount the transistors and screw each one in place with the nut supplied and with the dot indicating the collector. They may now be soldered at each of the four points.

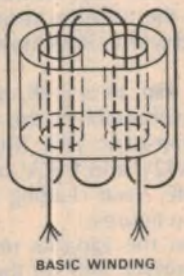
With the unit completely wired and assembled, a thorough check should be made of all work, making sure that all components are in the right place and that polarities are correct where necessary. Satisfied that all is well, a power supply is needed that will deliver between 12 and 14 volts, preferably 13.8 volts, at a normal load current of 2½ amps, with peaks up to 5 amps. A car battery may be used for the power supply. You will also need a dummy aerial, 50 ohms non-inductive and capable of handling at least 10 watts. For alignment of the receiver section you will need a signal generator capable of giving a signal in the 3.5MHz band. A 27MHz transceiver is assumed.

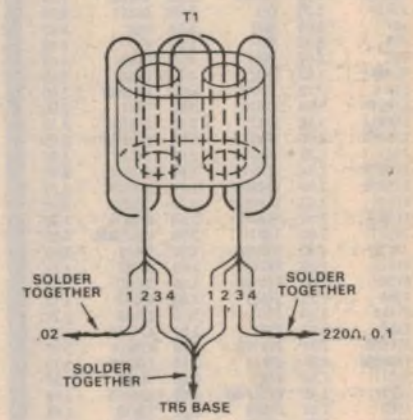
Before embarking on the main job of alignment, there are a few preliminary

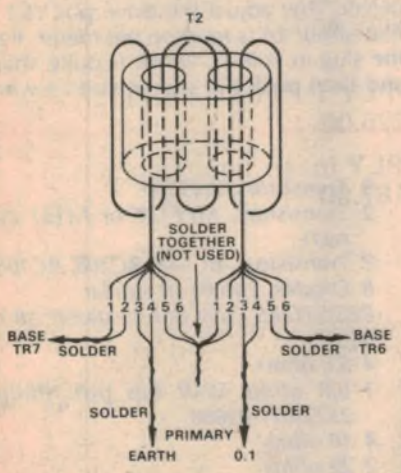
COIL WINDING DATA FOR TRANSVERTER

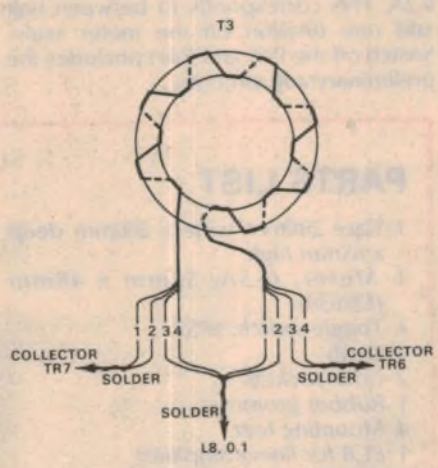


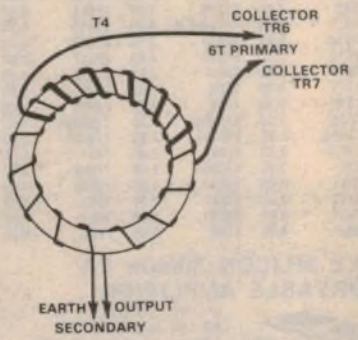
L1,2,3,4,5


BASIC WINDING









L1. 10¾ turns 20B&S enamel c/w on Neosid 790/1 former with F14 slug.

L2, L3, L4. 45¾ turns 34B&S enamel c/w on Neosid 790/1 former with F14 slug.

L5. 18¾ turns 26B&S enamel c/w on Neosid 790/1 former with F14 slug.

L6, L7, L8. Parallel four strands of 28B&S enamel wire and twist together evenly with about 10 twists per inch. Wind on balun core as shown in drawings and then carefully terminate as shown in drawing. Centre tap not used.

T1. Wound and terminated the same as L6-7-8 but centre tap used.

T2. Parallel six strands of 28B&S enamel wire and twist together evenly with about 10 twists per inch. Wind on balun core similar to previous units above and carefully terminate as shown in drawing. Centre tap used.

T3. Parallel four strands of 28B&S enamel wire and twist together evenly with about 10 twists per inch Wind eight turns on 4C6 toroid anc carefully terminate as shown in drawing.

T4. Wind secondary of 14 turns of 20B&S enamel wire on 4C6 toroid. Then wind primary of six turns of 16B&S enamel wire over secondary as shown in drawing.

RFC1, RFC2. Wind in formers by running 26B&S enamel or TC wire continuously through five of the six holes, giving a winding end at each end of the former.

27MHz HIGH Q FILTER (optional). Three coils 8¾ turns 20B&S TC wire 13mm long, on Neosid 790/1 former with F29 slugs. All coils shunted with 150pF polystyrene capacitors. Input and output coils each tapped one turn from cold end (see text).

Solid State 27/3.5MHz Transverter

checks which must be made. Set the 6.8 ohm variable resistor VR2 so that there is no resistance in circuit. This cuts off any forward bias on the output transistors TR6, TR7. Connect the dummy aerial to the output and connect the supply negative lead. Add a milliammeter set to its highest range, in series with the positive lead and which is connected to the supply. The current is now checked under "receive" conditions. The original prototype read 14.5mA and ours read 12mA, so yours should be around these figures. Remove the meter and reconnect to the supply.

Now operate the PTT switch on the front panel, at the same time watching the 5A meter. The meter should show little or no reading. If it swings full scale, there is obviously trouble. This should not occur in your case however, as we have added the 10 ohm resistor at the input to the driver to stop the driver from "taking off".

Assuming that all is well, now take a voltage measurement at the emitter of the driver transistor TR5. Readings we took were 0.42V and 0.45V on the two units available. Your reading should be close to these figures.

Now adjust the variable resistor VR2 with a screwdriver, and set the collector current for the final at between 0.1A and 0.2A. This corresponds to between half and one division on the meter scale. Switch off the PTT and this concludes the preliminary adjustments.

Connect the transceiver to the transverter input socket. With the dummy aerial connected and with the PTT switch unoperated, switch on the power supply to the transverter. Listen for the local oscillator crystal in a receiver tuned to 23.67MHz. Adjust the slug in coil L5 and make sure that the oscillator is under the control of the crystal. The oscillator should not shift in frequency when under the control of the crystal. The coil slug is adjusted for maximum reading on the receiver tuning meter. If the crystal drops out of oscillation, set the slug in a position where the crystal starts reliably each time it is switched on.

Select an appropriate channel on the transceiver and feed the generator into the socket with the dummy load. Adjust the generator around 3.5MHz until a signal is heard in the transceiver. Set the output from the generator to a low level to make sure that no overloading occurs. Now adjust the slugs in coils L1 and L2 for maximum response. This must be done without any 27MHz high Q filter in circuit.

Before adjusting in the transmit mode, turn the 500 ohm drive pot VR1 to the "off" position. Adjustments should be made with the transceiver set to "AM". Operate the PTT switch on the transverter and the PTT switch on the transceiver. Now adjust the drive pot VR1 so that about 1A is read on the meter. Peak the slug in coil L3, which is quite sharp, and then peak the slug in coil L4 which

PARTS LIST

1 Case 230mm wide x 200mm deep x 65mm high
1 Meter, 0-5A, 52mm x 48mm (Q2030)
1 Toggle switch, SPST
1 Knob
2 Coax sockets
1 Rubber grommet
4 Mounting feet
1 PCB for linear amplifier
1 PCB for mixer (see text)
1 Relay, 4 c/o, 185 ohms, 21/4CA or similar
1 Socket for relay
1 Crystal, style D, ambient temperature, tolerance .003%, third overtone series mode, 23.67MHz
1 Socket for crystal
5 Balun Cores, Philips 4312-020-31520
2 Choke formers, Philips 4312-020-36640
2 Toroids, Philips 4322-020-91020
5 Neosid formers, type 790/1
5 Slugs (F14) and rubber for above formers
3 Transistors, 2N5590
2 Transistors, MPF121 or M131 (see text)
2 Transistors, BC548, BC208, BC108
8 Diodes, EM401 or similar

RESISTORS (¼W unless stated otherwise)
4 5.6 ohms
1 6.8 ohms WW tab pot, Philips 2322-011-02688
4 10 ohms
2 22 ohms
1 68 ohms 5W
2 100 ohms 1W
4 100 ohms
1 150 ohms
1 220 ohms 1W
1 220 ohms
2 470 ohms
1 500 ohms linear potentiometer
1 560 ohms
1 1k
1 4.7k
2 10k
1 47k

CAPACITORS
1 33pF ceramic
1 68pF ceramic

is rather broad. Do not allow the meter to indicate beyond 2½A during these adjustments. This reading corresponds to an output of approximately 10W. Restore PTT switches, operating the transceiver one first.

If you are including the 27MHz high Q filter, then it may be added at this stage. No provision was made for it initially but it is quite a small assembly and it may be conveniently screwed to the back panel between the rubber grommet and the coaxial socket. Having put the filter in circuit, switch on to transmit and adjust the three slugs for maximum reading on the 5A meter.

If you have a low powered transceiver and you are unable to get enough drive from it, then the 470 ohm resistor shunting L4 may be increased in value so that sufficient drive can be achieved. The value of the resistor may be increased to 1k or even up to 2k if required.

As mentioned earlier, on AM the final should not be driven to more than 2½ amps as indicated on the meter. The final is capable of being driven to 20 to 30W PEP and it is also capable of being driven to this level on CW, although if this is done on a prolonged basis damage may be done to the output transistors. Also, it will not be possible to modulate the final under these conditions. On SSB the unit will deliver between 20 and 30W PEP depending on the acceptable level of intermodulation distortion. If on a prolonged whistle on SSB, the drive control is adjusted for 4½ to 5A, the output will be about 25 to 30W PEP. It should also be noted that it may not be possible to drive the final current up to 5A or so unless the supply voltage is around the nominal 13.8V.

It is worth noting that if the two final transistors are replaced with a pair of 2N5591s, the final may be driven to 40 or 50W.

The transverter is designed for a 50 ohm aerial system. It is essential that this be observed and the SWR should be less than 1.5 for correct operation. Also, full output will not be realised unless this is so. In addition, the final may produce spurii unless it is correctly terminated. As the linear is broad banded, harmonics are present and if the transverter is to be used on a broad band aerial such as a trap dipole or similar which will respond to harmonics, the unit should be used with an aerial tuning unit or a low pass filter. If the transverter is to be used on a mobile whip or a high Q aerial system, then no filter is necessary and the output may be fed directly to the aerial, making sure that it is 50 ohms.

Dick Smith Novice Operating Contest

Dick Smith Electronics has asked us to announce that they are sponsoring a "Novice Operating Contest" to encourage Novice Licence holders to get on the air.

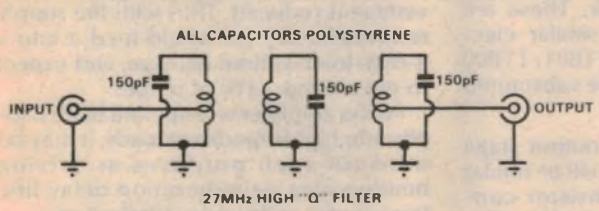
The contest will be limited to Novice Licence holders only, and will carry prizes to the total value of $450.00. To be eligible to enter, here's what you have to do:

(1) Work 5 Novice stations in each state of Australia;
(2) Work 5 overseas stations;
(3) In addition to (1) and (2) above, work 5 CW stations;
(4) Have all contacts confirmed by QSL cards;
(5) Send a copy of your operating log to Dick Smith Electronics. Confirmation will be asked for if required.

Prizes will be awarded, as follows, to the first three Novices able to meet the above requirements.

- 1st Prize: $300.00 worth of Midland amateur equipment;
- 2nd Prize: $100.00 worth of Midland amateur equipment;
- 3rd Prize: $50.00 worth of Midland amateur equipment.

Entries should be placed in an envelope clearly marked "NOVICE CONTEST", and forwarded to Dick Smith Electronics Pty Ltd, 162 Pacific Highway, Gore Hill, NSW 2065.



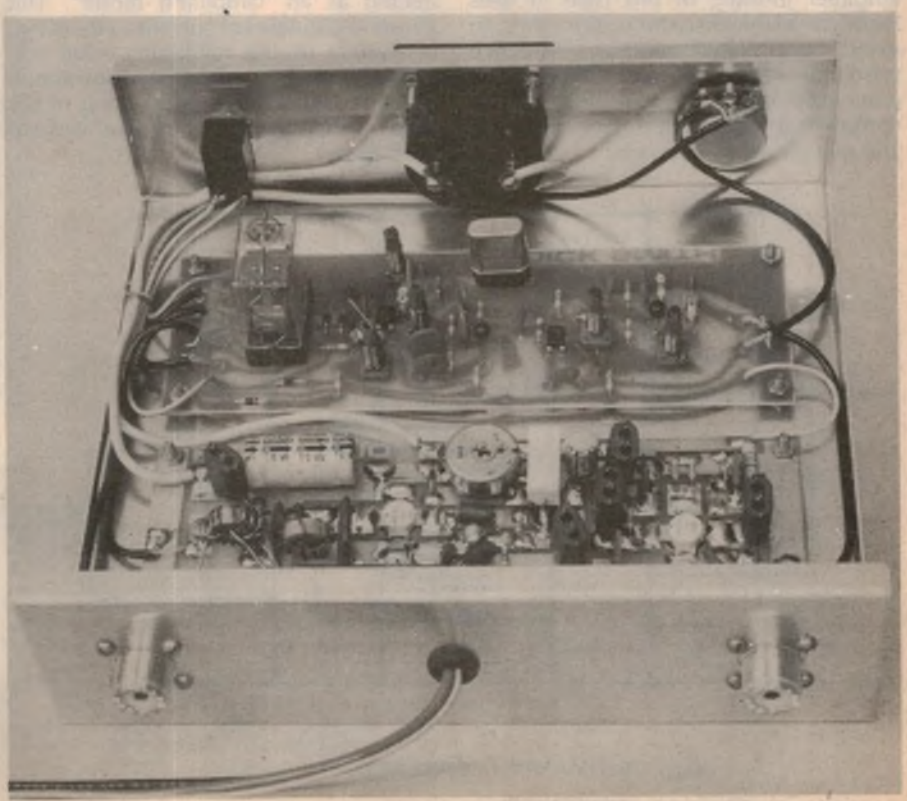
This optional 27MHz high "Q" filter (at left) can be used to improve spurious response rejection, if required.

1 68pF 630V polystyrene
2 100pF ceramic
1 330pF ceramic
1 330pF 630V polystyrene
1 470pF ceramic
1 470pF 630V polystyrene
2 .0022uF ceramic
1 .0022uF silver mica
1 .0047uF ceramic
2 .02uF 50V ceramic
10 0.1uF 50V ceramic
1 4.7uF 30VW tantalum
1 100uF 16VW electrolytic
1 1000uF 16VW electrolytic

MISCELLANEOUS

Coax cable, heavy and light hookup wire, winding wire (16B&S, 20B&S, 26B&S, 28B&S, 34B&S), solder, screws, nuts.

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



A new low-power utility audio module

Here is a new general-purpose low power audio amplifier module. It uses a handful of low cost parts on a small PC board, and is ideal for all those projects which call for a small but stable amplifier delivering up to about 2 watts.

by JAMIESON ROWE

There'll probably always be a need for small audio amplifier modules, as long as people have an interest in building electronic projects. For the fact is that a surprising number of electronic devices involve an audio amplifier. Think of radio receivers, small transmitters, record players, tape recorders, intercoms, movie sound projectors, test instruments like signal tracers, electronic musical instruments, and even electronic games. Almost all of them use an audio amplifier of one sort or another.

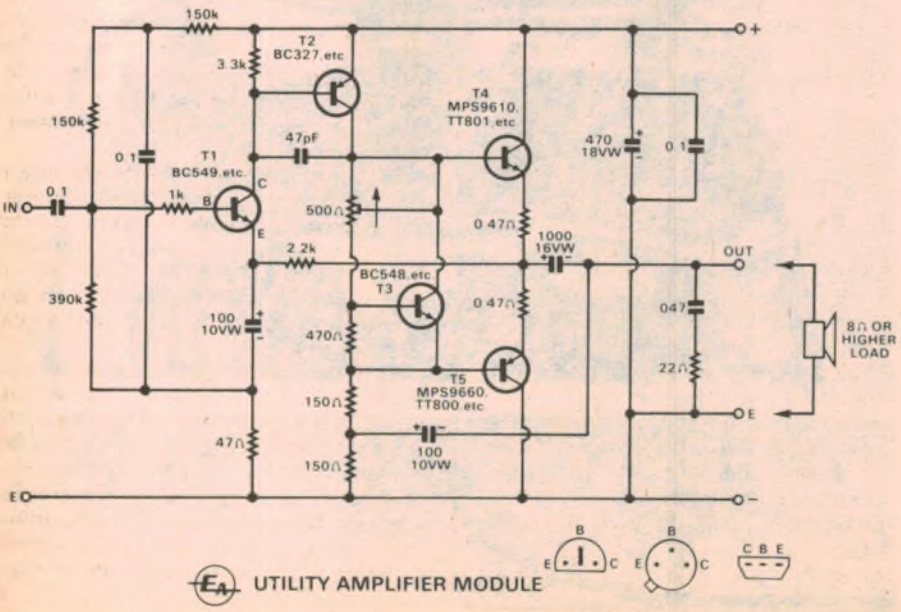
It would be very tedious having to design a new and different audio amplifier every time you built one of these projects. Happily this is not necessary, because most of the applications call for a fairly similar sort of amplifier. This makes it possible to come up with a utility or "general purpose" amplifier module which can be used in a great many such situations.

Here is a new design for a small utility amplifier module of this type. It uses readily available discrete components, to avoid the availability and obsolescence problems which can occur with ICs. The parts used are very low in cost, and the complete amplifier can be built up easily and quickly on a PC-board.

We have taken special pains with the design in an effort to avoid some of the instability problems sometimes encountered with earlier designs. The new module should be particularly tolerant of parameter variations in the transistors and other components, and give stable operation under all normal conditions.

Only five transistors are used, and all are low cost types. The input stage uses a BC549 or similar low-noise NPN device, which feeds a class-A driver stage using a BC327 or similar PNP device. This in turn feeds the complementary-symmetry class AB stage, which uses a MPS9610 and MPS9660 pair. These are plastic pack devices very similar electrically to the familiar TT801/TT800 devices, which may in fact be substituted if you wish.

Bias stabilisation for the output stage devices is provided by a BC548 or similar general-purpose NPN transistor connected as an "amplified diode". This allows the quiescent current to be set up accurately to the minimum value sufficient to prevent crossover distortion. It also gives good thermal tracking of the Vbe characteristics of the output devices.



UTILITY AMPLIFIER MODULE

Together with the overall unity DC feedback provided by the amplifier, this gives a very high degree of thermal DC stability. A matching degree of AC stability is provided by the 47pF capacitor shunting the driver stage, the series R-C "Zobel network" shunting the output, the 1k stopper resistor in series with the input stage base, and the 0.1uF capacitor shunting the 470uF supply by pass electrolytic.

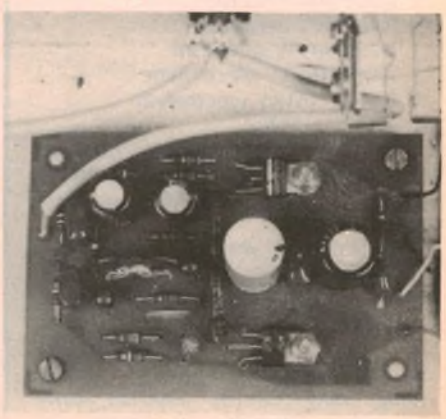
The amplifier is designed to operate into loads of 8 ohms and above, with supply voltages in the range of 12-16V. With a 16V supply it will deliver around 2W into an 8-ohm load with about 0.5% THD, over the range 100Hz-10kHz. The power output into higher impedance loads and/or with lower supply voltages is naturally lower, but should still be adequate for many typical applications.

The amplifier could be used with loads lower than 8 ohms, providing the supply voltage is reduced. Thus with the supply reduced to 9V, you could feed it into a 4-ohm load without damage, and expect to get around 1.5W of output.

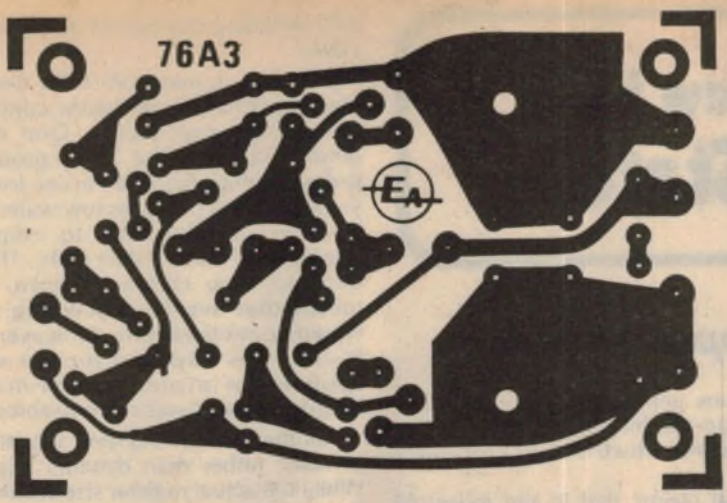
As the amplifier will operate quite happily into high impedance loads, it may be used for such purposes as driving headphones, reverberation delay line transducers and similar applications.

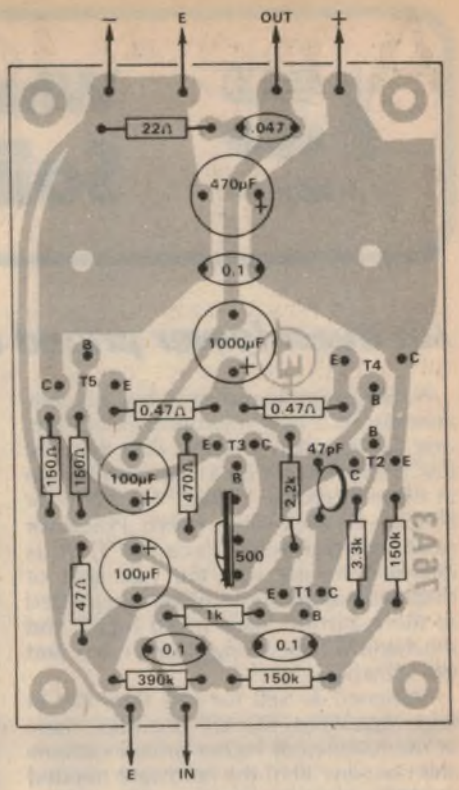
The voltage gain of the amplifier is approximately 48 times, determined by the ratio of the 2.2k feedback resistor and the 47-ohm resistor in the emitter of the input stage. This means that the amplifier has an input sensitivity of around 100mV RMS for full output.

The frequency response of the amplifier is very smooth, rolling off very slowly at the high end to reach the −3dB point above 35kHz. With an 8-ohm load



Above is the new module as it appears in the simple organ described in this issue. The circuit is shown at left.





The PC board pattern used for the new module is shown above, reproduced actual size to permit tracing. The diagram at right shows how to wire up all of the components.

the low frequency −3dB point is around 120Hz, determined almost solely by the 1000uF output coupling capacitor. We used this value because it is a convenient physical size for the PC board, but you can use a larger value if you are able to mount it away from the board. With a 2000uF capacitor the lower −3dB point, as measured, falls to around 60Hz for an 8-ohm load.

For loads higher than 8 ohms the existing 1000uF output capacitor gives a lower figure for the −3dB point, as you might expect. Thus for a 16-ohm load it falls to around 60Hz, and for a 100-ohm load it falls to around 30Hz.

The bias divider for the input stage is bootstrapped, to increase the effective input impedance over most of the audio range. This lifts the input impedance to around 500k at the middle of the range, falling to the basic value of around 100k at approximately 50Hz and 10kHz.

The amplifier should thus be quite suitable for use with most medium-to-high impedance sources, such as preamps, radio tuners and so on. It could even be pressed into service to operate from a crystal pickup cartridge, although the bass response would not be very good.

The module components are mounted on a small PC board, whose pattern is coded 76A3. It measures 90 x 60mm, yet incorporates two copper pads of around one square inch each, capable of providing adequate heatsinking for the output transistors in most circumstances.

Wiring the module should be quite straightforward if you use the diagram as a guide. The main points to watch are that you fit the polarity-sensitive components in correctly—the transistors and electrolytic capacitors.

To ensure a good thermal path from the output transistor chips to the PC board pads beneath the board, use a 1/8 in Whitworth brass screw and two nuts to clamp each transistor mounting lug. Push the screws through the holes in the board from the copper side, then fit a nut to each to act as a spacer. Then fit the transistors, with their lugs threaded on the screws and their pigtails through the appropriate holes. Then fit the second nut to each screw, to clamp each lug snugly between two nuts. Note that the pigtails of the two devices are bent differently, and that one device mounts the opposite way to the other.

When the amplifier is complete, there is only one setting-up adjustment to be done. This is to set up the quiescent current in the output stage, to a value just large enough to prevent crossover distortion. The adjustment is best done using an oscilloscope, but can be done by ear if an oscilloscope is not available. Either way you will need a source of reasonably pure sine waves, from an audio generator or a frequency test record.

The procedure is quite simple. Before applying power, turn the bias and pot to the minimum resistance position and connect a suitable load of 8 ohms or higher. Then apply power, and feed a sinewave signal of about 30-50mV into the amplifier from a generator or other suitable source. Then, monitoring the output either with an oscilloscope or by ear, slowly increase the bias pot resistance until all trace of crossover distortion has gone.

It is a good idea to check the quiescent amplifier current drain with a multimeter, if one is available. This would be around 15-20mA. Similarly the voltage between the junction of the two 0.47ohm output emitter resistors and the negative supply rail should be very close to half the total supply voltage.

If the voltage is significantly larger or smaller than half the supply, you will not be able to obain full output—due to asymmetrical clipping. Assuming all components are in order, this may be due to a convergence of parameter spreads. The remedy would be to adjust the value of the uppermost of the three resistors in the input stage bias divider, from its present value of 150k.

The parts you'll need:

1 PC board, 90mm x 60mm, code 76A3
1 MPS9610, TT801, BD135 or similar transistor
1 MPS9660, TT800, BD136 or similar transistor
1 BC549 or similar transistor
1 BC548 or similar transistor
1 BC327 or similar transistor
5% ½watt resistors: 2 x 0.47ohms, 1 x 22ohms, 1 x 47ohms, 2 x 150ohms, 1 x 470ohms, 1 x 1k, 1 x 2.2k, 1 x 3.3k, 2 x 150k, 1 x 390k.
1 500ohms tab pot, vertical PC type
1 47pF ceramic capacitor
1 .047uF LV polyester (greencap)
3 0.1uF LV polyester (greencap)
2 100uF 10VW electrolytic, PC type
1 470uF 18VW electrolytic, PC type
1 1000uF 16VW electrolytic, PC type (see text)

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

What's new in Solid State

An even lower priced microprocessor!

National Semiconductor has recently announced a new microprocessor chip, one that is much lower in cost than the PACE chip described a few months ago in these columns. Called "SC/MP", for Simple, Cost-effective Micro Processor (and pronounced "scamp"), it is intended to slot into the vast area of dedicated applications hitherto regarded as the realm of "hard-wired logic" and mechanical logic using gears, cams and trip switches.

Designed to sell for less than $10 in large quantities, SC/MP provides many of the features of higher priced systems and contains all of the hardware needed to perform most controller and switching functions where processing speed is not a critical factor. With the addition of a read-write memory (RAM) chip, a read-only memory (ROM) chip, a power supply, and a console if required, SC/MP becomes a complete stand-alone microcomputer.

SC/MP is claimed to be the first microprocessor designed to fit the many applications in which 4-bit microprocessors are too difficult to use and for which currently available 8-bit units are too powerful and too expensive. These applications generally involve the low-speed man-machine interface found in commercial, industrial and consumer systems.

National claims that in the industrial and commercial areas, SC/MP fills the bill for electronic cash registers, traffic controllers, elevator control systems, automatic computing scales, food processing machinery, lumber and paper mill process controllers, instrument controllers, and word processing systems. In the consumer field, it is similarly suitable for use in appliance controllers, electronic games, heating controllers, air conditioning and security monitoring systems, and sophisticated calculators.

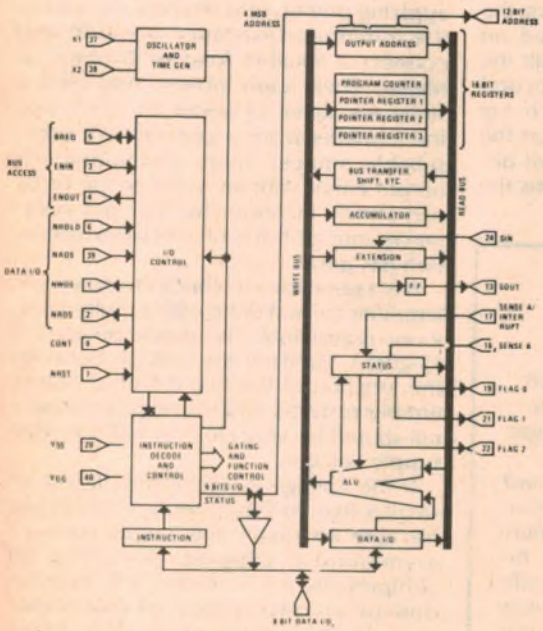
To date, microprocessors have generally been priced at more than $50 and have been employed in relatively complex data-processing systems such as peripheral controllers and communications processors. For a microprocessor to be economical in mechanically-orientated "sheet-metal logic" applications, National realised that the chip would have to be priced at around $10 to replace levers and gears. For a complete microprocessor system, its total cost would have to be lower than $40, including the cost of associated circuitry.

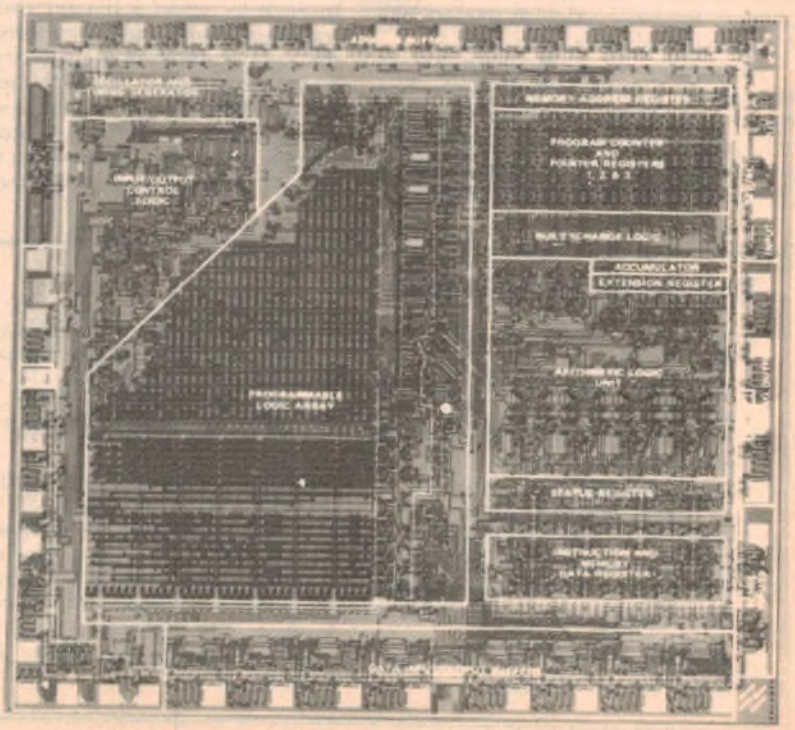
With this in mind, SC/MP's designers made several key decisions concerning technology and design. One was to employ a P-channel MOS production process, which has been in use for many years and which insures low wafer costs. Another decision was to employ a minimum of parallel data paths. This was done to keep chip size down, but it meant that overall processing speed would be relatively slow. However, since SC/MP was intended for the slower applications involving a man-machine interface, speed was not a problem.

Another design decision was the use of static rather than dynamic registers. While the actual register size would have been smaller if dynamic cells were employed, extra on-chip refresh circuits would have been required, and more external support circuits would have been needed to make up a complete system.

To keep the total cost of a system below the $40 level, all timing and strobe generation circuits were put on the SC/MP chip itself. Only an external capacitor or crystal is needed to determine operating frequency.

SC/MP interfaces directly with a wide variety of standard memory circuits, including ROM's, PROM's, and RAM's. No external logic is needed because the SC/MP chip has a write-data strobe, a read-data strobe, and an address-ready strobe built-in. The SC/MP also has a "wait" (or "memory ready") port, permitting the processor to interface directly with memories of almost any speed without complex clocking controls. The "wait" signal can also be used for single cycle input-output control because the





Above is the internal architecture of the SC/MP chip, while at right is a microphotograph of the chip with the various sections indicated.

processor stops all operations until the signal is completed.

Architecturally, SC/MP employs a unified bus system in which the central processor unit, memory, and peripheral devices are all connected to a common data bus. This configuration allows memory-reference instructions to directly reference peripheral devices. It also allows multiple SC/MPs to be tied to the bus for daisy-chain operation; when one SC/MP stops transmitting or receiving, it notifies the next SC/MP in the line that it can take over. In addition, SC/MP architecture provides serial data and control streamlining under software control and has built-in programmable delay.

The central-processing unit of the SC/MP is based on an 8-bit accumulator and an 8-bit extension register. The extension register, essentially an extra accumulator, also provides an 8-bit serial input-output function under program control and has a flip-flop latch at its output so that the register's contents can be manipulated while the serial output remains constant. The serial input-output ports can minimise cost by reducing the number of external data lines that must be routed around the system. The ports also can be easily expanded with standard multiplexer and demultiplexer chips that are controlled by SC/MP's latched flag outputs.

SC/MP can access up to 4,096 bytes of memory with its 12-bit latched address bus output, while four extra address bits are multiplexed and sent out on the data bus with the address-ready strobe to attain full 16-bit addressing. This means that SC/MP has direct access to up to 65,536 or "64k" bytes of memory.

In their press release announcing the SC/MP chip, National says that it believes the greatest future impact of microcomputers will probably not be in the low-cost replacement of standard hardware, but rather in the new methods of operation which they make possible. The largest market for microcomputers will, it says, be found in new applications which were once technically impossible or which could not be justified economically. In five years, new applications could encompass as much as 70 percent of sales.

National also predict that low cost microcomputers like SC/MP are going to produce a new generation of electronics designers, who will regard them as simple "building blocks"—much the same as today's engineers look at semiconductor components or commodity products.

Local agents for National Semiconductor are NS Electronics Pty Ltd, Cnr Stud Rd and Mountain Hwy, Bayswater, Victoria, or at 2-4 William St, Brookvale, NSW 2100 (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.

Building our new "760" electronic organ

Here is all the information you should need to build a simple one-manual organ using the MOS note generator module described last month. The organ you will get this way is very basic, but still capable of being musically satisfying. And it can be easily expanded in the future, as we will explain in later articles.

by JAMIESON ROWE

The simple low cost organ to be described here is, we believe, the most basic practical instrument which can be designed around the MOS note generator module described last month. It has been produced to meet the need for a really simple and low cost instrument, yet one which is still capable of giving enjoyable results.

It should cost you around $170 to build, including the simple case made from particle board. For this you get a table-top organ with a single 49-note keyboard, covering two octaves either side of middle C. There are four "stops", offering a surprisingly wide range of tone colour in the basic 8ft pitch. Other features offered are two-speed vibrato of adjustable depth, a control to allow the pitch of the organ to be matched to other instruments, and a switch to allow the keyboard to be "split" into right-hand and left-hand halves. This makes it possible to overcome at least partly the limitations of a single keyboard.

The organ has a small internal amplifier, capable of delivering about 2 watts into an external speaker—enough to produce modest volume in an average lounge room. Alternatively you can feed signals from the organ into your stereo system, to produce higher levels and a more satisfying overall result. There is also a headphone jack, to allow you to use a set of standard stereo 'phones for practice without disturbing the rest of the family.

But perhaps the most important feature of all is that this "bare minimum" organ is designed to allow for easy expansion later on, if you wish. The note generator module is capable of driving much more pretentious instruments, and in later articles we will be showing you how to expand the basic organ concept in a variety of ways—like adding a swell pedal, reverberation, a pedal keyboard, additional pitches, a second keyboard, and so on.

Of course, there is no reason why you can't simply build up the basic organ shown here and leave it at that. But just in case you do get "bitten by the bug", we have spent quite a lot of effort to ensure that virtually all of the parts you buy for the basic organ can be used in later versions. The main exception to this is the small wooden case, which can obviously only accommodate a limited amount of "works".

If you do proceed to more elaborate versions later on, we should perhaps warn you that there is bound to be some re-wiring. In fact the more elaborate the organ you wish to end up with, the more wiring you should expect. However we believe we have come up with modules which when the time comes will allow you to do this in easy stages, and with a minimum of effort. More about this in later articles.

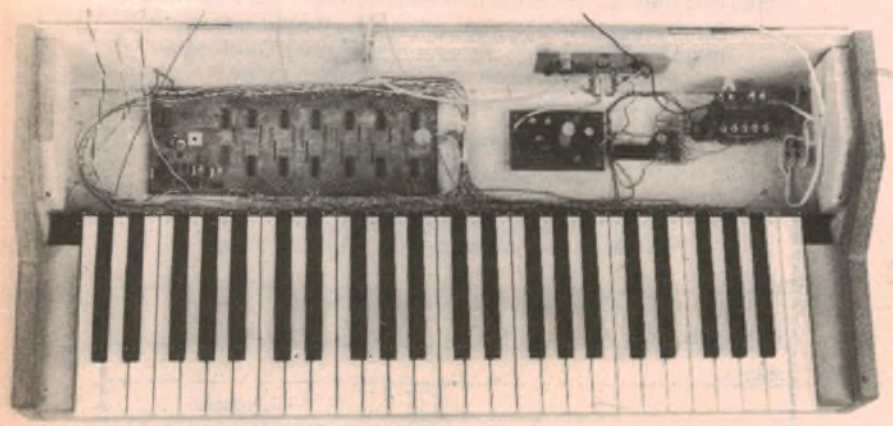
The basic Playmaster 760 organ uses the same general type of keying and tone colour filtering circuitry used in most modern electronic organs, although naturally in its simplest form. Notes from the note generator module are keyed by the keyboard switches, and then fed to a set of tone colour filters controlled by stop switches. From here the signals are controlled in amplitude by the volume control (or ultimately, the swell pedal control), and fed to the amplifier to drive a loudspeaker or headphones.

As you can see from the circuit diagram, each key of the keyboard connects to an appropriate note output of the note generator module via a 100k series resistor. The resistors serve two main purposes, one being to isolate the note generator outputs and prevent interaction when two or more keys are pressed together. The other purpose of the resistors is to allow proper mixing of the note signals, so that the volume of sound produced by the organ increases as it should when additional keys are pressed.

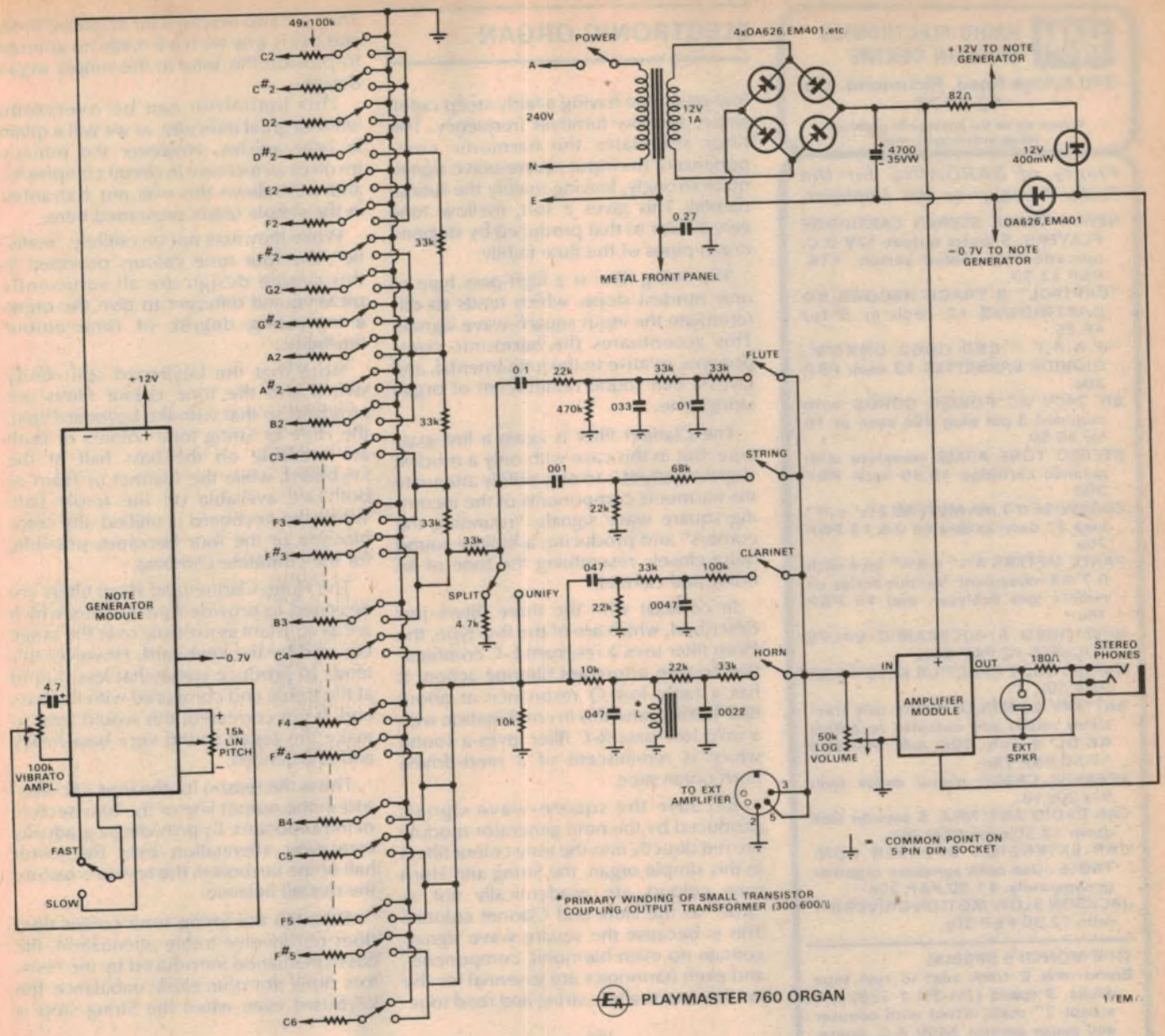
The keyboard switches are of the single-pole double throw (SPDT) type, with the moving contact of each brought out separately but the fixed contacts commoned for each group of six keys. The exception to this is the group at the extreme treble end of the keyboard, which has seven in the group because it includes the top C. For each group of keys the "normally closed" (N/C) contacts are commoned together, and the "normally open" (N/O) contacts are also commoned together separately.

The note signal input to each switch is connected to its moving contact, and the N/C fixed contacts of all switches are earthed. Thus with all keys up (none pressed), all note signals are simply shunted to earth and no signal is passed to the tone colour circuits.

The N/O fixed contacts of all switch groups are connected together to form the output rails to the tone colour circuits. Those of the four key groups forming the treble half of the keyboard are connected directly together, while those of the four bass-half groups are con-



This view inside the 760 organ shows just how simple it really is, thanks to modern MOS integrated circuits.



EA PLAYMASTER 760 ORGAN

Above is the circuit for the 760 organ, complete except that the note generator module described last month and the amplifier are shown as blocks. A view of the completed instrument is shown below.

nected via resistors whose purpose will be explained in a moment. Thus when any of the keys in either half of the keyboard is pressed, it allows signals from the note generator to reach one of the two keyboard output lines.

The reason for the two output lines, one for each half of the keyboard, is to provide for the two halves to be "split". This is a trick used on many small keyboard instruments, whereby the bass and treble halves of the keyboard may be separated and given contrasting volume and/or tone colour to obviate some of the limitations of having only a single keyboard.

As you can see, in the present case we have provided a switch to allow the two halves to be either kept separate, or joined together to provide a unified keyboard.

The tone colour circuitry consists of four separate filters with associated stop switches, which are labelled Flute, String, Clarinet and Horn. The Flute filter is a

ELECTRONIC ORGAN

low-pass type having a fairly steep cutoff slope, and low turnover frequency. This filter attenuates the harmonic components of the input square-wave signals quite strongly, leaving mainly the fundamental. This gives a soft, mellow tone very similar to that produced by stopped organ pipes of the flute family.

The String filter is a high-pass type of only modest slope, which tends to differentiate the input square-wave signals. This accentuates the harmonic components, relative to the fundamental, and gives a thin sound reminiscent of organ string tone.

The Clarinet filter is again a low-pass type, but in this case with only a modest slope. Its effect is to only mildly attenuate the harmonic components of the incoming square wave signals, "rounding the corners" and producing a hollow sound quite closely resembling the tone of an orchestral clarinet.

In contrast with the three filters just described, which are of the R-C type, the Horn filter uses a resonant L-C combination to give a formant filtering action. It has a fairly low-Q resonance at about 800-1000Hz, and this in combination with a mild low-pass R-C filter gives a sound which is reminiscent of a reed-driven horn organ pipe.

Because the square-wave signals produced by the note generator module are fed directly into the tone colour filters in this simple organ, the String and Horn tone colours are academically not as "true" as the Flute and Clarinet colours. This is because the square wave signals contain no even harmonic components, and even harmonics are essential for the synthesis of realistic string and reed tone. They are also essential for diapason tone, and this is why we have made no attempt to provide this tone in the simple organ design.

This limitation can be overcome without great difficulty, as we will explain in later articles. However the remedy involves an increase in circuit complexity, and we believe this was not warranted in the simple organ presented here.

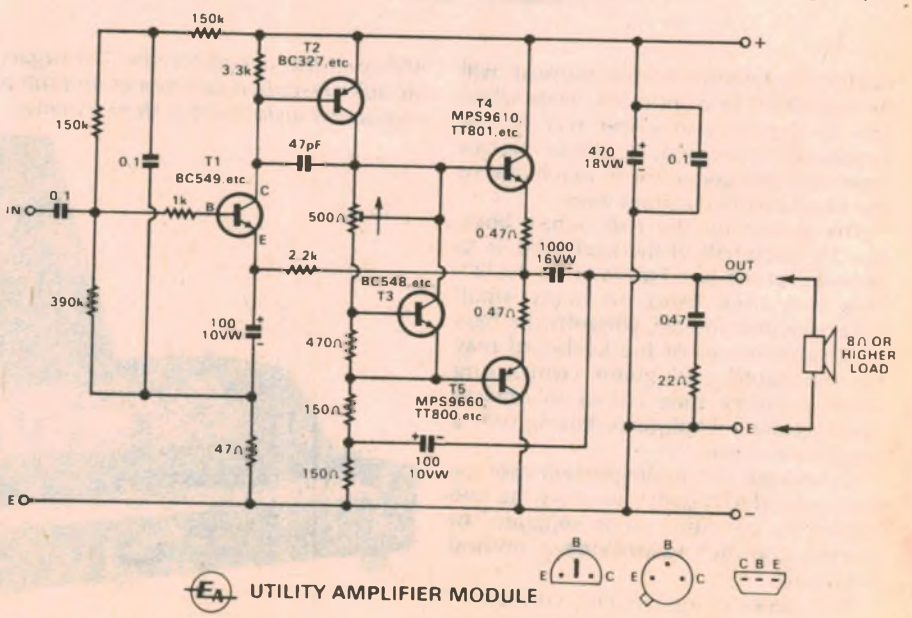
While they may not be entirely "realistic", the four tone colours provided in this simple design are all sufficiently pleasing and different to give the organ a surprising degree of tone colour flexibility.

Note that the keyboard split/unify switch and the tone colour filters are arranged so that with the keyboard split, the Flute or String tone colours or both are available on the bass half of the keyboard, while the Clarinet or Horn or both are available on the treble half. When the keyboard is unified any combination of the four becomes possible, for the complete compass.

The Flute, Clarinet and Horn filters are designed to provide tone colours which are as constant as possible over the range covered by the keyboard. However this tends to produce somewhat less output at the treble end compared with the bass end. If not corrected, this would tend to make the organ sound very bass-heavy and unbalanced.

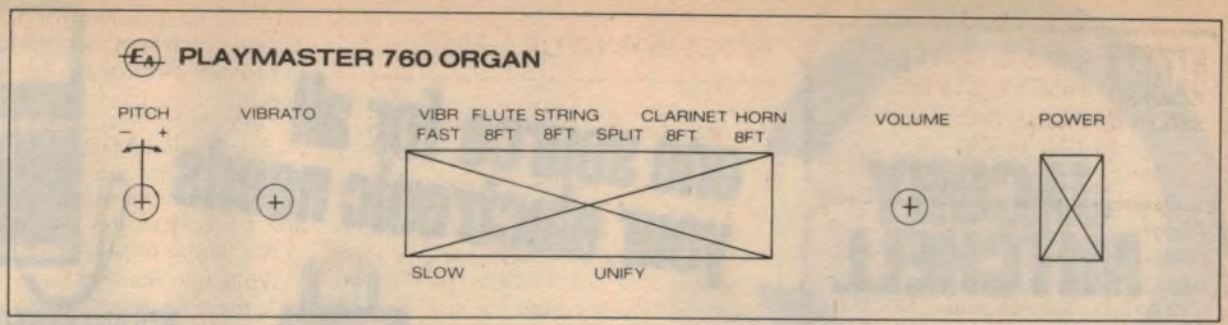
This is the reason for the four 33k resistors in the output line of the bass section of the keyboard. By providing a gradually increasing attenuation over the lower half of the keyboard, the resistors restore the overall balance.

Although the String tone colour filter does not involve treble attenuation, the bass attenuation introduced by the resistors does not noticeably unbalance the keyboard even when the String stop is



EA UTILITY AMPLIFIER MODULE

The circuit of the amplifier module. Using only five low-cost transistors, it delivers around 2W into an 8-ohm speaker.



Here is the front panel artwork for the 760 organ, reproduced exactly half size for those able to copy it photographically.

used alone. This is presumably because the output of this filter is primarily proportional to the rate of change of the input signal, not its amplitude.

The 10k resistor shunting the output line of the treble half of the keyboard is a load resistor to ensure correct note mixing. This is also the purpose of the 4.7k resistor connecting to the split/unify switch, which acts as a mixing load for the bass half of the keyboard when the two are split apart.

From the switches used to select the outputs from the tone colour filters, the signals pass to a volume control. This is a simple shunt control in the basic organ, but if you wish it can be replaced by a more convenient swell-pedal type control. More will be said about this in a later article.

Connected directly across the volume control is a 5-pin DIN socket, wired so that the organ can be connected easily to the Tape or Radio inputs of most stereo systems using a standard cable. The socket is arranged to supply a mono signal to the stereo system, for circuit simplicity, although this could be elaborated upon it you wish.

In the organ itself the signal from the volume control is taken to the small internal amplifier. This is a new low-power utility amplifier module which we have designed to replace earlier designs. It uses five low-cost transistors, in a fairly conventional DC coupled feedback amplifier configuration. However we have taken special pains to ensure that the circuit is very tolerant of device parameter variations, and should be highly stable under all conditions.

The input stage uses a BC549 or similar low-noise NPN device, and this feeds a class-A driver stage using a BC327 or similar PNP device. The output stage uses a low-cost complementary pair, the MPS9610 and MPS9660. These are Motorola plastic power devices, currently available very cheaply. They are electrically very similar to the familiar TT801/TT800 combination, which could also be used if you have them.

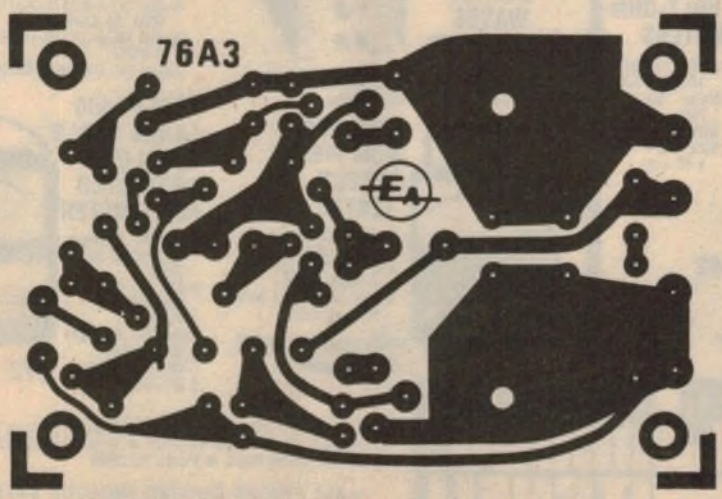
The output transistors operate in class AB, and a BC548 or similar low-cost general purpose NPN device is used as an "amplified diode" bias stabiliser. The quiescent current is set to a value of just sufficient to prevent cross-over distortion, using the 500 ohm tab pot in the base circuit of the BC548.

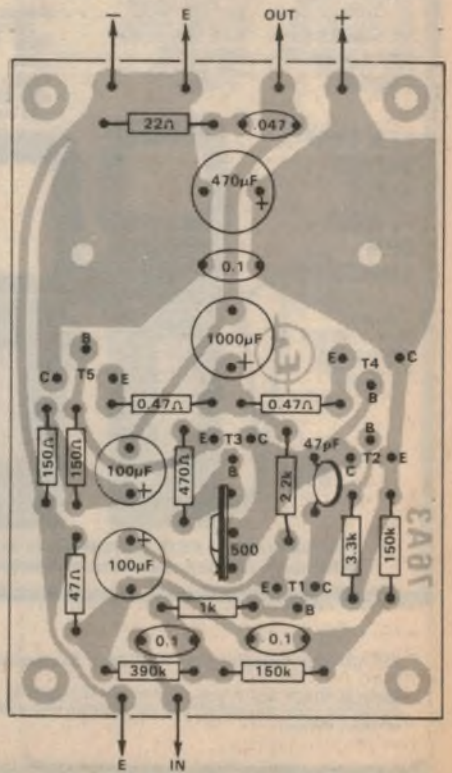
The biasing transistor together with the overall unity DC feedback provided by the circuit give the amplifier high DC stability. To ensure good AC stability, we have provided HF rolloff within the feedback loop by means of the 47pF capacitor between base and collector of the driver stage. There is also a series R-C "Zobel network" across the output, a 1k stopper resistor in series with the input stage base, and a 0.1uF capacitor across the 470uF supply bypass to ensure reliable HF bypassing. Together these measures should ensure that the amplifier is stable with virtually any combination of devices, and under any normal operating conditions.

Output of the amplifier with the supply voltage provided in the organ and into an 8-ohm load is close to 2W, with less into a 16 ohm load. Frequency response into an 8-ohm load is −3dB down at 120Hz and 35kHz. The modest low frequency response is due almost solely to the 1000uF output coupling capacitor, which we have used because of its convenient physical size. If you care to use a 2000uF capacitor, fitting it external to the PC board, you will extend the low −3dB point down to around 60Hz.

With a 16-ohm load the −3dB point lowers to around 60Hz, even with the 1000uF coupling capacitor.

The amplifier will operate quite happily into any load impedance from 8 ohms upward. To operate the organ with a set of headphones for "private" playing, it is simply necessary to unplug the speaker and plug in the 'phones. These don't plug directly into the speaker socket, however, as they could be





Above is the PCB pattern for the amplifier module, actual size, while the diagram at right shows how to wire it up.

JACOBY MITCHELL

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5D, Amps: 60/300
Volts: 150/300/600
Size: 115 x 60 x 40 mm

6B, Amps: 10/50
6C, Amps: 30/150
6D, Amps: 60/300
Volts: 150/300/600
OHMS: 0/300
Size: 190 x 65 x 40 mm

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$77

KEW SNAP 8, 9 ROTARY SCALE SNAP-ON AC VOLT-OHM AMMETERS

8-Amps: 6/15/40/100/300
Volts: 150/300/600
OHMS: 0/2000
Size: 215 x 70 x 40 mm

9-Amps: 10/30/100/300/900
Volts: 150/300/750
OHMS: 0/2000
Size: 230 x 75 x 45 mm

KEW SNAP 7 ROTARY SCALE DC VOLT-OHM AMMETERS

Amps: 30/75/150/300/600
Volts: 3/30/300
OHMS: 0/2000
Size: 255 x 87 x 40 mm

$186

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Sensitivity: > 10 mV/DIV
Single Beam

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5510, 5 INCH, 10 MHz OSCILLOSCOPE

Band width: DC-10 MHz
Sensitivity: 10 mV/cm; Single Beam

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DC ACCURACY 2%
Volts: DC, 0-0.25/1/2.5/10/50/250/500/1000, 20 KOPV
Volts: AC, 0-2.5/10/50/250/500/1000, 5 KOPV
Amps: DC, 0-50uA/1/10/100 mA/10A

KEW K1400 LARGE SCALE OVERLOAD PROTECTED MULTIMETER

Volts: DC, 8 ranges, 0.25/5000, 20 KOPV
Volts: AC, 6 ranges 2.5/5000, 50 KOPV
Amps: DC, 6 ranges 50 uA/10A
OHMS: 3 ranges 0.2K/20 megohms

$72

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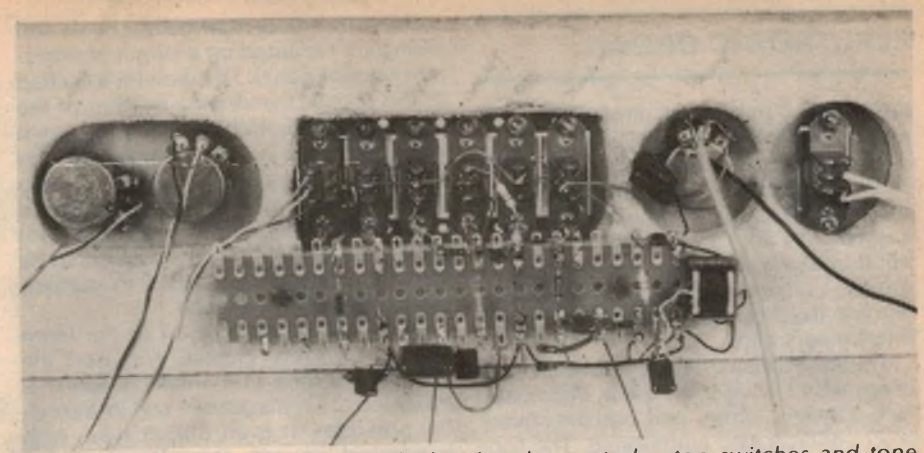
24/76

damaged by overload (so could your ears!). Instead we have provided for a standard stereo 'phone jack, with a 180-ohm series resistor to prevent overload. A 2-pin DIN socket is used for the speaker connection.

The power supply of the organ is a very simple affair, but is quite adequate for the job. A standard 12V/1A transformer is used, driving a rectifier bridge which uses four OA626/100 or similar 100V/1A diodes. This is followed by a 4700uF reservoir capacitor, required to filter the ripple down to an acceptable level.

A fifth OA626/100 diode is used to set up the 0.7V negative potential required by the note generator module, by connecting it in series with the negative output of the supply. The load side of the diode becomes the nominal "earthy" supply rail, so that the true negative output becomes a source of -0.7V. A simple shunt regulator using a 12V/400mW zener diode provides a stabilised source of 12V for the note generator module, while the unregulated output of the basic supply powers the amplifier module.

Note that the negative supply connection of the note generator module does not run directly to the power supply, but is taken via the amplifier module. This is to avoid an earth loop within the organ. Similarly the negative side of the organ circuitry is not connected directly to the mains earth, but via a 0.27uF capacitor. Again this is to avoid an earth loop, when the organ is connected to an external amplifier system. The mains earth of the organ is directly connected only to the transformer frame and the metal front panel, to ensure that the organ will be safe. The 0.27uF capacitor is to prevent RF interference when the organ is used by itself.



The rear of the sloping front panel, showing the controls, stop switches and tone colour filter components.

Now to describe the physical side of the organ, and to make suggestions regarding the components and their assembly.

The prototype organ is housed in a simple case which sits on any convenient table. It is made from particle board, and measures 780 x 333 x 150mm, not counting the music stand which adds a further 160mm to the height.

The case is made from four small sheets of particle board, as sold cheaply in department stores for shelving. All four sheets were a nominal 900 x 300mm, with three 10mm thick and one 18mm thick. One of the 10mm sheets provided the base; another the rear, lid top and the narrow strip along the front beneath the keyboard. The remaining 10mm sheet provided the music stand, with about half the sheet unused. The 18mm sheet provided the two ends of the case and the sloping part of the lid, together with the small cheeks at each end of the keyboard and a small cleat which supports the music stand.

The construction of the case should be fairly clear from the diagram. This of course only a suggested case; by all means house your organ in a different case if you so desire. If you are certain that you will eventually upgrade to a larger instrument, you may wish to fit it directly into a spinet-style cabinet.

The keyboard we have used is avail-

REMAINING PARTS REQUIRED FOR SIMPLE ORGAN

1 4-octave keyboard, catalog no. K6018 from Dick Smith Electronics, or other keyboard as desired
49 100k ¼W resistors
4 33k ¼W resistors
1 180 ohm ¼W resistor
8 8-way or 7-way tagstrips (not miniature)
1 Front panel, 320 x 80mm, with legends
5 SPDT rocker switches, C & K type 7101-J3ZB with white rockers, or similar
1 SPDT rocker switch with black rocker, C & K type 7101-J3ZB or similar
1 DPDT mains-rated rocker switch with red rocker, C & K type 7201-J3ZQ or similar
1 50k log pot
1 4.7uF 16VW tantalum electrolytic capacitor
1 5-pin DIN socket
1 2-pin DIN speaker socket
1 stereo phone jack socket, 6.5mm

STOP FILTER COMPONENTS
5% ¼W RESISTORS: 1 x 4.7k, 2 x 10k, 4 x 22k, 4 x 33k, 1 x 68k, 1 x 100k, 1 x 470k
LV greencaps or polyesters: 1 x .001uF, 1 x .0022uF, 1 x .0047uF, 1 x .01uF, 1 x .033uF, 2 x .047uF, 1 x 0.1uF
1 20-pair section of miniature resistor panel
1 Small transistor audio matching or output transformer with winding having nominal impedance of 300-600 ohms

AMPLIFIER MODULE
1 PC board, 90 x 60mm, code 76/a3
1 MPS9610, TT801 or BD135 NPN medium power transistor
1 MPS9660, TT800 or BD136 PNP medium power transistor
1 BC327 or similar PNP silicon
1 BC548, BC108 or similar NPN silicon
1 BC549, BC109 or similar low noise NPN
Resistors, ¼W or ½W 5%: 2 x 0.47 ohm, 1 x 22 ohm, 1 x 47 ohm, 2 x 150 ohm, 1 x 470 ohm, 1 x 1k, 1 x 2.2k, 1 x 3.3k, 2 x 150k, 1 x 390k
1 500 ohm PC-type tab pot
1 47pF ceramic
1 .047uF greencap
3 0.1uF greencaps
2 100uF 10VW PC type electro
1 470uF 18VW PC type electro
1 1000uF 18VW PC type electro

POWER SUPPLY
1 12V/1A transformer, type 2155 or similar
5 OA626/100, EM401 or similar diodes
1 12V/400mW zener, BZX79/C12V or similar
1 82 ohms ½W resistor
1 4700uF 35VW electrolytic
1 8-pair section of miniature resistor panel
Mains cord and plug, cable clamp, 3-way section of B-B connector strip

MISCELLANEOUS
Particleboard or similar material for case: 3 sheets 900 x 300 x 10mm, 1 sheet 900 x 300 x 18mm
3 Knobs, as desired
1 Aluminium plate, 60 x 120mm, for rear sockets
2 35mm brass hinges for case lid
Screws, nails, PVC glue, hookup wire, solder, etc.

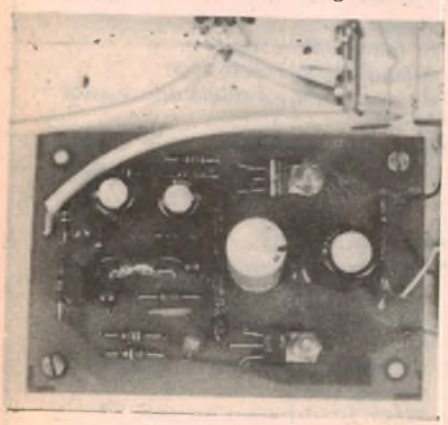
able from Dick Smith Electronics, as mentioned in the first article. It is very nicely made, with a solid steel frame and rigidly moulded keys which have a smooth and satisfying touch action. The keyswitches are only of the SPDT type, but they use gold plated silver-palladium moving contacts and gold plated nickel-chrome fixed contacts. Reliability should thus be very high.

The key contacts are grouped in sets of six, with each group having their fixed N/C contacts commoned, and their fixed N/O contacts also commoned. The former are accessible under the keyboard, while the latter are brought out at the rear along with all the moving contact lugs.

The keyboard bolts to the base of the case using six 5mm countersink-head machine screws, which mate with tapped holes provided in the frame. But before the keyboard is mounted, all of the N/C contact lugs of the key groups are connected together in "daisy-chain" fashion using hookup wire, and a length of the same wire brought out to connect to the signal common.

To support the 49 keying resistors, eight 8-way or 7-way tagstrips (the standard size, not miniature) are screwed to the baseboard just behind the keyboard connection lugs. Each tagstrip serves one of the key groups, with the resistors each supported by a keyboard lug and an appropriate tagstrip lug. From the tagstrip lugs hookup wires are then taken to the appropriate wires of the note generator board.

The output lugs of the four treble key groups are connected together via short lengths of hookup wire, again in "daisy-chain" fashion, with a final length of wire connecting from the middle-C group lug to the tone colour filters. Similarly the output lugs of the bass key groups are also connected together, but this time using 33k resistors. A wire connects the last lug (that nearest the centre of the keyboard) to the tone colour filters, with the final 33k resistor on the filter panel rather than at the keyboard lug.



A close-up view of the amplifier module. Note the mounting of the output devices.

The tone colour filter components and wiring are mounted on a length of miniature resistor panel. The panel is attached to the rear of the sloping portion of the lid, immediately behind the stop switch and control panel. The filter panel of the prototype used a 24-pair length of resistor panel, but a 20-pair section would be more than adequate. The wiring is not critical, except that signal leads should be kept as short as possible to reduce pickup of spurious signals.

The small inductor used in the Horn filter is not very critical. We used the primary winding of a small transformer intended for replacement use in transistor portables. It is an output type, with a nominal primary impedance of 500 ohms. Almost any similar transformer could be used, with a nominal impedance between about 300 and 600 ohms. The main thing is that its inductance should resonate with the parallel capacitor at about 1500Hz—which may require changing the capacitor value if your transformer has an inductance rather different from ours. This is easily done.

The metal front panel which mounts the stop switches and other controls measures 80 x 320mm, with legends as shown. The stop switches, vibrato speed switch and power switch in the prototype are all C & K brand rocker switches, selected for their moderate cost and fairly quiet operation. The stop and vibrato switches are SPDT types with gold-plated contacts, coded type 7101-J3ZB; there are five with white rockers and one with a black rocker (the vibrato switch). The power switch is a DPDT mains-rated type coded 7201-J3ZQ, and has a red rocker.

Other similar rocker switches could be used instead if desired, although we found the C & K type to be the most satisfactory. The only slight drawback even with these is that they still tend to be a little noisy in operation. This could perhaps be remedied by cementing small pieces of felt underneath the rockers.

The lettering on the prototype front panel was done using 3M Scotchcal, which necessitated using countersink-head screws to replace all of the round-head screws supplied with the switches. Similarly countersink-head wood screws were used to fasten the panel itself to the sloping front of the case lid, after suitable clearance holes had been cut in the latter. The Scotchcal was then fitted to the panel, and finally the potentiometers mounted. A similar approach could be used with an etched escutcheon plate, except that it would be attached to the front panel via the pot bushes and nuts.

Note that the 0.27uF capacitor used to connect the organ negative line to the mains earth is physically mounted between the case of the volume control pot (connected to mains earth, along with the metal panel) and an adjacent lug of the tone colour filter panel, connected to signal common.

Wiring of the amplifier board should be fairly straightforward, using the wiring diagram provided. The output transistors are not required to dissipate significant power in this circuit, and do not need much heat sinking. We simply used ⅛-in brass screws and nuts to provide a path between the device lugs and the copper pads beneath the board. The screws are threaded through the board from the copper side, with one nut on each to act as a spacer, and then another nut to clamp the transistor lugs.

When mounting the amplifier module in the organ case, make sure to mount it a reasonable distance from the note generator module and the wires connecting from the generator to the keying resistors. Otherwise you will get "singing"—a pronounced all-notes-at-once background sound audible even when no keys are pressed. Shielded cable should be used for the signal leads between the volume control and the DIN socket, and the socket and the amplifier input, for the same reason.

The power supply wiring is very simple, and is wired on an 8-pair length of miniature resistor panel. The wiring is not critical, and you can wire the panel in almost any way you wish.

The three audio output connectors are mounted on a small metal panel attached to the rear of the organ case behind a small cutout. The panel is again quite uncritical, and may be fashioned from a small scrap of aluminium sheet.

The main thing to bear in mind when wiring up the organ is that the soldering iron should be connected reliably to earth, along with the negative supply line of the organ circuitry. Preferably the iron should be a low voltage type, to avoid leakage troubles. These precautions are to avoid damage to the MOS devices on the note generator module.

When the organ is completed, it should be virtually ready for playing as soon as power is applied. The pitch may not be exactly in line with International Concert Pitch (middle A equals 440Hz), but this is scarcely likely to worry you unless you have "perfect pitch", or intend using the organ with other instruments. You can simply set both the preset pitch trimmer capacitor and the front-panel pitch pot to mid range, and play away to your heart's content.

If you do want to set the pitch range so that it is centred on ICP, this can be done quite simply in a variety of ways. If you have a piano or other instrument set to correct pitch, or a tuning fork, it is simply a matter of setting the pitch pot to mid range and then adjusting the preset trimmer until you get zero beat between your reference and the corresponding note from the organ.

If you don't have either a reference instrument or a tuning fork, you could achieve the same result by setting the master oscillator to 2MHz. This can be done either with a digital counter, or some other type of frequency meter, or failing these with a normal radio receiver placed nearby. This will pick up the 2MHz signal from the organ master oscillator as an image signal, so that it should appear on the dial at around 1190kHz. The easiest approach is to set the radio dial to this figure, and then adjust the organ trimmer until you hear the carrier. Remember not to have the vibrato on, though, or the carrier will be wobbling up and down!

Well, there you have it—a very simple electronic organ, yet one which may be expanded if you wish into quite a pretentious organ. In the next article we will begin telling you how to do this, step by step.

Planning to build a full-scale organ?

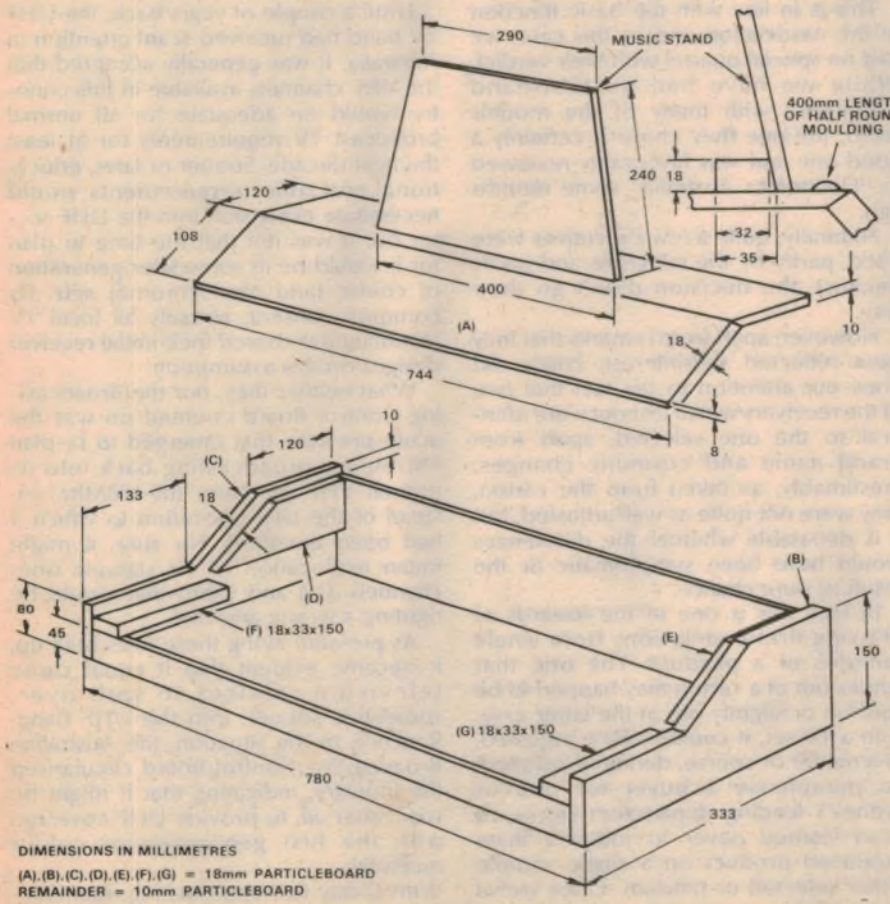
Those readers who are following this series of articles with the ultimate aim of building up a full-scale console type organ will no doubt be interested to learn that full 61-note organ keyboards should be available locally before the end of April. We are informed of this just as the present article was going to press, by the Electronic Organ Company (Aust) Pty Ltd.

The 49-note keyboard used in the simple Playmaster 760 organ described in the present article is of course also quite suitable for organs up to the "large spinet" type, as most spinet organs have either 44-note or 49-note keyboards, which are more than adequate for the majority of popular music. However the enthusiast who wants to build an instrument capable of playing all of the classical literature may well wish it to have keyboards of the traditional 5-octave compass.

For these people the Electronic Organ Company will be able to supply such keyboards at a price of $105.00 each, plus an additional freight charge of $5.00 per keyboard for orders outside the Sydney metropolitan area. This price compares very favourably with that of the 4-octave keyboards. Delivery within the Sydney area is free.

The keyboards conform fully to AGO specifications, and have single-pole gold/gold contact switches. They should thus be very suitable for use in organs based on our designs.

The Electronic Organ Company carry out all business by mail order only. Their address is 124 Livingstone Avenue, Pymble, N.S.W. 2073.



Here is a drawing of the organ case, showing all of the important dimensions. You can build it using low-cost particle board offcuts.

Forum

Conducted by Neville Williams

Colour TV: "Choice" started something!

It is not altogether surprising that published comparisons of commercial products should, at times, raise the hackles of executives and others concerned in the particular field. "Choice" magazine certainly elevated a few temperatures recently with its review, in the February 1976 issue, of colour television receivers. We lost count of the number of people who talked to us in an effort to "put the record straight!"

The problems and emotions flowed, not just from the original article, available only to "Choice" subscribers, but from widely-read news items about the report and from chain conversations beginning: "According to Choice . . ."

As often happens in such circumstances casual readers (and listeners) over-reacted to the criticisms, to the disadvantage of receivers not specifically favoured. Seemingly forgotten was that part of the report which indicated that all the receivers arrived in good condition, well packaged and complete with instructions, warranty cards and appropriate small items. They all worked and, assuming normal installation and checking resources, would presumably have provided owners with acceptable colour pictures. But I heard of no headings along the lines "All Colour Receivers Worked". It was the criticisms that were bandied around.

Again, casual readers (and listeners) tended to fasten on to brand names and to draw across-the-board inferences—even though the models in a particular brand line may come from two or three different countries. "Choice" was concerned with a particular class of receiver; in all probability, their verdict on another receiver group would be different.

If people in the industry have tended to become exasperated in recent weeks, it's partly because of the number of times they've had to interject: "Yes, but . . ." and the number of times that they have had to apply what they feel is a more realistic weighting to the factors governing the choice of a colour television receiver.

Let's take a closer look at the situation.

In preparation for the particular feature, representatives of the Australian Consumers Association bought sixteen different 43cm (18in) colour receivers, as offered on the Australian market, and proceeded to inspect and test them for a variety of performance characteristics of immediate interest to purchasers. They voiced their approval and criticism, summarised their findings in a table and made certain recommendations about the set to buy.

This is in line with the basic function of the Association and, in this case, we had no special quarrel with their verdict. While we have had no first-hand experience with many of the models listed, the one they chose is certainly a good one and was favourably reviewed in "Electronics Australia" some months ago.

Naturally, quite a few executives were irked, partly by the criticisms and partly because the decision didn't go their way.

However, apart from remarks that may have reflected self-interest, critics did draw our attention to the fact that two of the receivers which lost out were identical to the one selected, apart from brand name and cosmetic changes. Presumably, as taken from the carton, they were not quite as well adjusted, but it is debatable whether the differences would have been symptomatic or the result of pure chance.

In fact, this is one of the hazards of drawing firm conclusions from single samples of a product. The one that comes out of a carton may happen to be spot-on or slightly off; in the latter case, with a TV set, it could well be adjusted, as a matter of course, during installation. To paraphrase a buyer for one of Sydney's leading department stores: "I soon learned never to judge a mass produced product on a single sample either selected or random. Once we've narrowed our choice, we insist on inspecting multiple samples."

These matters aside, by far the most contentious part of the "Choice" survey was the weight attached to the provision or otherwise of a UHF tuner in addition to the normal VHF channel selector. The message that came through was that UHF translators would begin to appear in areas suffering from poor VHF reception by the end of 1976, and that UHF will eventually supplant VHF as the main television band. Thus, without provision for UHF reception, a receiver may be outmoded in a few years' time.

The statement was highlighted by the media, and both manufacturers and dealers have since had to face customers agitated because they feared that their favourite programs would soon disappear from the screen of their new colour receiver. Either that, or their difficult decision to buy a particular set had been thrown back into the melting pot.

As in the cities, so in the country—except that the reports in country newspapers tended to be read more closely and to produce a more acute reaction. To quote the remark of one well-known sales manager: "I only wish I could divert my incoming calls to 'Choice' and let them explain the true position in relation to UHF!"

To borrow his phrase, what is the "true position in relation to UHF?"

UHF: WHERE AND WHEN?

Until a couple of years back, the UHF TV band had received scant attention in Australia. It was generally accepted that the VHF channels available in this country would be adequate for all normal broadcast TV requirements for at least the next decade. Sooner or later, educational and other requirements would necessitate expansion into the UHF sector but it was felt that the time to plan for it would be in some later generation of colour (and monochrome) sets. By common consent, virtually all local TV manufacturers based their initial receiver designs on this assumption.

What neither they, nor the Broadcasting Control Board counted on was the acute pressure that emerged to re-plan FM/stereo broadcasting back into its normal VHF spectrum (88-108Mhz) instead of the UHF allocation to which it had been banished. For sure, it might mean reallocation of TV stations from channels 3, 4 and 5 but that would be righting a wrong anyway!

As pressure along these lines built up, it became evident that it could cause television services to spill over, somewhat sooner, into the UHF band. Reacting to the situation, the Australian Broadcasting Control Board circularised the industry, indicating that it might be wise, after all, to provide UHF coverage with the first generation of colour receivers.

With C-day fast approaching, manufacturers and others needed that suggestion like they needed the proverbial "hole in the head"! It had been problem enough

to get their prototypes and inventories to the freeze point; there was certainly no inclination to start again, aggravate their development costs and problems, and add at least another $25 to the cost of every receiver.

This, for the privilege of including a facility that may not be needed during the life of the set!

So it was that the majority of Australian-made receivers appeared without a UHF tuner fitted. The facility is included or provided for in most imported receivers, mainly because UHF television operates in the countries of origin. A UHF tuner has to be deliberately left out rather than put in.

So much for the background. More to the point now is how important or otherwise a UHF facility is likely to be to the average Australian viewer, at least within the next decade.

Those most likely to be affected are viewers in heavily populated urban locations who are prevented by local topography from receiving a reasonable signal from the existing VHF transmitters. There is a possibility that, within the next year or so, UHF translators will be installed to serve some such pockets of population. Universities may also become increasingly active with UHF television.

If you live in such an area, or if you are likely to become involved in, say, University TV extension courses, a receiver with a built-in UHF tuner could be an advantage.

If you are not in either of these groups you can almost certainly forget about UHF television for many years to come.

Even if you live in a small, shadowed area, you can still probably forget it. A far more practical alternative would be a master antenna and community cable distributing the signals at VHF. UHF translators are far too expensive to consider for a few dozen homes.

The vast majority of viewers in urban and country areas alike have access to as many programs as the industry can support for the time being, and the incentive to initiate more programs or more outlets involving UHF is very small indeed.

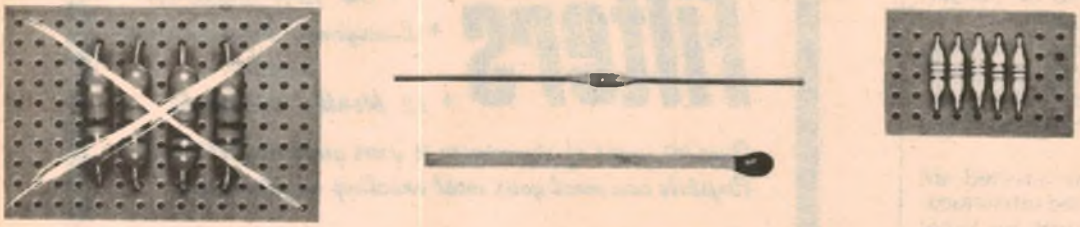
A point that seems to have been lost on many people is that the UHF proposals are not peculiar to colour receivers. If transmissions come up on UHF in particular areas, they will be of interest to all viewers, whether they have colour or monochrome sets. If it is logical to provide UHF facilities in one, then they should also be provided in the other!

Behind this statement lie the pressures that are likely to operate for and against the inclusion of UHF tuners in the forthcoming generations of TV receiver.

In most colour, and in prestige monochrome receivers the pressure will be to include a UHF tuner as a sales feature: provision for the future.

In economy receivers, the pressure will be to eliminate every non-essential dollar

How to cut costs on your valuable P.C. board real estate...



use type GLP miniature resistor.

IRH Components introduces the Metal Glaze type GLP resistor, a miniature ½ watt, with a maximum surface temperature rise of 50°C, the physical dimensions of many other ⅛ or ¼ watt resistors but a full ½ watt rating at 70°C ambient.

The smaller size allows .4" (10 mm) lead spacing as standard for horizontal printed circuit board mounting — reduces demand on expensive PC board real estate. Even greater packaging density can be achieved by vertical mounting.

Another IRH "FIRST," the Australian made GLP is a result of extensive research, development & testing for Australian conditions.

STOCK THE GLP resistor and you automatically stock ⅛ watt, ¼ watt and ½ watt and significantly reduce your resistor inventory. USE IT with confidence.

GLP FEATURES INCLUDE:

- Low cost.
- Small size. Length 5.5 mm Diameter 2.0 mm.
- ⅛, ¼, ½ watt rating.
- Thick film reliability.
- 60/40 plated leads for excellent solderability.
- Solvent resistant coating and colour bands.

irh
COMPONENTS
DIVISION OF NATRONICS PTY. LIMITED
The Crescent, Kingsgrove, N.S.W. 2208. Tel. 50 0111
74 Raglan Street, Preston, Vic. 3072. Tel. 44 5021

To: IRH components, The Crescent, Kingsgrove, N.S.W. 2208

Please forward your engineering bulletin featuring the GLP resistor.

NAME.....

ADDRESS.....

.....POSTCODE.....

GLP/76

to keep the price as low as possible—for as long as possible!

On the subject of cost, we were reminded that the inclusion of a UHF tuner is not the end of the matter. For good UHF reception, a separate special aerial is usually essential, together with low-loss lead-in cable and, often, some kind of a pad to connect the aerial to the receiver, or to merge UHF and VHF inputs. An aerial manufacturer who rang us on the subject said that they, like other manufacturers, had designs ready but were not expecting any immediate calls on them. They were much more interested in the FM market. The cost of a UHF TV aerial (supply, instal and connect) would most likely be about $100.

The same manufacturer went on to express apprehension about an aspect we hadn't thought upon. Having in mind the number of operators who were all too ready to tear down adequate existing aerials in favour of "colour arrays", he could foresee the possibility of a racket developing around UHF: "Give them half a chance and they'll be selling double arrays (save money while we're on the job) so that you can be ready for the new UHF stations!"

In the meantime, an undesirable effect of the uncertainty of UHF is to narrow the options of prospective purchasers, perhaps to their own disadvantage. In choosing a receiver fitted with a UHF tuner, they may bypass some other factor which could be much more important to them during the normal life of the particular set.

They may, for example, settle for a receiver which is smaller than they really wanted, in a roundabout way exchanging picture size for the more complex front end. That would be fine if they ever had a use for UHF but it would be a rather poor trade if they didn't! For what it is worth, most of the people on the staff of E.A. have opted for receivers with larger screens—and no UHF tuner.

Their attitude is simply that, if they are caught in a UHF situation (and they don't expect to be) they will go looking for an external UHF converter to use ahead of their existing receiver.

No less important are matters of servicing and spare parts. In fact, one of the major gripes I heard from service personnel about the article in "Choice" was that it substantially ignored this whole matter. I can understand why because, while one may make an educated guess about future service back-up, one doesn't usually publish guesses of that kind!

However, industry executives are on record as saying that more than half of the receivers currently on the Australian market will have disappeared by the end of the present year; with them will go the incentive to maintain complete service back-up. Servicemen claim that, even now, it is difficult to obtain circuit diagrams for some receivers, and difficult to obtain replacement components or precise details of non-available components to aid in the location of substitutes.

To quote just one example which was brought to our notice, a well established Sydney suburban service organisation recently found itself with an imported colour receiver suffering from thyristor failure. Try as they might, they could not obtain a copy of the circuit to help determine whether the failure was spontaneous or caused by some other fault. After considerable delay they managed to establish that direct replacements were no longer available but they were supplied by the receiver distributor with alternatives having type numbers unknown to themselves or the distributor's own technical representative. Of sheer necessity, they had to guess which way round they went—and they guessed wrong! They then had to obtain two more thyristors and looked like being able to return the set—one month and quite a few dollars after the original breakdown!

I imagine the set would have had a UHF tuner but it would have been cold comfort if the particular brand had been selected on that account.

To summarise, I think the position is this:

1. If you are in the minority group which is most likely to be concerned with a UHF service, attach some importance to a UHF tuner, whether the set is colour or monochrome.
2. The presence of a UHF tuner is sufficient reason to prefer one set over another—provided all other things are equal.
3. Don't buy a smaller receiver just to acquire a UHF-equipped model that is within your price range. For most viewers, a larger picture will bring much greater pleasure than a knob that is never used.
4. Whatever set you buy, UHF or non-UHF, ask pointed questions about service back-up, not just from the interested salesman, but from other multi-brand stores and any service people that you may happen to know.

And that, I think just about rounds up the murmurings that followed release of the "Choice" report. The publishers would resent some of the remarks we heard, but they must surely relish the publicity!

A typical comment:

Dear Sir,

You may have had drawn to your attention the report on colour TV in "Choice" magazine.

My own opinion is that this was not so much a comparison between the capabilities of the various brands purchased, but of the relative standards of service given to the purchaser by the retailers and/or the manufacturers. At the end of the article, the critics say that the receivers had apparently not been correctly adjusted internally when tests were carried out to evaluate their performance, but that the performances were improved when the internal adjustments were correctly carried out.

Further, one receiver was downgraded in respect to another, apparently because, although it was advertised as being capable of UHF reception, a vital circuit component was deliberately not connected to the circuit, thus inhibiting the UHF function. The circuit element (not named) was deliberately well packed inside the cabinet, together with instructions on the fitting of the component if it should be required. I agree that the advertising of the receiver may have been at fault but, apart from the obvious need for mentioning the state of the UHF when received, my feeling is that this should not have been taken into account when judging the capabilities of the receiver.

However, I do agree with "Choice's" complaints (in other contexts) of poor service. In this town it is particularly noticeable with motor vehicles; for most purchasers of motor vehicles, the vehicle is no better than the service available, and it is noticeably poor in respect to some otherwise excellent brands.

A.B. (Mackay, Qld.).

New polyphonic keyboard uses digital scanning

All polyphonic electronic keyboard instruments to date have one thing in common—a lot of circuitry duplicated for each note on the keyboard, most of which is idle at any given instant. This article describes a method of controlling eight tone-generating and keying circuits which cover the keyboard range, thus allowing up to eight notes in a chord while drastically reducing circuit redundancy. The approach makes the concept of a polyphonic music synthesiser a reality.

by MICHAEL J. BAUER, B.E.*

Even an accomplished musician rarely keys more than eight notes simultaneously. Hence, a great reduction in circuit redundancy (and therefore cost) would be achieved if it could be arranged to have only eight identical sound generating, waveshaping and keying (envelope) circuits (collectively termed a 'channel'), each capable of covering the pitch range of the keyboard.

Naturally, this would involve some form of 'keyboard control logic' (or a heck of a lot of mechanical switching!) which would decide which of the eight channels would accommodate which note, and when. The object of the control logic, then, is to define the frequency of oscillation for each of the eight tone-generators, and to provide timing information at the start and end of notes, according to the manner in which the keyboard is played.

Digital integrated circuitry was found to be the best way of implementing these functions. As well as the inherent advantages of digital control (eg, it can't go out of tune), a number of features of the overall system are worth noting:

(1) Minimum circuit redundancy means that more sophisticated sound treatments can be incorporated into each channel. These include complex waveshaping (eg by 'digital harmonic bank'), giving a wide range of timbres without costly filters; dynamic amplitude and timbral variations; random variation (eg controlled drift in pitch); and touch-sensitive (piano-forte) keyboard.

(2) A general-purpose, non-specialised instrument with a variety of sound structures can be built up with substantial savings over conventional techniques.

(3) Interfacing with a digital computer for composing, recording, or parameter control purposes can be readily accomplished.

The design is based on readily available components and is suitable for adaptation to large-scale integration (LSI). A 'chip-set' comprising a keyboard logic IC and eight programmable oscillator ICs would form the heart of the instrument. Additional discrete circuitry would be added on to produce the desired complete instrument; but only eight of everything is needed, not 49 or 73!

Referring to the overall system block diagram Fig. 1, one gets an idea of how it all fits together. Operation is best understood by beginning with the tone-generators.

Each oscillator must be capable of being controlled in frequency over the keyboard range (at least), say six octaves, and must track every other oscillator identically. For this reason, a programmable digital oscillator (PDO) was developed, whose stability and accuracy exceeds that of its analog, the voltage-controlled oscillator (VCO).

The programmable digital oscillator produces an audio output pulse waveform whose frequency depends on semitone and octave data stored internally. This data is sampled from data busses

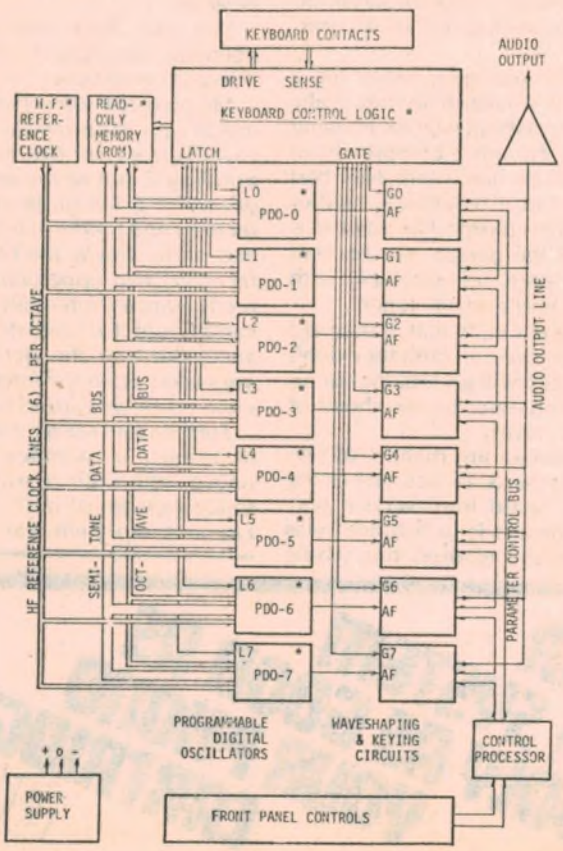


Fig. 1: Overall system block diagram.

*Computer Department, Gordon Institute of Technology, PO Box 125, Belmont 3216.

(common to all eight PDOs) whose binary-coded information is continually changing, as directed by the control logic.

As can be seen from Fig. 3, the PDO is little more than a preset binary counter whose input data is stored in an array of latches (data flip-flops). The counter is made to reset itself to its preset input data upon reaching its 'terminal count', at which point an output pulse appears.

The counter will repeat this cycle indefinitely to produce an audio-frequency pulse-train, assuming that the present data and high-frequency reference clock rate remain constant. The preset data is thus used to control the semitone desired, whilst the HF reference clock determines which octave, simply by selecting one of several clock lines (whose pulse-rates are multiples of one octave apart) via the eight-input multiplexer, using the octave data lines to address the multiplexer.

Since the semitone and octave data is stored in latches, the actual information present on the data input busses may be continually changing without affecting the operation of the PDO. The desired frequency is obtained when the control logic pulses the latch 'enable' line at the correct instant.

The mechanical state of the keyboard, ie, the combination of depressed keys, must be converted into electronic signals. Scanning an array of contacts by sequentially sensing the state (open or closed) of each key is simplified by organizing them into a matrix (12 x N, where N is the number of octaves). Only a single ON-OFF contact is required for each key, and only 18 wires are needed between keyboard and the control logic. Each contact in turn is addressed, its state appearing at the output of a multiplexer, while simultaneously a binary code (KEY DATA) representing the semitone and octave data of the note is generated.

The KEY DATA is used to address a read-only memory (ROM) whose output is the semitone data BUS applied to the PDO bank. The ROM is therefore programmed with the data to give the correct frequency ratios between semitones, when applied to the preset inputs of a PDO. The number of lines (bits) in the data bus determines the accuracy of pitch; an 8-bit system is considered adequate.

The scanner operates at a high rate such that all keys will have been observed in about a millisecond.

A distinguishing feature of this system is the profound use of memory. So far, two memories have been introduced: the latch system in the PDOs and the ROM containing the semitone data. An additional, most important device which makes the whole concept possible is that part of the control logic termed the associative memory. This device stores the KEY data corresponding to the current note in progress in each channel.

The associative memory configuration

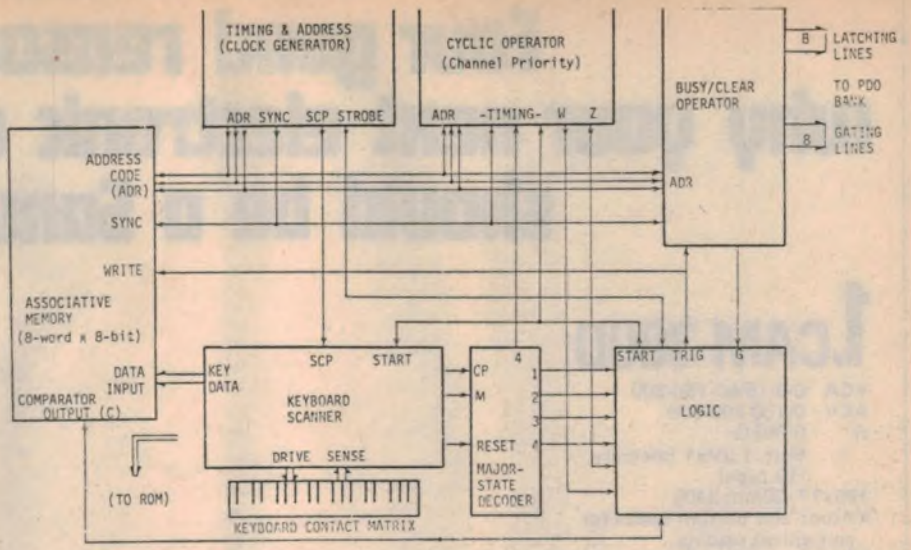


Fig. 2: Keyboard control logic block schematic.

is a conventional read/write random-access device coupled to an identity comparator, whose output (C) goes HIGH if a stored word matches the input (key) data. It is addressed such that each channel is observed sequentially. As the scanner advances, each key's data is compared with all entries in the associative memory.

An additional circuit termed the busy/clear operator keeps track of which channels are engaged in producing an audible note (ie, 'gated' or busy), and those which are idle (clear, released). It also changes the state of any channel from clear to busy or vice-versa, when required. The GATE output lines are used to control 'envelope shapers', which could range from simple on-or-off types to programmable 'attack-decay-sustain-release' configurations.

An arrangement of combinatorial logic correlates signals from the scanner, associative memory and busy/clear operator. The result of this correlation will then determine what execution is required (if any) and appropriate pulses will be delivered on the LATCH and GATE output lines at the correct instants. The keyboard logic is really a simple, special-purpose digital computer.

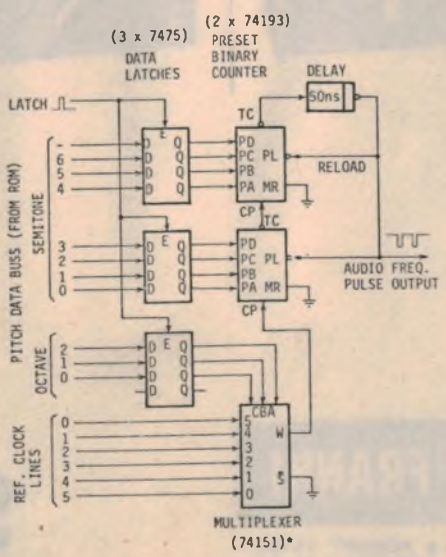


Fig. 3: Programmable digital oscillator logic diagram.

Assume that the system is idle, ie, no notes are ensuing and all outputs from the busy/clear operator are zero. A key is then pressed. Since the associative memory is searched (all channels) for each key, it will be discovered that the new note sensed by the scanner is not present in memory. This, coupled with the fact that no channel is busy, is a contradiction to the normal state of affairs, because every note in progress must be present in memory. Hence, the control logic will attempt to find a non-busy channel, and initiate the new note there by causing the PDO of that channel to sample the pitch data busses, ie, the L and G lines are strobed.

At the same instant, the binary code for that note is written into the corresponding associative memory location of that channel. All these actions occur before the scanner advances to the next note on the keyboard.

On subsequent scans, there will be no anomalies or contradictions associated with that note, or the channel in which it resides, until it is released. Then, by a similar set of circumstances, the busy/clear operator will return the status of that channel to clear.

A channel which has just been released will be put on lowest priority to receive a new note, so that the 'old' note is given the longest possible duration, ie, the note may remain audible after the key is released, depending on the envelope shaper parameters.

The complete circuit for the keyboard control logic is actually a lot simpler than might be construed from the above description of operation, but apart from the limit on the number of notes in a chord, there are no compromises.

In designing the channel circuitry after the PDO, one encounters the problem

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0-1.2-12A (300mV) ±2%
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sanwa
MULTITESTERS

of how to control a certain sound parameter in all eight channels simultaneously, using a single front-panel control, eg, envelope time constants, harmonic selection, etc. Such parameters will require programmable, or voltage-controlled, circuitry which we might expect to be more complex than a single circuit designed for monophonic application.

In fact, the total amount of circuitry is substantially less than that required for eight non-programmable units, because much of the circuitry is common to all eight modules and is lumped into a device termed a 'control processor' (see Fig. 1). As an illustration, consider the design of a keying circuit (transient generator, envelope shaper) which is to have programmable attack, decay and release rates.

The transient is generated by charging a capacitor during attack, and discharging during decay and release periods (Fig. 4). The output controls the audio gain of the channel via a voltage-controlled amplifier, which is typically a simple FET arrangement. In order to vary the decay rate, for example, the decay resistance is effectively increased by switching R_d in and out of circuit. This is achieved using an open-collector gate, to which is applied a 20kHz pulse train of variable duty-cycle, from the control processor. Timing signal A, derived from a monostable (one-shot), will disable the decay gate during attack.

Many useful ideas that can be incorporated into each channel can be found in the abundance of literature on monophonic sound synthesizers. In particular, some innovators are taking a more and more digital approach to waveform synthesis (1) (2).

A highly desirable feature to be incorporated into a polyphonic instrument is a touch-sensitive keyboard, ie, audio output level dependent on the way the key is struck. If we are prepared to adjust our playing technique slightly, in accordance with a minor compromise, then touch-sensitivity can be inexpensively

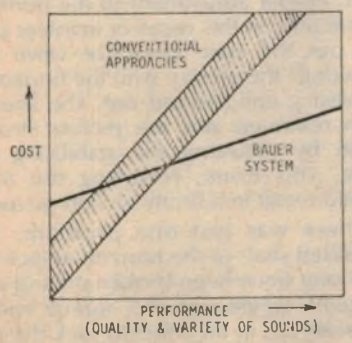


Fig. 5: Performance vs cost of conventional and Bauer approaches.

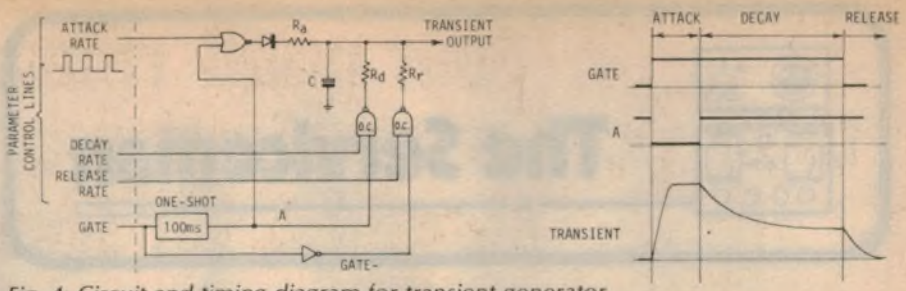


Fig. 4: Circuit and timing diagram for transient generator.

added to the multiplexed keyboard design. The additional items required are:

(a) A single transducer which will give out a voltage level proportional to the force (or velocity) with which any key is struck (eg, this may take the form of a plastic tube along the length of the keyboard, just under the keys, filled with an incompressible fluid which activates a pressure transducer at one end);

(b) Eight sample-and-hold units, one for each channel, whose inputs are connected together to the output of the pressure transducer (these circuits do not need tight specifications);

(c) Eight voltage-controlled attenuators, one inserted into the audio line of each channel, whose control inputs are the outputs of their respective sample-and-hold circuits.

The control gate inputs of the sample-and-hold units are activated by the leading edge of the GATE pulses coming from the keyboard control logic. Thus, at the instant a note is struck, the 'keyboard pressure' will be remembered by a sample-and-hold unit, which will then determine the audio gain of the channel accommodating that note.

The compromise, then, is that if two or more notes are struck at the same instant (ie, within a few milliseconds of each other), then they must necessarily have the same output level. It would be difficult, therefore, to produce a chord whose notes were at different levels. But notes, and chords, in close succession can be forced to have very different levels, and that, after all, is the object of the exercise.

Applications of the digital polyphonic keyboard are limited only by one's budget and imagination. Although the system could be used for a 'special purpose' instrument (eg, electronic 'piano'), such an application does not take maximum advantage of the reduction in circuit redundancy. As the channel complexity increases above this point, however, substantial savings are realized (Fig. 5).

The benefits of the new system become most apparent when one considers a 'general purpose' instrument, using some of the innovations applied to monophonic sound synthesizers, in conjunction with digital techniques.

The musician who now relies on several keyboards (eg, organ, minimoog, electronic piano/harpsichord, mellotron, etc) to produce the variety of sounds he wants can look forward to replacing them with a single, compact, easily programmed digital polyphonic synthesizer.

Further into the future, we may see several keyboards (plus control logic) plugged into a digital computer which, in turn, drives a large synthesizer. Thus, each musician makes his particular artistic contribution, while the computer irons out any 'human errors' and correlates the individual performances into one coherent piece of music.

References:

(1) Bernard A. Hutchins, Jr. "Experimental Electronic Music Devices Employing Walsh Functions", J. Audio Eng. Soc. N.Y. Oct 73, Vol. 21, No. 8.

(2) Ralph W. Burhans. "Pseudo-Noise Timbre Generators", J. Audio Eng. Soc. N.Y. Apr 72, Vol. 20, No. 3.

The Serviceman

So who needs money?

Most of us have read, at one time or another, about the age of barter, when people exchanged goods and services directly, without involving money. Well, a friend and I revived the old custom recently in the modern context of TV sets and motor cars.

The episode had its beginning when I was lamenting one day, in company, that I wasn't looking forward to the next weekend. A car belonging to a younger member of the family was boiling the radiator water away just about as fast as it could be filled. It was showing all the signs of a blown head gasket—which a handyman father might be kind enough to fix!

"Nothing to it" one of the company remarked, a professional fitter by trade, "as long as you've got the right metric spanners and something to clean your hands after you've finished."

My supply of metric tools was about as good as my stock of enthusiasm for a job that I'd successfully dodged since my younger days, and it must have showed through.

"Tell you what I'll do' my mentor suggested. "I'll come round and fix your wagon if you'll do the same for the old TV set in the rumpus room. We'll pay for our own parts but swap labour."

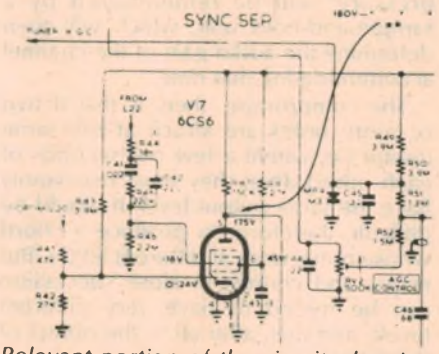
It sounded like a pretty good deal to me. Even if I had to spend quite a few hours restoring an allegedly decrepit TV set, at least I'd be spending my time efficiently. So the deal was on!

The set turned out to be a venerable old HMV model, housed in a metal cabinet and with a swing-out chassis—not a very elegant example of the swing-out art but certainly an improvement on some of the other very early sets, where accessibility was the last thing they had thought about!

The owner had warned me that a lot of the wiring was "old and hairy and cracked" and this deterred me somewhat, having in mind what used to happen in some of the old broadcast sets in some situations—particularly those with rubber covered hookup wire.

Fortunately, the owner's description of the set turned out to be pessimistic. It was certainly smothered inside with household dust and lint but the wiring underneath seemed to be in quite normal condition. Having in mind the nature of the exchange, and the fact that I was doing it as a spare-time job, I spent the first half hour getting rid of as much of the dust as I could reach, at that stage, from the chassis, from inside the cabinet and from the moveable EHT cage. I removed the valves one by one, got rid of the thick layers of goo around the pins, squirted the sockets and worked the valves in and out a few times to clear any contact fouling.

Only then did I switch the set on, to be faced by a condition that I had been warned about: complete lack of picture sync. Careful juggling of the vertical control—the only one readily accessible—would slow the picture roll but gave not



Relevant portion of the circuit, showing the rather unusual sync separator arrangement.

the slightest hint of locking. It seemed fairly obvious that not a whiff of sync was reaching the oscillators, so the first step was to have a look at the sync separator stage.

First, I dug out the circuit to refresh my memory. Which was just as well because I realised that I had almost forgotten this particular sync separator arrangement and, in fact, it had been used on only a few HMV models. The sync separator valve was a 6CS6—a rather special valve having two input grids. Grid No. 1 was used solely as a noise gating device, video signals being fed to it from the video detector circuit.

Grid No. 3, which was more akin to the normal input grid, was used for the conventional sync separator function, positive going video signals being fed to it from the output of the video amplifier.

Unfortunately, in the set itself, the sync separator was not all that accessible, even with the chassis swung out, because of the limited length of the flying leads to the yoke, etc. However, by dint of much probing, I was able to establish that there was no voltage on the No. 1 grid (shown as 0.24 on the circuit), and no voltages on the screen (shown as 45). Aha! Almost certainly a broken-down screen bypass, and this was confirmed by a "dead short" measurement from screen to chassis.

Perhaps due to a bit of old-fashioned canniness, I didn't simply cut the capacitor out but unsoldered the accessable earthy end. And just as well; the capacitor was okay but the screen/chassis short remained. When I pulled out the 6CS6, the short disappeared with it, and checking the valve pins showed a short between screen and No. 1 grid. It was good news because I had found the sync fault so easily; bad news because I didn't have a replacement on hand! However, resorting to an old trick, I rapped the valve hard on the table top, pins down. A further check showed that the short had disappeared and nothing I could do would restore it. Fairly obviously, it had been due to a loose fragment of foreign material which I had managed to dislodge.

Fair enough, but why had the fault shown up as a complete screen/chassis short, when the No. 1 grid was isolated from chassis by a resistive network? As I pondered that one, looking curiously at the socket, I noticed an odd scrap of wire between the No. 1 grid pin and an adjacent earthed pin. Closer inspection showed that it had been quite deliberately soldered in position, effectively shorting the noise gating input to that grid. When I cut the link and restored the 6CS6 to its socket, the picture locked immediately and we were in business.

How or when the link got there I would have no way of discovering but assume that a previous serviceman had added it, presumably while trying to cope with the earlier sync problems.

I soon discovered, however, that my troubles in this department were not over. Proper adjustment to the horizontal circuitry in this receiver involves pulling out the sync separator valve and "floating" the picture with the horizontal stabilising coil shorted out. The short is then removed and the picture floated again by adjusting the stabilising coil core. This done, restoring the 6CS6 should result in a firmly locked picture.

There was just one problem: The moulded shaft of the horizontal lock pot had long since been broken off and subsequent digging at the stump with a screwdriver, in an effort to lock the picture, had chewed the moulding away. Amongst my spares, I had the right value

pots in the wrong-style, and right-style pots in the wrong value but, again, good fortune was on my side. By slipping the back off the mangled pot, I was able to substitute the rotor and shaft moulding from a good one and restore it to normal operation. This done, it was only a minute's work to set up the adjustments correctly.

Well now . . . what next?

As received the set would tune channels 7, 8 and 10 correctly but not channel 2. The picture was fair enough but there was no sound—fairly obviously because the slug in the oscillator core needed adjustment. No less obviously, the slug was frozen solid and there was no way to put it right without removing and dismantling the tuner. I thought of my friend having to remove all the paraphenalia from the engine before lifting the head and realised that I, too, had no option but to do the whole bit.

In this receiver, access to the tuner involves removing the control knobs and undoing the best part of a dozen self-tappers in order to lift off the whole top of the cabinet, complete with speaker, leaving the chassis proper attached to a baseboard.

Did I say attached? Before even touching the tuner, I had to finish the job of cleaning out what was left of years of mess, then locating other screws and bolts that would replace those that had been lost over the years.

And so to the tuner:

I disconnected it completely and cleared a spot under the bench light where I could see what I was doing. Removing the sideplates gave the immediate impression that someone had sprayed the inside with honey! I guess that the "honey" was really the residue left behind by countless squirts of contact cleaning liquid. My first job was to squirt it afresh, then try to wipe away and brush away the surplus. Only when I had cleaned it up as best I could did I look closely at the channel 2 biscuit.

Sure enough, the slug was jammed but, more than that, previous efforts to turn it had dislodged the entire coil from the biscuit body. Clearly, I was up against a do or die situation so I squirted the slug with the cleaning penetrant and waited for a couple of minutes for it (hopefully) to take effect. Then holding the coil as firmly as I could in the biscuit, I attacked the core with a screwdriver. Either the core would loosen or the coil former would collapse. Fortunately for me, the former happened first. What a mess it was—a brass core thoroughly gooed up with verdigris and long-dried-out core compound.

Thus emboldened, I got to work on the cores for 7, 9 and 10, which were almost in as bad shape. They ended up fairly loose after cleaning, but I hoped that a coating of new core locking compound would help them stay put. Oh, yes . . . and a few dabs of "Tarzan's Grip" to bed the coils more effectively in their biscuits!

With the tuner back in place, I was able to optimise all channels, leaving me only one job to do—replacement of a very noisy audio switch/pot. This done, the cabinet work was reassembled and my friend's TV set was fully back in business, in a lot better shape than he or I had earlier imagined possible.

Would this kind of attention have been worthwhile under normal service conditions?

As I first saw it, it was obviously an old set that had had a hard life; a set that had been patched up by a succession of other servicemen who had been enjoined merely to "keep it going for a while longer". Ultimately, it had reached a stage where it had sync problems, tuner problems, a couple of faulty pots and who knows what else. There comes a time when "patches" become too costly both in terms of dollars and the serviceman's reputation; either the set has to be abandoned or given a thorough overhaul at whatever that might cost.

I was lucky because the problems I found were directly repairable, but it could have been just the reverse.

One other interesting point, and I am through with what started out to be a fairly brief story:

Those old HMV receivers were well known for their wide video passband and their sharp pictures. This one was no exception, despite its age, but the quality is now a mixed blessing. While it resolved all there was to be seen on the test pattern, it also responded eagerly to the 4.43MHz colour sub-carrier and this was all too evident as a grainy effect in the pictures.

Hopefully, the kids in the rumpus room won't be worried by it at normal viewing distances.

And, finally, a brief story concerning the questionable tactics of some less scrupulous organisations.

It would seem that these organisations are not above overselling their services if they can "prove" to the customer that, say, a new aerial is essential for a colour set. This story is typical.

A friend, who is in the electronics game, stopped to chat with one of his near neighbours and the neighbour, bubbling with anticipation, confessed that he had just rung a hire firm for a colour set.

Later that morning, my friend saw the hire company's van outside the house and, at the first opportunity after it had gone, asked his neighbour if the set had been delivered.

"No", replied the neighbour, "the bloke came and connected a meter of some kind to the aerial, and said the aerial wasn't good enough. He reckoned I had 700 something—millivolts I think—on channel 7, but a lot less on the other channels. And he said that, because I wanted a 26in set, there wasn't enough signal. If I'd only wanted an 18in job it would have been all right, but for the big set I'd need a new aerial. So I had to sign up for that first."

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THE ARLUNYA TC 46 Colour and Monochrome Picture Tube Tester and Reactivator is a rugged compact portable instrument designed to test and, if necessary, reactivate non-exhausted CRT's in situ in colour or monochrome TV receivers. It has been carefully designed to minimise costly operator errors such as the application of excess heater voltage or misreading of meter scales, etc.

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- Accurately measures emission with beam current collected at first anode avoiding difficult connections to the final anode.
- Enables fast comparison of red, green and blue guns.
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Circuit & Design Ideas

Conducted by Ian Pogson

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

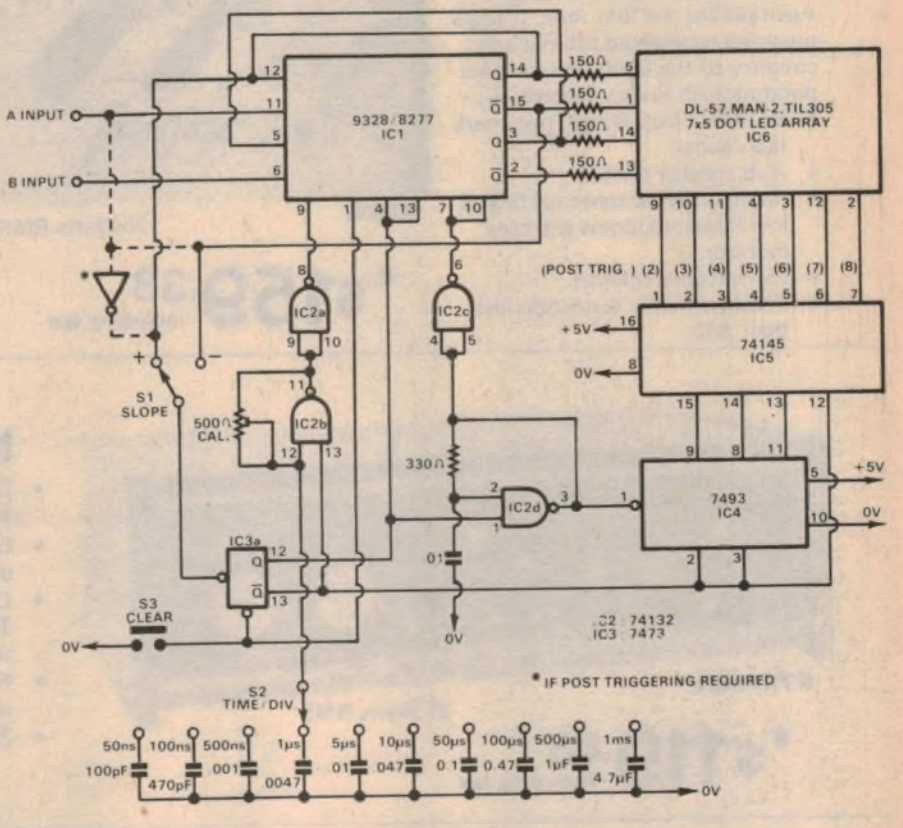
Hand held logic storage scope

In measuring fast logic to check for the width, coincidence, or delay between two logic pulses a normal storage scope is of little use as it is limited by its maximum writing speed. The accompanying circuit not only allows the storage of two logic conditions but displays their relationship either before or after a trigger. The circuit can be split into three sections: (1) Dual eight-bit store formed by IC1. (2) Trigger and timebase circuit formed by IC2a & b and IC3. (3) Scan and display circuit formed by IC2c & d and IC4, IC5 and IC6.

In the idle mode the dual 8-bit shift register IC1 is clocked by the timebase oscillator IC2a & b, a Schmitt trigger whose frequency of oscillation is controlled by the 500 ohm feedback pot and the capacitor selected by S2. Each positive transition to the clock input of IC1 stores the logic conditions at the A and B inputs into the register and shifts the previously stored conditions through. In this way the frequency of the oscillator determines the interval between sampling and thus the scale of the horizontal trace will be displayed.

When either a positive or negative edge as selected by S1, triggers IC3 (transfers a high to the Q output), this disables the time-base circuit and enables the scan and display circuit. At the same time the inputs of IC1 are connected back to the outputs to recirculate the stored data. This results in the stored data being displayed and recirculated continuously in synchronism as they are clocked by the same scanning oscillator.

Two traces are thus formed on the 7 x 5 dot matrix IC6 in such a way that a high stored in channel A will light column 1 of 5 via the Q output and a low will light column 2. Similarly a stored high or low on channel B will light columns 4 and 5, respectively. Rows 1 to 7 will show the logic conditions in successive periods after the unit was triggered. Even though the stored and scan circuit are capable of 8 rows, only 7 are shown as this is the limit of the LED array used. Pressing the clear button resets the unit to its idle state.



As shown in the circuit diagram the trigger is taken off the output of the shift register and thus when the unit is triggered the store contains data strobed in after the data at the output was stored. If, however, the unit is wired as shown dotted, it will be triggered by data at the input and thus the store contains the conditions previous to this occurrence, which is then displayed, a useful feature.

The unit was built on two boards and housed in a clear probe assembly. The tip of the probe was connected to the A input, with the B input and supply via flying leads.

(By Mr B. Hunter, 4/30 High Street, Carlton, NSW 2218.)

Precise voltage sensing using an IC

The type 723 linear voltage regulator is commonly used in linear series shunt and switching voltage regulators. However, it is also ideally suited to voltage sensing. The IC has an inbuilt stable voltage reference and differential amplifier which are the main requirements for a voltage sensing circuit. The differential amplifier is operated in the open loop mode as a comparator.

Pins 4 and 5 are the inverting and non-inverting inputs of the amplifier (14-pin package), with the 7V reference available at pin 6. Depending on whether high or low voltage sensing is required the reference, or a divided down value, is applied to pin 4 or 5. The other pin is connected to a voltage proportional to the voltage to be sensed. The capacitor from pin 13 to ground is necessary to maintain stability. A driver transistor is used to drive a relay, lamp, etc.

This circuit is designed for a nominal 12V maximum sensing, which may be

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- 25 watts per channel.
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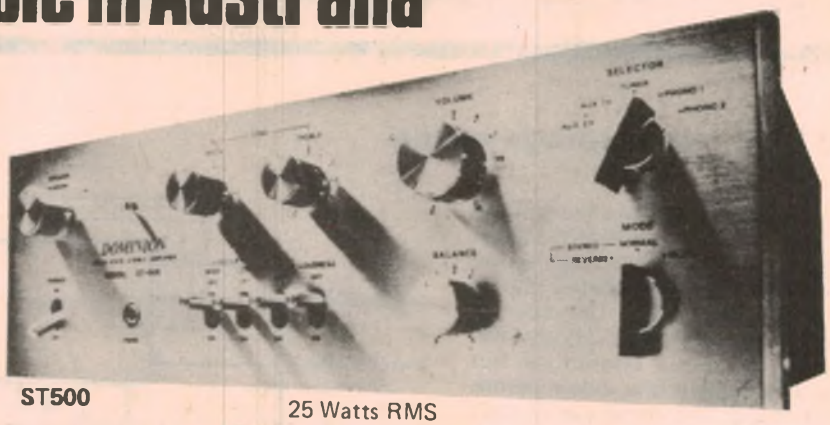

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KTX4000V

- Designed for use with magnetic, ceramic and crystal cartridge.
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- Furnished with tape recorder output terminal.
- 25 watts per channel.

SX9000R

- Twin Microphone mixing Panel combining dialogue, or musical instrument output on tape with other source material.
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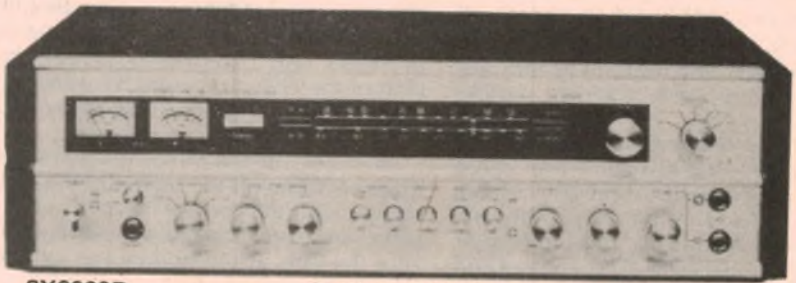

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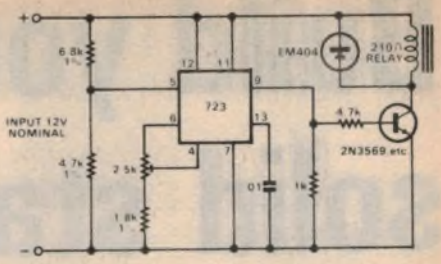
adjusted between about 8V and 17V. The hysteresis is small, being less than 50mV. A small amount of positive feedback may be applied if a voltage differential is required. The circuit requires low standby current drain and the maximum voltage which may be applied to the circuit must be kept below 40V. A fairly obvious application for the unit is to sense battery voltages.

(By Mr M. R. Mack, 299 Poath Road, Hughesdale, Victoria 3166.)



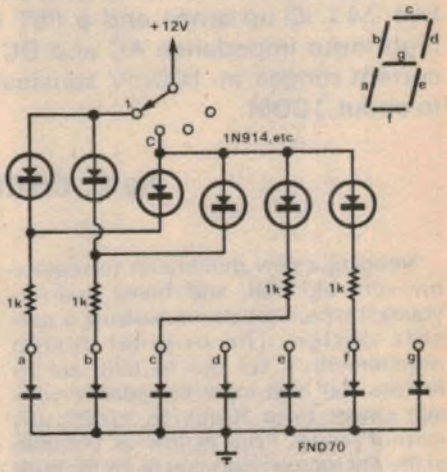
An amateur FM channel indicator

Seven segment displays are widely used these days as numeric indicators in frequency counters, etc. However, they can also be pressed into service to display some letters of the alphabet, provided some letters such as K, Q, W do not have to be used, also if some aplha-numeric conflicts do not arise such as B and 8.

In spite of these restrictions, 144MHz amateur band channel designations may lend themselves to this system. While the implementation of switching will be up to the individual and his requirements, there may be some cases where there are spare switch sections available on the channel selector. The diagram shows the wiring for C and 1 and it may be extended as required.

In my particular case I have only four channels fitted, F, C, E, 1, so segments a, c can be permanently on and segments d and e are not used and so only seven diodes and five resistors are required. This method of channel indication is useful on crowded panels and is very good for mobile use since the channel can be read at the full extension of the microphone cord quickly and easily.

(From "Break-In".)



Etch resist for use in drawing pens

Mixing about three parts of black marker-pen ink refill with two parts of dark coloured nail polish makes a quick drying etch-resist for one-off PCBs that can be applied with a Nestler type tubular drawing pen. A non water based ink refill must be used—Maruzen Wonder Marker Refill is a suitable brand.

A Nestler B5 pen gives crisp, easily seen uniform lines of a suitable thickness, permits the use of a straight-edge and generally gives more control than is possible with brushes or fibre tips.

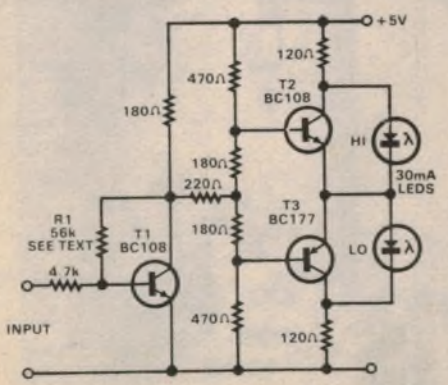
Make up small quantities as required by slowly adding nail polish to four drops of ink, in a container such as a milk bottle top, until it forms a solution just thick enough to lie on the PCB without spreading. This quantity of solution in the pen reservoir will cover a good deal of copper with only occasional use of the clearing plunger in the pen. Duco thinners removes the etch resist, degreases the PCB and washes out the pen. Careful mopping with a fine brush dipped in clean thinners removes small sections of line and allows corrections to be made.

(By Mr. N. H. Campbell, 19 Brushy Creek Road, Lenah Valley, Tasmania 7008.)

Logic probe

Here is a circuit for a logic probe which I designed and which has shown itself to be easier to build and simpler to use than the majority of those which I have seen. Over the past nine months or so, several of these units have been built and all are proving to be 100% reliable with regular use.

The circuit uses three transistors, two of which in the quiescent state are biased on and shunt the two LEDs so that neither LED operates. The third transistor is used to amplify the input current pulse and change the output state. In setting up, R1 should be adjusted to make the collector potential equal to half the supply rail voltage, after which no further adjustment is necessary.



(By Mr P. S. Lockhart, 1 Minor Road, Albany, WA 6330.)

Build your own solid state multimeter

This article describes an easy-to-build solid state multimeter employing two 741 IC op amps and a FET input buffer. The unit offers eleven high input impedance AC and DC voltage ranges, twelve AC and DC current ranges at 100mV sensitivity, and eight resistance ranges up to about 100M.

by C. CHRISTENSEN*

Needing a new multimeter to replace my very old unit, and being a do-it-yourself type, I set about evolving a suitable design. The original design requirements I set out to fulfil are as follows: (a) high input impedance voltage ranges from 100mV to 1,000V; (b) current ranges from as low as possible in the microamp region up to 1A for both AC and DC; (c) resistance measurements from 1 ohm to about 100 megohms; (d) 10 decibel steps on the range switch; and (e) battery operation at reasonable current drain.

After a great deal of experimentation, a circuit was evolved which more than met these requirements. Although the circuit was rather demanding in terms of rotary switch poles, the junk box yielded a plentiful supply and, in due course, the multimeter was completed and lived up to expectations.

A total of 53 ranges are catered for, not including decibel readings. AC and DC voltage ranges are 10mV, 30mV, 100mV, 1V, 3V, 10V, 30V, 100V, and 1000V at an input impedance of a little over 10 megohms. Current ranges for both AC and DC are 10uA, 30uA, 100uA, 300uA, 1mA, 3mA, 10mA, 30mA, 100mA, 300mA, 1A and 10A at a sensitivity of 100mV. Resistance ranges are R x .1, R x 1, R x 10, R x 100, R x 1k, R x 10k, R x 100k, and R x 1M. These have a centre scale reading of 10 or multiples or sub-multiples of 10. Battery consumption is modest at under 5mA.

The circuit description is best commenced by considering the final stage of the circuit. IC2 in conjunction with the bridge rectifier constitutes a precision rectifier system that is used to drive a 1mA meter movement. This system will indicate on the meter average values of waveforms supplied by IC1. Either a positive or a negative voltage of 1V, in relation to 0V, at the output of IC1 will drive the meter to full scale.

Consider a sine wave of say 2V p-p at the output of IC1. For one half cycle of this sine wave, the meter tendency is to move from zero to full scale and back to zero. This will be repeated during the second half of the cycle. In practice, these movements are integrated by the damping of the meter needle to display a reading of around 70% of full scale. A full scale reading would require a drive from IC1 of 2.8V p-p, or 1V RMS.

The excellent linearity of the precision rectifier also enables it to be used as a meter driver for DC, and it is therefore not switched out for DC measurements. An advantage of this scheme is that measurements are indicated, no matter which polarity is applied to the input. How this polarity can be determined if in doubt will be explained later.

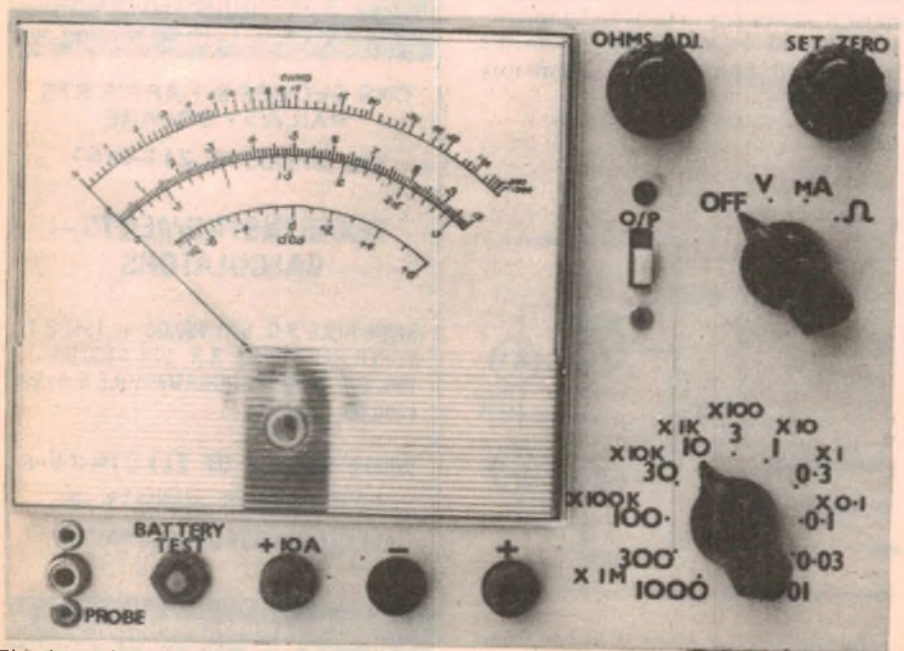
On the prototype, the difference in near full scale readings between positive and negative inputs is less than 1%. Preset pot VR3 is used to bring the meter reading to full scale when 1V is present at the output of IC1. VR6 is the ohms adjust pot.

IC1 is a buffer, with gain when necessary, to provide drive to the precision rectifier without adding any appreciable loading to the preceding FET. For measuring resistance and voltage on the 1V ranges and higher, it operates at unity gain; for current ranges at a gain of 10; and for millivolt ranges at a gain of 10 or 100. VR1 is used to set the gain of this stage at 100, while VR2 sets the gain at 10.

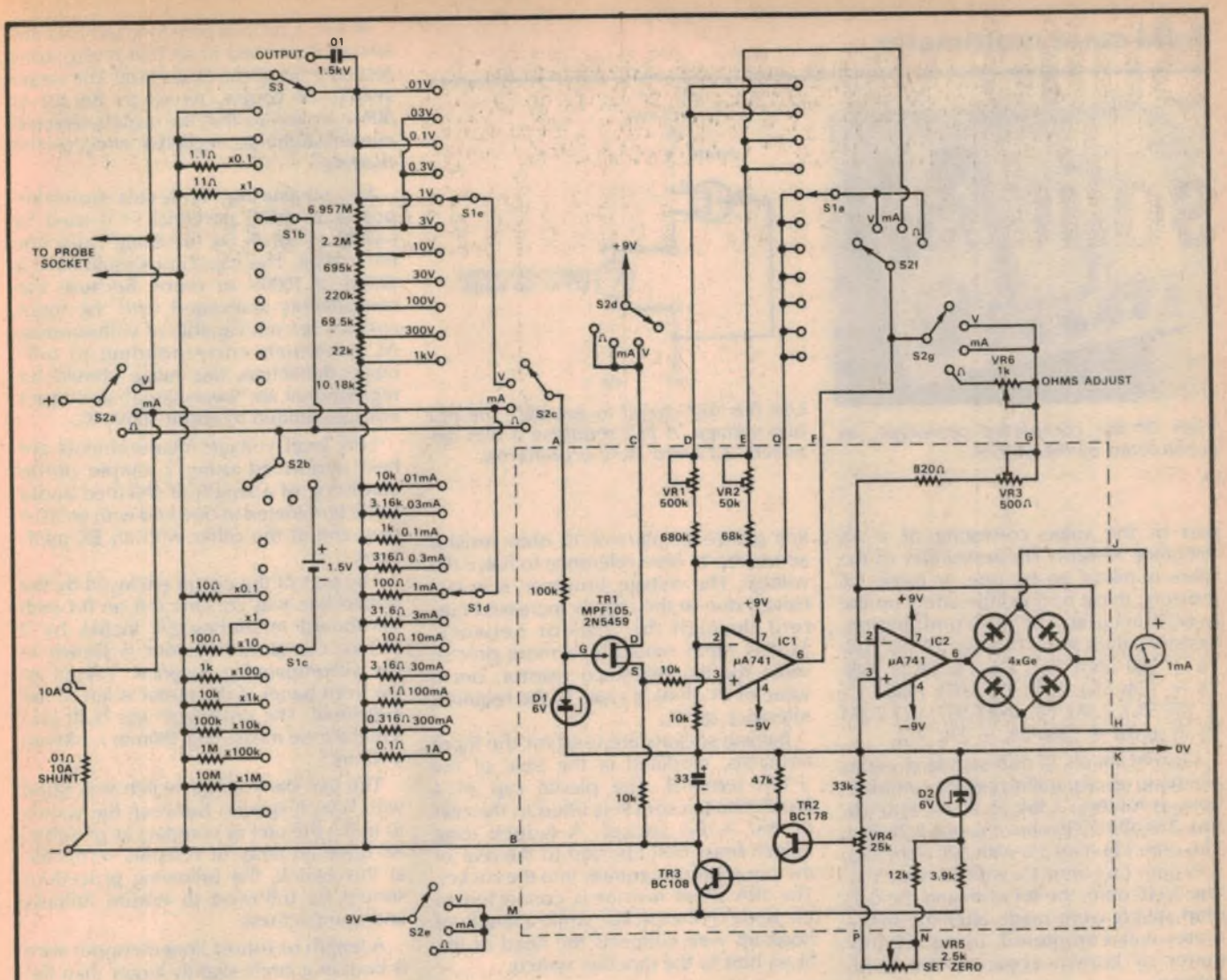
The two lower millivolt ranges, however, leave a little to be desired. This is because the gain bandwidth of a uA741 with a closed loop gain of 100 would be limited to less than 1kHz if one were unlucky enough to have a worst case IC in this position. On the other hand, a typical uA741 will hold a gain of 100 up to almost 9kHz.

The FET driving IC1 is connected in source follower configuration and presents negligible load to the high resistance voltage input attenuator. As the non-inverting input of IC1 is fed from

*17 Centaur St., Redcliffe, Queensland 4020.



This frontal view clearly shows the front panel details of the prototype.



The complete circuit diagram for the multimeter. The precision rectifier driving the meter is left in circuit for DC measurements.

the source of the FET, both points need to be at virtually 0V potential for the meter to show a zero reading. For this reason the negative supply for the FET has to be biased below 0V by the amount of voltage drop in its source resistor. Only a small current flows through the FET, so it will operate close to its gate-drain cut-off voltage.

The bias voltage for this purpose is supplied by a zener stabilised regulated supply in the negative line. Trimpot VR4 is a coarse adjustment of this bias voltage, providing a range from −2.2V to −4.3V, which should allow for the production spread of many 2N5459s.

A FET with a gate-source cut-off voltage from 4.3V to 5.4V can be accommodated by connecting the set zero point n directly to the junction of zener diode D2 and the 3.9k resistor, and by increasing the 33k resistor between the VR4 trimpot and 0V to 47k. The set zero pot may be shunted with a 3.9k resistor if the zero setting is found to be too sensitive. The setting of VR4 would then have to be readjusted.

Fig. 1 shows the test circuit used to establish the FET bias voltage.

A FET requiring a bias of much less than −2.5V would not be suitable as the negative going excursions of peaky AC waveforms could cause current cut-off in the FET, thereby clipping part of the waveform. The prototype has a bias voltage of −3V. The FET is protected from overload, excepting for very fast rise times, by the 100k resistor and zener diode D1. This diode should have a breakdown voltage of about twice the FET negative supply bias.

Potentiometer VR5 is for fine adjustment of the bias, and serves as the set zero pot. This pot is also used to determine the polarity of a DC input when in doubt. Clockwise rotation of the knob causes an increase in meter reading for a positive inputs and decrease for negative inputs.

Use of a uA740 with suitable input protection in place of the FET and IC1 was considered, but rejected on the grounds of cost. However, its use would have been advantageous by eliminating the need for a regulated power supply, which is the cause of some drift on the two lowest millivolt ranges. This is because minute changes in the emitter to base voltage of the BC178 and in the breakdown voltage of the regulating zener due to temperature variations are amplified 100 times by IC1.

On ranges where IC1 amplifies 10 times, the meter needle is quite stable after an initial warm-up time of about three minutes. During this time, the meter drifts by only 8% of full scale. Drift is negligible when IC1 is at unity gain.

Resistors used in the range switching section should preferably be of high stability and close tolerance. I used 5% resistors as a temporary measure and found that in all but a few cases their tolerance was of a much higher order, so much so in fact that they will probably become "temporarily permanent" in my own multimeter.

For the voltage input attenuator only 9 high tolerance resistances are required. Unusual values are made up of series combinations of resistors, the greatest

View of the completed prototype, as constructed by the author.

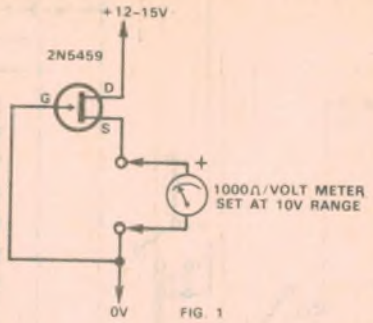


FIG. 1

Use this test circuit to establish the FET bias voltage. A FET requiring a bias between -2.2V and -4.3V is preferred.

part of the value consisting of a 1% tolerance resistor. The remainder of the value is made up by one or more 5% resistors, these having little effect on the overall accuracy of the combination. Resistor values are as follows: 10.18k (10k 1% + 180 ohm 5%), 22k 1%, 69.5k (68k 1% + 1.5k 5%), 220k 1%, 695k (680k 1% + 15k 5%), 2.2M 1%, and 6.957M (3 2.2M 1% in series + 330k 5% + 27k 5%).

Current shunts of non-standard values are made up of parallel resistor combinations as follows: 3.16k (3.3k 1% with 82k 5%), 316 ohm (330 ohm 1% with 8.2k 5%), 31.6 ohm (33 ohm 1% with 820 ohm 5%), 3.16 ohm (3.3 ohm 1% with 82 ohm 5%). The 0.316 ohm, the 0.1 ohm and the 0.01 ohm shunts were made after the multimeter was completed, using another meter of known accuracy for comparison.

Resistance ranges from R x 1M to R x 10 ohms are of conventional design. The two lower resistance ranges operate differently, necessitating an extra switch bank. They work in an almost constant current mode, with the unknown resistor to be measured lowering the voltage drop across the 11 ohm or the 1.1 ohm reference resistor, depending on the range selected. These two values of resistance are made up of parallel pairs of resistors, each twice the required value.

A closer look at one of the resistance ranges, eg. R x 1 ohm, will reveal that the 1.5V cell passes current through the series connected 11 ohm and 100 ohm resistors which act as a voltage divider. One tenth of the battery voltage appears across the 11 ohm resistor and also across the test leads and the FET input. IC1 amplifies this by a factor of 10 to 1.5V, which is sufficient to bring the meter to full scale using the 1k ohms adjust pot VR6.

An unknown resistor across the test leads reduces the voltage across the 11 ohm resistor, causing the meter reading to drop by a like amount. As the scale reading for the resistance range has 10 at its mid-point, it would seem wrong at first glance to place a 10 ohm resistor across the 11 ohm reference to halve the voltage. The voltage, however, is in fact halved due to the slightly increased current through the resistor network. 11.1111 ohms would be a more precise value for the reference resistor, but a value of 11 ohms is close to the required tolerance of 1%.

Banana sockets are used for the input terminals, modified in the case of the +10A terminal. The plastic cap of a fourth banana socket is fitted to the rear of the +10A socket. A ¼-inch long ⅛-inch brass bolt epoxied to the rear of the cap projects centrally into the socket. The 10A shunt resistor is connected to the body of the socket, while a length of hook-up wire connects the head of the brass bolt to the function switch.

In use, a banana plug inserted into this socket is pressed in so that it also contacts the tip of the brass bolt. The range switch, of course, needs to be set at 30mA or less so that the switch-selected current shunt has negligible effect on the reading.

For measuring AC levels superimposed on a DC potential S3 is used to switch a 0.01uF DC blocking capacitor into circuit. This capacitor should have a rating of 1000V or more. Because the components associated with the input circuitry are not capable of withstanding AC potentials corresponding to full-range deflection, this range should be regarded as an "over-range" and input voltages limited to about 500V AC.

Low level voltage measurements are best performed using a simple probe consisting of a length of shielded audio cable terminated at one end with an RCA plug and at the other with an EZ mini-hook.

The part of the circuit enclosed by the dotted line was constructed on 0.1-inch Veroboard measuring 3¾ inches by 2 inches. Component layout is shown in the accompanying diagram. Layout of the front panel of the meter is left to the individual. The prototype was built into a metal case measuring 190mm x 140mm x 65mm.

The five bank range switch was fitted with ¼-inch spacers between the wafers to make the unit as compact as possible. As quite an array of resistors terminate at this switch, the following procedure should be followed to ensure tidiness and compactness.

A length of robust tinned copper wire is bent in a circle slightly larger than the

LIST OF COMPONENT PARTS

SEMICONDUCTORS
- 2 uA741C ICs
- 1 BC178 or similar silicon transistor
- 1 BC109 or similar silicon transistor
- 1 Zener diode (D2) BZY96/C6V2
- 1 Zener diode (D1) see text
- 4 OA95 or similar germanium diodes

RESISTORS (¼ or ½W, 5%)
1 82 ohm, 1 180 ohm, 2 820 ohm, 1 1.5k, 1 3.9k, 1 8.2k, 3 10k, 1 12k, 1 15k, 1 27k, 1 33k, 1 47k, 1 68k, 1 82k, 1 100k, 1 330k, 1 680k

POTENTIOMETERS
1 500 ohm trimpot, 1 50k trimpot, 1 500k trimpot, 1 25k trimpot (multi-turn type preferred), 1 1k lin. rotary, 1 2k or 2.5k lin. rotary

RESISTORS (¼ or ½W, 1%)
1 1 ohm, 2 2.2 ohm, 1 3.3 ohm, 2 10 ohm, 2 22 ohm, 1 33 ohm, 2 100 ohm, 1 330 ohm, 2 1k, 1 3.3k, 3 10k, 1 22k, 1 68k, 1 100k, 1 220k, 1 680k, 1 1M, 4 2.2M, 1 10M, (1 0.316 ohm, 1 0.1 ohm, 1 0.01 ohm, see text)

CAPACITORS
- 1 33uF/10V electrolytic
- 1 0.01uF/1000V polycarbonate

SWITCHES
- 1 1 pole 11 position 3 section rotary
- 1 1 pole 11 position 2 section rotary (combine with above to make 5 section switch)
- 1 3 pole 4 position 3 section rotary
- 1 slide or toggle switch, 240V rating

MISCELLANEOUS
- 1 0-1mA meter movement, 118mm, 100 ohms with suitable scale.
- 1 piece 0.1in Veroboard, 3¾in x 2in
- 1 socket RCA M698 (probe)
- 2 pointer knobs
- 2 small round knobs
- 4 banana sockets
- 10 ¼in long brass spacers
- 1 9V battery, No. 2512
- 1 battery plug to suit above
- 1 case (size to suit)
- 1 1½V size C cell

Screws, solder, hookup wire, Letraset

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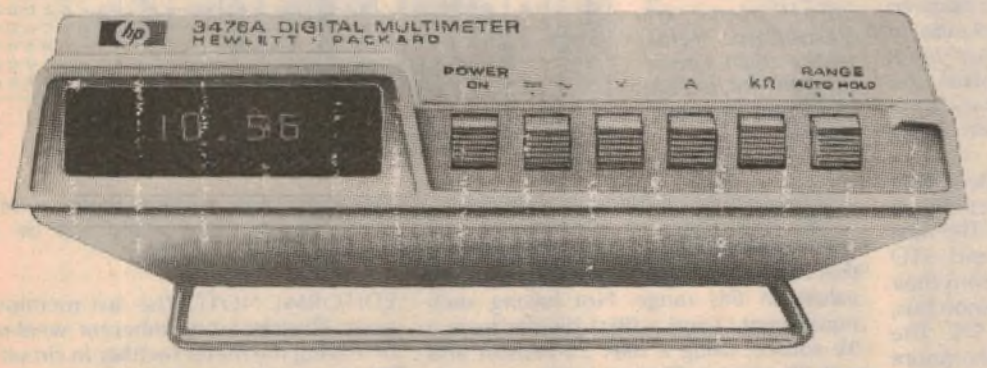

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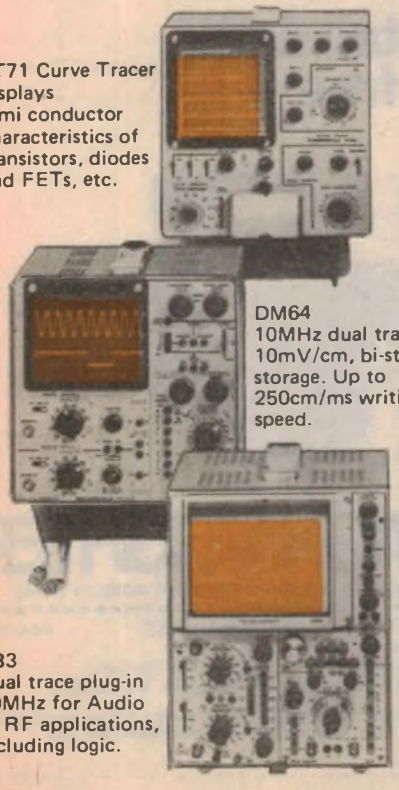

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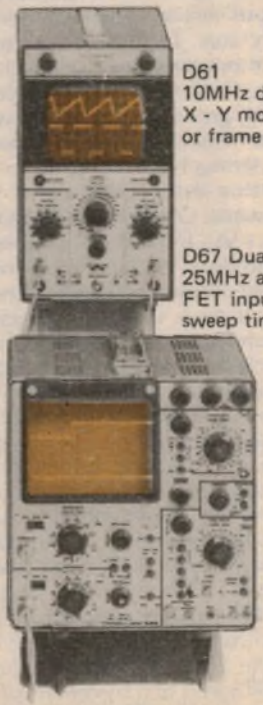

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switch clicker plate. This wire will become the common bus for all the shunts, except for the voltage input attenuator, and must be insulated from the body of the switch. Four narrow pieces of insulating material are epoxied radially to the mounting thread side of the clicker plate, so that about 6mm projects past the edge of the plate. The common bus is then epoxied to these projections so that it is clear of the clicker plate.

S1A is the wafer nearest to the clicker plate, and inter-terminal connections on this wafer should be made first. The next three wafers are S1B, S1C and S1D respectively, and the resistors from their terminals all connect to the common bus, as does the 10.18k pair from S1E. The other voltage attenuator resistors mount either around the edge of the fifth wafer or just above its surface.

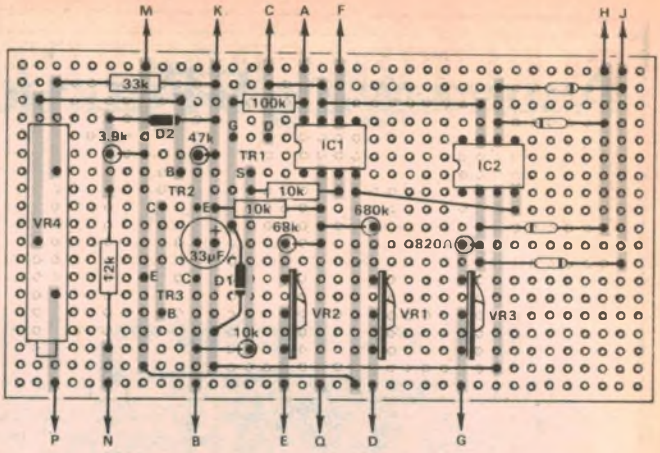
As a safety precaution, it is advisable to have all wiring and circuitry fully floating and not connected in any way to the case. This will ensure that there is less likelihood of danger to the user in situations requiring measurements of the power mains. On those occasions when it is necessary to have the internal circuitry shielded by an "earthed" case, a jumper lead terminated with small alligator clips can be connected from the case to the negative test lead.

The wiring layout for interconnection of the various sections and switches is left to the individual. To facilitate wiring and checking afterwards, use a colour code system, eg., blue wiring for all voltage input wiring, green for all current wiring, and so on. Check all wiring carefully before switching on.

The setting-up procedure is quite straightforward. Connect a current meter into the +9V line and, if possible, another into the −9V line. Select the 10V range on the constructed multimeter and switch on. If all is well, neither current meter should read more than 8mA.

On switch-on, it is most likely that the multimeter needle will be driven hard over to the end of the scale. Adjust trimpot VR4 such that the needle returns to zero. Turn the function switch to mA, centralise the set zero pot, and readjust VR4 to zero the meter needle. Current in the +9V and the −9V lines should now be about 4mA and 4.8mA respectively.

Calibration is effected using an accurate meter for comparison and, preferably, a variable power supply. After checking the zero setting, the 1V range must be calibrated first by means of VR3. For the 1mA range, both sets of meter leads are connected in series with about a 10k resistor in circuit to limit the current. Bring up the power supply voltage so that the reference meter reads 1mA and adjust VR2 for full scale deflection.



At right is the component layout diagram for the small piece of Veroboard. Refer to the main circuit diagram for details of external connections.

The 10mV range is adjusted by VR1 and is calibrated from any suitable source that can provide and accurately indicate values in this range. Not having such equipment I used a 101:1 divider from a 1V source, using a 100k 2% resistor and a 1k 2% resistor. The test leads were connected across the 1k resistor and, to compensate for the 101:1 divider so made, the meter needle was brought up to 99% of full scale.

The meter is now ready for use. A word of warning concerning operation however. Be wary when testing for leakage current in capacitors on the 10uA range. If the voltage source used for the test is not rock steady, the residual ripple voltage can cause a slight meter reading, even though there might not be any leakage in the capacitor.

EDITORIAL NOTE. The last mentioned point illustrates one inherent weakness of leaving the meter rectifier in circuit for DC measurements. When attempting to measure a DC voltage on which an AC signal has been superimposed, it will be impossible for the meter to distinguish between the two components, and an incorrect reading will be displayed. Constructors involved in measurements of this type may care to modify the switching so that the unit functions as a true DC-only meter when DC voltage ranges are selected.

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Logic convention & laws

To design digital circuits in general, and logic circuits in particular, it is almost essential to have a sound grasp of two important subjects. One is logic polarity convention, which determines the function actually performed by a circuit module. The other is the laws of logic, which are usually defined symbolically as the axioms of Boolean Algebra.

by JAMIESON ROWE

In chapter 2, you may recall, we noted that there is no fixed and immutable relationship between logical quantities or values and the electrical values or events used to represent them. The relationship may be chosen at will, and varied as desired, in order to achieve a desired logic function in the most efficient manner.

The relationship chosen and assigned to a particular circuit or part of a circuit is described as the "logic convention". There are two main logic conventions, one more or less the opposite of the other. These are defined in terms of the logic values "truth" (1) and "falsity" (0), and the two electrical voltage levels which are assigned to correspond to them.

If the more positive of the voltages—the "high" level—is taken to represent 1, and the more negative or "low" level to represent 0, this is described as the "positive logic convention". Not surprisingly if the opposite scheme is used, with 1 represented by the low voltage level and 0 by the high voltage level this is described as the "negative logic convention".

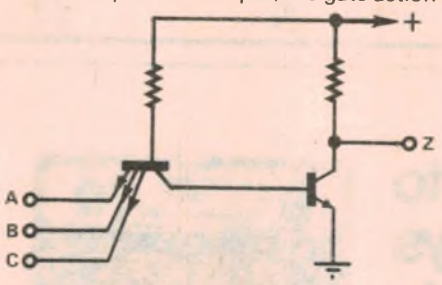
A particular logic circuit may use the positive convention throughout, the negative convention throughout, or a combination of the two. In fact the third of these possibilities is the most common, as it tends to allow the most simplification of the circuitry.

The point to grasp here is that we are entirely free to assign logic conventions as we may see fit, varying them where necessary. And as noted in chapter 2, the logic convention we use determines the logical function performed by any particular circuit module such as a gate.

In short, gates DO NOT have a fixed logic function, contrary to what you may have been led to believe by over-simplified explanations, or by the practice of manufacturers who often give gates a nominal logic function (usually the function corresponding to the positive logic convention).

This is a very important point, and deserves further emphasis. If you look at the top of Fig. 1 you will see a basic TTL gate. The electrical operation of this circuit is such that the output voltage is high (more positive) if any of the inputs is taken low (more negative). The output goes low (more negative) only when all of the inputs are high (more positive).

From this it should be fairly clear that if we adopt the positive logic convention for both inputs and output, the gate action



CONVENTION ADOPTED		FUNCTION PERFORMED
INPUTS	OUTPUT	
+	+	NAND
−	−	NOR
+	−	AND
−	+	OR

FIG. 1

will correspond to the NAND function. And this is the nominal logic description often given to the gate in manufacturers' literature. But it is really only one of the possibilities.

If we choose to adopt the negative convention at both inputs and output, for example, the gate action will now correspond to the NOR function. But we can also choose to adopt the positive convention at the inputs, and the negative convention at the output—in which case the gate will effectively change into an AND gate. And last but not least, we can adopt the negative convention at the inputs, and the positive convention at the output, when it will become an OR gate.

The four possibilities are summarised in the table in Fig. 1, to help you to visualise the concepts involved.

By the way, don't confuse logic convention with power supply earthing. some logic circuits use an earthed negative supply rail, while others use an earthed positive rail. But this doesn't alter the logic convention, because voltage "high" is taken to mean the same as "more positive", and "low" to mean "more negative". It is therefore, quite feasible to use the positive logic convention in a system having an earthed positive rail, and vice-versa.

Hopefully you can see now why logic convention is important, because of its effective control over the exact logic function performed by a gate or other element. By choosing a suitable logic convention we can make a gate perform almost any desired logic function, and we can change the function a gate performs merely by assigning different logic conventions to its inputs and output.

Some readers may have already realised that this tremendous flexibility stems from the fact that logic functions like AND and OR are really only the opposite sides of the same logical "coin". If you like, AND and OR are merely different ways of looking at the same logical reality. They are in fact capable of being substituted for one another in some situations, providing one follows certain well-defined logical rules or "laws".

It is very worthwhile having a basic knowledge of these laws of logic, as they can help considerably when you are trying to simplify and rationalise logic circuits. They are usually defined symbolically, as algebraic expressions, and collectively they are known as the axioms of Boolean Algebra—in honour of George Boole.

Actually the law relating the AND and OR functions is known as the "law of duality" or "deMorgan's theorem", in honour of Boole's contemporary Augustus deMorgan. It is defined symbolically by the two expressions:

$$\overline{(A + B)} = \bar{A} \cdot \bar{B} \quad \ldots(1)$$

$$\text{and } \overline{(A \cdot B)} = \bar{A} + \bar{B} \quad \ldots(2)$$

In words, these define the theorem in terms of two complementary aspects. Expression (1) says that the logical complement of an OR function between two or more terms is equivalent to an AND function between the individual comple-

ments of the original terms. Expression (2) says that the dual of this is also true, that the logical complement of an AND function between two or more terms is equivalent to an OR function between the individual complements of the original terms.

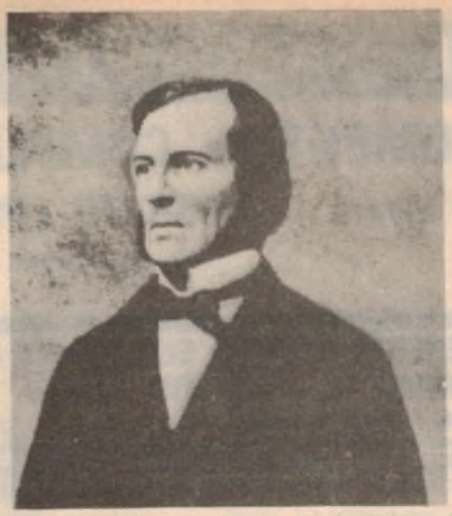
The axiomatic nature of deMorgan's theorem can be demonstrated using a truth table. The aspect expressed by expression (1) can be demonstrated by the following table:

ORIGINAL TERMS		COMPLEMENTS		COMPOSITE FUNCTIONS		
A	B	$\bar{A}$	$\bar{B}$	A+B	$\overline{(A+B)}$	$\bar{A}\,\bar{B}$
0	0	1	1	0	1	1
0	1	1	0	1	0	0
1	0	0	1	1	0	0
1	1	0	0	1	0	0

as you can see, the last two columns have identical truth values in all rows, showing that the two functions concerned are in the logical sense identical.

A similar truth table can be drawn to demonstrate the axiomatic nature of expression (2). You may care to do this, as the exercise will help reinforce your understanding of this very important theorem.

Incidentally, did you notice the technique we just used to see whether two logical functions were identical? We worked out their composite truth values for all truth value combinations of their terms, and compared them. If both functions have the same truth values for all combinations of the truth-values of their terms, then from a logical point of view they are identical and we are entitled to substitute one for the other whenever this is convenient.



George Boole, the 19th century mathematician whose "laws of thought" formed the basis of modern Boolean Algebra.

Another two important laws of Boolean Algebra are known as the "laws of expansion". These are defined symbolically by the following two expressions:

$$(A \cdot B) + (A \cdot \bar{B}) = A \quad \ldots\ldots (3)$$

$$(A + B) \cdot (A + \bar{B}) = A \quad \ldots\ldots (4)$$

What expression (3) says is that if we have an OR function involving two composite AND terms, and the two AND terms are identical apart from one having a term B, and the other its complement B-bar, then the term B is really redundant—so that the overall OR function is equivalent to the remaining common terms of the two AND functions.

Similarly expression (4) says that if we have an AND function involving two composite OR terms, and the OR terms are identical apart from one having a term B, and the other its complement B-bar, then the term B is again redundant and the overall AND function may be reduced to the remaining common term(s) of the two OR functions.

Again it is possible to demonstrate that these are in fact axiomatic laws, by means of a truth table. Here is the truth table for the law of expression (3):

A	B	$\bar{B}$	A.B	$A\bar{B}$	$(A.B)+(A\bar{B})$
0	0	1	0	0	0
0	1	0	0	0	0
1	0	1	0	1	1
1	1	0	1	0	1

here you can see that the first and last columns have identical truth values for all combinations, so that they are in fact logically identical. I suggest that you try drawing up a similar table to demonstrate for yourself that expression (4) is also axiomatic.

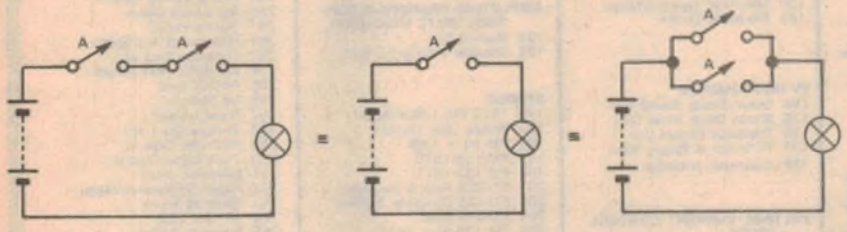


FIG 2

Two further laws of Boolean Algebra are known as the "laws of tautology". These are defined by the following expressions:

$$A + A = A \quad \ldots (5)$$

$$A \cdot A = A \quad \ldots (6)$$

Here expression (5) simply says that if we have an OR function involving two identical terms, we are simply stuttering, in that the function is logically equivalent to the duplicated term. Similarly expression (6) says that the same thing applies if we have an AND function involving two identical terms. In both cases we are entitled to replace the composite function by the duplicated term, as illustrated by the simple diagrams of Fig. 2.

You may care to verify these laws as before using truth tables, although they are fairly self-evident. This is also true with the remaining laws of Boolean Algebra, which we will now list briefly in their symbolic form:

The "laws of commutation" point out that the order of terms makes no difference in either the AND or OR functions:

$$A + B = B + A \quad \ldots (7)$$

$$A \cdot B = B \cdot A \quad \ldots (8)$$

The "laws of association" show that the order of carrying out successive functions of the same type is similarly unimportant:

$$(A + B) + C = A + (B + C) \quad \ldots (9)$$

$$(A \cdot B) \cdot C = A \cdot (B \cdot C) \quad \ldots (10)$$

The "laws of distribution" show that the AND and OR functions are distributive over each other:

$$A + (B \cdot C) = (A + B) \cdot (A + C) \quad \ldots (11)$$

$$A \cdot (B + C) = (A \cdot B) + (A \cdot C) \quad \ldots (12)$$

The "laws of absorption" show that both OR and AND functions which contain a common term are equivalent to that common term:

$$A + (A \cdot B) = A \quad \ldots (13)$$

$$A \cdot (A + B) = A \quad \ldots (14)$$

The "law of double negation" is simply a formal statement of the truism that a term is the complement of its complement, so that a double logical inversion restores the original term:

$$\text{not } (\bar{A}) = A \quad \ldots (15)$$

The definitions of the three final pairs of laws employ the symbols 1 and 0 to represent not just truth and falsity, but terms which are always true or always false respectively.

The "laws of the universe class" show that if one term of an OR function is always true, then the OR function itself is always true. Similarly if an AND function has one term which is always true, then the AND function is logically equivalent to the remaining term(s):

$$A + 1 = 1 \quad \ldots (16)$$

$$A \cdot 1 = A \quad \ldots (17)$$

This is illustrated by the simple diagrams of Fig. 3.

Conversely the "laws of the null class" show that an OR function in which one term is always false is equivalent to the remaining term(s), while an AND function in which one term is always false is itself always false:

$$A + 0 = A \quad \ldots (18)$$

$$A \cdot 0 = 0 \quad \ldots (19)$$

And finally the "laws of complementation" show that an OR function between

a term and its complement must always be true, while an AND term between a term and its complement must always be false:

$$A + \bar{A} = 1 \quad \ldots(20)$$
$$A \cdot \bar{A} = 0 \quad \ldots(21)$$

In other words, either a term is true, or its complement must be true. At least one of the two must be true, but they can't both be true.

These laws of Boolean Algebra may seem rather trite and academic, but if you intend doing much design of logic circuits it would be worthwhile becoming at least broadly familiar with them. They form the basis of techniques used to simplify circuits down to their simplest and most efficient logical form—techniques known as "minimalisation". We will look at such techniques and related matters in the next chapter.

Before we end the present discussion, however, there is one more fairly important point you should note. This is that because the logic function of circuit modules is dependent upon the logic polarity convention we assign, this makes it difficult to draw completely unambiguous logic diagrams. As a result, different people and organisations have evolved different ways of drawing them.

One approach is to represent all gates and other logic modules by a symbol which represents their nominal function according to the positive logic convention—regardless of the function they may be actually performing. This makes it easy to identify the module being used, but makes it relatively hard to follow the logic.

Another approach is to adopt the opposite scheme, changing the symbol used to represent each module according to the actual logic function it is performing. Not surprisingly this makes it easier to follow the logic, but it is harder to identify the types of module. For example many logic gates are packaged in multiples, in IC's, and it can be confusing if three electrically identical 3-input gates of an IC are represented on the logic diagram by three different symbols (because they are being used for different functions).

Where this sort of confusion could

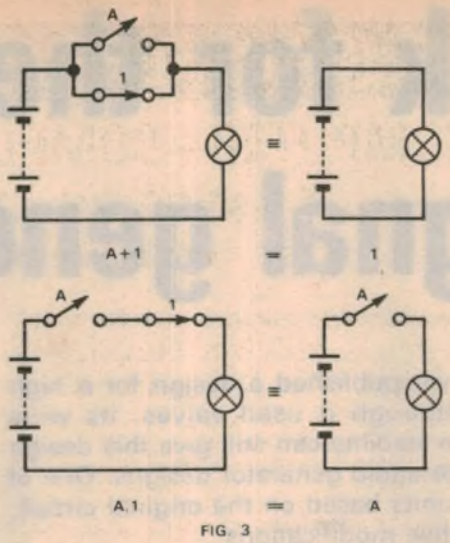


FIG. 3

occur, it can usually be avoided by using suitable identification labels such as "IC5a", "IC5b", etc. Providing this is done the "symbol according to function" approach is probably the more helpful of the two, and it is for this reason that we will be using the approach in this course.

However even with the "symbol by function" approach it is still difficult to represent all gate functions in a completely unambiguous manner. This is because the logic symbols in common use (those used here) do not distinguish between the internal logic functions performed by an element and the logic conventions at its terminals.

In particular the small circle or "bubble" is used by some people to indicate logical inversion or complementation within an element, and by others simply to indicate negative logic convention on input and output lines.

The symbols in Fig. 4 may make this clearer. The symbol in (a) is nominally that of a NAND gate, if the bubble is interpreted as part of the symbol itself. This symbol could therefore be used to represent the gate of Fig. 1 when the positive logic convention is assigned to both inputs and output.

But if we use the alternative meaning of the bubble, where it is merely an indicator that the negative logic convention applies to the line concerned, the same symbol can be used to represent the gate of Fig. 1 when it is performing the AND function.

Similarly the symbol in (b) could be used to represent the same gate when it is performing the OR function, with negative logic convention assigned to the inputs and positive logic convention to the output. Here again the bubbles at the inputs would not be seen as part of the gate itself, but as negative logic indicators on the input lines.

But we strike trouble if we try to represent the fourth application of the gate, with negative logic conventions at both inputs and output. Here it is a NOR element, which from a logical point of view involves inversion or complementation.

The trouble is, if we are already using the bubble to indicate negative logic convention at the output, we can't also use it as part of the NOR gate symbol—and

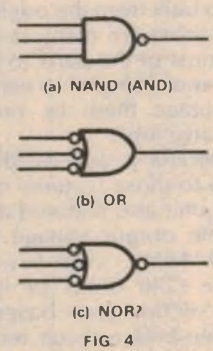


FIG. 4

vice-versa. And we can't simply use the symbol of Fig. 2(c), because this can be very misleading. It could mean that the gate performs the OR function with negative logic convention at both inputs and output, or that it performs the NOR function with positive logic at the output—and neither of these interpretations would be correct!

To resolve this sort of confusion it is really necessary to decide whether you are going to use bubbles to represent logical inversion, or negative logic convention—and then stick with your choice, at the same time stating your bubble interpretation on logic diagrams.

New look for the 1962 audio signal generator

Back in the February 1962 issue we published a design for a high performance audio generator. Although it used valves, its wide frequency range and good envelope stability can still give this design an edge over more recent solid state audio generator designs. One of our readers has built a number of units based on the original circuit, and here he gives details of worthwhile modifications.

by BERT TOOMEY*

*38 Bradbury Rd, Howick, New Zealand.

The generator described here is the third I have built from the original article. No doubt there are many readers who will have most of the parts to hand, and I trust this awakening of an earlier article may encourage them to, once again, tackle a "valve job".

This generator is well worth building. In addition to those features mentioned above, the unit also featured a switched and variable output voltage (between 1mV and 10V), and low output impedance (240 ohms or less). The oscillator section was based on the familiar Wien-bridge circuit, temperature stabilisation being achieved by an A54 thermistor.

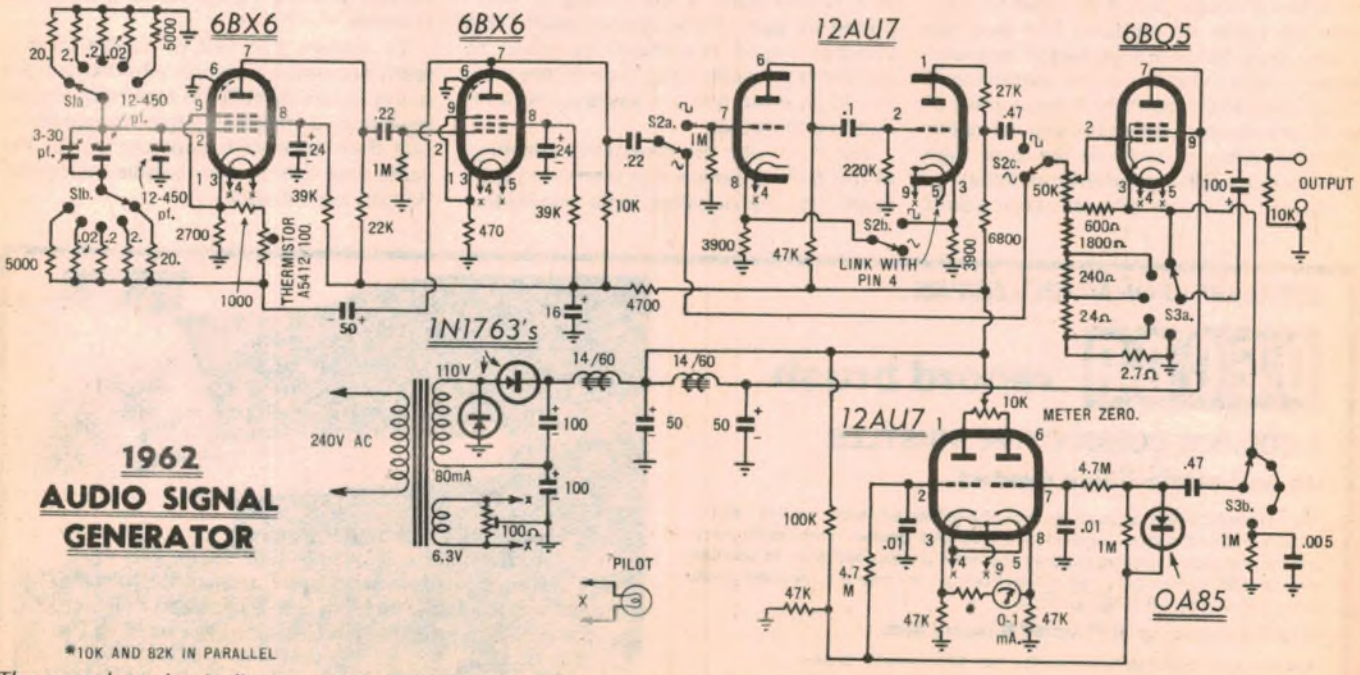
The revised instrument is housed in a cabinet measuring 195 x 160 x 210mm deep. Both the front panel and the chassis are made from 1.2mm thick aluminium. The front panel is secured to the chassis by the switch bushings. The rear of the chassis is supported by two screws, which are secured to the lip with nuts. These screws pass through the back of the case where they are again secured with nuts. PK screws could be used here, but it's a fiddle to get them in place.

Details of the front panel are shown in Fig. 1. The controls along the bottom are, from left to right: sine/square wave switch, range switch, and coarse attenuator. The knob below the meter is the fine output voltage control.

Chassis details are shown in Fig. 2. Holes marked B & C are 9.5 and 19mm diameter respectively. Leads connecting components above the chassis with those below are passed through holes marked lt.

Astute readers will notice that there are only four valve base holes; the arrows indicate valve base orientation viewed from above. The 12AU7 meter amplifier socket was mounted above the chassis on a printed circuit board, full size details of which are shown in Fig. 7. Leads marked T,U,V,W,X and Z are terminated as follows: T & W to meter zero, U & V to heaters, X to 0.47uF capacitor (s3b), and Z to B plus via a 100k resistor. Leads shown dotted are led out under the board.

The PC board was used because the mains transformer I employed had no heater winding, and the space was needed to accommodate the extra heater transformer. A centre tap was created by connecting two 22ohm resistors in series across the heater winding, their junction being connected to ground. Constructors having the correct transformer, should still employ the PC board, as it makes the below chassis space a little less cluttered.



The complete circuit diagram of the February 1962 audio signal generator.

Metalwork & detailed working diagrams

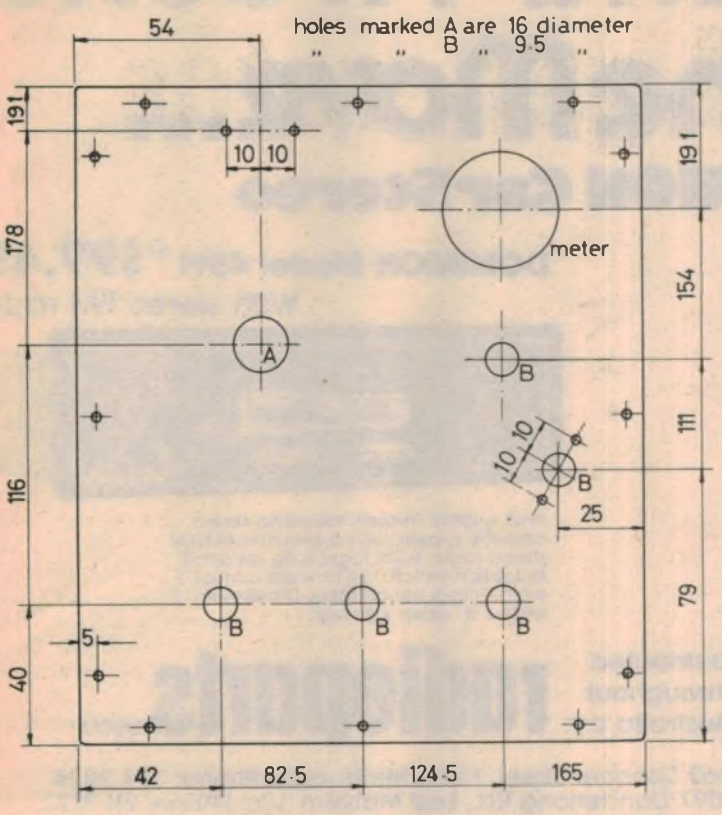


Fig:1. Front panel layout.

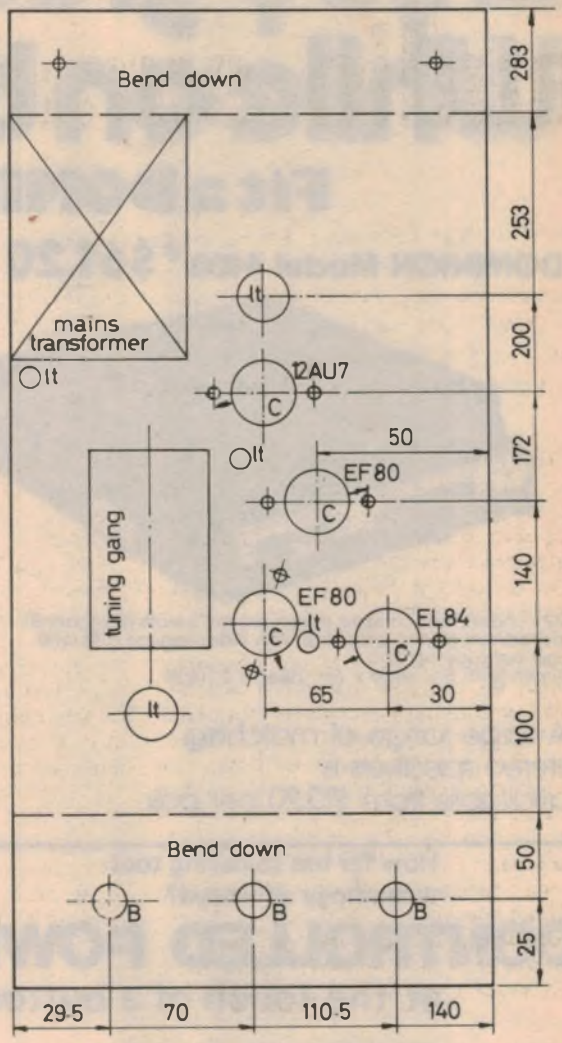


Fig:2 Chassis details.

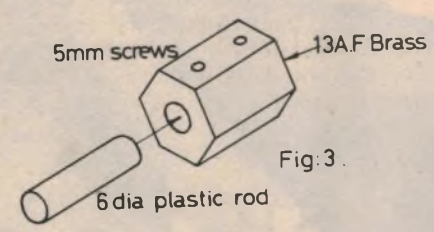


Fig:3.

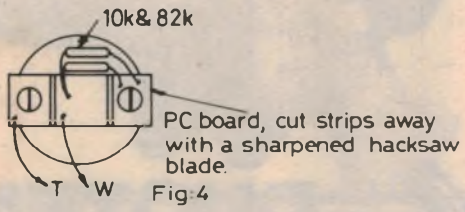


Fig:4

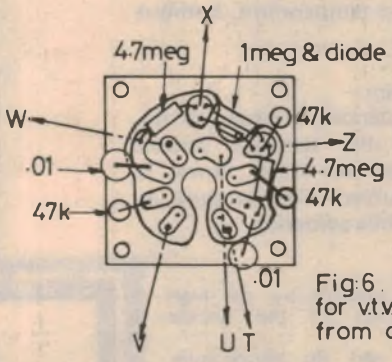


Fig:6. Half size detail for v.t.v.m. board, viewed from component side.

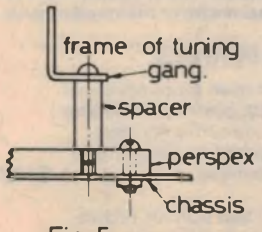


Fig: 5

EDITORIAL NOTE: As stated in the text, the signal generator described here is based on the design presented in the February 1962 issue, the circuit details being unaltered. For those readers who are interested, photostat copies of the original article are available through our Information Service. Details are given in the panel in the Information Centre at the back of the magazine.

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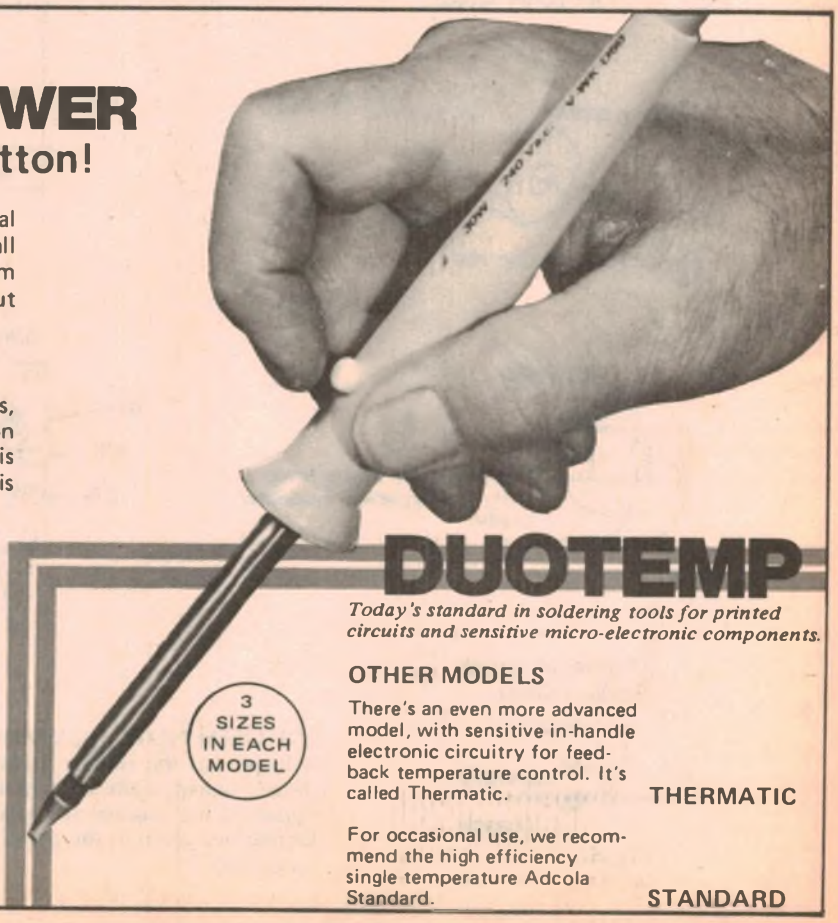

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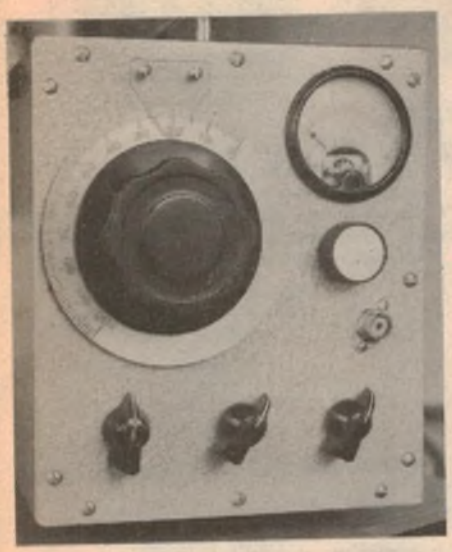
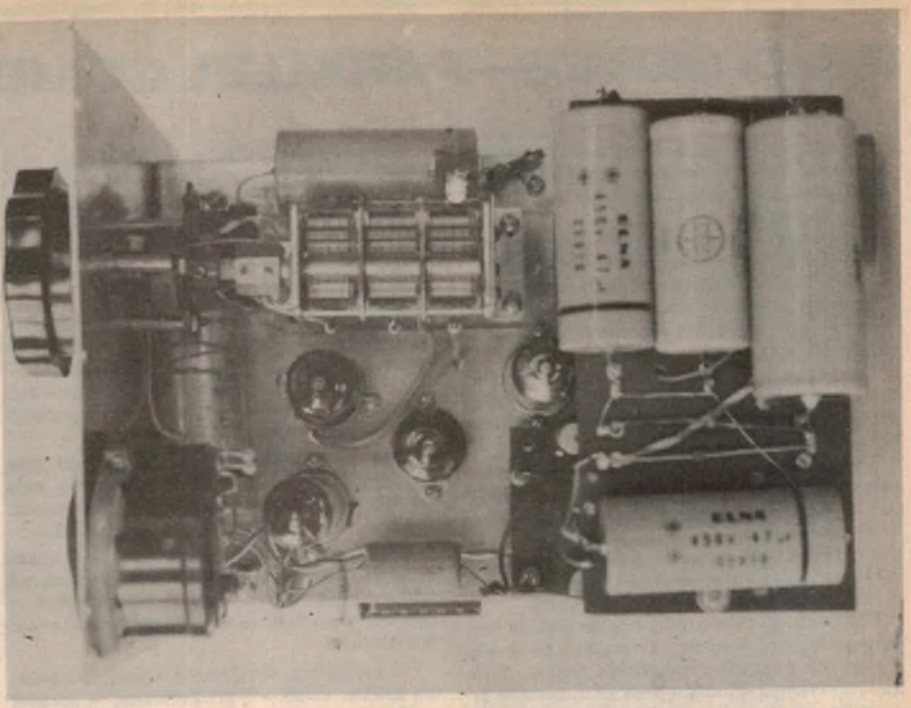
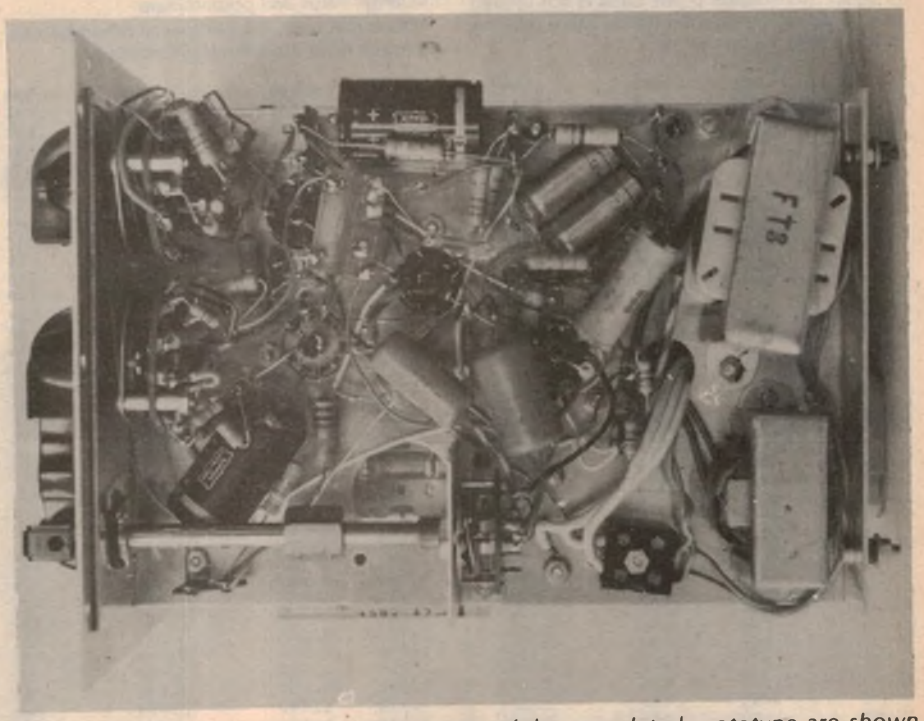


The completed audio signal generator as constructed by the author.

Fig. 7: actual size artwork for the PC board.





Above-chassis and under-the-chassis views of the completed prototype are shown at top and directly above respectively.

Power supply components were mounted on a piece of "industrial formica" secured to the top of the power transformer, with brackets made of aluminium. The formica used was 1.2mm thick. The far end of this board is supported by a length of threaded rod (see photos). The meter zero control is mounted underneath this assembly, being adjusted with a screwdriver through the rear of the cabinet.

Screen decoupling capacitors were mounted as close to the valves as possible, while the 50uF feedback capacitor was mounted above chassis next to the gang. In the original design, the variable capacitor was screened in a copper box, but no problems have been encountered by omitting this. Two sections of a three gang unit were used, as this happened to be available.

Note that the 100uF output capacitor is wholly "above ground", and metal case types should be insulated with electrical tape. This capacitor is mounted above the chassis, underneath the meter. The tuning gang is also insulated from the chassis. If insulated pillars are not available, the system shown in Fig. 5 will do. Make sure that the screws which are threaded into the perspex are cut short so as not to touch the chassis.

To connect the variable capacitor with the vernier dial, a simple insulated coupling was made. This is shown in Fig. 3. A similar coupling was used to connect the sine/square wave switch with its drive shaft. The bushing which carries this shaft through the front panel, was made from a discarded potentiometer.

Ventilation is important, as the thermistor is temperature sensitive. This was achieved by punching 60 6.5mm holes in the back of the cabinet. Holes could also be cut in the bottom of the case. Don't forget to mount the thermistor well away from heat producing components. Fig. 4 shows the method of mounting the shunt resistors on the back of the meter. Try to obtain a meter with a small boss. Too large a meter may foul the lip of the cabinet.

As a final comment, let me point out that the 1% resistors in the frequency determining circuit are a must if low distortion sine waves are to be expected.

R & C: SERIES—PARALLEL COMBINATIONS

Calculating the value of resistors in parallel — or capacitors in series — has always been an irksome task, particularly when it is tackled only occasionally.

Even more difficult is the task of producing a non-standard value using the most logical or convenient combinations of preferred values. How many possible combinations, in series or parallel, are there for any nominated final value?

Calculations of this magnitude can become quite cumbersome and, as a result, a convenient, but not immediately obvious, combination can be easily overlooked.

The accompanying computer-prepared table was designed to overcome this. It was submitted by Mr Thomas Hain and formed the basis of an article which we originally published in June 1975. We are re-presenting it in more compact form for the benefit of those who wish to display it in a workshop or laboratory.

The table gives, in numerical order, all the values between one and 10 that can be made up with two standard (preferred) values, from the 10% range, connected either in parallel or in series. Usefulness of the table is not limited to one decade, since the whole table may be multiplied by factors of 10.

To limit the number of combinations to a reasonable and justifiable figure, the constraint was applied that the ratio of the two values be no greater than 100:1 or less than 1:100. The table gives values which are, on average, 0.36% apart, and there are normally several combinations from which to choose.

Although originally composed for resistors only, there is no reason why the table cannot be used for capacitors as well. The letters "S" or "P" which follow the wanted numbers signify series or parallel resistors. For capacitors this instruction is simply reversed.

When two components are combined, due regard should be given to the tolerances, temperature coefficients etc, of each component, and their combined effect on the final value.

Where two unequal resistors are connected in series, the influence of the larger value will predominate. When they are connected in parallel, the influence of the smaller value will predominate.

For capacitors, the reverse is true: in series, the smaller value will predominate; in parallel the larger value will predominate.

More precisely, the composite tolerance can be found from the following formulas:

For series resistors:

$$T = \frac{T_1R_1 + T_2R_2}{R_1 + R_2}$$

Where:

T is the composite tolerance

T_1 is the tolerance figure for R_1

T_2 is the tolerance figure for R_2

For example, suppose we connect a 100 ohm, 10%, resistor in series with a 1000 ohm 1% resistor; what is the composite tolerance?

$$T_1 = \frac{(10 \times 100) + (1 \times 1000)}{100 + 1000}$$

$$= \frac{2000}{1100}$$

$$= 1.8\%$$

(This formula could also be used for capacitors in parallel.)

For parallel resistors:

$$T = \frac{T_1/R_1 + T_2/R_2}{1/R_1 + 1/R_2}$$

(This formula could be used for capacitors in series.)

1.000 S	.000	1.000	
1.010 S	.330	.680	
1.010 S	.010	1.000	
1.012 S	.012	1.000	
1.015 S	.015	1.000	
1.018 S	.018	1.000	
1.020 P	1.200	6.800	
1.022 S	.022	1.000	
1.027 S	.027	1.000	
1.030 S	.470	.560	
1.031 P	1.500	3.300	
1.033 S	.033	1.000	
1.039 S	.039	1.000	
1.040 S	.220	.820	
1.047 P	1.200	8.200	
1.047 S	.047	1.000	
1.056 S	.056	1.000	
1.068 S	.068	1.000	
1.070 S	.390	.680	
1.071 P	1.200	10.000	
1.080 P	1.800	2.700	
1.082 S	.082	1.000	
1.083 P	1.500	3.900	
1.090 S	.270	.820	
1.091 P	1.200	12.000	
1.100 S	.100	1.000	
1.100 P	2.200	2.200	
1.111 P	1.200	15.000	
1.120 S	.120	1.000	
1.120 S	.560	.560	
1.125 P	1.200	18.000	
1.137 P	1.500	4.700	
1.138 P	1.200	22.000	
1.149 P	1.200	27.000	
1.150 S	.330	.820	
1.150 S	.150	1.000	
1.150 S	.470	.680	
1.158 P	1.200	33.000	
1.164 P	1.200	39.000	
1.165 P	1.800	3.300	
1.170 P	1.200	47.000	
1.175 P	1.200	56.000	
1.179 P	1.200	68.000	
1.180 S	.180	1.000	
1.183 P	1.200	82.000	
1.193 P	1.500	5.600	
1.196 P	1.200	100.000	
1.198 P	1.200	120.000	
1.200 S	.000	1.200	
1.210 S	.390	.820	
1.212 S	.012	1.200	
1.212 P	2.200	2.700	
1.215 S	.015	1.200	
1.218 S	.018	1.200	
1.220 S	.220	1.000	
1.222 S	.022	1.200	
1.227 S	.027	1.200	
1.229 P	1.500	6.800	
1.232 P	1.800	3.900	
1.803 P	2.200	10.000	
1.818 S	.018	1.800	
1.820 S	.820	1.000	
1.822 P	2.700	5.600	
1.822 S	.022	1.800	
1.827 S	.027	1.800	
1.830 S	.330	1.500	
1.833 S	.033	1.800	
1.839 S	.039	1.800	
1.847 S	.047	1.800	
1.856 S	.056	1.800	
1.859 P	2.200	12.000	
1.868 S	.068	1.800	
1.880 S	.680	1.200	
1.882 S	.082	1.800	
1.890 S	.390	1.500	
1.900 S	.100	1.800	
1.919 P	2.200	15.000	
1.920 S	.120	1.800	
1.933 P	2.700	6.800	
1.939 P	3.300	4.700	
1.950 S	.150	1.800	
1.950 P	3.900	3.900	
1.960 P	2.200	18.000	
1.970 S	.470	1.500	
1.980 S	.180	1.800	
2.000 P	2.200	22.000	
2.000 S	1.000	1.000	
2.020 S	.220	1.800	
2.020 S	.820	1.200	
2.031 P	2.700	8.200	
2.034 P	2.200	27.000	
2.060 S	.560	1.500	
2.063 P	2.200	33.000	
2.070 S	.270	1.800	
2.076 P	3.300	5.600	
2.093 P	2.200	39.000	
2.102 P	2.200	47.000	
2.117 P	2.200	56.000	
2.126 P	2.700	10.000	
2.130 S	.330	1.800	
2.131 P	2.200	68.000	
2.131 P	3.900	4.700	
2.145 P	2.200	82.000	
2.153 P	2.200	100.000	
2.160 P	2.200	120.000	
2.168 P	2.200	150.000	
2.173 P	2.200	180.000	
2.179 P	2.200	220.000	
2.180 S	.680	1.500	
2.190 S	.390	1.800	
2.200 S	.000	2.200	
2.200 S	1.000	1.200	
2.204 P	2.700	12.000	
2.222 P	3.300	6.800	
2.222 S	.022	2.200	
2.227 S	.027	2.200	
2.233 S	.033	2.200	
2.239 S	.039	2.200	
3.260 P	3.300	270.000	
3.267 P	3.300	330.000	
3.300 S	.000	3.300	
3.300 S	1.500	1.800	
3.313 P	3.900	22.000	
3.328 P	5.600	8.200	
3.333 S	.033	3.300	
3.339 S	.039	3.300	
3.347 S	.047	3.300	
3.356 S	.056	3.300	
3.368 S	.068	3.300	
3.377 P	4.700	12.000	
3.380 S	.680	2.700	
3.382 S	.082	3.300	
3.400 S	.100	3.300	
3.400 S	1.200	2.200	
3.400 P	6.800	6.800	
3.408 P	3.900	27.000	
3.420 S	.120	3.300	
3.450 S	.150	3.300	
3.480 S	.180	3.300	
3.489 P	3.900	33.000	
3.520 S	.820	2.700	
3.520 S	.220	3.300	
3.545 P	3.900	39.000	
3.570 S	.270	3.300	
3.579 P	4.700	15.000	
3.590 P	5.600	10.000	
3.600 S	1.800	1.800	
3.601 P	3.900	47.000	
3.630 S	.330	3.300	
3.646 P	3.900	56.000	
3.688 P	3.900	68.000	
3.690 S	.390	3.300	
3.700 S	1.000	2.700	
3.700 S	1.500	2.200	
3.717 P	6.800	8.200	
3.723 P	3.900	82.000	
3.727 P	4.700	18.000	
3.754 P	3.900	100.000	
3.770 S	.470	3.300	
3.777 P	3.900	120.000	
3.801 P	3.900	150.000	
3.817 P	3.900	180.000	
3.818 P	5.600	12.000	
3.832 P	3.900	220.000	
3.844 P	3.900	270.000	
3.854 P	3.900	330.000	
3.860 S	.560	3.300	
3.861 P	3.900	390.000	
3.873 P	4.700	22.000	
3.900 S	1.200	2.700	
3.900 S	.000	3.900	
3.934 S	.039	3.900	
3.947 S	.047	3.900	
3.956 S	.056	3.900	
3.968 S	.068	3.900	
3.980 S	.680	3.300	
3.982 S	.082	3.900	
5.638 P	6.800	33.000	
5.656 S	.056	5.600	
5.668 S	.068	5.600	
5.682 S	.082	5.600	
5.700 S	1.000	4.700	
5.700 S	.100	5.600	
5.700 S	1.800	3.900	
5.720 S	.120	5.600	
5.750 S	.150	5.600	
5.780 S	.180	5.600	
5.790 P	6.800	39.000	
5.820 S	.220	5.600	
5.870 S	.270	5.600	
5.900 S	1.200	4.700	
5.930 S	.330	5.600	
5.941 P	6.800	47.000	
5.974 P	8.200	22.000	
5.990 S	.390	5.600	
6.000 S	2.700	3.300	
6.000 P	10.000	15.000	
6.000 P	12.000	12.000	
6.064 P	6.800	56.000	
6.070 S	.470	5.600	
6.100 S	2.200	3.900	
6.160 S	.560	5.600	
6.182 P	6.800	68.000	
6.200 S	1.500	4.700	
6.279 P	6.800	82.000	
6.280 S	.680	5.600	
6.290 P	8.200	27.000	
6.367 P	6.800	100.000	
6.420 S	.820	5.600	
6.429 P	10.000	18.000	
6.435 P	6.800	120.000	
6.500 S	1.800	4.700	
6.505 P	6.800	150.000	
6.552 P	6.800	180.000	
6.568 P	8.200	33.000	
6.596 P	6.800	220.000	
6.600 S	3.300	3.300	
6.600 S	2.700	3.900	
6.600 S	1.000	5.600	
6.633 P	6.800	270.000	
6.663 P	6.800	330.000	
6.667 P	12.000	15.000	
6.683 P	6.800	390.000	
6.703 P	6.800	470.000	
6.718 P	6.800	560.000	
6.733 P	6.800	680.000	
6.775 P	8.200	39.000	
6.800 S	1.200	5.600	
6.800 S	.000	6.800	
6.868 S	.068	6.800	
6.875 P	10.000	22.000	
6.882 S	.082	6.800	
6.900 S	.100	6.800	
6.900 S	2.200	4.700	
6.920 S	.120	6.800	
6.950 S	.150	6.800	

R & C: SERIES—PARALLEL COMBINATIONS

1.233	S	.033	1.200
1.239	S	.039	1.200
1.240	S	.560	.680
1.247	S	.047	1.200
1.256	S	.056	1.200
1.268	S	.068	1.200
1.269	P	1.500	4.200
1.270	S	.270	1.000
1.282	S	.082	1.200
1.290	S	.470	.820
1.300	S	.100	1.200
1.302	P	1.800	4.700
1.304	P	1.500	10.000
1.320	S	.120	1.200
1.320	P	2.200	3.300
1.330	S	.330	1.000
1.333	P	1.500	12.000
1.350	S	.150	1.200
1.350	P	2.700	2.700
1.360	S	.680	.680
1.362	P	1.800	5.600
1.364	P	1.500	15.000
1.380	S	.180	1.200
1.380	S	.560	.820
1.385	P	1.500	18.000
1.390	S	.390	1.000
1.404	P	1.500	22.000
1.407	P	2.200	3.900
1.420	S	.220	1.200
1.421	P	1.500	27.000
1.423	P	1.800	6.800
1.435	P	1.500	33.000
1.444	P	1.500	33.000
1.454	P	1.500	47.000
1.461	P	1.500	56.000
1.468	P	1.500	68.000
1.470	S	.270	1.200
1.470	S	.470	1.000
1.473	P	1.500	82.000
1.476	P	1.800	8.200
1.478	P	1.500	100.000
1.481	P	1.500	120.000
1.485	P	2.700	3.300
1.485	P	1.500	150.000
1.499	P	2.200	4.700
1.500	S	.680	.820
1.500	S	.000	1.500
1.515	S	.015	1.500
1.518	S	.018	1.500
1.522	S	.022	1.500
1.525	P	1.800	10.000
1.527	S	.027	1.500
1.530	S	.330	1.200
1.533	S	.033	1.500
1.539	S	.039	1.500
1.547	S	.047	1.500
1.556	S	.056	1.500
1.560	S	.560	1.000
1.565	P	1.800	12.000
1.568	S	.068	1.500
1.579	P	2.200	5.600
1.582	S	.082	1.500
1.590	S	.390	1.200
1.595	P	2.700	3.900
1.600	S	.100	1.500
1.607	P	1.800	15.000
1.620	S	.120	1.500
1.636	P	1.800	18.000
1.640	S	.820	.820
1.650	S	.150	1.500
1.650	P	3.300	3.300
1.662	P	2.200	6.800
1.664	P	1.800	22.000
1.670	S	.470	1.200
1.680	S	.180	1.500
1.680	S	.680	1.000
1.688	P	1.800	27.000
1.707	P	1.800	33.000
1.715	P	2.700	4.700
1.720	S	.220	1.500
1.721	P	1.800	39.000
1.734	P	1.800	47.000
1.735	P	2.200	8.200
1.744	P	1.800	56.000
1.754	P	1.800	68.000
1.760	S	.560	1.200
1.761	P	1.800	82.000
1.768	P	1.800	100.000
1.770	S	.270	1.500
1.773	P	1.800	120.000
1.779	P	1.800	150.000
1.782	P	1.800	180.000
1.788	P	3.300	3.900
1.800	S	.000	1.800
2.247	S	.047	2.200
2.256	S	.056	2.200
2.268	S	.068	2.200
2.270	S	.470	1.800
2.282	S	.082	2.200
2.288	P	2.700	15.000
2.299	P	5.900	5.600
2.300	S	.100	2.200
2.320	S	.820	1.500
2.320	S	.120	2.200
2.343	P	2.700	18.000
2.350	S	.150	2.200
2.350	P	4.700	4.700
2.353	P	3.300	8.200
2.360	S	.560	1.800
2.380	S	.180	2.200
2.400	S	1.200	1.200
2.405	P	2.700	22.000
2.420	S	.220	2.200
2.455	P	2.700	27.000
2.470	S	.270	2.200
2.473	P	3.900	6.800
2.480	S	.680	1.800
2.481	P	3.300	10.000
2.496	P	2.700	33.000
2.500	S	1.000	1.500
2.525	P	2.700	39.000
2.530	S	.330	2.200
2.553	P	2.700	47.000
2.555	P	4.700	5.600
2.576	P	2.700	56.000
2.588	P	3.300	12.000
2.590	S	.390	2.200
2.597	P	2.700	68.000
2.614	P	2.700	82.000
2.620	S	.820	1.800
2.629	P	2.700	100.000
2.641	P	2.700	120.000
2.643	P	3.900	8.200
2.652	P	2.700	150.000
2.660	P	2.700	180.000
2.667	P	2.700	220.000
2.670	S	.470	2.200
2.673	P	2.700	270.000
2.700	S	.000	2.700
2.700	S	1.200	1.500
2.705	P	3.300	15.000
2.727	S	.027	2.700
2.733	S	.033	2.700
2.739	S	.039	2.700
2.747	S	.047	2.700
2.756	S	.056	2.700
2.760	S	.560	2.200
2.768	S	.068	2.700
2.779	P	4.700	6.800
2.792	S	.082	2.700
2.799	P	3.300	18.000
2.800	S	.100	2.700
2.800	S	1.000	1.800
2.800	P	5.600	5.600
2.806	P	3.300	10.000
2.820	S	.120	2.700
2.850	S	.150	2.700
2.870	P	3.300	22.000
2.880	S	.180	2.700
2.880	S	.680	2.200
2.920	S	.220	2.700
2.941	P	3.300	27.000
2.943	P	3.900	12.000
2.970	S	.270	2.700
2.988	P	4.700	8.200
3.000	S	1.500	1.500
3.000	S	1.200	1.800
3.000	P	3.300	33.000
3.020	S	.820	2.200
3.030	S	.330	2.700
3.043	P	3.300	39.000
3.071	P	5.600	6.800
3.083	P	3.300	47.000
3.090	S	.390	2.700
3.095	P	3.900	15.000
3.116	P	3.300	56.000
3.147	P	3.300	68.000
3.170	S	.470	2.700
3.172	P	3.300	82.000
3.195	P	3.300	100.000
3.197	P	4.700	10.000
3.200	S	1.000	2.200
3.205	P	3.900	18.000
3.212	P	3.300	120.000
3.229	P	3.300	150.000
3.241	P	3.300	180.000
3.251	P	3.300	220.000
3.260	S	.560	2.700
4.000	S	.100	3.900
4.000	S	1.800	2.200
4.003	P	4.700	27.000
4.020	S	.120	3.900
4.048	P	6.800	10.000
4.050	S	.150	3.900
4.078	P	5.600	15.000
4.080	S	.180	3.900
4.100	P	8.200	8.200
4.114	P	4.700	33.000
4.120	S	.820	3.300
4.120	S	.220	3.900
4.170	S	.270	3.900
4.195	P	4.700	39.000
4.200	S	1.500	2.700
4.230	S	.330	3.900
4.271	P	5.600	18.000
4.273	P	4.700	47.000
4.290	S	.390	3.900
4.300	S	1.000	3.300
4.336	P	4.700	56.000
4.340	P	6.800	12.000
4.370	S	.470	3.900
4.396	P	4.700	68.000
4.400	S	2.200	2.200
4.445	P	4.700	82.000
4.460	S	.560	3.900
4.464	P	5.600	22.000
4.489	P	4.700	100.000
4.500	S	1.800	2.700
4.500	S	1.200	3.300
4.505	P	8.200	10.000
4.523	P	4.700	120.000
4.557	P	4.700	150.000
4.580	S	.680	3.900
4.580	P	4.700	140.000
4.602	P	4.700	220.000
4.620	P	4.700	270.000
4.634	P	4.700	330.000
4.638	P	5.600	27.000
4.644	P	4.700	330.000
4.653	P	4.700	470.000
4.679	P	6.800	15.000
4.700	S	.000	4.700
4.720	S	.820	3.900
4.747	S	.047	4.700
4.756	S	.056	4.700
4.768	S	.068	4.700
4.782	S	.082	4.700
4.788	P	5.600	33.000
4.800	S	1.500	3.300
4.800	S	.100	4.700
4.820	S	.120	4.700
4.850	S	.150	4.700
4.871	P	8.200	12.000
4.880	S	.180	4.700
4.897	P	5.600	39.000
4.900	S	2.200	2.700
4.900	S	1.000	3.900
4.920	S	.220	4.700
4.935	P	6.800	18.000
4.970	S	.270	4.700
5.000	P	10.000	10.000
5.004	P	5.600	47.000
5.030	S	.330	4.700
5.090	S	.390	4.700
5.091	P	5.600	56.000
5.100	S	1.800	3.300
5.100	S	1.200	3.900
5.170	S	.470	4.700
5.174	P	5.600	68.000
5.194	P	6.800	22.000
5.242	P	5.600	82.000
5.260	S	.560	4.700
5.302	P	8.200	15.000
5.303	P	5.600	100.000
5.350	P	5.600	120.000
5.380	S	.680	4.700
5.398	P	5.600	150.000
5.400	S	1.500	3.900
5.400	S	2.700	2.700
5.431	P	5.600	180.000
5.432	P	6.800	27.000
5.455	P	10.000	12.000
5.461	P	5.600	220.000
5.486	P	5.600	270.000
5.500	S	2.200	3.300
5.507	P	5.600	330.000
5.520	S	.820	4.700
5.521	P	5.600	330.000
5.534	P	5.600	470.000
5.545	P	5.600	560.000
5.600	S	.000	5.600
5.634	P	8.200	18.000
6.980	S	.180	6.800
6.982	P	8.200	47.000
7.020	S	.220	6.800
7.070	S	.270	6.800
7.100	S	1.500	5.600
7.130	S	.330	6.800
7.153	P	8.200	56.000
7.190	S	.390	6.800
7.200	S	3.300	3.900
7.200	P	12.000	18.000
7.270	S	.470	6.800
7.297	P	10.000	27.000
7.319	P	8.200	68.000
7.360	S	.560	6.800
7.400	S	2.700	4.700
7.400	S	1.800	5.600
7.455	P	8.200	82.000
7.480	S	.680	6.800
7.500	P	15.000	15.000
7.579	P	8.200	100.000
7.620	S	.820	6.800
7.674	P	10.000	33.000
7.675	P	8.200	120.000
7.765	P	12.000	22.000
7.775	P	8.200	150.000
7.800	S	2.200	5.600
7.800	S	3.900	3.900
7.800	S	1.000	6.800
7.843	P	8.200	180.000
7.905	P	8.200	220.000
7.958	P	8.200	270.000
7.959	P	10.000	39.000
8.000	S	3.300	4.700
8.000	S	1.200	6.800
8.001	P	8.200	330.000
8.031	P	8.200	390.000
8.059	P	8.200	470.000
8.082	P	8.200	560.000
8.102	P	8.200	680.000
8.119	P	8.200	820.000
8.182	P	15.000	18.000
8.200	S	.000	8.200
8.246	P	10.000	47.000
8.282	S	.082	8.200
8.300	S	2.700	5.600
8.300	S	.100	8.200
8.300	S	1.500	6.800
8.308	P	12.000	27.000
8.320	S	.120	8.200
8.350	S	.150	8.200
8.380	S	.180	8.200
8.420	S	.220	8.200
8.470	S	.270	8.200
8.485	P	10.000	56.000
8.530	S	.330	8.200
8.590	S	.390	8.200
8.600	S	3.900	4.700
8.600	S	1.800	6.800
8.670	S	.470	8.200
8.718	P	10.000	68.000
8.760	S	.560	8.200
8.800	P	12.000	33.000
8.880	S	.680	8.200
8.900	S	3.300	5.600
8.913	P	10.000	82.000
8.919	P	15.000	22.000
9.000	S	2.200	6.800
9.000	P	18.000	18.000
9.020	S	.820	8.200
9.091	P	10.000	100.000
9.176	P	12.000	39.000
9.200	S	1.000	8.200
9.231	P	10.000	120.000
9.375	P	10.000	150.000
9.400	S	4.700	4.700
9.400	S	1.200	8.200
9.474	P	10.000	180.000
9.500	S	3.900	5.600
9.500	S	2.700	6.800
9.559	P	12.000	47.000
9.565	P	10.000	220.000
9.643	P	15.000	27.000
9.643	P	10.000	270.000
9.700	S	1.500	8.200
9.706	P	10.000	330.000
9.750	P	10.000	390.000
9.792	P	10.000	470.000
9.825	P	10.000	560.000
9.855	P	10.000	680.000
9.880	P	10.000	820.000
9.882	P	12.000	56.000
9.900	P	18.000	22.000
9.901	P	10.000	1000.000
10.000	S	1.800	8.200

Practical electronics demonstration:

THE ASTABLE MULTIVIBRATOR

by A. J. LOWE

Our Teach Yourself Board this month describes a circuit with many possibilities—the astable multivibrator.

The layout and size are standard, as on all these boards. The photograph and diagram show the details.

Construction is a little more crowded than usual so it pays to check sizes of components rather carefully before knocking any nails into the board. Take care with the capacitors—the polarity is important. The metal can is the negative terminal and must be connected as shown in the circuit. Sometimes electrolytic capacitors have black insulation round the positive terminal and as black is often associated with negative it can be misleading. Stick to the rule that the can is negative and all will be well.

Before you study this board please make sure you understand the facts on the board called "The Transistor As A Switch".

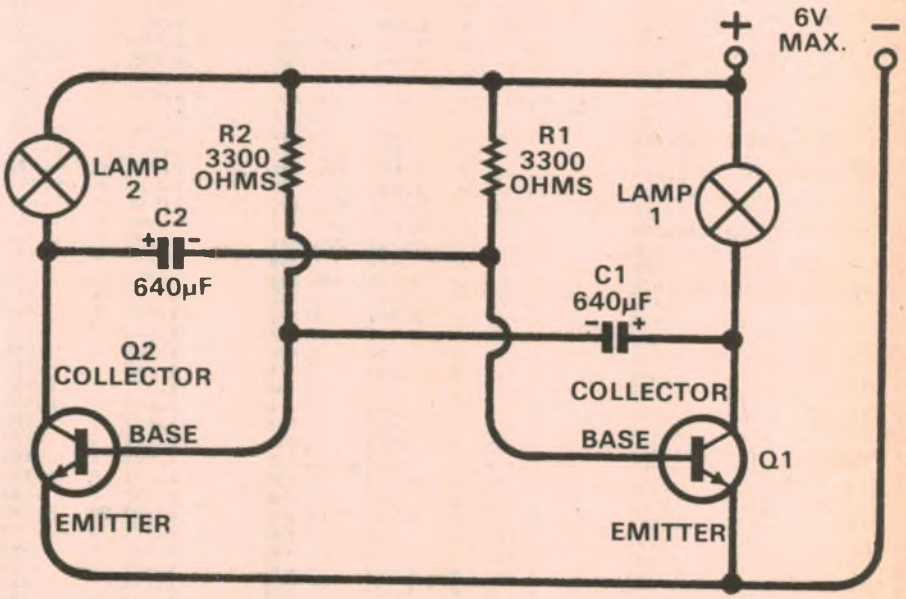
Multivibrators are very common in electronic circuits. They have two operating sections—in this model each section includes a lamp.

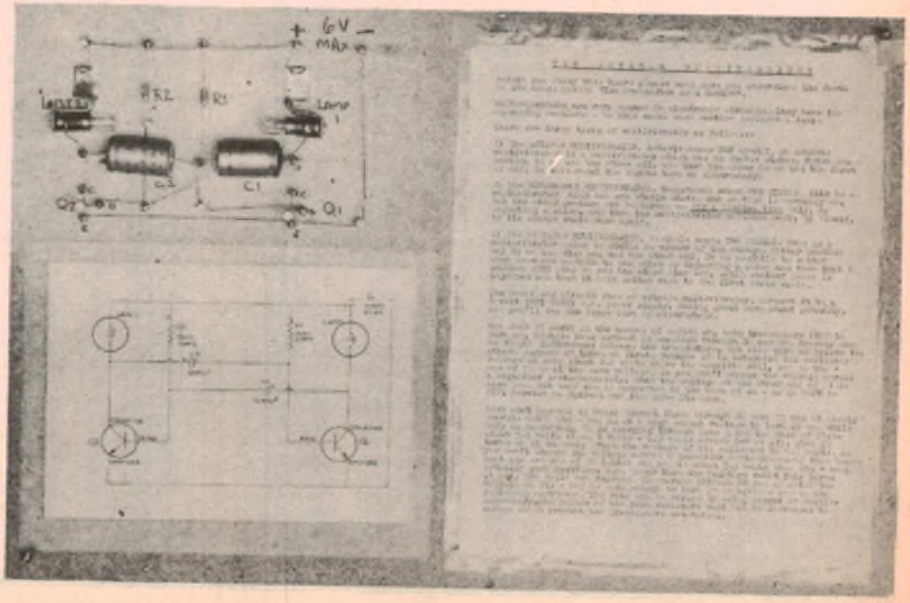
There are three types of multivibrator:—

(1) The ASTABLE MULTIVIBRATOR. Astable means NOT STABLE. An astable multivibrator is a multivibrator which has no stable states. First one section is on and the other off, and then the other is on and the first is off. In this model the lights turn on alternately.

(2) The MONOSTABLE MULTIVIBRATOR. Monostable means ONE STABLE. This is a multivibrator which has one stable state. One section is normally on, but the other section can be turned on for a limited time only, by injecting a pulse. Then the multivibrator switches back, by itself, to its stable state.

(3) The BISTABLE MULTIVIBRATOR. Bistable means TWO STABLE. This is a multivibrator which is stable in either of two states. Either section may be on and stay on, and the other off. It is possible to switch from one section to the other by injecting a pulse and that section will stay on and the other stay off, until another pulse is injected when it will switch back to the first state.





PARTS LIST

2 resistors 3300 ohms or to suit transistors
2 electrolytic capacitors 640uF 16V
2 lamp holders
2 lamps 6 volts 0.1 amp
2 npn transistors BC 108 or similar, nails, wire, etc
1 6 volt battery.

HOW THE ASTABLE WORKS

The model and circuit show an astable multivibrator. Connect it to a 6 volt (NOT MORE) DC power supply, taking great care about polarity, and you'll see the lamps turn on alternately.

How does it work? At the moment of switch on, both transistors TEND to turn on, because base current is supplied through R1 and R2. However due to slight differences between the transistors, one will turn on before the other.

Suppose Q1 turns on first. Because Q1 is saturated its collector voltage is only about 0.2 volt above the negative rail, and so the positive end of C1 is at the same voltage. As the voltage across a capacitor cannot change instantaneously the voltage at the other end of C1 is also low. But this end is connected to the base of Q2—so Q2 MUST be OFF, because no current can flow into its base.

Next, current flows through R2 into C1, and C1 slowly charges until its negative end is at a high enough voltage to turn Q2 on. While this is happening, C2 is charging through lamp 2 and the base of Q1, to about 5.3 volts (ie, 6 volts—0.7 volt across B-E of Q1). When Q2 turns on it suddenly drops the voltage of its collector to 0.2 volt. As the voltage across a capacitor cannot change instantaneously this means that the negative end of C2 (which was, and is, about 5.3 volts below its positive end) actually goes negative, ie, lower than the negative rail! This turns Q1 off. The cycle now repeats.

Capacitor C2 charges through R1 and Q2 until the voltage at its negative end is high enough to turn Q1 on again—and so the switching continues. The rate can be varied by using larger or smaller capacitors. The values of the base resistors must not be increased to values which prevent the transistors from saturating.

FURTHER SUGGESTIONS

(1) Measure the voltages around the circuit. Watch the voltage across a capacitor increase as it charges and decrease as it discharges. Immediately after the end of the discharge the capacitors are charged slightly in reverse. It's easier to note this on an oscilloscope because the reverse voltage exists for only a short time.

Be sure to check that the base of each transistor does drop to a voltage actually lower than the negative rail. This is a rather surprising fact about astable multivibrators. In this state the circuit is applying a reverse voltage to the transistor base and emitter terminals.

There are limits as to how much of this a transistor can stand and sometimes transistors in multivibrator circuits break down on account of this reverse voltage. The transistors in the prototype stand up to this treatment but, if you have trouble, you can prevent further damage by inserting a diode between each emitter and the negative rail.

(2) The model is designed to flash quite slowly to allow enough time to measure voltages. Try connecting a large capacitor, say 1000uF, in parallel with one of the capacitors on the board—taking care about polarity. Note that one lamp now stays on longer than the other. Work out the reason for this.

(3) Unscrew one lamp and note that this stops the action.

Classical Recordings

Reviewed by Julian Russell

Tchaikovsky: The Four Orchestral Suites

TCHAIKOVSKY – The Four Orchestral Suites played by the New Philharmonia Orchestra conducted by Antal Dorati. World Record Club Stereo R/01861 (S/57457). Three boxed discs.

Many years ago when I was a youth and Sir Henry Wood was conducting the Promenade Concerts at the Queen's Hall in London there appeared during the season, year after year, as regularly as Beethoven's Fifth Symphony, a Theme and Variations from Suite No. 3 in G by Tchaikovsky. So far as I can remember no other suite by this composer – or part of one – was ever played nor can I remember if Rosa Newmarch's famous program notes ever mentioned one.

Yet Tchaikovsky wrote four suites in all, and all are now obtainable in the one box superbly recorded and played by the New Philharmonia Orchestra under Antal Dorati. At least three of these unfairly neglected suites – except for an occasional movement – will probably be novelties to most record buyers, as they were to me. These suites were, the accompanying pamphlet tells us, among the composer's most popular works at the time of their composition. The notes go on to explain why, all very logically but at too great length to be quoted here.

The Suite as a musical form has a genuinely aristocratic ancestry, brought to perfection by J. S. Bach and Handel before the introduction of the classical symphony. And the first of the Tchaikovsky Suites, in D Minor, is laid out in very similar form to that used by the earlier composers – but of course it uses a very different music language. It starts with an Introduction and Fugue – and very exhilarating it is – and comprises five other separate items.

By the way, Tchaikovsky Suites were not early works. The four were composed between 1877 and 1888 when the composer had reached the full maturity of his genius.

The second movement of the first suite is a Divertimento in the form of a symphonic waltz and is as unmistakably Tchaikovsky as are all the pieces in the other three suites.

The Fourth Suite uses themes by Mozart. All the music of the First Suite might well have been taken from an unpublished ballet. It is full of variety, gorgeously orchestrated, its melodies all worthy of one of the world's greatest melodists.

The third item is an Intermezzo, the fourth a very brief Miniature March which could have been written for toy soldiers, a telling contrast to what has gone before. The fifth movement is a Scherzo, a little more ordinary though much ingenuity is used in the scoring. It is the sort of thing Tchaikovsky did better in the Fourth Symphony. The Suite finishes with a Gavotte, but no ordinary one, for here you have a cyclical coda using the sturdy theme from the first movement to close.

On the reverse side is the Third Suite I mentioned at the beginning of this column. In this the first movement is an Elegie that used to be popular as Palm Court music before the introduction of that pestilential nuisance, Musak. Not so familiar is the Valse Melancolique, which is just that but still very good. The third is a Scherzo, an example of beautifully clean writing and scoring and played at a speed that left me dazed. Then comes the Theme and Variations mentioned above, made up of brief items with brilliant solos for the first desk players, cor anglais, violin and others, some exciting antiphonal brass sequences, and finishing with a truly gallant Polonaise. Importantly Dorati never drools over the juicier passages but offers instead music of great warmth and elegance.

Suites Nos. 2 and 4 are shorter, occupying only one side each. No. 2 consists of five pieces with a most beautiful opening number, Jeu de Sons, in which the sound swells and contracts like something live in the conductor's hands. It contains several short sections, all of them lovely. Then you have another delicious waltz followed by another spectacularly scored Scherzo. An unusual feature of this is the addition of four accordions to the orchestra. There is also a long, gradual crescendo on the horns leading into a splendid climax for the horns on their glorious own. The fifth movement is entitled "A Child's Dream" and is just that, enchantingly innocent, sometimes tranquil and sometimes restless. It is accompanied by no program, but you will find it quite easy to supply one of your own. The concluding Danse Baroque is much more 19th-century Russian than true baroque but it makes an exhilarating ending.

The Last Suite (No. 4) Tchaikovsky called "Mozartian" and as the title indicates is a tribute to his beloved Mozart. In this Tchaikovsky used four Mozart pieces, preserving their Mozartian spirit while at the same time impressing on them his own highly individual personality.

If you enjoy Tchaikovsky's music as much as I unabashedly do here is a boxful of "new" delights by that great composer.

Liszt: Complete Piano Works—"rare brilliance"

LISZT—Complete Piano Works. Volume 2. The 19 Hungarian Rhapsodies and the Rhapsodie Espagnole. Volume 5. Paganini Etudes. Trancendentale Etudes. Three Poetic Caprices. Two Concert Etudes. Ab Irato (In Anger). Grosses Konzert Solo, and Glanes de Woronice. World Record Club Stereo. Vol. 2 No. S/5130-3. (Four Boxed Discs.) Vol. 5. No. R 01909 (5795-6-7-8). Four Boxed Discs.

Mlle. Clidat is equipped with a resplendent technique in which delicacy of touch is as effective as her most forceful statements. She has, however, a tendency to self-indulgence in the matter of rubatos and sometimes pulls the tempos about mercilessly. This type of playing seems not to meet, in France, with the disapproval it arouses in most other countries. You may remember the late Samson Francois who used much the same style and was during the 1960s about the most popular pianist in France. Ironically Samson was the family name of some generations of official French executioners, and they certainly would not have been popular.

Mlle. Clidat also has a tendency to linger rather too long over the slower passages of the music though when she gets going on the fast ones she is very impressive indeed. However, despite this she has a true Lisztian feeling for romantic melody and showy virtuosity. I didn't play all the 19 Rhapsodies in Volume 2 but chose for the most part those I know best.

For instance I think almost everbody has heard at some time or other No. 2. After Mlle. Clidat has finished dawdling over the slow opening section the second, faster movement is splendidly rhythmical and accurate. In fact quite a pianistic achievement. No. 13 is also well known to me and here again she uses the same style. Her passion is sometimes a little gusty, but then from what one reads of Liszt's own playing of these works she may well be right. But I doubt if even Liszt

hesitated quite so long on the top note of a phrase.

Yet there is always much to enjoy when her tone sparkles and she rushes fast passages in an absolute torrent of sound. Unfortunately in the two volumes available to me there were none of the biggest of the Liszt piano works—the Sonata and others—though the Paganini transcriptions are most certainly among his best. These she plays with rare brilliance and surprisingly few wrong notes in a collection as long and difficult. And in these she adjusts perfectly to what might be called nowadays a true Liszt style.

She is always ready to switch from one mood to another without any apparent loss of concentration. She even gives his more vulgar outbursts some true dignity. Her Feux Follets (Will o' the Wisps) is a ravishing performance of this almost inhumanly difficult piece.

Buyers will find an informative leaflet in both boxes and despite the slight blemishes mentioned above the two can be summed up as most enjoyable recitals. She does not chase virtuoso notoriety for its own sake and if she is sometimes a little facile she is seldom meretricious.

Stereo Dolby Cassettes

STRAVINSKY – Petrouchka. Complete ballet in its original form. London Philharmonic Orchestra conducted by Bernard Haitink. Philips Dolby Stereo Cassette 7300 354.

This cassette offers a good example of the superiority of the Dolby system over the original type of cassette recording. There is quite remarkable quality of detail from the opening bars on. The many different orchestral timbres are most faithfully reproduced. To take two examples, listen to the simulated hurdygurdy music and the old magician's theme in the first scene.

I liked this Haitink reading of a Stravinsky ballet better than I did his Firebird. I still feel, however, that he has never conducted the work for dancers, or if he has, I cannot imagine them being comfortable about what he must have offered them. Right from the start the bustle of the showground scene is too studied. There is little or no sense of occasion. The rhythm of the puppets' dance is vigorous but somehow it hasn't the startling lift one gets in the theatre.

In the second scene Haitink gives the character of Petrouchka his spikiness but without suggesting his ill-co-ordinated movements, especially at the entrance of the ballerina and her frightened exit. Even the vividly characterised Moor (by Stravinsky) tends to be dehumanised here. (Can you use "dehumanised" about a puppet that comes to life? In any case I cannot think of any other way to describe that sense of gaudy insolence, or oriental laziness that the composer gave him.) I missed, too, the side drum roll that separates the movements and gives the ballet continuity during the changes of scene.

This is Stravinsky's original version of his ballet in which, to use his own phrase, the orchestra was extravagantly large. The playing throughout of the London Philharmonic Orchestra is no less than superb and if you are looking for a good performance, though not a balletic one, in handy cassette form this is for you. Personally however I'd prefer to wait until a reading by one of the first rate ballet conductors becomes available. Dorati would be one, Ansermet another, or Stravinsky himself, And the more cassettes I play the more I appreciate their ease of handling – no putting the pickup on the disc, no chance of scratching the surface and all the other conveniences now that the Dolby process has improved the quality of the sound to the extent it has.

★ ★ ★

RACHMANINOFF—The Bells, Choral Symphony based on a Russian translation of poems by Edgar Allen Poe. R.F.S.F.R. Russian Chorus and the Moscow Philharmonic Symphony Orchestra conducted by Kiril Kondrashin.
FIVE SONGS. Ivan Koslovsky (tenor) and the Bolshoi Theatre Orchestra conducted by Israel Gusman. World Record Club Dolby Cassettes. C 02212.

This production has a shortcoming that appears to be common to many cassettes—lack of information about the music. All you get about "The Bells", one of Rachmaninoff's major works, is that it is a "choral symphony after Edgar Allen Poe" and the fact that it is four movements. There is no text to inform you of what the vocal soloists or choristers are singing about, and that they sing in Russian still further mystifies those who haven't taken the precaution of having themselves born in that country. And the same applies to the five Rachmaninoff songs that make up the weight.

To help those who haven't a copy of the poems handy I have, after laborious enquiries, found that the first movement can be briefly described as Silver Sleigh Bells, the second Golden Wedding Bells, the third Brazen Alarm Bells and the last Iron Bells Tolling. With this in mind following the work becomes much easier.

The work, though so seldom played or recorded, was considered by the composer to be his best. The recording master was made in 1963 and transferred recently using the Dolby system, to a cassette. In the first movement there is a Petrouchka-like bustle before the voices enter with a true Russian sound. The tenor sings words while the chorus seems to be confined to one syllable throughout, although here I might be mistaken. The engineering shows traces of its age despite the Dolbyisation. Much the same can be said about the other three movements except the second, which features a typical wobbly Russian soprano quite uncomfortable to listen to. Her voice sounds young and fresh but her high notes have a piercing quality that seems to drill its way through the listener's forehead. Frankly she gave me quite a headache that persisted for some time after she had finished.

But despite these shortcomings the work itself can be recognised as having magnificent material and it is a pity no more modern Western recording is available. The third movement is all choral and filled with an impressive sense of urgency. The fourth movement features a baritone of good quality if sometimes a little unsteady.

I am afraid it is a production that I cannot, with the best will in the world, recommend except to the very curious. But I did enjoy enormously the five songs sung by tenor Ivan Koslovsky. If you still have the very old Monarch recording of Rimsky-Korsakov's opera Sadko you will recognise him, by the unique quality of his voice, as one tenor in the "Song of the Hindu Merchant". His voice is of almost cloying sweetness though a little nasal and his style is reminiscent of the late Vladimir Rosing though much more mellifluous. He deals splendidly with long legato phrases. One or two of the songs will be familiar to musicians of my generation. "O, Do Not Sing Again" should be fairly well known under the alternative title of "The Nightingale and the Rosie". It is a lovely piece of sensuous music though as presented here seems a little more extended in the middle section than I remember it. "Spring Waters", too, is fairly well known – a passionate short rhapsodic outburst. It might be described as a pagan acclamation.

"By My Window" I heard here for the first time, nor had I ever heard the fifth song, "How Fair This Spot" before. All are most attractively sung, though some Western critics might not approve of the tenor's use of falsetto heat tone. This little recital is all I can recommend about this production.

Lighter Side

Reviews of other recordings

Devotional Records

HERE COMES THE SON. The Paul Johnson Singers. Stereo, Word WST-8636-LP. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals.)

John Fisher's "The New Covenant", which I reviewed recently, was sub-titled "A Teaching Musical"; it relied strongly on narration to link the various songs. This one, sub-titled "A musical drama on the greatest life ever lived" has no narration. Rather is it a sequence of group and solo numbers based in more or less chronological order on events in the life of Christ:

Here Comes The Son—His Name Is Jesus—The Gift Of Love—Cold And Lonely Night—He Kept The Wine A'Flowin'—We Have Been Chosen—Born Again—He Felt The Pain—Satan Got A Hold—He Spoke The Living Word—Afraid Of Love—Carpenter Tools—He Was Saying To The World—Christ Arose—Jesus Is Alive—Make Us One, Father.

Composed, arranged and conducted by Paul Johnson, the general musical format follows the modern popular idiom of driving rhythm, amplified guitars with vocals styled to suit. It belongs very much to the youth Gospel scene and, if your interest lies in that direction, you may want to know more about it. According to a jacket note, a complete vocal score is available from Word Inc, and presumably from the Australian distributors.

Like the performance itself, the technical quality is well up to standard. (W.N.W.)

★ ★ ★

REJOICE AND SING with the Le Masurier Quartet. Stereo, Bass JPB-7510. (From Crest Record Co., 122 Chapel St, St Kilda 3182. $5.95.)

The artists featured in this album are a brother/sister quartet: Jen, Val, Doug and Mal Le Masurier. Familiar figures in Melbourne churches, they appear to specialise in unaccompanied quartet arrangements of well known hymns and Gospel songs. There are eighteen here which I must perforce abbreviate:

All Day Long My Heart Keeps Singing – Heaven Came Down – Gospel Train – This World Is Not My Home – His Lovely Face – Christ's Own Peace – Come Ye Souls By Sin Afflicted – None Other Lame – Psalm 23 – Now I Belong To Jesus – It Is Well – No-one Understands Like Jesus – A Place Of Quiet Rest – His Hands Were Pierced – Good Christian Men Rejoice – Mary Hushed The Little Jesus – Lord Of The Dance – Psalm 22.

I found the first track rather off-putting with harmony that, to my ear, was just not spot on. "Heaven Came Down" was better but still not above criticism. Unaccompanied singing is extraordinarily difficult, partly because it demands complete precision and balance, and partly because there is no instrumental to cover for blemishes that might occur.

My conviction is that the Le Masurier Quartet would be very acceptable in live situations – rallies and church services – but as heard here, they lack the ultimate polish necessary to come accross well in a sustained sound-only program.

Diction is good, the hymns have their own appeal and you may well enjoy the result – provided you accept them on the basis of "talented amateur" standards, rather than professional. (W.N.W.)

★ ★ ★

A PRAYER FOR EACH DAY. Rev Alan Walker OBE. Stereo, M7, MLX-104.

Rev Alan Walker, Superintendent of the Central Methodist Mission in Sydney and President of Life Line International, is one of Australia's best known clerics. On this unusual album he presents eighteen prayers centring on personal and communal needs. I list them for your guidance:

On A Beautiful Day—When Feeling Lonely—When Needing Forgiveness—Prayer For Strength—For A Threatened Earth—Prayer For Health—Overcoming Fear—Prayer For A Family—Prayer For Today—Prayer For World Need—When Feeling Worthless—Prayer For Australia—Finding Life's Meaning—Overcoming Sorrow—Prayer For Peace—Prayer For Inner Freedom—When I Have Failed—Becoming Sure Of God.

The prayers are informal in the sense that they do not follow any particular creed or denominational format but, rather, are spontaneous prose. They are formal only to the extent that they have had to be composed and read for general participation, much like prayers in any non-liturgical service. Subdued organ themes by well known musician Eric Smith introduce each new track.

The prayers are clearly enunciated in a voice that is extremely well known and that is all that it is appropriate to say; after all, this is not a "performance" in the usual sense of the term. If you would find a group of spoken prayers helpful, then you can buy with confidence. (W.N.W.)

Instrumental, Vocal and Humour

LIONEL HAMPTON 1946. Astor Gold series COPS 7501.

If you are looking for a record such as this as a replacement for aging 78's, you might be a bit disappointed as the quality is somewhat limited, especially on the first track on side I. His "Tempo's Birthday" was copied from a test pressing from a private collection in Switzerland and a number of the other tracks also appear for the first time on regular release. However died-in-the-wool Hampton fans will forgive these minor criticisms.

Recorded in both New York and Los Angeles the titles are: Tempo's Birthday – Ridin' On The L&N – Chord-A-Re-Bop – Limehouse Blues – Cobb's Idea – Air Mail – Special – Playboy – Cobb's Idea and Tempo's Birthday (again, with changes in personnel) – Adam Blew His Hat – The Pencil Broke – Empty Glass – Hamp's Walking Boogie – Don't Let The Landlord Gyp You – I'm Mindin' My Business.

Well worth a listen if you like the Hampton style. (N.J.M.)

★ ★ ★

JOY OF MUSIC + CONCRETE. Hiroshi Ishimaru and the Yomiuri Nippon Symphony Orchestra. QX quadraphonic, W & G, WG-35/Q/5629.

While the title immediately suggests that there is a gimmick about this record, it is not immediately evident. It opens with the familiar chords of Von Suppe's "Light Cavalry Overture" and the exhilarating sound of a full symphony orchestra, very cleanly recorded. It is sometime later that horses thunder across the sound stage and whinny as they pass. After that, J. Strauss' "Thunder and Lightning Polka" and "Train Polka" are predictable, with occasional storm and train noises.

The remaining tracks are Minuet,

Reviews in this section are by Neville Williams (W.N.W.), J. Rowe (J.R.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.) and David Edwards (D.W.E.).

"Fireworks Music" (Handel) – Syncopated Clock (Anderson) – The Typewriter (Anderson) – The Toy Symphony; allegro, minuette, allegro (L. Mozart) – Hunting Polka (J. Strauss) – Village Swallow (J. Strauss) – Cloudburst, "Grand Canyon Suite" (Grofe).

Recorded originally by Nippon Columbia of Japan, using regular matrix encoding and QX "Mastersonic" processing, the sound is particularly clean and would be a good choice for demonstration purposes, whether played in quadraphonic or ordinary stereo. The music, of course, is very well known and many will enjoy its familiar strains, laced with sound effects – the "concrete" bit. However, there will be others who find the sound effects redundant, contrived and intrusive. Take your pick! (W.N.W.)

★ ★ ★

Jack Speering, Hal Carter

COME DANCING with Hal Carter and Jack Speering. Festival L-35566.

Old-time dance buffs will get a kick out of this record, with four dance styles and twelve titles to choose from.

The tracks are: Consider Yourself – Around & 'Round The Old Band Stand – I Love The Night Time – Morning Has Broken – I'll Be With You In Apple Blossom Time – When You And I Were Seventeen – Wait 'till The Sun Shines Nellie – Anytime – I'm Nobody's Baby – My Bonnie Jean From Aberdeen – Who's Sorry Now – All His Children.

These two highly talented artists have careers dating back before the war, on radio and the dance halls in Sydney, Penrith and Newcastle and their long experience certainly shows in this enjoyable disc. (N.J.M.)

★ ★ ★

THE CHIEFTAINS 4. The Chieftains. Interfusion L 35584. Festival Release.

"The Chieftains are a bunch of lived in faces that play Irish traditional music, not Paddy McGinty's Goat, but the stuff that's real as poteen . . .". So says Alun Owen, celebrated scriptwriter and author of "A Hard Day's Night." The seven Chieftains play all the traditional Irish instruments, including the uilleann pipes, the bodhran and the bones.

Their music evokes strong thoughts of Ireland, almost enough to make you want to start packing immediately. However, if you're poor like me (why else would I spend my nights reviewing records!) then you'll just have to be content with this record. Sit yourself down with a glass of your favourite beverage, and you won't be disappointed.

The quality of the recording is extremely good, with crystal clear highs that seem to just glide from the speakers into the room. (D.W.E.)

★ ★ ★

ACADEMY AWARD WINNERS, Tony Fenelon Plays the Mighty Wurlitzer. Stereo, Crest CRES-TV-203. (Crest Record Co, 122 Chapel St, St Kilda 3182, $4.99.)

Although Crest forwarded this one in their first review selection for 1976, I am 99% certain that I reviewed it about five years ago. This is confirmed by the jacket note which introduces the album as Tony Fenelon's "album debut". He has certainly recorded quite a few since then. Then why give it a repeat mention?

Primarily because it will still delight those theatre organ fans who do not know of its continued existence. Played on the huge 4-manual instrument in the Regent Theatre, Melbourne, it has the traditional theatre sound which relies on registration changes and lush, massive pipe ranks, rather than keyboard gymnastics to entertain. Not that Tony Fenelon is short in this department; then, as now, he impresses with his tempo and precise phrasing, as befitted the resident organist in Australia's largest theatre.

The program is of firm favourites: Zip A Dee Doo Dah – Mona Lisa – Days Of Wine And Roses – High Hopes – Three Coins In The Fountain – Secret Love – Moon River – Love Is A Many Splendoured Thing – When You Wish Upon A Star – Never On A Sunday – Over The Rainbow – It Might As Well Be Spring – Gigi.

Well recorded and responding to simulated quadraphonic, it is an enjoyable and genuine memento of an era that it now largely a memory. (W.N.W.)

★ ★ ★

FERRANTE AND TEICHER PLAY THE CARPENTERS SONGBOOK. Ferrante and Teicher. United Artists L 35683. Festival Release.

Ferrante and Teicher swept to the top of the charts with their melodious renditions of such songs as: Exodus–Midnight Cowboy–Sunrise, Sunset–and Tonight. On this album, they play all those lovely Carpenters hits, with just as much magic and style as before.

In order, the tracks are: Only Yesterday–(They Long To Be) Close To You–Yesterday Once More–All My Life–Top Of The World–Reflection–Sing–Superstar–We've Only Just Begun–Rainy Days And Mondays–For All We Know–Hey Babe! This Love Will Never End.

This album is delightfully easy to listen to, and makes ideal dinner music. The music just flows along gently from one track to the next, without becoming boring or repetitious at any stage. Recording quality is very good. (D.W.E.)

LIGHTER SIDE—continued

FOUR AMERICAN MURDER MYSTERIES. Written by Bernard Barshay and narrated by Morris Schrieber. Mono, Folkways FL-9871. (From Crest Record Co, 122 Chapel Street, St Kilda 3182. $6.50.)

From the jacket notes, I gather that this is one of a series of teaching records issued by Folkways Records of New York. As a non-educator, in another country, listening to just one of the series, it would be presumptuous of me to offer more than a purely personal reaction to the disc.

Bernard Barshay began his working life as a police and court reporter, graduating later to drama, radio and television, and ultimately becoming a recognised authority and educator in these fields.

The four short stories in the album were apparently inspired by actual court cases around the turn of the century. They are recounted in an economical style, but with a subtle suggestion of the phraseology of the period. In their covering letter to me, Crest Records hint that the stories could be listened to for diversion but I doubt that they would justify the purchase price in that role.

Their most likely application in the local educational scene would possibly be as a synopsis of good potential stories, which would provide the basis for creative development; involving style, situations and characters.

Included with the record is an 8-page pamphlet containing the full text as read. In short, a possible album university and high-school libraries, appropriate to teaching training and junior high school assignments. (W.N.W.)

DREAMING MY DREAMS. Waylon Jennings. RCA Victor APL1-1062.

Waylon Jennings is a successful singer from America, and should be known to most C & W fans. This album gives a fair sampling of his style, and is quite enjoyable. I can best describe this style by quoting what Neil Diamond has to say on the cover.

"The human voice is the most important instrument at our disposal, yet it is one of the most difficult to understand or define. You either hear it, or you don't. It either moves you, or it leaves you cold. It has never been successfully reproduced by an electronic synthesizer because it is more than just a sound . . . it is the soul itself. When I listen to this album I hear the soul of Waylon Jennings, and I am moved by what I hear. It is a beautiful soul . . . one that reflects the joy and the pain of a man who has seen lots of both".

The eleven songs included are all of a high standard. The two which particularly appealed to me were "Let's Turn Back The Years", an old Hank Williams standard, and the final track, a live version of "Bob Wills Is Still The King".

- Recording quality is very good, with almost no traces of surface noise. If you are a C & W fan, this is a record I would certainly recommend. (D.W.E.)

HOT AUGUST NIGHT. Neil Diamond. MCA Records MAPS 6385. Astor Release.

Most Diamond fans will know of this double record set, which has been re-released, presumably to coincide with Neil's Australian tour. For those who are not fans, the album is a live recording of a 1972 concert, held on a "Hot August Night".

Tracks featured are: Prologue – Crunchy Granola – Done Too Soon – Solitary Man – Cherry Cherry – Sweet Caroline – Porcupine Pie – You're So Sweet – Red Red Wine – Soggy Pretzels – And The Grass Won't Pay No Mind – Shilo – Girl You'll Be A Woman Soon – Play Me – Canta Libra – Morningside – Song Sung Blue – Cracklin' Rosie – Holly Holy – I Am . . . I Said – Soolaimon/Brother Love's Travelling Salvation Show.

The quality of the recording is excellent, with extremely clear highs. The soul and sensuality of the performer comes through clearly. (D.W.E.)

BIRD CALLS FROM AUSTRALIA. Recorded by Newton Hobbs. Mono, RCA VPL1-0096-G.

Recordings of bird calls are rather like those of steam trains: they fascinate listeners who are enthusiasts and bug those who aren't! However, this particular recording offers a further possibility – that of a gift or a keepsake for overseas visitors. Its handsome double-fold jacket carries beautiful colour plates of four birds, including the colourful lorikeet and a pair of kookaburras, while supplementary information includes an outline map of Australia and a paragraph about each of the birds featured in the twenty-one tracks.

While some of the birds are common to large areas of Australia, most of the actual recordings were done in New South Wales. The quality is very good, with incidental noises far enough down to expose an unusual hazard to bird calls – the monotonous buzzing of bush flies. In fact, one blowfly that roars across the sound scene is enough to make one reach for the Mortein!

So there it is, for those who are enthusiasts or on the lookout for an eloquent piece of Australiana. (W.N.W.)

★ ★ ★

REG LINDSAY IN NASHVILLE. Interfusion L 35451 Festival Release.

This record of Reg Lindsay in the Mecca of Country music should really please his many fans, with the usual high quality that one has come to expect from Nashville. The backing is provided by The Nashville Sounds Quarter on these thirteen tracks: Takin' A Chance – These Empty Rooms – Fine As Wine – Too Many Memories – There You Go – For The Good Times – I'd Walk A Mile For A Smile – To Get To You – Walking Shadow, Talking Memories – How Far Our Love Goes – I Just Try To Smell The Roses Along The Way – God Never Made A Better Move – You've Got Everything You Want.

It is good to see our performers getting the recognition they deserve. (N.J.M.)

★ ★ ★

RIDIN' HIGH. Jerry Jeff Walker. MCA Records MAPS 8121. Astor Release.

Jerry Jeff Walker is a contemporary C & W artist. Judging from this record, he should be quite popular. He has a very appealing voice, with an attractive drawl to boot. The tracks on this album range from ballads to fun songs, with a mixture of just about everything else in between.

Jerry himself describes the album as a "cosmic gangbang", and then has the nerve to say that even he doesn't quite know just what it means, so you'll have to excuse me if I just mention a few of my favourite tracks.

Working backwards, I found the last track, titled "Pissin' in the Wind" particularly memorable; it's a perfect put-down to Kristofferson, Swan and others. Others to impress were "Like A Coat From The Cold", which is a very moving ballad, and "Mississippi You're On My Mind". Even though I've never been there, this song did conjure up for me a vision of a quiet Mississippi town.

Technically, the recording is very good, the backing group (The Gonzo Band) can be clearly heard without intruding, and Jerry's voice is always understandable. I would thoroughly recommend this record to all country music fans. In fact, I'll probably be down buying a new copy by the time you have read this review, as I'm sure that my review copy will be worn out by then! (D.W.E.)

DENIS WALTER, LIVE, on Young Talent Time. Harlequin L25252. Festival

When you realise that Denis Walter is barely 21, his mature and powerful voice comes as a pleasant surprise. With the backing of the Young Talent Time Orchestra under Geoff Hales he makes a first class job of twelve titles, such as: The Last Farewell – You're A Lady – If I Loved You – My Best Girl – I'll Catch The Sun – One Life – This Nearly Was Mine – The Shadow Of Your Smile – Let Me Try Again – My Cup Runneth Over – The Way We Were – This Is My Life.

I think this will be one local performer who won't fade from the spotlight in a hurry. (N.J.M.)

Cantata easy-listening cassettes

HAMMOND A LA MELONE. Stereo Dolby-B cassette, Cantata A-122. (Available from local record shops, distributed by Goldring Sales & Service in all states.)

For space reasons, cassette packs are usually rather sparse in the information they carry but this one is notably so. The one meaningful word is "Hammond"; there is no hint of the model, the player, the backing group or the country of origin. Sufficient to say that the organist is a typical exponent of dance-a-long sound, who likes penetrating treble with loads of vibrato and who works consistently against a rhythm background of percussion and guitar.

Whatever "a la melone" means, the track titles are: La Paloma – Down By The Riverside Medley – Michel Polka – Vienna Remains Vienna – Aloa Oe – Wine, Women And Song – Medley: Moscow Nights, Black Eyes, Steinka Rasin – Medley: Listen What's Coming In, In The Luneburger Heather – Love Brings Great Joy – La Bamba.

As noted in the title, the cassette is primarily intended for decks with Dolby-B circuitry and switching Dolby in certainly chops the background hiss. Otherwise, it would need to be played with some treble cut. Quality is okay, as you would expect from a recording which poses little problem in the way of dynamic range. Playing time, by the way, is 35 minutes.

The music? Typical Hammond plus rhythm dance-a-long which some like in the home and some don't but which would probably make good highway listening. (W.N.W.)

★ ★ ★

HAPPY MUSIC – 1. Sid Sidney and his Orchestra, with Gene Harrison and Jacques Romain. Cantata stereo cassette, Dolby-B A-102. (Distributed through Goldring Sales & Service.)

As will be evident from the above title, Cantata have acknowledged the orchestra but leave the rest to your imagination, apart from listing the titles: Santiago – Trumpet Story – Underdog – Katjuschka – Promised Land – Funny Funny – Vodkatime – Two Guitars – I'll Be There – Tschagalatschag – Reflection – Patta Patta – Dance Of Time – Thank You And Goodbye.

Happy music? What kind of happy music? Well, it's light, tuneful, rhythmic, against a background of percussion. You can sit and tap your toes or get up and do your own thing.

Cantata are keen for you to know that this isn't any old recording on any old tape; it's Dolbyised on TDK dynamic and, played back on an appropriate deck, it's certainly quiet and clean. If your cassette player doesn't have a Dolby facility, turn the treble down a trifle. (W.N.W.)

★ ★ ★

MOTORING MUSIC – 1. The Sid Sidney Orchestra with Enrico Mirando, The Cornely Singers and the Montenegro Trio. Cantata stereo cassette, Dolby-B A-105. (Distributed through Goldring Sales & Service.)

What is motoring music? Presumably, according to Cantata, it is gently rhythmic middle-of-the-road, with a variation in the nature of the sound from track to track, but always avoiding dynamic extremes. I guess I can't quarrel with that and the result would certainly be highly listenable as highway music:

Happy Feeling – The World Of Love – Songs Of Love – Bossa Catania – Mame – Black Eyes – He's Got The Whole World – Hallelujah – Hawaiian War Chant – Red Roses For A Blue Lady – From Merry-Go-Round Of Love – Somebody, Somebody – Dream Of Love – Malaguena.

Recorded on TDK tape using Dolby-B pre-emphasis, the quality is excellent. Noticeable on this cassette as on some others in the Cantata series is the wide stereo stage which seems on occasions to extend beyond the actual speakers. A good one for the car – and the living room! (W.N.W.)

New Products

Texas Instruments SR-52 programmable slide-rule calculator

The newest and most expensive calculator in the Texas Instruments range is the SR-52, which has scientific notation and considerable calculating power—plus full programmability. It is even supplied with a basic library of program cards.

The SR-52 is supplied in an attractive cardboard carton with polyurethane protective packing, which also accommodates a double-insulated mains power pack, soft zippered vinyl carrying case, basic program library, manuals for instructions and explanation of the basic program library, programming pad, plus spare magnetic cards. In addition, there is a brief (32 pages) operating guide normally kept in the vinyl carrying case.

As on the less pretentious SR-50 and SR-51, the easy-to-read buttons are small, but adequately spaced. They have click-stops for positive tactile sensation, ie, you know when the key entry has actually been effected. Readout is via a multi-digit LED display in red. The digits are quite small at about 2.5mm high, but are legible even where the ambient lighting is very bright.

Scientific notation is used as a matter of course with 10-digit mantissa and exponent up to ±99. Thus the SR-52 will compute and display numbers as large as $\pm 9.999999999 \times 10^{99}$ or as small as 1.0×10^{-99}. Answers are automatically converted to scientific notation when the calculation result exceeds 10^{10} or is less than 10^{-10}. Variables may also be entered into the calculator directly in scientific notation or displayed results may be converted to the scientific notation by pressing the Exponent and Equals buttons.

There is a caution to be applied the the above last remark, in that use of the "=" key completes all pending operations. The solution to this possible hassle is explained in the very comprehensive manual which needs to be read over and over—together with practice exercises on the unit, before you can claim familiarity.

Calculations involving parentheses are a delight to perform on the SR-52. For example, try (5 + (8/(9−(2/(3 + 1))))) on your own calculator. It is normally quite a laborious task but it may be entered directly as written into the SR-52. The SR-52 recognises each "(" keystroke as a pending operation which is stored in an internal register until the correct sequence ")" keystroke, whereupon that operation is completed. The limit on the SR-52 is large—it can accommodate as many as eleven operands with ten operations pending.

Entry mode of the SR-52 is full algebraic, with parenthesis.

The result, by the way, of the above parenthesis problem is 5.941176471 which is obtained in 21 keystrokes on the SR-52.

While the calculation capability with parentheses must be regarded as fancy just consider the following calculation sequency: 5 x 4 + 8 x 3? Now if this is performed on an ordinary calculator the result is 84 but that is just one intrepretation. The result on the SR-52 is correct at 44. There is an accepted convention to solve this problem and it is known as the "algebraic hierarchy". This rule states that unless parentheses are present to indicate otherwise, multiplication or division should be performed prior to addition or subtraction. So the SR-52 follows this convention automatically. How about that!

Almost overshadowing the powerful arithmetic capability of the SR-52 is its ability to handle recorded programs of up to 223 steps, and involving up to five variables. The programs are stored on magnetic film tags measuring 18 x 75mm. The programs are fed into the memory by poking them into the slot on the right side of the calculator—a motor draws them through. The SR-52 can also write and store programs on the magnetic films. A basic library of twenty programs, together with comprehensive manual is included in the purchase price.

In the time we had available for writing this review we could not even begin to become familiar with the program capability of the SR-52. On the face of specifications it appears to be comparable with more expensive programmable desk top calculators having print-out facilities. An optional printer is available for the SR-52.

At around $350, the price of the SR-52 is about half that of its nearest competitor. In a word, terrific!

Retailer enquiries should be made to the Australian distributors for Texas Instruments calculators, A. J. Ferguson Pty Ltd, 44 Prospect Road, Prospect, SA 5082 or interstate offices. (L.D.S.)

New marine SSB transceiver

International Transceiver, the first to produce an Australian-made marine SSB transceiver, has just announced another first. It is the SB80, a new miniature marine SSB transceiver using the direct-conversion technique.

The new SB80 transceiver is fully approved by the PMG and has already proved its capability aboard the "South Pacific".

Graeme Cohen, IT technical director and designer of the unit, believes it to be the first commercial marine application of an SSB speech processing technique which eliminates expensive crystal filters and IF amplifiers. This is a considerable achievement in view of the high technical standard required for APO approval.

The speech processing technique used involves converting the RF input signal directly to AF, simultaneously phasing out the lower sideband. This is achieved by using very fast matched digital dividers for the 90-degrees-apart injection signals, and four-phase wideband audio phase shift networks.

Matched and balanced hot carrier diode quads are used for the two mixers, while precision but easily reproduceable RC networks are used for the AF phase shift. The system is bi-directional. In the receive mode the higher frequencies of both sidebands are attenuated by a 9-pole filter of Butterworth response, which gives the desired SSB selectivity.

The transceiver is rated at 60-80 watts PEP, depending upon installation, and has provision for five channels including 1 or 2 duplex. Its size is extremely small, the case being a mere 172 x 56 x 274mm

(W x H x D). The unit plugs into a rugged reversible cradle and can be readily removed for security when not in use.

Features include low battery current, an effective noise limiter and squelch control, a rugged die cast case with matching cradle and a built-in aerial tuning unit.

International Transceivers stress that despite the small size of the SB80, it is professionally engineered to ensure ease of maintenance and installation. It has fewer components than existing equipment, to ensure greater reliability.

The suggested price with five channels fitted is $795 plus sales tax.

Further enquiries from International Transceivers Pty Ltd, 535 Pittwater Road, Brookvale, NSW 2100.

Automatic digital LCR bridge

Recently released by Hewlett-Packard is a new automatic digital LCR bridge, the model 4261A. Offering an accuracy of 0.2% of reading, it requires only user selection of function: L, C or R. Readout is via a 3½-digit LED display, with a second display for dissipation factor, scaled in terms of D, C/D or L/D.

The 4261A is capable of making rapid and easy parameter measurements on components such as semiconductors, pulse transformers, filter coils, electrolytic and film capacitors. It can also measure the internal resistance of devices like dry cells.

Measurement ranges are 0.1pF-1900uF and 0.1uH-190H at 1kHz, for C and L, from 1 milliohm to 19M for R, and from .001 to 1.900 for dissipation factors. C and L can also be measured at 120Hz, with ranges of 1pF-19mF and 1uH-1900H. Each of the three functions is covered via 8 ranges, for both testing frequencies.

Two test signal levels are available: 1V and 50mV. Three internal bias voltages may also be selected, or alternatively an external bias source. A range hold function allows repetitive measurements.

Measurements are made with the five terminal method, but are easily converted to 4, 3 or 2 terminals as required. Three test fixtures are available as accessories.

A pull-out instruction card on the front panel provides a ready references while making measurements.

BCD output and remote control are optional. Price of the basic 4261A is $1619 duty free, plus duty and sales tax where applicable. Further information from Hewlett-Packard Australia Pty Ltd, 31-41 Joseph Street, Blackburn, Victoria 3130, or offices in most other states and in New Zealand.

NEW PRODUCTS

50MHz pulse generator

The new Textronix PG 508T is a high quality general purpose 50MHz pulse generator with several unique features. It has a high-level output to drive CMOS—20V in a ±20V window as well as 10V into 50 ohms. Also a control error light that warns of conflicting control settings. Both the high and low levels of the output waveform are independently adjustable, and the instrument has true 50 ohm output.

Triggering may be at 50 ohms or 1M impedance, the latter allowing the use of a standard oscilloscope probe.

Independent rise and fall time controls allow up to 100:1 difference in rise and fall times. Further information from Tektronix Australia Pty Ltd, 80 Waterloo Rd, North Ryde, NSW, or offices in other states.

Pushbutton options

C & K Components has issued a four-page brochure describing the 7 termination options now available on their momentary snap-acting pushbutton switches type 8125 and 8225. The switches, SPDT and DPDT respectively, are available with standard, PC, quick-connect and four different wire-wrap terminations, all with .030 terminal

thickness. C & K's unique epoxy seal feature is used on the wire-wrap options. The brochure gives full specs for the switches, and is available from C & K Components (Aust.) Pty Ltd, P.O. Box 101, Merrylands, NSW 2160.

Miniature metal glaze resistors

IRH Components has introduced a new miniature ½-watt version of their well-known metal glaze resistor. Designated type GLP, the new resistor has physical dimensions very similar to those of ¼W and even ⅛W in other brands, yet has a full ½-watt rating at 70°C ambient. The maximum surface temperature rise is 50°C.

The smaller size allows the use of 10mm (0.4in) lead spacing as standard for PCB horizontal mounting—conserving costly PCB real estate. Length of the resistor is 5.5mm, and diameter is 2mm. The leads are plated with 60/40 solder for

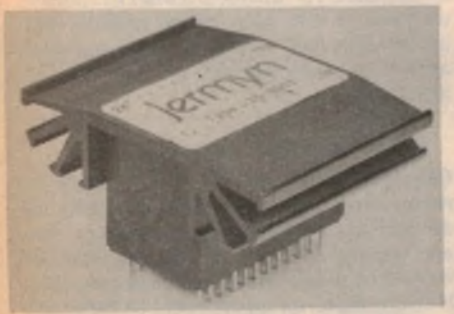
excellent solderability, and both coating and code bands are solvent resistant.

Like the larger IRH metal glaze resistors, the GLP resistor offers the high stability and reliability inherent in thick film technology. The resistors are locally made, and the result of extensive research, development and applications testing.

Further enquiries from IRH Components Pty Ltd, Box 71 PO Kingsgrove, 2208.

Power modules

Jermyn Manufacturing has introduced a range of modular power supplies under the name Powerbase. Available in 5, 12 and 15 volt versions, with regulated output currents of up to 400mA and unregulated outputs of up to 800mA, the J35 series is particularly suitable for powering small TTL or CMOS systems. The



modules are designed to plug into a standard 24-pin DIL socket—a socket being supplied with each supply.

The low voltage AC input requirements enable several modules to be driven from a single transformer. The integral and electrically isolated heatsink of the Powerbase modules provides optimum cooling over a wide temperature range.

Size of the modules is 32mm x 21mm x 25mm (L x W x H).

The modules are distributed by Swann Electronics Pty Ltd (formerly McMurdo Australia), of PO Box 350, Mount Waverley, Victoria 3149.

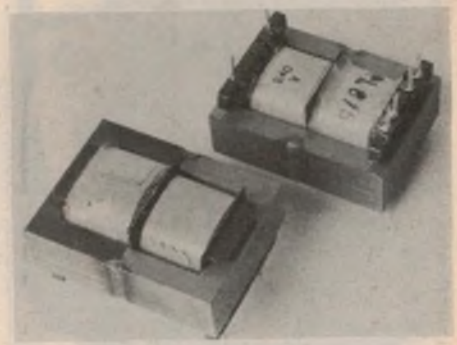
Range of 5VA PC-type transformers

Ferguson Transformers have announced a new range of miniature PC-mounting stepdown transformers with 5VA rating, designed for use in modern low-power electronic equipment. There are seven models in the range.

The new PL/5VA range of transformers has been produced in response to a demand for miniature low-rating transformers suitable for direct PCB mounting. The transformers use a novel "strapless" construction, with two sets of E-shaped laminations strip welded together. The primary and secondary windings are wound on separate plastic bobbins, which are mounted immediately adjacent on the centre arms of the E's. This gives good magnetic coupling, together with dielectric isolation conforming to AS C126.

In the normal "PL" configuration the transformers have connections to both primary and secondary windings brought out to stout wire pins, designed both to make connections to the PC board, and to attach the transformer physically. However, for those applications where it is considered inadvisable to have mains voltage on the board, the primary connections can be brought out to separate quick-connect terminals. This leaves the pins on the primary bobbin free for purely physical attachment. These versions are prefixed rather than PL.

The PC pins are spaced with centres on 0.1-inch pitch, to make them fully compatible with standard PCB formats.



Primary pins are spaced on 0.8in centres, and are 1.7in from the secondary pins. The overall size of the transformer is 51 x 38 x 30mm (L x W x H).

The seven types in the range all have dual secondary windings, which may be connected in either series or parallel.

The series-winding output voltages are given by the numerals following the "PL" in the type numbers: PL6, PL9, PL12, PL15, PL18, PL24 and PL30. Parallel connections give roughly half these voltages, with proportionally higher current ratings. All are rated at 5VA, with nominal 15% regulation from no load to full load.

Trade enquiries to Ferguson Transformers at 331 High St, Chatswood, NSW 2067.

Letters to the editor

Gunn diodes

I read with interest your article on a 10GHz link based on a Gunn oscillator published in the September issue. UK amateurs over the last five years have been using these devices to achieve quite remarkable ranges. It can be shown that relativley small equipment—a 10mW source, 18in parabolic dish aerials and an IF bandwidth of about 200kHz—has a range of up to 1000km over completely unobstructed paths. The maximum distance worked in the UK is a mere 256km, which is very close to the maximum possible in a country with the highest mountain of 4400 feet. The signal strengths were colossal.

Another technique which we have used is to fire the signals through the humidity duct which in good weather forms over water. Using this technique it is possible to work long distances with even smaller equipment. Best effort so far is 322km (S.Wales to Scotland), but English stations also have worked to Holland and the Channel Islands.

As you point out, Gunn oscillators cannot be conveniently amplitude modulated, but waggling the DC supply up and down by a few hundred mV produces excellent FM if the oscillator is basically stable. A fairly common practice therefore is to use standard 10.7MHz broadcast FM IF circuitry in the receiver. Two transceivers with their oscillators spaced in frequency by 10.7MHz will enable two-way operation over unobstructed paths of up to a couple of hundred km if 18in dishes are used. Alternatively, standard broadcast receivers fitted with a low-noise preamp of about 20dB gain can be used, or if an untuned preamp is used, then the FM receiver tuning can be used for fine tuning.

Other points of possible interst are:

(a) Trying to feed Gunn oscillators from a transformer also blows UK diodes, especially if the primary is undamped. Always fit a zener diode across the Gunn terminals rated at about 0.5V above the working voltage, as a spike clipper.

(b) Horn aerials are particularly suitable for Gunns because badly designed oscillators can be very sensitive to the match of the load—sometimes they will hop in frequency by the odd GHz or so.

(c) Careful checks of several standard UK dustbin lids of the smoothly rounded type show these to be near enough perfect paraboloids to be usable up to 30GHz!

(d) A ptfe (teflon) tuning screw of ⅛-¼in diameter makes a much more reliable tuner.

(e) A lot of 10GHz information has been published in the Radio Society of Great Britain's "Radio Communication". This has been collected in the new edition of the VHF Manual due to be published in the new year.

Dain Evans, G3RPE
Hemel Hempstead, UK

COMMENT: Many thanks for the information, which will no doubt be of considerable interest to microwave enthusiasts.

Advertising coupons

I am a 13-year-old reader and I agree with Mr. Clapton's complaint in E.A. January 1976 about advertising coupons being placed behind technical articles. You might like the advertisers to be happy, but what of the readers? Sometimes, though very rarely, you repeat advertisements through the magazine. Why not put some of these ads behind a coupon? Anyway, the main purpose of a magazine should be to entertain readers, not tell them that so-and-so's DVOMs are cheaper and better than any other, which is normally a load of rubbish anyhow. I am sure other readers will agree with me, so please hear our plea and put coupons out of the way of articles.

G. Field
South Oakleigh, Vic.

COMMENT: If you took our reply to mean that we place the interests of advertisers above those of readers, you are wrong. We are in the position of having to please both, as far as possible. If there were no advertisers to help pay our bills, you'd have to pay far more for the magazine. As it happens, many readers do find the advertisements of great interest and value, and have told us so many times. It is not at all easy to prevent advertisements with coupons from appearing behind editorial material at times.

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.

peter's meters~price beaters!

MODEL Y —82HNR

Meter 8uA
36 Ranges With OFF Position
0-0.5-2.5-10-50-250-1K (100KΩ/V)
0-5-10-50-250-1K (15KΩ/V)
0-10u-500u-5m-50m-500m
0-10K-1M-10M-100M (130 Mid-Scale)
-20 to +62
165H x 130W x 85D
625g
1.5V (UM3) x 1 .15V (W10) x 1
4Φ x 4

$30 P.P. $3

MODEL Y —50HN

Meter 8uA
23 Ranges With OFF Position
0-2.5-10-50-250-1K (100KΩ/V)
0-5-25-100-500-1K (10KΩ/V)
0-10u-5m-50m-500m
0-10K-100K-1M-10M (130 Mid-Scale)
-20 to +62
142H x 93W x 450
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/V)
0-6-30-120-600-1.2K (15KΩ/V)
0-30u-3m-300mA
0-60K-6M (45 Mid-Scale)
0.0001-0.01
0.001-0.1
-20 to +16
125H x 88W x 38D
235g
1.5V (UM3) x 1
2Φ x 3

$14 P.P. $3

MODEL FM—20YN

Meter 25uA
24 Ranges With OFF Position
0-5-25-125-250-500-1K (40KΩ/V)
0-10-50-250-500-1K (20KΩ/V)
0-25u-5m-50m-500m
0-10K-100K-1M-10M (48 Mid-Scale)
-20 to +62
142H x 98W x 400
290g
1.5V (UM3) x 1
2Φ x 4

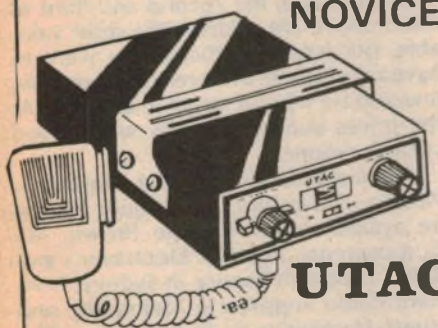
$20 P.P. $3

MODEL Y—60FM

Meter 25uA
23 Ranges With OFF Position
0-0.6-3-15-60-300-600-1.2K (30KΩ/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
280g
1.5V (UM3) x 1
2Φ x 6

$17 P.P. $3

NOVICES



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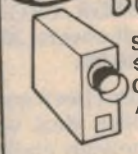

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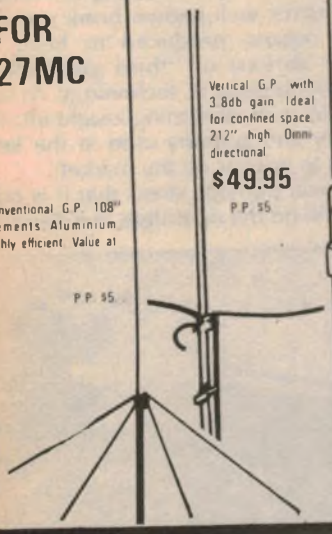
FOR 27MC



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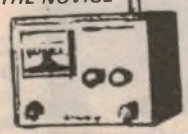

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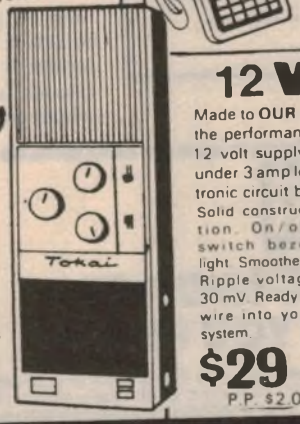

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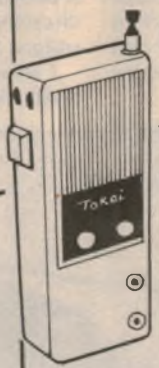

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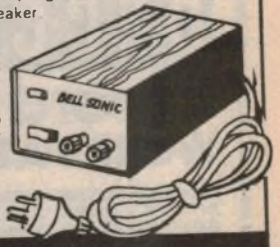

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PETER SHALLEY

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Books & Literature

Transistor data

THE TRANSISTOR MANUAL, 1973. Soft covers, 214 x 147mm, 167pp. Price $3.95.

TRANSISTOR SPECIFICATIONS MANUAL, published by Electronic Technology Publishing Co., Kowloon. Soft covers, 214 x 278mm, 160pp. Price $5.80.

THE WORLD TRANSISTOR CROSS-REFERENCE GUIDE. Soft covers, 207 x 296mm, 177pp. Price $10.00.

Until recently there haven't been many data books available which deal with anything like all of the seemingly endless number of different Japanese transistors. This has made it particularly difficult for the service technician, trying to repair the ever-increasing proportion of radios TV sets and other equipment coming from Japan.

These three books should help remedy the situation. At least it should

now be possible to find out the characteristics of most transistors found in Japanese equipment, in order to try and choose a replacement from the devices which are in fact available!

All three of the books are basically written for the Asian technician, but those who like this reviewer have no knowledge whatever of Japanese or Chinese should still find them quite useable. This is because the actual data itself uses standard symbols to represent device parameters and test conditions, etc.

Of the three, the second and third as listed above are perhaps the most valuable, but I suspect that if you want to have as complete a reference as possible, it would be wise to invest in all three. At the prices concerned, they seem good value for money.

We understand from the importers, Paradio Electronics, that copies should be available from George Brown, MS Components, Pre-Pak Electronics and Radio Despatch Service in Sydney, from Ham Radio Supplies in Melbourne and Hunts Electronics in Toowoomba, Qld. (J.R.)

Electronic organs

ELECTRONIC ORGANS, Volume 3, by Norman H. Crowhurst. Published by Howard W. Sams Inc, Indianapolis 1975. Soft covers, 212 x 280mm, 143pp, many illustrations. Recommended retail price $7.80.

This is the latest updating of Norman Crowhurst's well-known book on electronic organs, produced to keep the reader abreast of "third generation" instruments using IC technology. As such it provides an interesting insight into the circuitry and systems used in the latest organs to appear on the market.

I should perhaps stress that it is not a textbook on the operation and design of

electronic organs. Rather it is a book intended to supplement a basic knowledge of organ technology, by giving a "comparative anatomy" of representative current models from US manufacturers. After a very brief introduction, the author examines ten organs one by one, with a chapter for each.

The organs examined are all from well-known firms: Allen, Baldwin, Conn, Gulbransen, Hammond, Kimball, Lowrey, Rodgers, Wurlitzer and Yamaha. The information given varies from organ to organ, probably due to different degrees of co-operation from the makers concerned. For example that on the Allen computer organs is very sketchy, and of little value, while that on the Hammond Concorde is quite extensive, and very informative.

Overall, I found it a very interesting book, giving a great deal of useful information on the latest generation of organs—or most of them, at least. It seems very good value for money at the price quoted.

The review copy came from Prentice/Hall of Australia Pty Ltd, but copies are apparently in stock at all major bookstores. (J.R.)

Slot car racing

SIMPLE ELECTRIC CAR RACING, by Vic Smeed. Published by Argus Press London. Stiff paper cover, 104pp 185mm x 125mm, illustrated by diagrams and photographs. Price in Australia $2.25.

To a dyed-in-the-wool slot car enthusiast, this small book may be regarded as rather basic and even dated—it was first published in 1965, with a paperback edition following in 1970.

However, to a non-expert in the subject, it does appear to contain a lot of interesting material, written by a man who has fairly obviously been part of the developing slot car scene during the past fifteen years. He recalls the virtual start of the craze with the original "track cars" and gives a very practical hobby-level treatment of how modern slot cars are made, adjusted and operated.

Chapter headings are: In The Beginning – The Workshop – Motors – Gears, Wheels and Tyres – Pickups and Steering – Chassis – Bodies – Tracks – The Electrics – Racing – Appendices on rules and colour codes.

At the prices quoted, it should be a very economical and easy-to-read introduction to the subject, either for the would-be hobbyist or for the reader who merely wants to know what slot cars are all about. Our copy came from Thomas C. Lothian Pty Ltd, 4-12 Tattersall's Lane, Melbourne 3000. (W.N.W.)

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Decadade oscillator Type DG 38A
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ILFORD 17.5 mm SPROCKETED MAGNETIC TAPE

1000 ft reels brand new original packing
$4.00 ea. quantity available
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$60

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1 mile twin (2 miles) genuine ex-Army. Don 8 perfect condition $35 per drum $1 cartage to rail freight payable at destination.

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Provides a visual indication of signal output Tests: electrode open circuits, short circuits, current gain. $14.95 ea.
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4 DIGIT RELAY COUNTERS

50 volt DC, suit slot car Lap counters, etc.
$1.25 each. P & P 60c.

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ONLY **$9.95**
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Frequency Meters.
$35.00

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25 x 30 $5.95
40 x 40 With Tripod $8.95
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P & P A. $1.70, B. $2.25,
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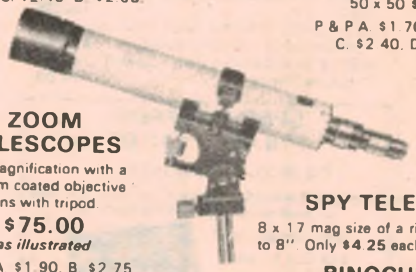

ZOOM TELESCOPES

60 magnification with a 60mm coated objective lens with tripod.
$75.00
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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.
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3in x 2in containing 2 valves, qty of resistors, etc.
ONLY 75c. P & P 60c.

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½"	$23.30
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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.

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Palec Model SG1 150 Kc/s to 30 M/cs
240 VAC $37.50
$1.00 cartage to rail.
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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.

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Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio, etc.
$2.50 P & P 20c
200 MA 24 volt, ⅛in push movement.
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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.

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A compact and handy tester for workshop or lab where quick circuit checks are required
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30,000 ohm per volt **$23.75** P & P $1.05

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¼" x 2400' on 10½" reels $4.95
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Panoramic Adaptor

E.M.I. type PRA-1 455 variable Kc
Course 440-520 Kc
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1½" Diam 4½" F.L. 75c 2½" Diam 2" F.L. $1.50 each. Or $2.50 per pair. P & P 40c

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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.

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REPERFERATOR

Genuine Siemens Type 33c $65.00

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70 OXFORD STREET, SYDNEY 2010

SORRY NO C.O.D.

The Amateur Bands

by Pierce Healy, VK2APQ

Record Attendance at Gosford Field Day

This month we have a report on the NSW Central Coast field day, and a collection of overseas and local news items.

The Central Coast Amateur Radio Club held its 19th annual field day on Sunday, 22nd February, 1976 at the Gosford Showground. The registered attendance of 575 persons broke all previous attendance records, and is now without doubt the largest attended single event held in amateur radio circles in Australia.

It is truly a family day when amateurs, their families including grandchildren and friends meet in a very friendly atmosphere. The attendance figure was made up of 335 men, 116 ladies and 124 children.

This year the weather was overcast, but the occasional heavy shower of rain did not dampen the enjoyment of those attending. The eleven field events in the form of HF and VHF scrambles and hidden transmitter hunts were eagerly contested. The title of overall winner of the day's events was shared between E. Piip, VK2BQP and A. Beard, VK2ZIW with J. Oxley, VK2YCO as runner up. The youngest competitor and prize winner was five year old Bradley Skeers who won a junior 144MHz pedestrian hidden transmitter hunt.

There was a large display of the latest in amateur equipment by Sideband Electronics Sales; Dick Smith; Vicom; Intersell Pty Ltd; Bail Electronic Services; Kevin Cox; and 6UP Shop. In addition there was a disposal store, a ladies' stall and a display of projects by members of the WIA Youth Radio Scheme.

The amateur television display provided a direct outside broadcast of the 144MHz hidden transmitter hunts. Video tapes in colour were also shown.

The CCARC extends its thanks to: R. H. Cunningham; Hy-Q International; Ampex Australia; AWA Sales; Fairchild Aust.; Plessey Products; Union Carbide; Standard Components; Ferguson Transformers; Deitch Brothers; and Richard Foote. These firms in addition to those who provided displays, provided generous donations of prizes.

A visit to the Australian Reptile Park or a coach tour of the beautiful Central Coast area was enjoyed by many who did not participate in the field events.

The club issued a questionnaire seeking ideas for improving the field day. The response was poor (probably too difficult to answer), but any further ideas would be welcome. Send them to CCARC, PO Box 238, Gosford, NSW, 2250.

Members of the CCARC thank all who attended and helped to make the day a success and look forward to seeing everyone along to the 1977 field day.

Novice examination

As these notes were being compiled, word came to hand that the first examination for the novice licence would be held in late March. It may be recalled that the first novice licence examination was set down for 23rd June, 1975. But an industrial dispute affecting the radio branch prevented the examination taking place. So another nine months has been added to the novice licence saga given in August 1975 issue of these notes.

Novice manual

A 92 page manual of questions and answers to assist those interested in gaining an Australian Amateur Operator's Novice Certificate of Proficiency has been written by Keith Howard, VK2AKX and is available through the Westlakes Radio Club.

The book is divided into nine sections each dealing with a particular aspect of electronic and radio theory under the following headings: UNITS; ELECTRONS AT WORK; CIRCUITS; COMPONENTS; POWER SUPPLIES; PROPAGATION; MODULATION; TRANSMITTERS; OPERATING. Following the text on the subject covered in each section, questions with answers related to the text are given. These are in the format of the examination paper for the novice licence.

The book is priced at $2.00 per copy plus 40 cents postage. In addition to being a manual for the novice licence it would be a useful source of reference to anyone wishing to refresh their memory concerning electronic theory and practice.

Copies may be obtained from The Westlakes Radio Club, PO Box 1, Teralba, NSW 2284.

New format for "QST"

After nearly half a century the American Radio Relay League has been forced by rising cost to change the page size of the publication "QST". This publication is one of the most widely read, purely amateur radio magazines in the world.

The cost of producing the pocket size publication increased alarmingly over the last couple of years, particularly due to the cost of paper. New type printing equipment was designed for different page sizes than that used for "QST". This resulted in a large paper wastage due to trimming to size.

The new format came into being with the January, 1976 issue and will mean a saving of over $100,000 a year to the ARRL. The size is now the same as "Electronics Australia". A larger type font and a three column setout makes for much easier reading and more attractive layout. Some changes have also been made in editorial approach and the captions of articles. The editors regret that it may be necessary for bookshelves to be redesigned to accommodate the larger size "QST". However, the saving to the ARRL will be considerable.

Here are some items of interest I gleaned from the new look "QST" January, 1976:

Among the anniversary celebrations planned by amateurs observing the United States of America bicentennial will be one highlighting the 70th anniversary of women in radio.

In 1906, Anna Nevins became the first woman to enter this field of communications. Three years later YLs (amateur abbreviation for women operators—Young Lady—irrespective of age) opened the door to the amateur radio service for all who followed.

In the past 70 years the focus of the YL operator picture shifted from a USA to an international activity. Today there is about 50,000 YL operators representing 130 countries. YL clubs in many countries have encouraged women to become interested in amateur radio, to find that they are not only welcome but are also wanted as contacts on the air.

Through individual and club sponsored public services, YLs have built a record of service that parallels the entire amateur picture and through the personal YL to YL association are helping to further international friendship.

Women have been busy these past 70 years building a tradition that has become a part of many radio clubs and international radio societies.

By their world wide association, women radio operators are contradicting Rabelais' statement that "Half the world does not know how the other half lives".

Under the heading "International News", formerly IARU news, the subject covered deals with the introduction of novice licence in Australia and a theory paper for the Amateur Operator's Certificate of Proficiency about which the question "How do you think American amateurs would fare?"

In a photograph taken at ARRL/IARU headquarters is Alf Chandler, VK3LC Australian (WIA) intruder watch co-ordinator.

OSCAR 7: Overloading in mode "B" (432MHz uplink) is becoming a serious problem in the USA, threatening the lifetime of the batteries and causing cross modulation, desensing and mode switching. If a signal is particularly loud on the 144MHz down link then the uplink station is probably using more than the recommended 100 watts erp on the 432MHz uplink. Tactful reminders to reduce power are suggested.

Civil emergency net

The role of amateurs, in particular those forming the WICEN organisation in New South Wales, in times of emergency was stated at a WICEN group meeting held at the Wireless Institute Centre in February. The main points being as below.

In a declared emergency third party traffic may be handled as required by the State Emergency Service (SES) and police. WICEN is a recognised communication unit and may work freely with both those bodies.

Identification will be issued to WICEN members. RTTY and amateur television (ATV) modes of transmission may be used. It was also agreed that WICEN frequencies would be reviewed.

Those interested in joining this community service group should write to the NSW WICEN Co-ordinator, Howard Freeman, VK2NL, Wireless Institute Centre, 14 Atchison Street, Crows Nest, 2065.

Repeater operators meet

There was a good attendance of representatives of repeater operator groups at Wireless Institute Centre, Crows Nest on Sunday the 15th February, 1976.

Four points were discussed. The first brought agreement that modification is necessary to the present seven channel repeater plan. The second indicated that the majority favoured the present 50kHz channel spacing in lieu of changing to 25kHz spacing.

Thirdly, the meeting thought it undesirable to require any special form of access to activate a repeater. On the fourth point, it was agreed that future state repeater committees should be more representative of repeater operators and users.

Sydney moonbounce

The University of NSW Amateur Radio Society has formed a group to study the techniques of E-M-E communication and to construct equipment for the purpose of carrying out experiments in that field on 144MHz.

Membership is open to any amateur interested in

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

this aspect of amateur radio. All the present members are new to this field of experimentation and it is proposed to hold regular discussion over the air on the eleven and two metre bands. Those who gain the new novice grade licence are invited to join the group.

The group organisers are Steve Blair, VK2BZB in charge on the design and construction of the 144MHz receiver; Sam Voron, VK2BVS, construction of the 1kW power amplifier; John Woodard, VK2BOO, construction of the 3000 volt power supply and Robert Morgan, construction of an 80 element crossed yagi rotatable antenna array for 144MHz circular polarization.

At the present time assistance is being sought in obtaining two ceramic sockets for QY4/500A (QBL4/800) tubes.

To join the group call in on any one of the following net frequencies:— 27.125MHz the eleven metre calling channel, any weekend. 1.825MHz or 28.5MHz the Sydney 160 and 10 metre nets, at 11.00am and 7.30pm each Sunday night.

Novice licencees should try 3.570MHz or 21.150Mhz, the proposed 80 and 15 metre calling channels.

RADIO CLUB NEWS

CAIRNS AMATEUR RADIO CLUB: Here is an announcement of interest from the secretary of the CARC.

One of the most stimulating aspects of amateur radio is the thrill of chasing the elusive award.

One of the most satisfying aspects of amateur radio is service to the community.

Combine the two, and you're sure to end up with enthusiasm.

The CARC are in the happy position of having just such a combination on their hands; 1976 is the year in which their district celebrates its centenary.

To ensure the widest publicity net for the district's 100 years celebration, the Centenary Committee in association with CARC have introduced what is sure to become a coveted and much-discussed award amongst amateur operators.

The award is an elaborately designed certificate, ideal for framing and given pride of place in a successful operator's station.

The club plans to make the award worthwhile and only a limited number are to be printed.

To ensure that interested operators have an opportunity of vying for the award, CARC suggests that you keep a close lookout for stations operating from the Cairns district, North Queensland.

Not only is the CARC hopeful that the award will create interest among active members, but are also hopeful that it will give publicity to a district that is world famous for its natural beauty and tourism attributes.

CAIRNS CENTENARY AWARD RULES: All amateur stations outside the Cairns area are eligible to participate. For award purposes the area is defined as within 160kM radius of Cairns.

To qualify stations in VK and ZL call areas must QSO three Cairns area stations.

Overseas stations must QSO two Cairns area stations.

Send a copy of log details of QSOs to—CARC VK4HM, PO Box 1426, Cairns 4870, Qld. Awards will be forwarded in bulk via QSL bureaus unless the cost of postage and packing (quarto size) is remitted with application.

The award will be available for the whole of 1976, Cairns Centenary Year.

Call signs of stations in the Cairns area are: VK4's TL, MH, SU, YG, AMO, NF, AE, NU, ZY, RY, HK, YT, HM, VI, KV, VT, QX, CI, NI, DJ, DB, ZCS, ZBU, ZNZ, ZIP, ZIB.

ILLAWARRA AMATEUR RADIO SOCIETY: The December EME (moonbounce) tests provided a first contact with W9GAB, whose signals peaked at 6dB over noise. A further contact was made with K2UYH, singals up to 11dB over noise. A few words were copied of his SSB under conditions of deep fading,

using 2.1kHz bandwidth.

During the European test period about eight hours later, contact was made with F9FT (to 6dB over) and PA0SSB was heard calling but no contact was made. A check revealed that the dish antenna was pointing 2.5 degrees off the moon. Heavy cloud had prevented visual checks overnight and insufficient correction had been made at the start of the second test period for angular velocity between moon and the original sun reference hour angle, hence the lower than normal signal from F9FT.

As verbal approval was received in December to allow EME transmissions between 432.000MHz and 432.050MHz on a strictly non-interference basis, the Drake 2B IF channel receiver was modified to allow remote shifting of its calibration oscillator frequency. This provides measured offset from WWV at 15MHz, as a reference on its 100kHz crystal harmonic at 432MHz for adjustment of transmitting frequency.

The January tests were another allnight effort, but results more than compensated for lost sleep. First contact was made with W1SL (the 10th attempt), K0TLM, W0YZS who called during VK2AMW CQ period, and finally JA1VDV, the first attempt and was the first VK-JA UHF contact. This was on 432.045MHz and illustrates the need for transmitter frequency change capability as 432.000MHz is usually not available in Japan, being a national FM calling frequency.

The European test period five hours later produced contacts with F9FT and 15MSH. ZE5JJ was heard again, but he had a receiver pre-amp problem and could only give a "T" report. Heavy rain at both ends did not help in setting up for the VK-ZE test.

MANLY WARRINGAH AMATEUR RADIO CLUB: The first meeting of the club was held early in 1975. At present there are 50 financial members.

Meetings are held in the Manly Air League Hq., Hinkler Park, Manly, NSW, each Tuesday evening from 7.00pm to 10.00pm for lectures and general business. Each Saturday afternoon constructional projects are undertaken.

To date 20 members have been prepared for the novice licence examination. There is no charge to those attending lectures and Morse code practice, except club membership fees.

The club call sign is VK2MW and the 146MHz net frequency is used.

Details may be obtained from the president Ron Waterhouse, VK2ZPZ, phone 938 2910 or secretary Tony Richardson, VK2YCR, 15 Pertaka Place, Cromer 2099, phone 982 3707.

SOUTH EAST RADIO GROUP: On the 28th January, 1976, the 144MHz band opened from Mount Gambier to Albany, Western Australia, the stations worked were VK6KJ, VK6BE, VK6WG. VK6BE also copied 432MHz signals from VK5NC but was not able to transmit on that band to make a two way contact. The next evening VK7ZDA on Mount Barrow, Tasmania, was worked at good signal strength.

Work on the FM repeater is progressing and when completed is expected to give good coverage of the south-east of South Australia and western Victoria on channel 3.

WA VHF GROUP: Using a flying spot scanner, tests have been carried out on the group's amateur TV transmitter. An ouput of 20 watts is planned for the transmitter. It is hoped that regular meetings of the ATV group will be held at the Wireless Hill headquarters of the VHF group.

For information write to the WA VHF Group (Inc), PO Box 189, Applecross, WA 6153. Telephone 641558.

WIA WESTERN ZONE VICTORIA: The zone will be holding its annual meeting in May and a convention in November, 1976. A novice licence class of 20 students was conducted at the Lake Bolac High School with some coming up to 100km to attend lectures and Morse code practice.

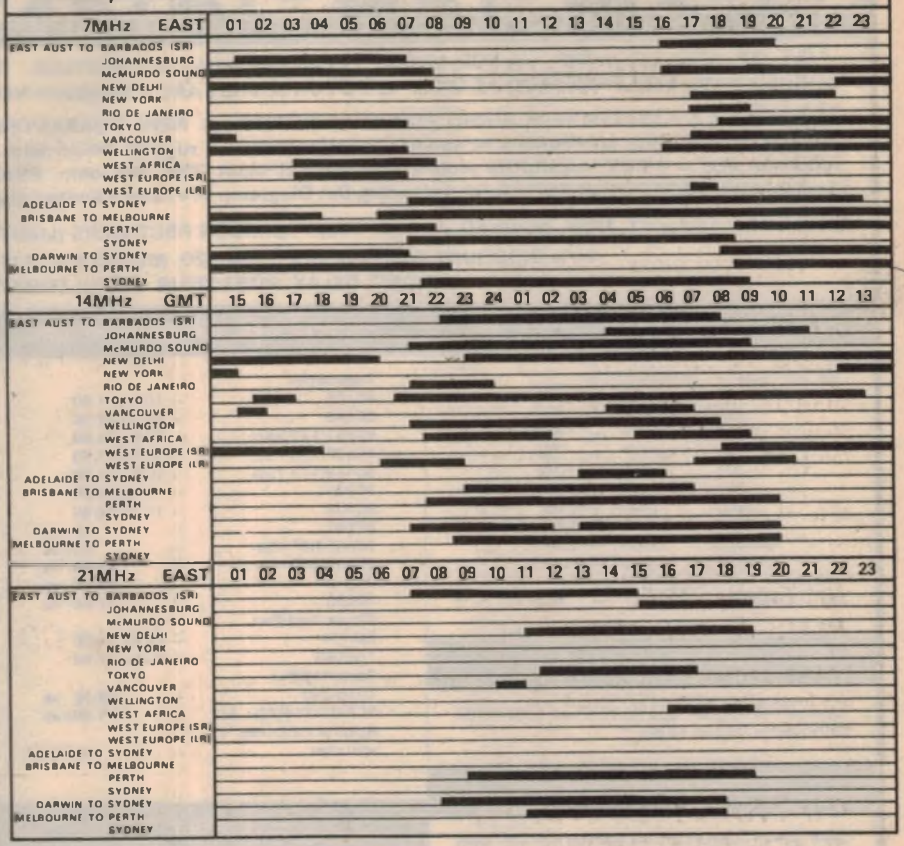
Weekly nets are held through the zone repeater VK3RWZ, channel 7 on Monday night at 9.00pm. Also at 8.00pm Wednesday nights on 3600kHz.

At the 1975 convention 168 persons attended the dinner and more than 200 were present for the field day and barbeque held at Warrnambool.

The secretary is Peter Solly, VK3AQO C/- High School, Lake Bolac, Vic. 3351.

IONOSPHERIC PREDICTIONS FOR APRIL

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. 4.76



WIA Youth Radio Scheme

Thirty persons attended the annual general meeting of the NSW division of the WIA YRS held at Wireless Institute Centre on Sunday, 15th February, 1976.

Officers elected to form the management committee for the next twelve months were:

State supervisor for NSW: Rex Black, VK2YA, 10 David Street East, Springwood 2777. State secretary: Ms Betty Barnaby, Penrith High School, Penrith 2750. State education officer: Ken Hargreaves, VK2ZIL, 52 Marlin Avenue, Floraville 2280. Treasurer and registrar: Noel Ericsson, VK2MF, 17 McIntyre Street, Brighton-Le-Sands 2216. Private studies supervisor: Reverend Bro Cyril Quinlan, VK2ACQ, Marist Brothers High School, Eastwood 2122. Publicity officer: Sam Voron, VK2BVS, 2 Griffith Avenue, East Roseville 2069.

During the past twelve months the number of club registrations increased from 15 to 26. The IREE pennants awarded to clubs attaining the highest standard of achievement by its members were presented to the Parramatta Marist Brothers Senior High School and to the non-school club—St George Training Annexe.

At Katoomba, Cessnock and Beacon Hill High Schools new approved elective courses in electronics have been introduced using the YRS syllabus and notes. Incentive packages of useful components have been presented to students who gained YRS certificates during 1975.

Details on all YRS activities and information on the formation of clubs may be obtained from any of the committee members given below.

ST JOHN'S CHURCH OF ENGLAND BOYS' SCHOOL: Catering for students, with an invitation for parents to join in the activities, a WIA YRS course is conducted on the first and third Monday evenings of each month from 7.15pm to 8.30pm.

The aim of the project is to assist members in their studies to gain the novice amateur licence.

Classes are held in the St John's Church Hall, 150 Cox's Road, North Ryde, NSW. Full information may be obtained by calling at the hall on either of the Monday evenings.

EASTERN AND MOUNTAIN DISTRICT RADIO CLUB: Classes for the Amateur Operator's Certificate of Proficiency (AOCP) and AOLCP will commence in April, 1976, in the Apex Workshop and Clubrooms in Nunawading Reserve, Silver Grove on Friday evenings, commencing at 7.30pm.

Enquiries should be made to the Class Manager, EMDRC, Ken Palliser, VK3GJ, Flat 4, 30 Cootamundra Crescent, Blackburn, Vic 3130.

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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	
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Stick Rectifier	
TV18-2MT	— $2.00 ea.
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7420	35c
7430	35c
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over $200 — 15%

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