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Australia's Top Selling Electronics Magazine

Electronics Australia

March 1985
AUST $2.30
NZ $3.30

AM Stereo is here!

How it works, new tuners, stations list

REVIEWS: ★ Mission CD player ★ Yaesu VHF transceiver

Win a PCB kit

Bonus 100-page Jaycar Catalog

Playmaster Series 200 Stereo Amplifier

Stereo TV Sound Receiver to build

Speech Synthesiser for Commodore 64

VCR Hifi Sound Explained

It had to happen! Teletext for only $199

Unbelievable . . . but true!

Now you can save hundreds of dollars on the technological breakthrough of the decade: Teletext!

Hundreds of pages of information — at your fingertips — that you haven't had access to in the past:

- Sport
- News & Weather
- Finance
- Education
- TAB details
- Theatre programs
- Even captions for the deaf . . .
- And much, much, much more!

AND THE BEST PART OF ALL:
IT'S FREE COMPLIMENTS OF YOUR LOCAL TELEVISION STATION!*

At last, a low cost, easy-to-build kit that you can use with your VCR to give sharp, clear Teletext pictures on any TV set.

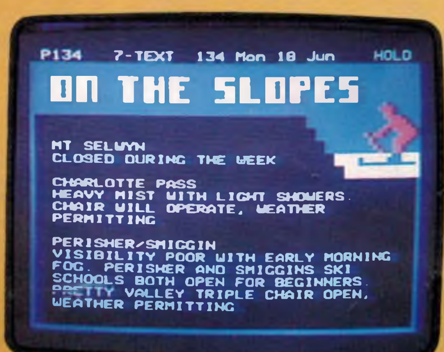
EXCLUSIVE TO
DICK SMITH ELECTRONICS PTY LTD

Don't pay $500-$700 for a Teletext decoder . . . or even $1000-$1200 for a new 'Teletext' TV: build it yourself only $199

Cat K-6315

And it's complete to the last nut and bolt — including the deluxe two-tone brown case shown here PLUS our exclusive step-by-step construction manual!

STOP PRESS! Stations transmitting Teletext include ATN7 Sydney, BTQ7 Brisbane, CTC7 Canberra and all NSW Regionals except NRN11 Coffs Harbour. Many commercial stations, and the ABC, transmit Teletext subtitles for deaf people. Teletext services are expanding all the time, so check your local station for details.



Electronics Australia

Volume 47, No. 3
March 1985

On the cover

AM stereo is with us at last. In our article beginning on page 14, Leo Simpson explains the new technology and takes a look at the new breed of receivers.

Playmaster Series 200

In this, the second article in the series, we give a full circuit description of this high quality audio amplifier. Also, we show you what it looks like! Turn to page 36.

What's coming

Next month we intend to describe a video processor for home use. This device provides a number of special effects to enhance your video home movies. See also page 103.

Stereo TV Receiver

Build this Stereo TV Sound Receiver and hear your favourite programs in stereo. Designed by staff at Dick Smith Electronics, this project uses prealigned tuner modules to make assembly a breeze. See page 76.

Features

Hifi, Video and Reviews

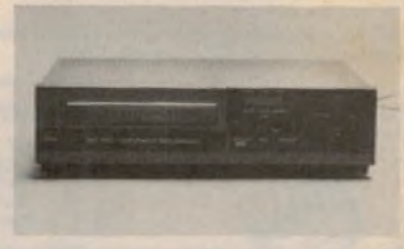
Projects and Circuits

Personal Computers

Columns

Departments

Mission CD Player



One of the latest entrants into the CD player market is the Mission DAD 7000. It is manufactured by Philips and then specially modified by Mission. Find out how it performs by turning to the article beginning on page 26.

How can one piece of furniture have many uses?

These smart and attractively designed Desk and Table Units have been specifically created to solve the numerous specialist furniture needs around the home and office —

ATTRACTIVE 'EASY-CLEAN' FINISH
JUST WIPE WITH A DAMP CLOTH

Just think of all the things they could be used for!

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- Word Processor Desk
- Video Games Table
- Children's Homework Desk
- Personal Writing Desk
- General Utility Table

UTILITY TABLE

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Width — 720mm
Height — 700mm
Depth — 490mm

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FLOPPIDEX MAGNETIC DISC STORAGE CASE

Holds 10 off 5¼" Discs

- Easy open & close with Lock.
- Protects Discs from dust.
- Fits into most briefcases — You can carry it with you.
- Storage pockets fan open for easy access and replacement.
- Ivory plastic top with steel shielding case.

TOP VALUE

$22

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STRONG AND STURDY CONSTRUCTION

UTILITY DESK

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Width — 780mm
Height — 860mm
Depth — Top 310mm
Desk 600mm

Order Code UT100

ALL UNITS SUPPLIED SECURELY BOXED WITH FULL INSTRUCTIONS FOR QUICK ASSEMBLY
YOU ONLY NEED A SCREWDRIVER!

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The electronic equipment shown is for functional display purposes only and are not part of the offered goods package.

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FD100		Floppidex	$22	+ $3	

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EA/3/85

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*Recommended and maximum price only.

Stereo: a new era for AM broadcasting

As of February 1st, 1985, Australia has AM stereo transmissions using the Motorola C-QUAM system. This month some 50 commercial AM stations throughout Australia will be on the air in stereo. In the capital cities just about all commercial stations are in stereo and many provincial stations have made the change too. We expect that within two years, every Australian AM station will be in stereo. Isn't it great to see this major development taking place in such a short time? It's the biggest thing that's happened in AM broadcasting in 60 years. We're very excited about it.

Frankly, Australia has made a courageous and well-informed decision to adopt the Motorola C-QUAM system. While all the indications were that Motorola was becoming market leader in the USA, it still required a certain degree of pluck, on behalf of the Department of Communications and the Minister for Communications, to opt for a single-standard system. They could have taken the easy way out and let the market sort it out, as in the USA. They didn't and that's good.

As it happens, Australia's lead has been noted in the USA and will probably mean an earlier end to the market wrangle over there. In the meantime, there has not been a great deal of equipment available for the introduction of AM stereo — which is a pity. That was one of the reasons why our feature article on this subject was left until this month, when more products would be available (see page 14). Let us hope that more companies stop sitting on the fence and decide to introduce AM stereo tuners and receivers.

Let us also hope that AM receivers will now be developed to obtain much better sound quality. For too long AM listeners have had to be satisfied with poor quality sound from "cut to the bone" superhets. If AM stereo circuitry is refined to the same degree that FM stereo has been, the full potential of the AM medium can be realised. And that will mean sound quality almost as good as we have come to expect from FM. (All right, all right, I can hear all you pop-music haters. Programming is another issue altogether.)

Local manufacturing is a possibility

The introduction of AM stereo also represents an opportunity for local manufacture of domestic receiving equipment. There are some 20 million radio receivers in Australia which will have to be replaced. Surely not all of these have to come from Asia. Electronics manufacturing does not necessarily mean a large labour content these days although tooling and set-up costs can be high. There are a number of companies both small and large that are favourably placed to commence making AM stereo receivers. Let us hope that some of them grasp the opportunity while it lasts. And here's a hint. If those products are aimed at the quality sector of the market there is no reason why they cannot be sold in the USA. The wideband AM tuner made by AWA in New Zealand many years ago was sold in the USA. It can be done again.

Leo Simpson

GREAT NEW PRODUCTS FOR 1985!

JAYCAR 1985 CATALOGUE

— DID YOU MISS OUT?

The new 100 page Jaycar Electronics catalogue appeared in this month's issue of Electronics Australia. If you missed out, send SAE to Jaycar Electronics or call in to any one of our stores listed on page 5.

SY4015 Relay 48V 6 PDT

We had these on special 12 months ago and sold thousands. Now is your chance again. They will work from about 15 volts but are reliable at coil voltages above 20.

Usually $6.95 — **This month 95c 10UP 75c**

"PHONY" PRODUCTS??

These products are more "Phonie" than "Phony." And why? Because Jaycar gives you the greatest range of Phone accessories & components at the best prices!

Jaycar ELECTRONICS

TELEPHONE PLUGS & SOCKETS

Cat. PP1400 Standard line plug only $2.95 10 up $2.45
Cat. PP1410 Line or Surface Mount Socket. Only $3.95 10 up $3.50
TELEPHONE CABLE (Solid colour coded conductors)
Cat. No. WB1602 2 pair (4 wire) Only $0.50/Metre 100M $0.45/M
Cat. No. WB1603 3 pair (6 wire) Only $0.70/Metre 100M $0.65/M
Cat. No. WB1610 10 pair (20 wire) Only $1.50/Metre 100M $1.20/M
All telephone cable covered in standard cream outer sheath.

– MAKE YOUR OWN EXTENSION LEADS & SAVE!!

ROTARY TELEPHONE DIALS

Brand new dials surplus to requirements from a famous local manufacturer. They are very high quality, with governor & contacts fitted. Ideal for telephone enthusiasts. 1000's of uses e.g. combination code etc.
Cat. YT6900 $2.95 SELLING FOR $4.95 elsewhere.

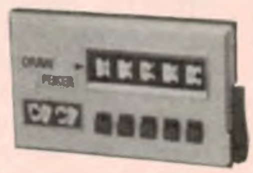
Built-up 'phone leads

5 & 10 metre leads are fitted with high quality stranded wire cables featuring thick sheath wall & secure termination. Will work with PABX's etc. & are suitable for heavy commercial use. The 15 & 20 metre cable is supplied on an attractive telephone-shaped wind-up reel & the double adaptor is just that – plug two 'phones into the one socket.
Cat. YT6010 5M LEAD NOW $12.95
Cat. YT6012 10M LEAD NOW $15.95
Save $4.00
Cat. YT6018 15M LEAD NOW $14.95
Save $5.00
Cat. YT6014 20M LEAD NOW $22.95
Cat. YT6020 Telephone Double adaptor $12.50

EXECUTIVE BLACKJACK MACHINE

- Plays real blackjack game with 3 hit chances.
- Pocket size. AA batt. powered. Battery extra.

CAT. XT1410
Normally $8.95 — This month **$4.95**
SAVE $4.00



DRAW POKER MACHINE

- Plays real poker game with draw action
- Pocket size
- Reels actually rotate.

CAT. XT1405
Normally $8.95 — This month **$4.95**
SAVE $4.00

EXECUTIVE POKER MACHINE

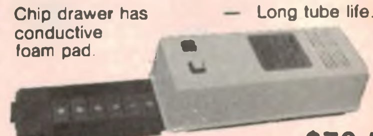
- Plays like the reel(?) thing.
- Pocket size
- AA battery powered (not inc).

CAT. X11400 — Normally $8.95
This month **$4.95** — SAVE $4.00

NEW!

EPROM ERASER

- Erase up to 9 chips at a time
- Safe and convenient.
- Chip drawer has conductive foam pad.
- High UV intensity at chip surface.
- 240V powered.
- Long tube life.



ONLY **$79.50**

CLOCK MOVEMENT

THIS MONTH **$9.95** — SAVE $5.00
NORMALLY $14.95

COMPUBOT

$39.95 — SAVE $10.00
NORMALLY $49.95

WATCH ROBOT?

Ideal children's toy. **$4.95**
Accurate quartz movement.
Watch converts to a Robot!

240-9V Plug adaptors Slashed!

Genuine 'ARLEC' 9V 200mA plug packs at unbelievable prices! Our 9V 100 MA unit usually sells for $8.95. For this month you can grab them for

$4.95!

(Supplied with DC plug on the end of 1.2M lead)
Cat. MP.3008

SAVE $4

UNIDEN 27MHz/156 MHz Marine Two-way

"Sea Wasp"

This great new marine two-way radio is fitted with all current 27MHz marine channels (**inc.** both distress), **plus** 2 vacant 27MHz channels for your own use. But the big news is that this radio will **receive** 2 of the OTC "Seaphone" VHF FM channels. That's right, it will receive channel 16 (Distress) & Channel 67 (weather). What a great idea! Apart from this it is a fully approved 5 watt 27MHz transceiver with many features.

ONLY $199

Cat. No DT5410

Jaycar ELECTRONICS

8 SECTOR BURGLAR ALARM KIT... NEW KIT

REF: EA Jan 1985
★ 2 delay sectors ★ 6 instant sectors ★ Steel box ★ Price includes battery ★ Siren driver ★ Variable exit/entry delay ★ Can use N.C. & N.O. on the one circuit!!
Cat. KA-1580

ONLY $129

"You ain't seen nuthin' yet!!!"

ULTRASONIC PEST REPELLER

NEW

ONLY $69

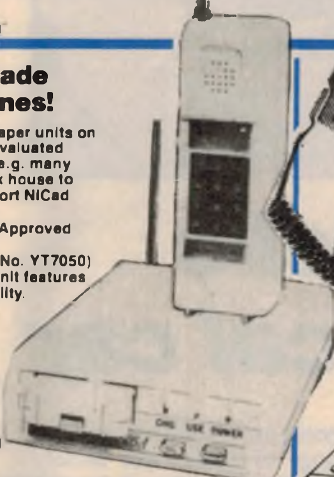
Which of these do you need to get rid of?
– mice, blowflies, birds, spiders, bats, rats, cockroaches, flies, moths or fleas?
The 'Verminex' ultrasonic insect/pest repeller creates a sonic environment which is totally hostile to the creatures mentioned above.
How does it work?
The environment is relatively devoid of ultrasonic sounds. Evolution has not had a compelling reason to protect non acoustic sensory mechanisms from ultrasonic stimulation. By subjecting an insect or rodent to a high level ultrasonic soundwave of a particular pattern the creature begins to behave in a typical fashion. The pest becomes disoriented, lethargic and bewildered. The natural reaction is to escape from the sound-affected area.
The sonic pattern is the secret and this pattern is a combination of scores of frequencies mixed together. The pattern was developed by Professor J.L. Stewart – the man who invented the Bionic ear. It works!
Like us, you would be skeptical at first that this would work. Our first reaction was, "If they are so good why haven't I heard about them before?" or "Surely a product like this – if it was any good – would have been around years ago." There have been ultrasonic repellers around but none of them have the patented soundwave pattern of the Verminex. We have on our file many, many letters of testimony to the fact that the Verminex is effective. The letters are from Australian Universities, Animal Husbandry research institutions, Commercial Piggeries, restaurants etc. Many of them had severe pest problems!
Your pest problem may not be as bad but it may still be a nuisance, which is why the domestic Verminex unit was developed.
We are so confident of the Verminex units' effectiveness, we make the following offer:
Buy the Verminex from us and use it for up to 14 days (21 days for mail order customers). If you are not happy with the product after using it as directed, return it to us in clean original condition & we will refund your money in full! (Less post/packing). What have you got to lose?
The Verminex covers an area of 2000 sq. ft. (uninterrupted) and is not cheap. But if the idea of dangerous chemicals, sprays, baits etc. worries you its a great solution. It is supplied with a 240V plug pack but can be battery powered.
What have you got to lose except the bugs? Cat. No YS5500

NEW

High Quality Japanese-made Heavy-Duty cordless 'phones!

Once again we were not happy with the cheaper units on the market. Several low-cost models were evaluated which we found to be unreliable in service (e.g. many would not penetrate from the front of a brick house to the back of the backyard. Some had very short NiCad battery life. Many were not approved).
The Telecom and Dept. of Communications Approved devices are JAPANESE-MADE Quality.
Two models are stocked: The CT-600A (Cat. No. YT7050) is designed for domestic applications. The unit features good range, good tonal quality & paging facility.

Cat. No. YT7050
Model CT600A
ONLY
$229



Cat. No. YT7060
Model CT505A
ONLY
$399

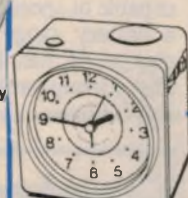
The CT.505A is a deluxe heavy duty unit which features a twin battery pack system. This enables you to continue operation in high-usage circumstances. Simply exchange the discharged battery pack with a freshly charged unit which comes from the base unit. The CT-505A provides the maximum range available in compliance with Australia's legal requirements. It also has unique security coding which prevents unauthorised use of your telephone.

Kids Bike "Emergency" Siren – Great New Toy –

CB-type microphone with siren/speaker/horn 4-way switch on mic. gives you: Police, Fire & Ambulance Sirens (all distinctive) PLUS Public Address! (It doesn't make enough noise to be a nuisance but is great fun!)
Cat. AS3190 **only $8.95**

Blotron "Electronic Blood/ Alcohol Checker.

Simply blow into the mouthpiece to see if you are over the limit. Dual analogue meter & led go/borderline/no go readout. Calibrated in Australia. Surprisingly accurate. Can be recalibrated if laws change. Specify 0.05 or 0.08.
Cat. YS5100 **only $75** save $3.



"Cube" Clock Radio

At last, a good old analogue display that is accurate, easy to read & easy to set (both time & alarm). 115mm square front (clock face 95dia.). Battery powered & therefore safe for kitchen or bathroom.
Cat. AR0952 **only $19.95**

ONLY $99

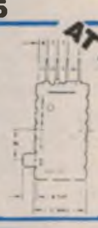
PASSIVE INFRA-RED DETECTOR

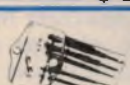
Jaycar breaks the $100 price barrier. Bulk buying by Jaycar has enabled us to pass on large savings on popular Passive Infra-Red detectors. PIR's (as they are known in the trade) are the most popular method of detecting movement in open areas. They are very reliable and being passive (i.e. they are not transmitters like microwave or ultrasonic sensors) they false trigger a lot less. For a technical description see page 21 of our 1984 Catalogue. The only drawback in the past was their fairly high cost. Now you have no excuse to install one (or two) as part of your alarm system.
(Please note that the illustration is indicative of PIR. We reserve the right to ship units of similar performance but possibly different physical appearance).
Cat. LA-5015

Quality VHF Video/Audio RF Modulator

NEW! AT LAST!

At long last a good quality, stable video/audio-to-RF modulator. It even will enable you to connect a Commodore VIC-20 to a VHF T.V.! Note that this module is specially tuned for Australian T.V. (VHF CHAN 0 & 1 5.5MHz Sound Subcarrier). A full data sheet & connection diagram is included!
Cat. LT3802 **$9.95 ONLY!**





BARGAIN! JEWELLER'S 6-PIECE SCREWDRIVER SET

In Vinyl wallet. Normally $3.95
FEB ONLY $1.98 ½ PRICE! Cat. TH2005

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HURSTVILLE: 121 Forest Road. Tel. (02) 570 7000

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Concord
Mon-Fri: 9am - 5.30pm; Sat 12pm

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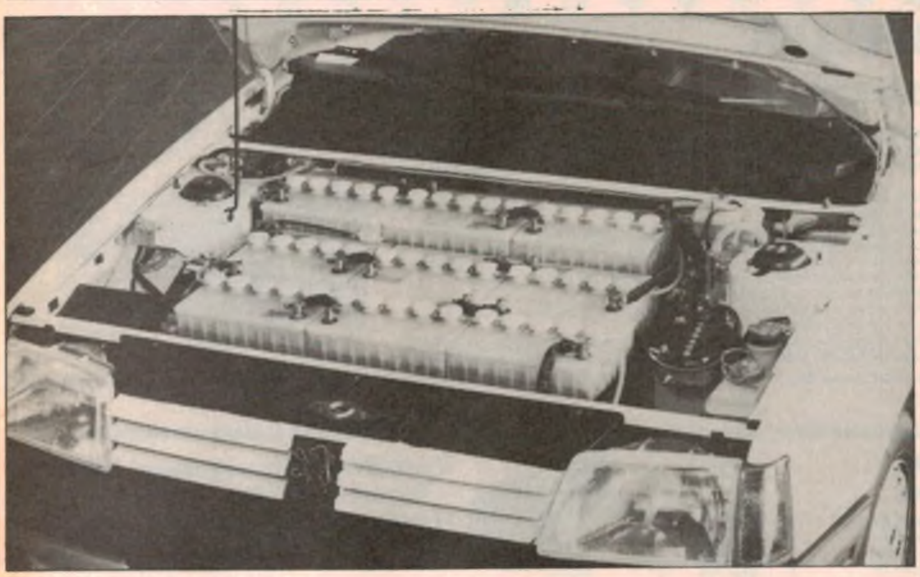
News Highlights



Nickel-iron cells power practical car

A practical electrically powered vehicle, the Electric 205, has resulted from a research program partially financed by the French Agency for the Exploitation of Energy. This car is capable of speeds up to 100km/h, and has a battery range of 140km per battery charge. It has been developed by the PSA Group (which includes the Peugeot and Citroen car companies), in close collaboration with SAFT, who developed the batteries used to power the car.

Unlike other electric vehicles which used lead-sulphuric acid cells, the Electric 205 uses nickel-iron cells as its power source. This feature allows a reduction of the total battery mass in relation to the available energy.

So that the internal passenger and boot capacities of the car can be unaffected by the propulsion system, the entire power train is grouped together at the front of the vehicle — the batteries are located under the bonnet, over the top of the electric motor.

To achieve the best possible compromise between various conflicting requirements, an extensive program of research was required. Limited space was the major problem, and this has to be considered in designing the vehicle body, the production of a power unit and control system and the development of a battery capable of providing adequate power without taking up too much room. The resulting components are claimed to be state-of-the-art in compactness and efficiency.

The car has been designed with the aim of providing the user with the benefit of low-cost off-peak overnight electricity for most of the battery charging. Energy is recovered and fed back to the batteries during braking. Accessories are powered directly from the battery system.

The Electric 205 is fully automatic, the noise level during operation is very low, and it produces no polluting gases.

Crisper chips from GE

General Electric scientists have developed a proprietary "contrast-enhancement" material that is applied to semiconductor wafers at the beginning of the fabrication cycle. This coating greatly extends the ability of today's process equipment to make chips with ultra-small circuits.

Aided by the coating, GE researchers have fabricated experimental micro-circuits with linewidths of only 0.4 microns employing commercially available equipment. Without the coating, the equipment is limited to the production of circuit lines twice as wide.

This 50% reduction in circuit widths is not the only benefit of the new coating. When employed in the manufacture of circuits with lines one micron wide and larger, it helps to produce chips with more precisely defined microstructures, resulting in improved operating characteristics.

Electronic News

Britain's daily newspaper The Guardian is leading the way for its Fleet Street rivals by moving into the world of electronic publishing — the first of the UK's national newspapers to do so.

It means that businessmen and women, journalists and current affairs researchers from all over the world will be able to retrieve and analyse the paper's news stories and feature articles using a simple keyboard and screen.

To make this possible, The Guardian will be included in Britain's largest news and current affairs service, World Reporter, published by the Thorn EMI subsidiary Datasolve.

By joining Datasolve's two-year-old World Reporter service. The Guardian will be making itself available alongside such important international news sources as The Washington Post, The Economist, The Associated Press, Keesing's Contemporary Archives, the BBC Summary of World Broadcasts and the BBC External Services News.

Using World Reporter, a researcher can identify stories going back over many years simply by typing brief instructions in English into a telephone-linked computer terminal. Key benefits of the the system are the instantaneous access to up-to-date international information in English, and the capability to retrieve vital news items from a large mass of material without adherence to rigid filing rules.

Using the computer, World Reporter scans the full text of its sources for references — an impossible task manually, but essential if "buried".

World Reporter Editor Mr Paul McFarland added: "By the end of the decade, electronic publishing must form a significant part of every major publication's activities. But unlike today's publications, people will be paying for the information rather than the medium."

IC patents in US

US microchip manufacturers may soon be able to invoke copyright protection for their designs. Existing copyright laws in the US and most other countries do not embrace the circuitry contained within an IC.

As a consequence, pirating of popular and innovative IC designs is common practice. Rival manufacturers actually copy the design by dismantling an IC and photographing the wafer, one layer at a time.

From the etching mask which is subsequently prepared, the copy manufacturer can produce an IC for a fraction of the normal cost.

Intel have claimed that a Japanese company — NEC — did copy one of their designs. Intel's case appeared good — the NEC design duplicated a redundant transistor mistakenly included in the original design.

Fingertip Computing

The British company Psion recently launched the Organiser miniature computer — a machine which they claim is the world's first pocket computer.

The key to the power and size of the Organiser are two thumb-sized solid state drives, concealed under a sliding protective cover. Plug-in data and program packs take the place of the discs or tapes used by desktop micros. Psion say that the plug-in packs will provide open ended data storage and ultra fast information retrieval.

The Organiser boasts a built-in database facility in the operating system. Using 8K and 16K data packs, a user will be able to create a large base of permanent information.

Three 16K program packs on Finance, Mathematics, Science and Engineering are available immediately. Psion say that these packs are the start of a comprehensive software library, to be released in the future.

A programming language has been written especially for the Organiser. Called POPL, it is easy to understand and will allow users to write, save and retrieve their own programs.

Plastic conductors

Conductive plastics may soon revolutionise printed circuit board manufacture. Polymers — known as polyacetylene (PAC) and polypyrrole (PPY) are combined to form a lightweight, versatile conductive film.

Chemists are also keen to test the polymers in batteries. Because they have a large, highly porous surface area, the new materials look promising as electrodes. Their main advantage in this role would be reduced battery weight.

To produce conductivity in the polymers, a doping agent such as iodine or lithium must be present during manufacture. In fact, plastics resemble present semiconductor materials in this respect. Speculation has arisen that plastics may also have applications in active semiconductor devices.

Newspaper raids French nuclear secrets

A French newspaper, *Le Canard Enchaine*, claims to have obtained secret computerised information concerning the French nuclear program. The information was obtained through one of the 525 Minitel computer terminals given to customers of the French telephone company. Subscribers use the terminals to gain access to a communal list of telephone numbers.

The leak originated at the International Company for Information Services (CISI). A large portion of the computer company is owned by the French Atomic Energy Commission. The two-thirds of CISI's computer capacity not required for the commission's use is utilised by other companies — among them, major French defence contractors.

Through its Minitel terminal, *Le Canard* managed to gain access to CISI files detailing a secret laser project, nuclear fuel storage, departmental tests of nuclear security, and simulations (using models) of recent bomb tests at Mururoa. To show how easily accessible the system is — like a public park, according to *Le Canard* — edited versions of the files were printed in the paper.

The more sensitive portions of the information were edited out before publication.

Le Canard says it made its discoveries by "borrowing" an access code from another telephone subscriber. Once inside the customer's file, the paper requested — and received — the names and access codes of other customers using the machine at the same time. *Le Canard* did this, they claimed, using access directions provided to every customer of CISI.

Having obtained the list of names and codes, *Le Canard* says it could then assume the identity of any one of the customers, by following a routine procedure detailed in IBM's manual for the CISI system.

Use of this system opened up a number of files — including CISI's own company file. Information thus disclosed involved CISI's financial difficulties of the previous year, and the efforts of the Atomic Energy Commission to bail the company out. Also, access codes were supplied for numerous subscribers, including companies holding aerospace contracts with the French government, and a manufacturer of missiles.

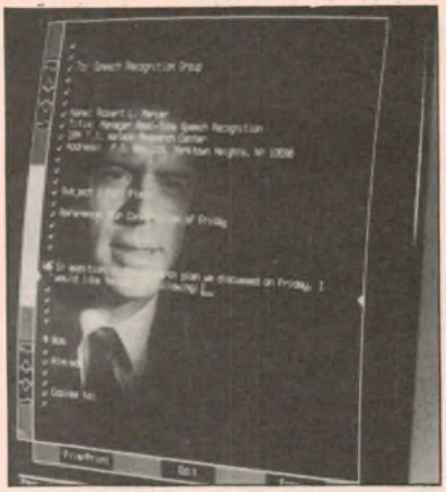
Le Canard claims it could have made changes to any of the files. While protected from permanent damage by safety systems, information could not be recovered without great expenditure of time and money.

In its own defence, CISI insists that the paper managed to gain access to the files only with the help of an informed insider — *Le Canard's* own computer operator. The man was dismissed by CISI recently for "pirating" restricted information. The paper claims he did this only to highlight faults in the system.

According to CISI, the security of the system is proven by the fact that he was caught.

News Highlights

IBM's new speech system



Computerised speech recognition systems would be of great value in the world of business and elsewhere. Unfortunately, the extremely wide range of voice intonations make accurate speech recognition with a wide vocabulary a difficult thing to achieve.

Work in this field has been considerably advanced recently by research at the Thomas J. Watson Research Centre, New York. IBM has developed an experimental system which can recognise sentences composed from a 500 word "business correspondence vocabulary", and identify over 95% of the words in these sentences correctly. IBM scientists believe this to be the most advanced speech recognition system yet developed.

Words, phrases and sentences appear on a computer terminal screen as the individual speaks. The resulting text may be altered or edited by voice or keyboard.

A 20-minute training session is necessary before any person can use the equipment. This allows the system to familiarise itself with the individual's voice patterns. During the session, which includes the reading of a standard text, a statistical recognition technique is employed. This means that the degree of similarity between the speech and the words stored in the memory are compared, and the probability that these words would be used with the other words in the sentence is considered.

Both pronunciation and context are considered, to enable the system to distinguish between words such as "to", "do" and "through" which are pronounced differently. Like-sounding words such as "to", "too" and "two" are selected according to their context in the surrounding words.

The sound segments are given identifiable labels before they are examined in their context. Several possible — or "candidate" — words are then chosen from the vocabulary. As more words are spoken, new candidate words are created and the original list of candidate words is revised in the light of this new data. The candidates are thus eliminated until the most probable word sequence is selected.

By spelling it out letter-by-letter, any word not in the system's vocabulary can be used. New words which will be frequently used can be added verbally. IBM plan to enlarge the vocabulary, to further expand the system's usefulness.

A drawback at present is the short pause required between words. However, IBM ultimately hopes to design a system which will be able to recognise continuous speech.

The speech recognition computations are performed by an IBM 4341 computer, working with three Floating Point Systems array processors. An IBM personal computer handles communications and other special purpose hardware is used for document formatting.

Aircraft trials for Antarctica

During November, officers of the Department of Science and Technology participated in an evaluation flight of a Dornier 228 aircraft at Canberra. The Dornier is being considered as part of a replacement Antarctic transport system.

This aircraft is typical of the type suitable for the Antarctic transport role. It is a twin turboprop with a seating capacity of up to 19 and maximum take-off weight of 5,700kg. It can be equipped with a special ski-wheel undercarriage for operations from snow and ice runways, and is designed for short take off and landing.

It is intended that the aircraft chosen for the Antarctic role will be used to transport personnel between Australian stations and between the various field research sites. Although the Dornier aircraft appears to be quite suitable, a Government decision on the new transport system has been deferred until the 1985-6 budget.

Power from the wind: new project

Britain is to build one of the most powerful wind machines on what has been described as the windiest site in the world. This is to be found at Burgar Hill on the main island of the Orkney group off the northern tip of Scotland.

Government go-ahead has been received, and the 45-metre high three-megawatt wind turbine is scheduled for completion by the second half of 1986, at a cost of $14.7 million.

The new machine has been designed and will be built by the Wind Energy Group (WEG) of companies that is made up of British Aerospace, the Taylor Woodrow construction company and GEC Power Engineering, and supported by the UK Department of Energy.

Since the idea of the new machine was first put forward in 1980, its design has been revised considerably. Prototypes of other large machines built in other parts of the world have faced both commissioning and operational difficulties and it is generally agreed that at present there is no fully proven design.

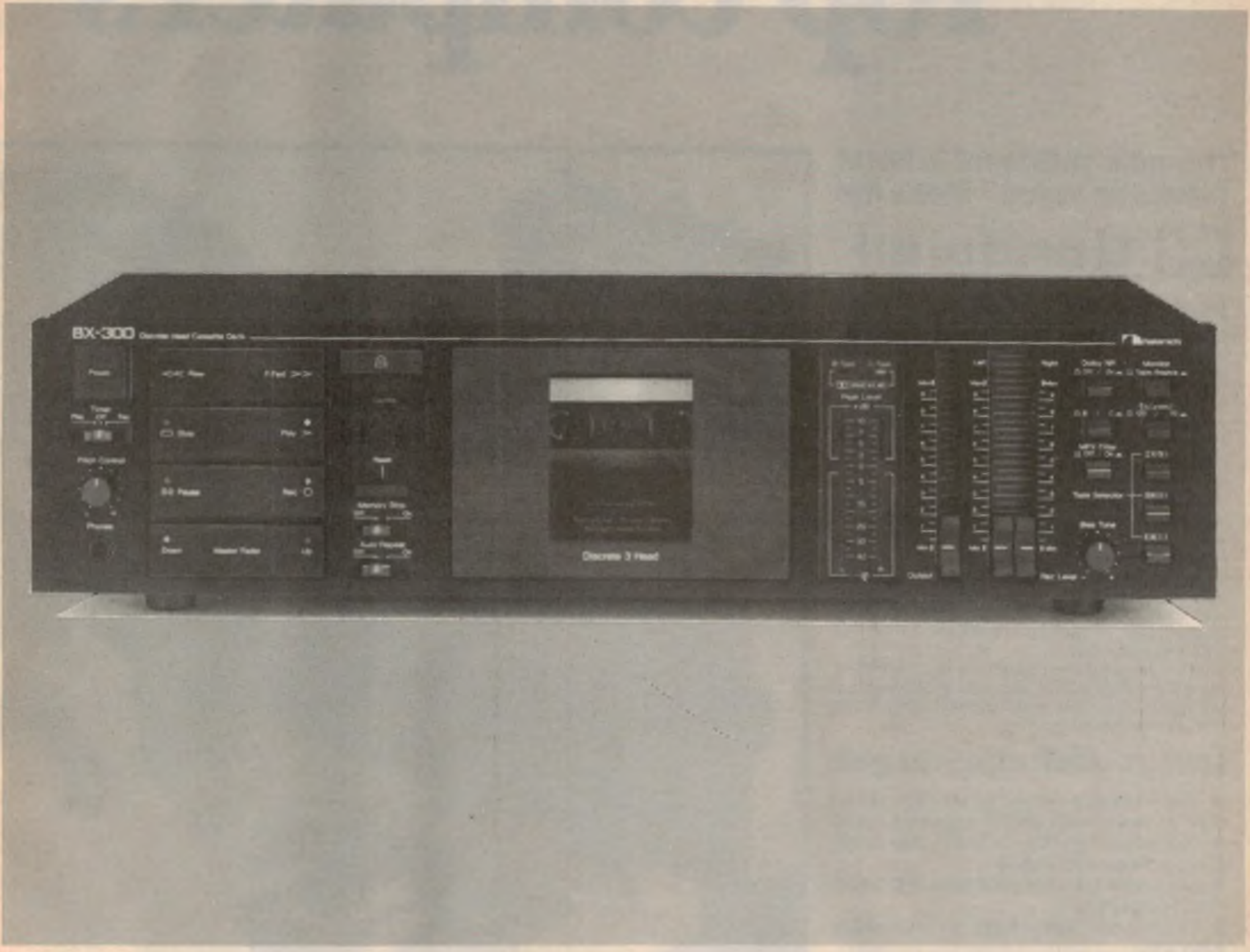
The final design of the newcomer will benefit from earlier lessons and difficulties. A smaller 250 kilowatt prototype machine with a 20-metre diameter blade has been operating on Burgar Hill since last year — at one time successfully withstanding wind speeds gusting to 152km/h. Information gleaned from this smaller model will also contribute to the new design.

Officials believe the new machine may provide the breakthrough to proven reliability for wind power machines. Apart from the teetered or hinged hub, innovations in design will include variable pitch tips over the outer 30% of the blades' span. The pitch will be computer controlled to regulate power level.

The machine will be linked to the local electricity grid and will be able to meet up to 10% of the island's power needs (this means providing electricity to 1000 homes). Initially, the electricity will be expensive — 10 pence per kilowatt hour, which is 40 to 50% higher than the present oil-powered generation cost. However, a production version is expected to cut this to about three pence per kilowatt hour.

If, after two years of evaluation, the success of the design is proven it could form the basis of an even larger 100 metre diameter bladed machine that is planned for a site in south-east England.

The Sound of Nakamichi



Never before has so much technology been concentrated in one modestly priced cassette deck. No other recorder in its class can claim to possess the three essential ingredients of sonic perfection — the legendary Nakamichi Discrete 3-Head approach to recording, the unique Direct-Drive Asymmetrical Dual-Capstan Diffused-Resonance transport, and the most sophisticated wide-range low-distortion electronics in the industry.

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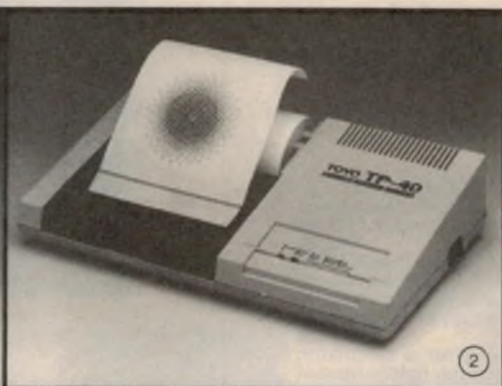

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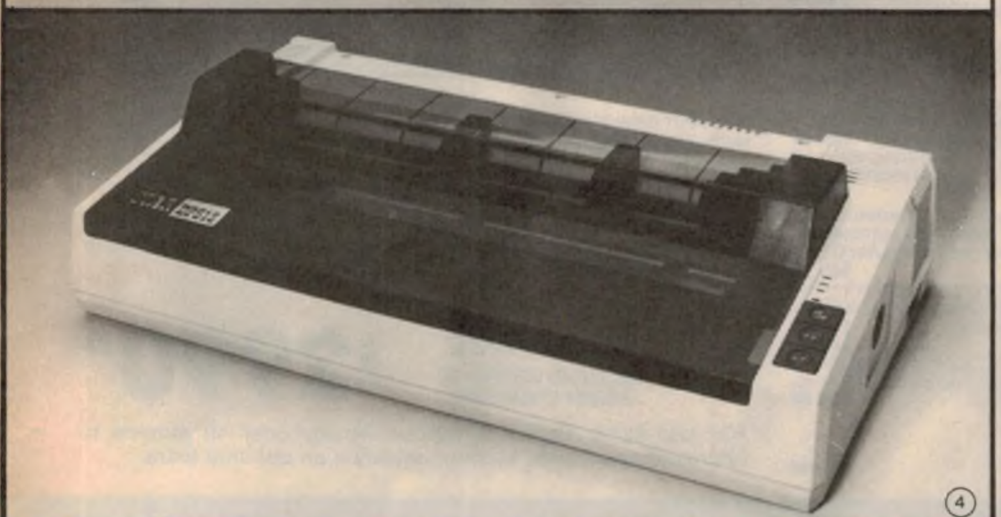

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Get ready, Australia . . .

AM Stereo is here at last!

by LEO SIMPSON

February 1, 1985 marked the beginning of AM stereo broadcasts in Australia. This means that the eight out of 10 radio listeners who favour AM stations can now listen in stereo.

Electronics Australia has been closely following the development of AM stereo in Australia ever since the first moves were made several years ago. When it all started in the USA there were five different systems of stereo AM transmission submitted to the Federal Communications Commission. In March 1982, the FCC in its wisdom decided upon the Magnavox system but a subsequent threat of legal action led to the rescinding of this decision. Instead, the market was left to sort out which system was the most desirable and thereby create a "de facto" standard which would subsequently be recognised by the FCC.

This non-decision by the FCC probably delayed the introduction of AM stereo in the USA by two years. It was the classic "chicken and egg" situation. While free-marketeers were happy that the FCC was "butting out" and leaving the market to decide, nobody else was happy. There was a vacuum.

The AM stations were reluctant to select a particular AM stereo system because it was not clear which would become the standard system and because there were no receivers. The receiver manufacturers, for their part, were reluctant to decide on a particular stereo decoder.

Eventually, two manufacturers, Sansui and Sony, came out with multi-system receivers which at least gave the potential for a radio audience. It remained for the stations to install new stereo studios and stereo exciters. As it happens, it is much more expensive to rewire a studio for stereo operation than to install an exciter.

A typical large city AM station is faced with a bill of half a million dollars or more for rewiring its studios to stereo while the cost of an exciter, only one of which is needed, is small beer at around $20K to $30K. With this cost factor in mind, the AM stations in the USA were able to go ahead and modify their studios. If they then purchased an exciter which proved not to be the eventual standard system, not a great deal of money would be lost.

The four contending AM stereo systems developed in the USA were Harris, Kahn, Magnavox and Motorola. A fifth system, Belar, was an early contender but was eliminated early in the piece.

The Harris, Magnavox and Motorola systems are essentially phase modulation systems while Kahn is a double sideband system. Each system aims to be fully compatible with existing mono radios and each has its pros and cons as far as

CONCORD HPL 500

The new Concord HPL 550 incorporates just about every feature possible in a car stereo system including FM stereo and AM stereo reception using the Motorola system. Tape deck facilities include Dolby B and C noise reduction as well as dbx noise reduction so that any cassettes made on the home hifi system can be played in the car. The tape drive system uses a DC servo motor to give excellent wow and flutter performance.

The inbuilt power amplifiers are rated at 25 watts per channel (in bridge mode) and can be switched to provide either two-channel or four channel operation with a built-in fader control. There is also provision for separate power amplifiers for those who wish to further upgrade their car system. Price is $939.00.

SONY CATERS FOR PERSONAL AM STEREO

Sony has two portable receivers both of which are compatible with all four broadcasting systems. Both also give FM stereo reception. The Sony SRF-A200 is a miniature stereo receiver purely which can run from internal batteries or a mains plugpack adapter. For headphone listening, the cord functions as an FM antenna. Dimensions are 228 × 100 × 38.5mm and mass is 620g. Recommended retail price is $119.00. Alternatively, for purely personal stereo listening there is the Sony SRF-A10 Walkman which is supplied with headphones. Recommended retail price is $99.00.

separation between channels, harmonic distortion and other performance parameters are concerned.

The turning point

The breakthrough for Motorola came in April 1983. The Delco division of General Motors opted for the Motorola system for its original equipment radios fitted to GM cars. It was announced that 1984 Buick cars would be fitted with a Delco radio having the Motorola decoder. This was to be a potent selling point for Motorola.

By early 1984 Motorola was leading the race for numbers of exciters sold to AM stations but Harris and Kahn were very close behind. Magnavox, the system initially favoured by the FCC, was virtually out of the race.

Another breakthrough came in April 1984 with the announcement that Pioneer Electronics (USA) Inc would also adopt the Motorola system. As one of the leading manufacturers of car radios in that country, Pioneer was also living up to its name. Eventually Chrysler, Ford, Nissan and a whole raft of electronics manufacturers got on the bandwagon and Motorola was looking very strong.

The Australian situation

Australia faced virtually the same situation as the USA. We had the same four contending systems but we did not have same free marketplace. The Department of Communications licensed some 14 stations for trials with the four systems. The results were not conclusive as far as establishing a preferred system was concerned. Then the lobbying began. It seemed as though each station was keen to see its own exciter brand as the preferred system. Some electronics manufacturers lobbied for a single system while others lobbied for a multiple system.

On the one hand it was argued that we should have a multiple system because we did not know which way the USA would eventually go. On the other hand, a single system would be desirable because it would be simpler to manufacture and cause less confusion to the listening public.

AWA CLARION 990E

The 990E is the top of the AWA Clarion line with inbuilt Motorola AM stereo decoding as well as conventional FM stereo operation. The 990E incorporates an auto reversing cassette player with Dolby B noise reduction, metal tape switch and permalloy playback head. The fully synthesised tuner employs a red LED digital readout which also incorporates a quartz crystal clock. There are 12 station presets (6 AM, 6 FM), automatic station seeking, automatic local/DX switching, fine-tuning, mono-stereo switch, loudness switch, bass and treble controls, a fader for front/rear speaker balance and 25 watts per channel output. AWA state that the 990E has been specifically designed for Australia and was extensively field-tested in Sydney and Melbourne before production began. The unit is made in Japan. Recommended retail price is $620.00 but the expected selling price is around $550.00

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AM Stereo in Australia

Electronics Australia weighed into the debate in October 1983 and June 1984. On both occasions we strongly recommended that a single system be chosen while not actually stating a preference for any.

By July 1984 it was becoming abundantly clear that the Motorola system was winning the battle. It led with numbers of exciters installed and also had the advantage that Motorola also produced an integrated circuit decoder. (National Semiconductor and Philips produced decoder ICs for the Magnavox system but that hardly mattered since Magnavox lost out in the sales war).

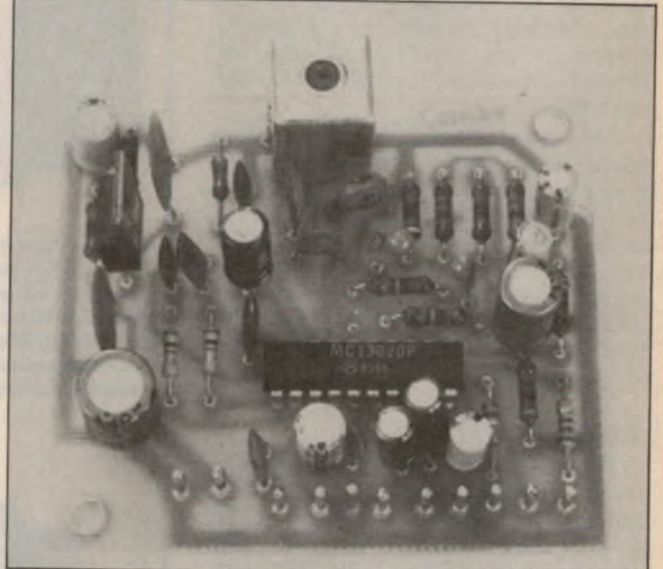
In August 1984 we took a punt on the Motorola system in deciding to publish a decoder in the October 1984 issue. We thought it was a winner and hoped that the Department of Communications would see it that way too. As events turned out, we were right, as the announcement by the Minister for Communications, Mr Duffy, in that month subsequently proved.

Since then there has been a flurry of activity at the AM stations to rewire studios, install exciters and tune antenna systems. Two models of exciters have been sold in Australia. One is made by Motorola and sold in Australia by Radio Manufacturing Engineers Pty Ltd (see page 23). Another is made by Delta under licence to Motorola (see page 18).

And just recently Harris Communications (Australia) Pty Ltd announced that they will be marketing an AM stereo exciter made under licence to Motorola.

While it has been a relatively(?)

EA'S OWN AM STEREO DECODER KIT



This decoder kit was described in the October 1984 issue and used the Motorola MC13020P in the recommended circuit. We showed how to add it to two Playmaster tuners and also gave details of a 9kHz whistle filter, two of which are required for a wideband stereo AM tuner. Kits for this decoder are available from all Jaycar stores at $19.95.

AM Stereo

straightforward matter for AM stations to install new exciters and get on with the expensive process of upgrading studios, it has not been so easy for manufacturers of the receiving equipment.

Even those manufacturers who had models on sale in the USA have not had it easy since new equipment has had to be designed to suit the Australian market and the lead times for new manufacture are quite long. For this reason very few brands of AM stereo equipment were actually on sale at February 1. By the time you read this all the models shown in these pages should be on sale.

Australian standards

Well what is so different about AM stereo standards in Australia? Two points are substantially different. The first is the nominal spacing of AM stations. In the USA it is 10kHz but in Australia it is 9kHz, the same as in most of the rest of the world.

Back in the days when radios were continuously tuned this would not matter mch but for hifi AM tuners it is different. Most employ synthesised tuning giving the 10kHz spacing automatically for the USA market. For Australia, a separate model has to be designed, giving the correct 9kHz spacing and frequency coverage.

Hifi AM tuners also require a whistle filter to prevent 9kHz beats becoming audible during night-time listening. Two filters, one in each audio channel, are necessary for stereo operation. Again, a hifi tuner designed for the USA with

EUROVOX CAR STEREO

Eurovox have two car stereo players with the Motorola AM stereo system. Above is the MCC 2330R long range AM/FM stereo radio with auto reversing cassette player, metal tape capability, 12 programmable memories (6 AM, 6 FM), night illumination, fully synthesised operation with LED digital display, automatic station seeking, up/down fine tuning, automatic stereo/mono blending for noise reduction, bass and treble controls and loudness switch and two-week memory retention when the car battery is disconnected. Power output is 7 watts per channel. Price of the MCC 2300R is $549.00.

Top of the Eurovox line is the MCC 2301R. This has all the features of the above model but includes Dolby B noise reduction, automatic program search and joystick fader control for four speaker operation. There are four inbuilt power amplifiers rated at 7 watts each. The unit can be connected to the Eurovox MO-4200 (4 × 40 watts) amplifier or the MO-480 (4 × 20 watts) amplifier. Price of the MCC 2301 is $689.00. By way of interest, Eurovox is an Australian company. Their car stereo equipment is designed in Australia and manufactured in Japan.

Not by a genie, but by the genius of AWA Clarion. Now you can have AM stereo with sound quality equal to AWA Clarion's uncompromising standards for both FM and cassettes. Even in the compromising environment of a moving automobile. Of course, AWA Clarion's sophisticated array of electronic features are easy to use. And there's a wide selection of models to meet your individual taste. AWA Clarion reliability? It's legendary. AWA Clarion Car Stereo. Listen, and drive happily ever after.

AWA Clarion

For further information: Amalgamated Wireless (Australia) Limited, 554 Parramatta Rd., Ashfield, N.S.W., 2131 Phone: 797-5757

YOUR WISH IS GRANTED

AM Stereo From AWA Clarion

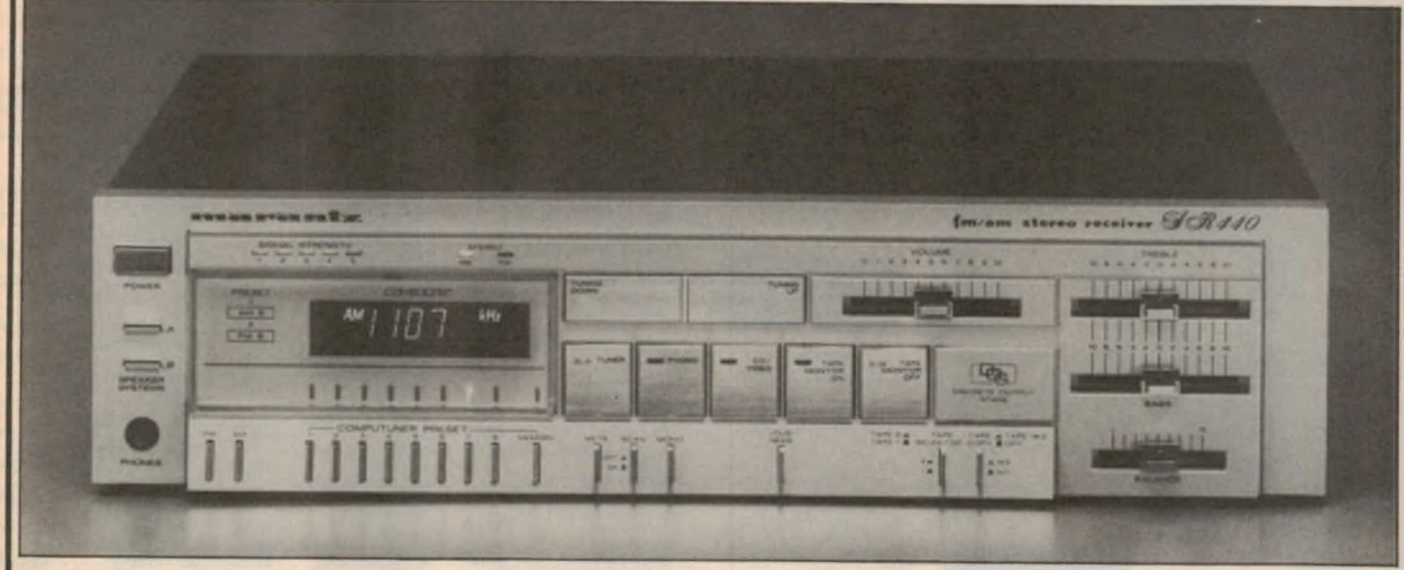
12 months warranty, backed by Amalgamated Wireless (Australasia) Limited with over 400 service agents nationwide.

990E ● PLL Synthesizer Tuner with Digital Quartz Clock ● SEEK Tuning & Touch-button Memory ● AM Stereo ● FM Noise Suppressing Circuits SASC and ACZ! ● FM Stereo/Mono Selector ● Auto Reverse ● Automatic Programme Control (APC) ● Key-On Play Key-Off Head Release ● High Power Output 25W + 25W ● Power Level Indicators ● 4-Way Balance Controls ● Dolby* NR Metal Tape Selector, Loudness, Separate Bass/Treble Controls ● Night Control Illumination

*TM Dolby Laboratories Licensing Corp

AM Stereo in Australia

MARANTZ SR-440



The Marantz SR-440 is the first stereo AM/FM stereo receiver available in Australia to be fitted with the Motorola stereo decoder. It incorporates all the expected features of a fully synthesised tuner with a total of 16 station presets (8 AM, 8 FM). Rated power output is 38 watts per channel with both channels driven. Rated harmonic distortion is .02%. Recommended retail price is $499.00.

10kHz whistle filters would be useless in this country.

The second point is that American car radios are much bulkier than the DIN size units sold on the Australian market. It would be no simple matter redesigning an American car radio to suit our market.

Performance

What sort of performance can we expect from the new AM stereo equipment? Will it be every bit as good as we have come to expect with FM stereo broadcasts? There are quite a few answers to those questions.

Initially, the car radio listener is seen as the major market for the AM stations. They are looking to regain a substantial portion of audience lost to the FM stations. In this strategy they are hoping to benefit by two drawbacks of FM reception in cars: multipath reception and "picket-fencing".

Multipath reception

This name is given to the unpleasant effect of several signals arriving via different paths to the car radio antenna. Since the vertical whip antenna used by most car radios is essentially omnidirectional, it is completely open to receive signals from any direction; it is unable to discriminate between the direct signal from the transmitter and reflected signals from buildings, hills and so on.

Multipath reception problems are worse for those stations which use horizontal polarisation. The pickup of the vertical whip antenna is bound to be poor in these cases and multipath is rife. Most commercial FM stations use mixed polarisation which gives better results with car radios while still giving good results with horizontally polarised domestic antennas which have the virtue of some discrimination against automobile ignition noise. Many of the Australian Broadcasting Corporation's FM stations use horizontal polarisation. This means that car radios get worse reception from those ABC stations than they do from the other FM stations.

Picket-fencing

If multipath reception was not enough of a problem there is also the problem of reception when driving through weak signal areas. As the car radio antenna passes through peaks and troughs of signals the recovered audio signal fluctuates accordingly. This leads to a

PIONEER KE-433AM

Pioneer was the first to have a stereo AM/FM car radio on the market in Australia incorporating the Motorola decoder. The KE-433AM incorporates many of the features of more expensive brands at a very reasonable price. At the time this issue went to press, this model was the cheapest car radio on the market with AM stereo included. The KE-433AM is a fully synthesised tuner with liquid crystel readout and fully illuminated controls. Features include a wide/narrow switch for best AM reception, local/DX switch, stereo/mono switch, fader control for 4-speaker operation, auto station seeking, programmable memory (6 AM, 6 FM) and metal tape switch. Recommended retail price is $349.00.

rie

Rod Irving Electronics

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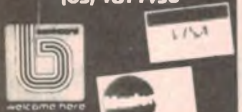

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$1-$9.99	$1.50
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$200-$499	$7.50
$500 plus	$10.00

Comet road freight is extra.

MAGNETIC REED SWITCHES

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N.C. Cat. S15057	$1.95	$1.85
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APPLE JOYSTICKS
Ideal for games or word processing. Fits most 6502 "compatible" computers.
Cat. C14200 **$24.95**

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DC +5V at 3A, +12V at 1A
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VERBATIM DISKS
"Lowest" price possible for "Highest" quality

	1-9	10+	100+
MD525-01	3.95	2.75	2.50
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Fantastic 12 function, dual L.E.D. Display, very popular in the USA and now available at Rod Irving Electronics
FEATURES:
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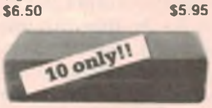

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A stylistic low profile case to give your system the professional look it deserves. Provision for two 5 1/4" slimline drives.
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LOCAL BURGULAR ALARM CONTROL PANEL
The odds against you are climbing and prevention is better than cure!
- Adjustable exit/entry time delay and alarm time (avoids unnecessary noise pollution)
- 12V D.C. 1.5Amp
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Adjustable for closed circuit or open circuit type glass. Instructions supplied.
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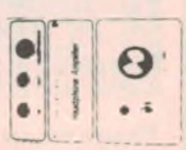
Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automotive ignition coil, it should prove an adequate deterrent to all manner of livestock. Additionally, its operation conforms to the relevant clauses of Australian Standard 3129 (EA Sept. '82)
82EF9 **$19.50**

EA AM STEREO DECODER
AM stereo is now broadcast in Australia on an experimental basis. This add-on decoder works with the Motorola C-QUAM system (EA Oct. '84 84MS10)
Cat. K84101 **$24.95**

150 W BASS AMP
This guitar amp for impeccable bass players features many facilities found on expensive commercial ones. It delivers 150 watts into 4 ohms, has a 1 band graphic, limiter, line out and bi-amp facilities (ETI Aug '84 ETI 1410)
Cat. K54100 **$299.00**



HEADPHONE AMPLIFIER
PRACTISE WITHOUT ANNOYING THE FAMILY!
If you play any type of electronic instrument, this headphone amplifier will surely interest you. It will let you practise for hours without upsetting the household, or you can use it to monitor your own instrument in the midst of a rowdy jam session. (EA Feb '84)
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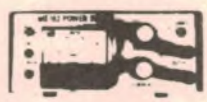
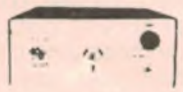
This clever electronic mousetrap disposes of mice instantly and mercifully without fail and resets itself automatically. They'll never get away with the cheese again! (ETI Aug '84)
Cat. ETI 1524 **$29.95**

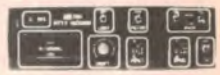


30 V/1 A FULLY PROTECTED POWER SUPPLY
The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both voltage and current metering is provided (ETI Dec. '83)
ETI-162 **$49.50**

EFFECTS UNIT
An "effects unit" that can create phasing, flanging, echo, reverb and vibrato effects
(EA June '83)
83GA6 **$65.00**



INVERTER
This 12-240V inverter can be used to power mains appliances rated up to 40W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on.
(EA May '82) **$49.50**



COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER
Here's what you've all been asking for — a full transmit-receive system for a computer driven radio teletype station. The software provides all the latest "whizz-bangs" like split-screen operation, automatically repeating test message, printer output and more. The hardware uses tried and proven techniques. While designed to team with the popular Microbee, tips are available on interfacing the unit to other computers. (ETI Nov. '84 ETI-755)
Cat. K47550 **$139.00**

1W AUDIO AMPLIFIER
A low cost, general-purpose, 1 watt audio amplifier, suitable for increasing your computers audio level, etc. (EA Nov. '84)
$9.95

12-230V DC-AC INVERTER
INCLUDING TRANSFORMER 300 WATTS
This EA Inverter is capable of driving mains appliances rated up to 300VA and features voltage regulation and full over load protection. (EA June '87)

Nominal Supply Voltage	12V DC
Output Voltage	see table
Frequency	50Hz± .005%
Regulation	see table
Maximum Load	300VA
Current Limiting	30A (primary)
Efficiency	see table

P & P $10.00 Anywhere in Australia
$195.00

rapid fluttering effect in the sound which is known as the "picket fence" effect.

There is a technical solution to multipath reception and picket fencing known as "diversity tuning". This system employs a receiver with two front-ends and a microprocessor to switch between the signals from each. The result is a great improvement on normal car radio reception. (See *Electronics Australia*, November 1984, page 14.)

Car radio reception of AM stereo broadcasts does not suffer from the above effects but it is still subject to the normal reception characteristics of AM.

Depending on the AGC characteristics of the receiver, fading of signals will still occur as the car passes through tunnels or under bridges and the reception area for AM stereo is slightly less than for AM mono reception. In weak signal areas car radios will switch automatically (or can be switched manually) from stereo to mono, as they already do for FM reception.

AM stereo reception will also be subject to the usual drawbacks of AM transmissions such as susceptibility to interference from mains-borne interference and lighting.

Even so, with careful design there is no reason why AM stereo tuners cannot be made to perform considerably better than the woeful standard we have come to expect from units made overseas.

Technical description

This article would not be complete without a brief technical description of how the Motorola C-QUAM system works. C-QUAM is an acronym for Compatible Quadrature Amplitude Modulation but while that is a fancy sounding technical term it is certainly not self-explanatory.

Let's start with amplitude modulation which is the standard transmission mode. Here the radio frequency carrier is varied in amplitude by the audio signal. This is the system used for more than 60 years by broadcast stations. The signal can be picked up and detected by a very simple receiving circuit, such as the crystal set.

The Motorola system uses two systems of modulation. The amplitude modulation just mentioned carries the compatible mono signal (left plus right channel) while the difference signal (left minus right) is broadcast as phase modulation of the carrier.

Phase modulation is more easily understood as a mild form of frequency modulation. In other words, the carrier frequency is deviated above and below the nominal value by the audio modulating signal.

So where does the term "quadrature" come into the picture? Another way of regarding the Motorola system is as two RF carriers separated by a phase angle of 90° (here's where the quadrature term comes from). One carrier is amplitude modulated while the other is phase modulated. Each modulation process results in its own set of sidebands.

What the Motorola system does is suppress the phase-modulated carrier but transmit its sidebands along with the amplitude modulated carrier. Then the receiver reconstitutes the suppressed carrier with a phase-locked loop which again has a fixed phase relationship to the incoming amplitude modulated carrier.

(More details of the AM stereo decoding process were given in the October 1984 issue of *Electronics Australia.*)

Requirements of the receiver

Many existing AM tuners are simply not good enough to enable the Motorola C-QUAM system to work well. Because the system entails phase modulation and

AM Stereo in Australia

PROFESSIONAL AM STEREO MONITOR RECEIVER

General Electronic Developments (Sales) Pty Ltd have available a broadcast standard monitor receiver, the type 112MS. This is a crystal-controlled 6-channel unit with the preset frequencies locally or remotely selectable. Sensitivity of the unit is quoted at 200μV and signal-to-noise ratio is better than 55dB at 1mV and 30% modulation. Switchable 9kHz notch filters and 6kHz low pass filters are included.

GED also have a stereo decoder board available using the Motorola C-QUAM decoder IC and incorporating low pass and notch filters. Prices on both these units can be obtained from GED, PO Box 376, Ryde, NSW 2112. Phone (02) 816 2211.

demodulation it is most important that the tuner be very stable. Not only does this mean the local oscillator must be very stable but the entire front-end bandpass characteristics must also be very stable.

Any drift in the local oscillator or the tuner's bandpass characteristics will result in the addition of "incidental phase modulation" to the signal and this will result in audible distortion. For the same reason, the tuner's bandpass characteristic above and below the carrier centre frequency must be symmetrical otherwise the upper sidebands will encounter a different response to the lower sidebands. Again the net result of this is incidental phase modulation or IPM. This also means that for best performance the tuner must always be tuned exactly to the centre of the channel.

Because of the two requirements of precise tuning and low drift, the majority of AM stereo tuners can be expected to be fully synthesised designs. These automatically give precise tuning and low drift but even synthesiser circuits can be a source of IPM.

Because a phase lock loop (an integral part of any synthesiser design) circuit involves an error detection process, the reconstituted carrier produced by the PLL can "hunt" above and below the desired frequency. This hunting again amounts to an extraneous phase modulation which will result in audible distortion. Careful filtering of the PLL error signal is essential.

For much the same reasons, the whole tuner must not be microphonic. Any mechanical variation of oscillator frequency or bandpass characteristics due to chassis distortion or vibration will again result in IPM.

It is also desirable that the tuner have a wide (ie, more than several kilohertz) IF bandwidth to give the best recovered stereo separation. Wide bandwidth is also desirable to give better frequency response!

SANSUI CX-990

Sansui's CX-990 is a deluxe car stereo radio/cassette player. It has a computer logic tape transport, auto reverse, amorphous playback head, Dolby B and C noise reduction, automatic program search, intro scan (each tape item is sampled for 10 seconds) 24 station presets (6 × 3 FM plus 6 AM), automatic station seeking, preamp outputs, LED level meters and input/output terminals for a graphic equaliser. Recommended retail price is $689.00

Forecast

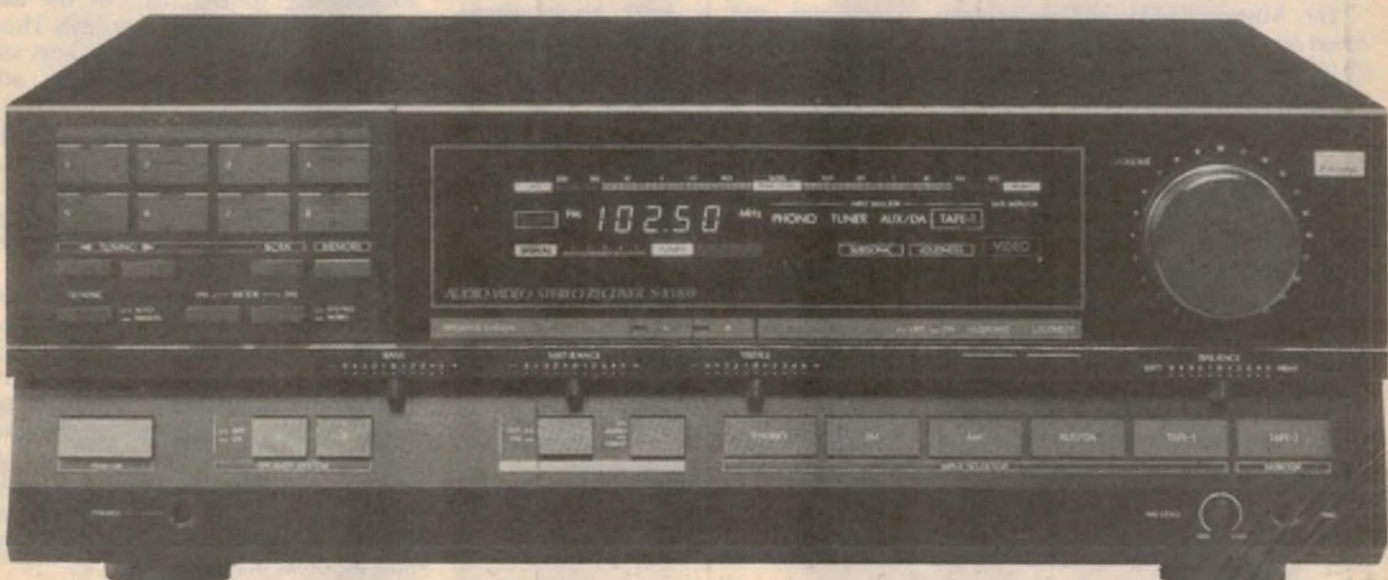
One point is clear. AM stereo will mean much better sound quality from that medium. When AM stereo tuners and receivers are refined to the same degree as FM tuners are (and this should

SANSUI HIFI AM STEREO EQUIPMENT

Sansui has four products incorporating AM stereo reception, three of which are depicted here. All four are compatible receivers, meaning that they can decode all four systems of stereo AM transmission although only the Motorola system will be used in Australia now.

The Sansui S-X1070 is a complete stereo AM/FM receiver rated at 55 watts per channel with both channels driven. Rated harmonic distortion is less than .02% at or below rated power output. The unit included a five-band graphic equaliser mounted behind a transparent panel and has illuminated legends to indicate the selected program source. Recommended retail price is $699.00.

SANSUI S-X1100



The S-X1100 is described as an audio/video stereo receiver by Sansui. It features a large multifunction, three colour fluorescent display which indicates the station tuned, the mode of reception, power output levels and program source selected. The unit has 16 AM/FM presets (8 AM, 8 FM) and fully balanced source inputs. Rated power output is 100 watts per channel with both channels driven while rated harmonic distorton is less than .005% at or below rated power. Recommended retail price is $1399. The top of the line model S-X1130, with more power and more input facilities, is $1699.00.

happen rapidly) we will enjoy much better sound.

Hopefully the process of refinement of AM receiver circuitry will not take long. After all, superheterodyne circuit techniques have been with us for many years. It should be possible to develop custom integrated circuits quite soon which will fully complement the Motorola C-QUAM system and thereby develop very high performance.

Ultimately, it should be possible to produce hifi AM stereo circuitry which has a reception bandwidth out to 15kHz, distortion of 0.1% or better, separatio n between channels of up to 40dB and signal to noise ratio approaching 60dB. That would add up to a tuner really worth listening to!

Mission DAD 7000 compact disc player

One of the latest entrants into the CD player market is the Mission DAD 7000 which has been received with great interest overseas. It is a neat and compact unit with an interesting heritage. It is actually manufactured in the Philips factory in Belgium and then modified by Mission Electronics in England.

The Mission DAD 7000 is actually based on the Philips CD104 which is one of a new generation of CD players establishing fresh benchmarks for price and performance. Mission have their DAD 7000 made by Philips and then the units are modified by Mission to their own specifications. Naturally, Mission are not saying just how extensive the modifications are but they presumably believe that buyers will be prepared to pay a premium for the Mission name and whatever audible differences in performance there may be.

Measuring only 320mm wide, 305mm deep and 90mm high, the DAD 7000 has a subtle charcoal grey finish over most of the case and a matt black plastic escutcheon which highlights the controls.

The initial impression is that the unit is a rugged little machine which is probably a result of its surprising weight for its size; it weighs all of 7kg. It also has a strong diecast chassis which is unusual for CD players; most have sheet metal chassis.

As with just about all CD players these days, the DAD 7000 employs a drawer loading system which has proved to be the easiest to use. Pushing the open/close button causes the drawer to slide out smoothly so that the disc can be simply dropped in. Then pushing the open/close button again or the Play button causes the drawer to slide back in and load the disc track information into memory. If the play button was pushed the music starts almost immediately.

The front panel layout of the Mission CD player is clean and uncluttered.

Styling of the DAD 7000 is downright spartan or, if you prefer marketing man's language, understated. The major controls for Play, Fast Forward, Fast Reverse and Pause have cryptic symbols and are clustered in a group on the far righthand side of the front panel. Immediately to the right of the disc drawer are the Programming keys. These are the Previous and Next track keys and the Open/Close, Store, Repeat and Stop/Clear keys.

Three LED indicators show the status of the Pause and Repeat functions as well as Error. An eight digit seven segment orange gas discharge display indicates Track number and playing time as well as play status.

Our reaction to the styling and presentation of the DAD 7000 controls is that it suffers from too much understatement. The control buttons are just too small and "dinky". The same can be said of the gas discharge digital display — it is just too small to be really useful.

Once a disc has been loaded into the player the display will indicate the number of tracks available on the disc and the total playing time.

Several options are available when playing a disc. Firstly, the programming facilities can be ignored and, by simply pressing the Play button, the entire disc can be played from start to finish. If during play, the Repeat button is pressed, the disc will be replayed from start to finish.

The player can be stepped backwards or forwards by use of the Previous and Next track switches. Alternatively, the Fast Forward or Fast Reverse search switches can be used to locate a particular section within a track. Three speeds are available with the search keys. During the first three seconds after pressing a switch searching proceeds relatively slowly, for the next three seconds, faster again and after six seconds — at maximum speed. The speed can be slowed by temporarily releasing the switch.

Really though, the fast forward and reverse facility is not all that useful since you cannot hear any bursts of music during these modes; the player is muted.

The Previous and Next switches count the track numbers down or up at a one second rate if the key is held depressed. Alternatively, it counts at the rate that the switch is continually depressed.

At any time the Pause key can be pressed to temporarily suspend play. When the Pause key is depressed again, play resumes at precisely the same point.

The three programming controls (Next, Previous and Store) work in conjunction with the display. The memory will accept up to 20 track entries. Each track can be stored only once but any order of track play can be achieved. Programming is done before the disc begins playing.

Programming is easy; just press the Previous or Next key for down or up counting of the track number displayed. When the required track number is found it is programmed by pressing the Store key. The program can be checked by pressing the Store key, when all the tracks will be displayed in the programmed sequence.

To erase the program press the Stop/Clear key. Alternatively the program is erased at the completion of playing all programmed selections.

Oversampling

As with the Philips CD104, the Mission DAD 7000 uses an oversampling technique to convert the digital information on the disc into an analog signal. This involves increasing the original sampling frequency by four times the original 44.1kHz to 176.4kHz. The sampled signal is digitally filtered, fed to a 14-bit D/A converter and thence to a sample and hold circuit.

The system is claimed to be 16-bit accurate despite the use of a 14-bit D/A converter. This is made possible by the digital filtering which duty cycle modulates the least significant bit of the 14-bit D/A converter. The main advantage of this technique is lower noise and improved linearity compared with other 16-bit systems.

Mission differs in the analog filtering which follows the sample and hold circuit. Whereas the Philips system utilises a third order Bessel filter with a roll off beginning at 30kHz, Mission uses an additional two stage filter to ensure that spurious signals related to the 44.1kHz sampling frequency bandwidth are kept at least 70dB below the 0dB output signal level.

The error correction system is the Cross Interleave Reed-Solomon Code (CIRC) used by most CD players presently on the market. This is designed to correct or mask erronous readings due to disc defects, dust, fingerprints and scratches, or irregularities in the disc tracking mechanism.

Inside

Removing the top cover reveals that the DAD 7000 is well constructed. The disc driver occupies about half the available space, while the remainder is taken up with two stacked printed circuit boards. Unlike some CD players, the power transformer is mounted inside the case.

At the time of this review we had a Marantz CD44 available for comparison (which is virtually identical to the Philips CD104). Examination of the two machines revealed only one readily visible internal difference and that was the potted filter board which is the refinement referred to earlier. Mission may have made other changes but they were not readily apparent.

The rear of the machine has a large heatsink and a captive lead fitted with RCA plugs instead of having a pair of RCA sockets. Some overseas reviews have criticised the captive lead concept but we regard it as logical and an extension of the practice used for turntables. It makes sense and could probably be extended to tuners and cassette decks.

Performance tests

First, we ran a check on linearity. Carried out using a 1kHz tone which is stepped down in 10dB steps to −90dB, this test checks how the output level changes in relation to the recorded level. The DAD 7000 had a discrepancy of 1dB at −90dB signal level and was very close to zero error for signals from a 0dB to −80dB. This is an excellent result and is one of the best we have obtained to date.

Frequency response tests showed a reasonably flat response over the entire audio spectrum; 0.6dB down at 20Hz and −0.5dB at 15kHz, falling to −1.5dB at 20kHz.

Measured signal-to-noise ratio of the Mission player was 103dB with respect to full output but this is in the absence of any signal. In the presence of signal, the signal-to-noise ratio is closer to 95dB.

Total harmonic distortion was measured at 0dB level and resulted in readings of .006% over the range 20Hz up to 200Hz, rising to .035% at 1kHz, .06% at 10kHz, .07% at 15kHz and .14% at 20kHz. The higher levels of distortion at higher frequencies are mainly due to the residual 44.1kHz sampling artefacts which are not completely removed by the filtering process.

Mission have been successful with this method of filtering, since we were able to measure low levels of harmonic distortion from the player. With some players that we have tested in the past, the distortion readings were masked by a residual 88.2kHz signal. The phase response of the machine is also very good and is within one degree over the whole audio range.

Intermodulation Distortion was measured at 0dB level at 400Hz and 7kHz in a 4:1 signal ratio. This resulted in a measurement of .005%.

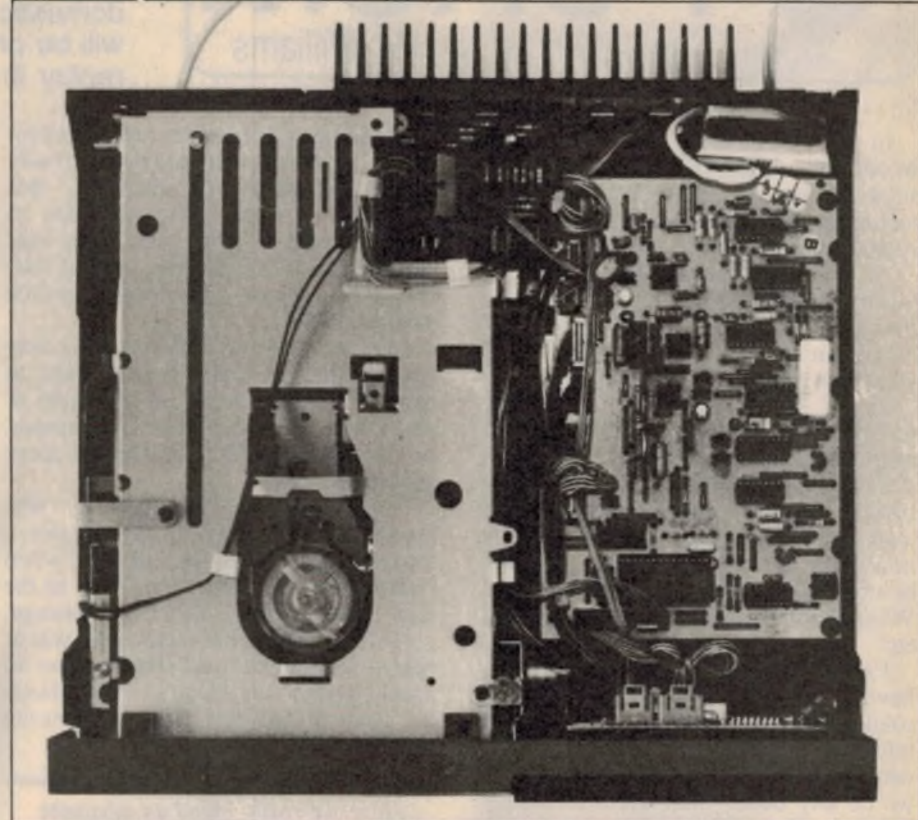
Separation between channels was also checked and resulted in readings of −100dB at 100Hz, −90dB at 1kHz, −71dB at 10kHz and −70dB at 20kHz. These results were for the right channel with respect to a 2V rms from the left channel. For the left channel we obtained −100dB at 100Hz, −86dB at 1kHz, −67dB at 10kHz and −63dB at 20kHz.

We also tested the DAD 7000 for handling of defects using the Philips No 4A test disc. The Mission was able to handle all defects without any audible effects which is good.

Vibration resistance was tested in a less objective manner by bumping the player while it was playing a disc. This proved that the Mission was not at all troubled by normal handling and is not prone to mistracking in normal circumstances.

In short, there is much to commend the Mission DAD 7000. It is a highly refined player which measures very well and sounds above reproach. It is not inexpensive though. Recommended retail price is $995.00.

Our review sample came from Len Wallis Audio, 43 Burns Bay Road, Lane Cove, 2066. Phone (02) 427 1204. (J.C.)



The "works" of the Mission CD player. The potted filter board can be seen in the top right hand corner of the chassis.

Family pics on video:

FORUM

Conducted by Neville Williams

It would seem that the "in" thing, these days, for those who are getting married, is to dispense with the services of a conventional photographer and, instead, have the whole proceedings recorded on domestic videotape. That way, the event will be preserved for future generations to replay in full sound and colour. I wonder!

In the normal way, I doubt that I would have thought twice about this subject, had it not been raised by technical journalists at an end-of-year symposium in Hobart, hosted by BASF.

At one point in the discussion, the journalists seemed far from convinced that a VHS or Beta cassette would be of much practical use to future generations, whatever its present-day attractions.

Indeed, on a broader basis, they were tending to question the validity of magnetic media generally for long-term storage of information — personal or official. How permanent are the base materials and the various coatings? For how long can the microscopic particles be expected to retain a magnetic pattern? What about the effects of print-through, etc?

For all our technological progress, have we really found an adequate solution to the problem of long-term information storage, particularly at a personal or family level? Pictorially, can we do any better than those seemingly timeless photographs that were left behind by our great grandparents? Long after they had passed on, their familiar faces still gazed down from the walls of the family home, a constant reminder of our heritage.

Out of curiosity, I looked up a book produced some years ago by the publishers of "Womans Day" magazine. Titled "Australian Memories", it is packed with old black and white pictures, sent in by readers, some of them dating back a century or more. Even though photography was still in it its infancy, it is surprising just how sharp many of the pictures were and how well arranged the lighting.

These days, we rarely take photographs in black and white; everything has to be in glowing colour, which we proudly display to our contemporaries. But whether our distant descendants ever get to see our pictures is quite another matter, and one that we don't really think much about.

The problem is that, unlike black and white pictures, most colour prints and transparencies, these days, are dependent on dye processes which are commercially inexpensive and convenient — but chemically unstable. Expose them to heat, humidity or light — especially light with an ultraviolet content — and they will change colour, or lose colour or fade away to a blur.

Even in complete darkness, they may react to their own chemical residues, to contaminants in the air, to the paper or plastic base, to surface "finishing" sprays, or to the materials from which some albums are made.

Even though the problem was apparent much earlier, it did not gain a lot of attention until the late '70s, when feature film distributors woke up to the fact that much of their footage, potentially valuable for television, was at risk — if not already a write-off. I ran an article on that subject in the Feb/March '82 issue of our then associate journal "VideoMag".

"Have we really found an adequate solution to the problem of long-term information storage, particularly at a personal or family level?"

But, closer to home, when comparing notes with a photographer friend, I had a look at a collection of 35mm slides which I had either taken personally or bought during the EA-organised "Technitour" to Osaka, Japan, for EXPO '70. My own Kodachrome slides had taken on hues ranging from a prevailing blue, through reddish-purple to a faded all-over orange — in the latter case, a complete write-off.

Looking at them, I could appreciate the reason for fellow journalists being concerned about the longevity of photographs, or other forms of information storage which are being considered in their stead; Sony's "Mavica" magnetic disc camera, for example.

Domestic video cassettes

More to the point, will a normal domestic VHS or Beta video cassette be more permanent than many present-day colour photographs or will they, too, prove to be a "write-off" in 10 or 15 years' time?

Just to cheer everybody up, one of the writers present, with connections in the television industry, said that one Sydney TV station had recently been forced to discard a large number of their older library programs because the tapes had deteriorated to the point where they were commercially unplayable. If that had occurred with professional tapes, what hope was there for the domestic variety?

By way of general comment, guest lecturer Ontje Arpe, BASF Chief Engineer (Video Application), Mannheim (Germany) pointed to the peculiar history of magnetic tape recording.

In one sense, he said, the technology was quite old, his company having delivered its first bulk shipment of coated plastic tape in 1934. But tape had not been taken up on a world basis until after the war and, for most manufacturers, the learning curve had not even begun until then, with video recording technology following on later.

As someone else remarked at that point: "Even in the '60s one British manufacturer was still making audio tape that curled and went hard and refused to wind. I know," he added, "I ended up with reels of it!"

Equipment problems

Lacking any knowledge of the circumstances, Ontje Arpe was not in a position to comment on the problems of the Sydney TV station. However, he said, all the evidence suggested that, if stored properly — away from extremes of heat, contamination and humidity — modern high quality video tape should have a very long life indeed — much longer than had just been attributed to an older product.

He went on to point out, however, that there was more to it than longevity

how long will they last?

of the actual tape. How many people would still have ready access to a fully functional VHS or Beta VCR in 25, or maybe 50 years' time? Without a suitable player, an ancient video cassette would be virtually useless — a mere dusty relic from a past era.

To emphasise his point, he demonstrated a video tape that had been made only in 1970, but on the kind of domestic open-reel recorder that had been rendered obsolete by VCRs. He was able to play it now only because he had come across a discarded deck that could still be made to work. Even so, the playback quality was poorer than it should have been, due to head alignment and tracking problems.

It had been said that the laser disc offers the prospect of almost timeless storage of sound, pictures, and other data, with the digitally encoded information sealed inside a plastic disc and read from outside by a beam of light.

Again, such a prediction ignores the life expectancy of a particular set of system standards and the fact that, of all the record/replay systems to date, laser optical disc technology demands the most specialised knowledge, skills and facilities. Once the standards, skills and facilities have been discarded in favour of some new method, it will be more difficult than ever for individuals to retain or contrive the means to play back obsolete laser optical discs.

In this technological age, said Ontje Arpe, we need to think not just of durable materials but durable standards, as well, if information is to remain accessible.

And that, I would judge, leaves us in something of a quandary, especially at this time when it is fashionable to search through recollections, records and family memorabilia to establish one's roots.

- We rarely take black and white pictures and even more rarely try to ensure that they are processed and mounted with an eye to longevity of the 100+ years variety.
- The vast majority of present day colour pictures, be they transparencies or prints, are fated to fade within decades, especially if they are displayed for people to look at! Long-life colour prints are possible using such methods as the dye transfer process, or Cibachrome prints from colour transparencies, but they are too expensive for the mass market.
- We are coming up with other media, electromagnetic and electro-optical which may conceivably preserve a lot of information for a very long time, but such media can only be accessed by specialised equipment which itself may become unavailable or impractical to maintain.

And, just to round things off, here's something else to stew about: We have developed abundant technical means to assemble, store and access vast amounts of information about our generation — enough, indeed, to sustain quite a phobia about the "big brother" state. Largely, as a reaction to that, there is serious discussion about deliberately omitting certain information from future records as, for example, any reference to the identity of a child's parents.

That's going to make it really tough for those who care about who they are and where they came from. One would almost think that somebody out there is intent on cutting down the family tree. Shades of George Washington!

But now for a complete change of subject:

Back to the VZ-200

From a reader in Oak Flats on the NSW South Coast comes a letter which is set out in the accompanying panel. I suggest you read it at this point.

In responding to W.T's letter, I have a strong urge to do so in similar terms: "Whoa! Slow down there."

For sure, I made a case, in the August '84 issue, for investing $99 on a VZ200 computer — a product that had been dubbed by some buffs as "useless". I did so on the basis that, for $99, it could offer members of a family a unique opportunity to gain hands-on experience and, with it, a degree of confidence, when faced with a larger computer at work or at school. I quoted examples of how this had already occurred in typical family situations.

Out of all this came the further notion of using the VZ200 as the basis of an

Forty years ago it cost a fortune. Can we do it now for $99?

Dear Sir,

Whoa! Slow down there with the eulogies to the VZ200 $99 computer. The monitor in ROM has a bug in it.

I followed with interest your praise of the VZ200 in "Forum". Even on the dole, $99 isn't too hard to scrape together so, when I saw the DSE advert in July, a trip to DSE in Wollongong became mandatory.

After acquiring rudimentary programming skills, I hit upon the idea of making my self-education more interesting by repeating Mauchly and Eckert with ENIAC, in calculating e (or pi) to a large number of decimal places (pi to 2040 places, "Scientific American", Dec '49, p. 30).

To begin, I wrote a program to print the product of any two integers, however large, exactly and was rewarded with intermittently correct results. Mostly it was correct but occasionally (the frequency increased as the computer warmed up) incorrect answers were outputted.(!)

After running the same thing on the demonstration CAT at Wollongong, to make sure it wasn't a bug in my program, I remembered an early exercise that had caused the VZ200 to crash:

10N = 1:INPUT S:FOR P=1 *to* S:N=N*P/(P+1):?N;: NEXT: RUN

If one RUNS *and then* INPUTS *23 two times, the second time the computer goes crazy.*

I had been informed that it was only POKEing into a memory location it didn't like and didn't think was important!

As a consequence, the VZ200 pays for itself many times over in the self-education required to debug the machine language monitor. In the meantime, it is not possible to use the computer for any calculations requiring great accuracy. Even the double precision feature available by using the STR$ and VAL functions is inconsistent in its output.

Is any other VZ200 user out there able to help me?

I don't hold anything against DSE but it would be nice to say that any Tom, Dick or Harry can do in 1985 with a $99 what the computer buffs did in the '40s and '50s with computers costing a fortune.

By the way, the Tandy "Understanding" series books are okay and they're cheap!

W.T. (Oak Flats, NSW).

inexpensive word processor — something for which there was an obvious opening. It worked out better than ever expected, helped along by a $90 "Princess" B&W TV set as a monitor, a 16K memory module, a mini-printer and interface, a cassette recorder, and a word processor program that had fortuitously become available on tape from DSE. The exercise culminated in "Forum" for November '84 entitled: "This was written on a 'useless' small computer".

I might add that, since then, many more such articles have been written on that same small word processor and on other systems like it. The pity of it is that, as I write, supplies of the VZ200 are in danger of drying up, just when their bargain price utility has become most apparent.

Far from disproving anything that I have said, W.T's letter carries the idea of $99 self-tuitional exercise well beyond anything that I had really considered. He gives no information as to his educational background but, if to begin with, he was as much a computer novice as he makes out, he has had his $99 worth several times over!

I'm not about to debate his remarks about the ultimate accuracy of the VZ200, because I certainly haven't devoted to it that kind of attention. Nor do I propose to. I'll happily leave that to other readers who may share W.T's enthusiasm for such exercises. In the meantime, someone who should know was not the least surprised by his observations.

Computers, he said, work to certain limits of accuracy, determined by their logic resources and speed of processing. Like most other products, they are designed with a market role and price in view. If user needs dictate a higher order of accuracy than a certain computer will give, the buyer's only option is to purchase a better one. As it is, the ultimate accuracy of the VZ200 is quite typical for budget priced PCs.

But while W.T. pursues further enlightenment on that score, I'm more impressed by the apparent build-up in the skills and potential of this hitherto unemployed reader. He should, by all means, keep probing and asking questions but, in the meantime:

Good on yer, mate!

"Dolbyised" tapes

From a New Zealand reader comes a letter which, with some abbreviation, reads as follows:

Dear Mr Williams,

I have read your magazine since it was called "Radio & Hobbies" and have always enjoyed the friendly and informative way it was written — especially as in "The Serviceman", "Let's Buy An Argument" and now "Forum".

On a personal note, I appreciate the way in which the photographs of the authors change from time to time, reflecting (not hiding) the passing of the years. I also appreciate the devotional record reviews, which you usually write yourself.

More to the point, I have just noticed Leo Simpson's statement on page 3 of the September issue regarding Dolby noise reduction. I cannot really agree that Dolby recorded tapes do not sound right when played back on a car cassette player. If anything, I think they provide a touch of treble emphasis that usefully offsets treble losses due to mediocre loudspeakers, etc. True, there may be more hiss but the car noises drown it, anyway.

I have an Akai cassette deck with Dolby NR and, for car use, I record my records on it using Dolby but deliberately play them back without it. There is no doubt in my mind that the treble has more "presence" than with the Dolby on, especially with poorer quality tapes.

L.M., Avondale,
Auckland, NZ.

In acknowledging the kind remarks of the writer, I am also mindful of the way in which changes in the title of the magazine, as mentioned, have reflected changes in its emphasis.

"These days, the magazine and its writers don't have the same opportunity to explain current technology to a hobby minded milkman or clerk, farmer or business executive."

In the days when it was "Radio & Hobbies", technical interest was focused mainly on radio, or "wireless" if you like, which merged fairly naturally with the other hobby interests of a technically minded person. Radio components were reasonably large and comprehensible, and circuit operation capable of explanation in everyday terms.

The "Radio, Television & Hobbies" era involved some new concepts but a good technical writer could still hope to communicate principles quite well to the uninitiated with the help of carefully worked out analogies, diagrams and text. Who can forget the classic explanations of camera tubes and picture tubes, electron beams scanning an image or building up a scene on a phosphor screen; and so on.

The game began to get tough when it became "Electronics". The objectives and methodology became more diverse, obscure, and difficult to explain. Components became smaller, with valves that glowed, and capacitors that moved, giving way to enigmatic little black blobs that didn't seem to do anything!

These days, the magazine and its writers don't have the same opportunity to explain current technology to a hobby minded milkman or clerk, farmer or business executive. Can you even imagine a simple, readable explanation of a computer, or an IC-based control system?

On the matter of listening to Dolby processed cassette recordings, it would not be the first time that I have heard the contention that they sound brighter, when played back "straight". Some have even maintained that Dolby processing causes an actual loss of high frequency response.

In fact, it doesn't; or, at least, it shouldn't, if operating correctly.

In recording mode, the widely used Dolby-B system applies a boost of up to 10dB to frequencies within the approximate range 3-20kHz, tapering down to 0dB at around 300Hz. The amount of boost applied depends on the level of signal, as recorded, reaching 10dB only at low signal levels, and diminishing progressively towards zero boost (normal flat response) as the level rises.

To maintain an overall flat response, a Dolby playback system should provide an equivalent amount of treble cut over the same range of frequencies and levels. That's what you apply when you switch to the "Dolby-B" setting during playback.

There is plenty of scope for argument as to who, in what circumstances, can detect maladjustment of the Dolby record/playback levels but Leo Simpson is being uncharacteristically conservative in simply saying that, without playback compensation, Dolbyised cassettes "won't sound right".

Does that make a nonsense of LM's observation? No, because if you assume playback through a mediocre system in a noisy environment, as in most cars, the extra bit of tape hiss won't count and the extra bit of treble may be welcome.

Perhaps I should add that essentially the same remark is applicable to those of us who have lost kHz of aural response over the passing years. Perhaps, if Ray Dolby had had to rely on the verdict of the over 55s, he might well have finished up in a garret rather than a penthouse!

dbx Soundfield One loudspeaker system

Stereo sound wherever you sit

dbx Soundfield One loudspeakers are a new attempt at a solution to an old problem: how to obtain an effective stereo effect regardless of a listener's position in the room.

Everyone is familiar with the Haas effect although they may not know the name for it. If you are listening off-centre to a pair of loudspeakers the one that is closest will tend to dominate, and so degrade the stereo image. To get the best stereo effect, you should listen at a point roughly equidistant from each loudspeaker.

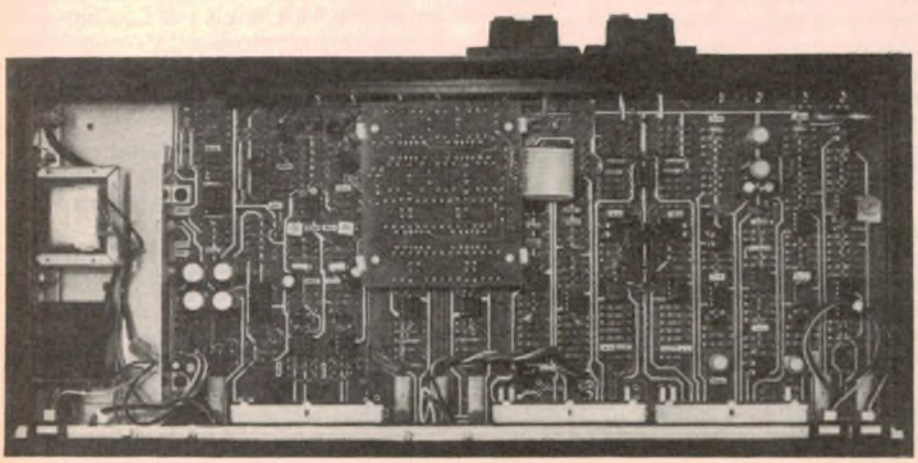
Of course if you must sit away from the ideal listening position you can always alter the balance setting to make the more distant loudspeaker louder. This corrects the situation for your new listening position but ruins it for the ideal spot. Some omnidirectional loudspeakers produced in the past have been attempts to get around this problem but the result has generally been at the expense of the stereo image. Now an engineering team at dbx Incorporated has come up with a new approach: the Soundfield One.

This new development takes advantage of the principle described above; that you can compensate for an off-centre listening position by raising volume of the more distant speaker.

Raising the volume of the distant speaker fools the brain into thinking that the two sound streams are arriving simultaneously (even though the louder one is slightly delayed) and restores the stereo image.

dbx engineers attacked the problem by laying out a grid of 60cm squares on the floor of a listening room and then had people stand in each square. Then the volume levels from a pair of loudspeakers were adjusted, in turn, to make each listening spot right for that listener. The volume levels for each listening spot were recorded and analysed by computer. The purpose was to determine what sort of sound radiation pattern was required from a pair of loudspeakers to give an optimum stereo effect in every location.

The inside of the Soundfield Controller is packed with active filter circuits to provide the complex equalisation required.



As the photograph on the opposite page shows, the Soundfield One loudspeakers are distinctly odd in appearance. Each is a large, free-standing column, 110cm high by 37cm square. Each column enclosure has 14 drivers. These include four 25cm woofers and four 10cm midrange drivers, with one of each size mounted on the four veneered sides of the cabinet. The remaining six drivers are dome tweeters, mounted in a hexagonal array. One of these tweeters is slightly different from the other five and this is pointed at the other enclosure of the pair.

Part of the enclosure design is the "hat" which fits over the hexagonal tweeter array. This has a solid top and acoustically transparent sides. It is there to prevent undue vertical radiation from the tweeters which would bounce of the ceiling and alter the desired dispersion pattern. Clip-on grilles attach to the four enclosure sides to give a somewhat more conventional appearance but by any measure they are still bulky and imposing beasts.

Crucial to the operation of the Soundfield One system is the Soundfield Imaging Controller. This is connected into the tape monitor loop of the amplifier (or between preamplifier and power amplifiers). Without this controller the Soundfield One speakers sound nothing like a high fidelity system; they are quite middly with no real treble or bass. The controller evidently adds a great deal of equalisation to the signal chain to correct these anomalies and also achieve the desired radiation patterns.

Additional functions performed by the controller include low frequency and high frequency compensation, ambience control, power monitor/protection, tape monitor (to replace the tape monitor function on the amplifier), auto bypass, auto balance, and rumble suppression. The first two controls are self-explanatory — they are a form of bass and treble control.

The ambience control is there to compensate for inadequate or excessive stereo separation in the source material. It appears to be a stereo enhance/reduction circuit.

The power/monitor protection function is interesting. As well as the set of input and output leads to the tape monitor, the Soundfield controller also has four wires which are connected across the amplifier's loudspeaker outputs. These are used to monitor to drive voltage to the Soundfield speakers. If it becomes excessive, the Controller reduces the gain in the signal chain and thus reduces the drive to the loudspeaker.

The auto bypass feature is used when listening via headphones or via an alternative set of loudspeakers. Under these conditions no signal is sensed at the Soundfield One drive terminals and so the Controller is automatically bypassed.

Rumble suppression takes the form of a stereo blend circuit which progressively combines the stereo signals below 100Hz. This can significantly reduce turntable rumble and, to some extent, acoustic feedback. The auto balance control is an automatic gain control with a slow time constant. It is supposed to keep the two stereo channels in balance and in this reviewer's opinion, would defeat the purpose of many stereo recordings — what happens when a solo performer is left or right of centre, as can happen during orchestral recordings? Fortunately, this control can be switched out.

As the accompanying internal photo and the above description shows, the Soundfield Controller is not a simple device. It is packed with circuitry.

A very complex crossover network is employed in each Soundfield One loudspeaker and this is claimed to keep the load impedance within the range of 4½ ± 1½ ohms over the whole audio range. This means that most amplifiers should not be troubled by load-induced instability. However, by no means can the Soundfield One be regarded as an easy load for amplifiers to drive. The complex and pronounced equalisation means that the load impedance "seen" by the amplifier will be anything but simple.

On the plus side, dbx claim that the Soundfield One system can be driven to healthy levels with as little as 40 watts per channel and 300 watts per channel will produce a peak sound pressure level of 110dB in most home listening environments.

The dbx Soundfield One comprises two large column loudspeakers, each with 14 drivers, and a Controller which is connected into the tape monitor loop of your stereo amplifier. The system gives a convincing stereo reproduction regardless of the listener's position within the room.

dbx do make a claim for the frequency response of the Soundfield speakers together with the Soundfield Controller. Average room power response (which means the total sound power radiated into the room) is claimed to be 20 to 20kHz within ±1.5dB. Verifying this is no simple task and requires extensive instrumentation.

In any case, this reviewer's listening tests Indicated that you could have virtually any frequency response you liked with the almost infinite control settings. For most balanced results we found that the low frequency compensation control should be set to the mid-position (which is detented) while the treble compensation should be set around maximum.

At those settings the Soundfield gives quite a reasonable overall balance although the sound reproduction does not sound as flat and as extended as with many topflight loudspeaker systems.

The important point though is whether the stereo image can be perceived from anywhere in the room. The answer, surprising to this reviewer, was that it works. You can hear a stereo effect anywhere in the room. Maybe it is not as sharp and as well defined as from the ideal listening spot for conventional speakers but it is still quite satisfying for a great deal of music.

Nor is the placement of the speakers critical. They need to be spaced away from the walls by about 60cm or more but within that limit, which is no more constraining than with many conventional loudspeakers, they are quite effective. In fact this reviewer even went to the extreme of listening very close to one loudspeaker and found that he could clearly hear the other speaker's contribution. When you think about what happens under these conditions with ordinary loudspeakers that is pretty astounding.

Conclusion

Making a fair conclusion about the Soundfield One system is not easy. It is a very expensive system (partly because of the currency exchange rate) but it does perform convincingly and must be rated as a major breakthrough. On the other hand, the overall performance when compared to topflight "conventional" loudspeakers, is not what we have come to expect. Prospective purchasers will have to decide whether the Soundfield One is really worth it.

(Continued on page 116)

Second article has the full circuit details

Playmaster Series 200 stereo amplifier

PART 2

This new stereo amplifier incorporates many features found only in topline commercial amplifiers costing many times its price. It has comprehensive input facilities selected by CMOS analog switches which are buffered by op amps.

by LEO SIMPSON & JOHN CLARKE

Last month we described many of the features of the new Playmaster Series 200 stereo amplifier and concluded with the description of the power amplifiers. In this article we shall describe the rest of the circuitry.

Let us start with the phono preamplifier which is identical to the circuit which was featured in the May 1983 issue of *Electronics Australia*. This uses ultra low noise transistors in a differential amplifier to drive an operational amplifier. This circuit concept is used frequently these days in many amplifiers and it has the advantage in that the noise performance is defined by the transistors rather than the op amp.

The type of transistor specified is the Hitachi 2SC2545, an NPN low noise transistor with a very low intrinsic base resistance. We have found this transistor superior to all other types we have tried. To render the residual noise level as low as possible we have used no less than four of these transistors in the differential stage, two pairs in parallel.

The effect of connecting transistors in parallel in this way is to halve the intrinsic base resistance. All other things being equal, this has the effect of improving the noise performance.

The collector currents of the differential pair are set at a total of 4.9mA which gives a good compromise between best signal-to-noise ratios for moving coil and moving magnet cartridges. By way of explanation, it is possible to obtain a slightly better signal-to-noise ratio for moving magnet operation by reducing the stage operating currents but this has the effect of worsening the performance when using a moving coil cartridge.

The operating current of the differential stage is set by Q5 which acts as a constant current source. This has the effect of ensuring good common mode performance and good power supply rejection, as well as optimum gain.

A 1kΩ resistor is connected in series with the drain of Q5. This is included solely as a fail-safe component in the event of Q5 failing in the short-circuit condition. We don't expect this to be a problem but a single resistor is cheap insurance which would let the circuit continue more or less normal operation. The resistor also comes in handy when the time comes to select the source resistor for Q5.

As a matter of interest, a similar insurance measure is incorporated in series with the collector of Q8 in the power amplifier.

The op amp used is the Signetics 5534 which is a high performance type with inherently low noise, high slew limiting, and the ability to drive a 600Ω load. It is this last ability which is most important for this circuit since it enables the use of a relatively low impedance negative feedback network. Again, the reason for this is to keep circuit-generated noise as low as possible.

As a result, the noise is quite a bit lower than with our previous Playmaster amplifiers which in themselves were notably quiet.

RIAA equalisation

This is determined by the components in the negative feedback loop of the preamplifier. To ensure that there is minimum deviation from the ideal RIAA characteristic curve the critical components are specified with tolerances of 1% or 2% as the case may be. This keeps the deviation to a maximum of ±0.3dB.

This specification may be regarded as gilding the lily but relatively small deviations in the RIAA compensation amount to an upward or downward tilt over a substantial range of the audible spectrum and this can lead to a fairly audible difference in perceived sound quality between amplifiers of otherwise equal merit.

Since the preamplifier provides both for moving coil and moving magnet operation it is necessary to change both the input impedance and gain of the circuit. For moving coil operation the input impedance is set at 100Ω shunted by .01μF and the gain is set at 1000. For moving magnet operation, the input impedance is set at 50kΩ and the voltage gain at 135 times.

These changes in gain and input impedance are arranged by a six-pole 2-position switch. This switches in the shunt resistor and capacitor to provide the low moving coil load and at the same time shorts out a 150Ω stopper resistor in series with the input which has the effect of improving the immunity to RF interference (and reduce any tendency to supersonic instability) in the moving magnet mode.

The gain is changed by switching the shunt leg of the feedback network, ie, the 33Ω resistor which is shorted out to provide the higher moving coil gain.

Since the 5534 is not an internally compensated op amp, a 10pF capacitor is connected between pins 5 and 8 to ensure stability at unity gain (which occurs at high frequencies). In addition, a 39Ω resistor is inserted in the feedback loop to prevent the gain rolling off

unnecessarily at supersonic frequencies. This also has the effect of reducing distortion at high frequencies which otherwise occur because of excessive loading of the op amp by its own feedback network.

Another measure which reduces sensitivity to stray RF signals is the combination of small inductors in series with the input signal together with shunt 100pF capacitors.

Also in the input network is a 47μF tantalum capacitor which provides a low impedance shunt path via the cartridge for noise produced by the 68kΩ bias and input load resistor. The capacitor could be omitted altogether if it were not for the fact that switching between the two preamp operating modes would otherwise produce a substantial change in the input offset voltage. This would be multiplied by the high gain to produce a loud switching transient. Not desirable.

The output of the preamplifier is coupled via a network consisting of a 2.2μF bipolar electrolytic capacitor and a 4.3kΩ resistor which provides a rolloff of the frequency response below 20Hz. From there on, the signal is fed to a 4052 dual 4-channel analog switch which provides source selection.

Line inputs

This device also handles the input signals from the high level program sources which are designated as CD (compact disc player), tuner and auxiliary. The latter may be any high level source such as TV sound tuner, hifi VCR or whatever.

Each input is connected to the appropriate pin on the 4052 via a 470Ω series resistor and a 56kΩ shunt resistor. The 470Ω series resistor is to limit any signal current to a safe value for the analog switch and the 56kΩ resistor is there to define the input impedance and to provide a charging path for any coupling capacitors in the source unit.

Let us leave the discussion of the analog switches till later in the article. For the time being it is enough to know that they function as distortionless switches.

Rumble filter

The signal from the 4052 is fed to IC2 which functions as a rumble filter, rolling off frequencies below 20Hz at 12dB/octave. This means that all high-level signal sources have the benefit of rumble filtering at 12dB/octave while the phono input has an 18dB/octave rolloff by virtue of the passive filter at the output of the preamplifier.

IC2 also provides the essential high impedance buffering for the analog gate which is necessary if low distortion performance is to be achieved.

Following IC2 is another 4052 analog switch which provides the tape monitor function for the amplifier. From there the signal is fed to IC3 which functions simply as a high-impedance unity gain buffer to drive the volume control. This is necessary if the volume control is not to be loaded down by the following circuitry and thus result in a control which is not progressive. IC3 also feeds the stereo/mono switch, S2.

The wiper of the volume control is fed to IC4 which is a 5534 op amp connected as a non-inverting amplifier with a gain of 5.7. As well as providing gain, this op amp buffers the wiper of the volume control and provides a low impedance source to drive the tone control stage.

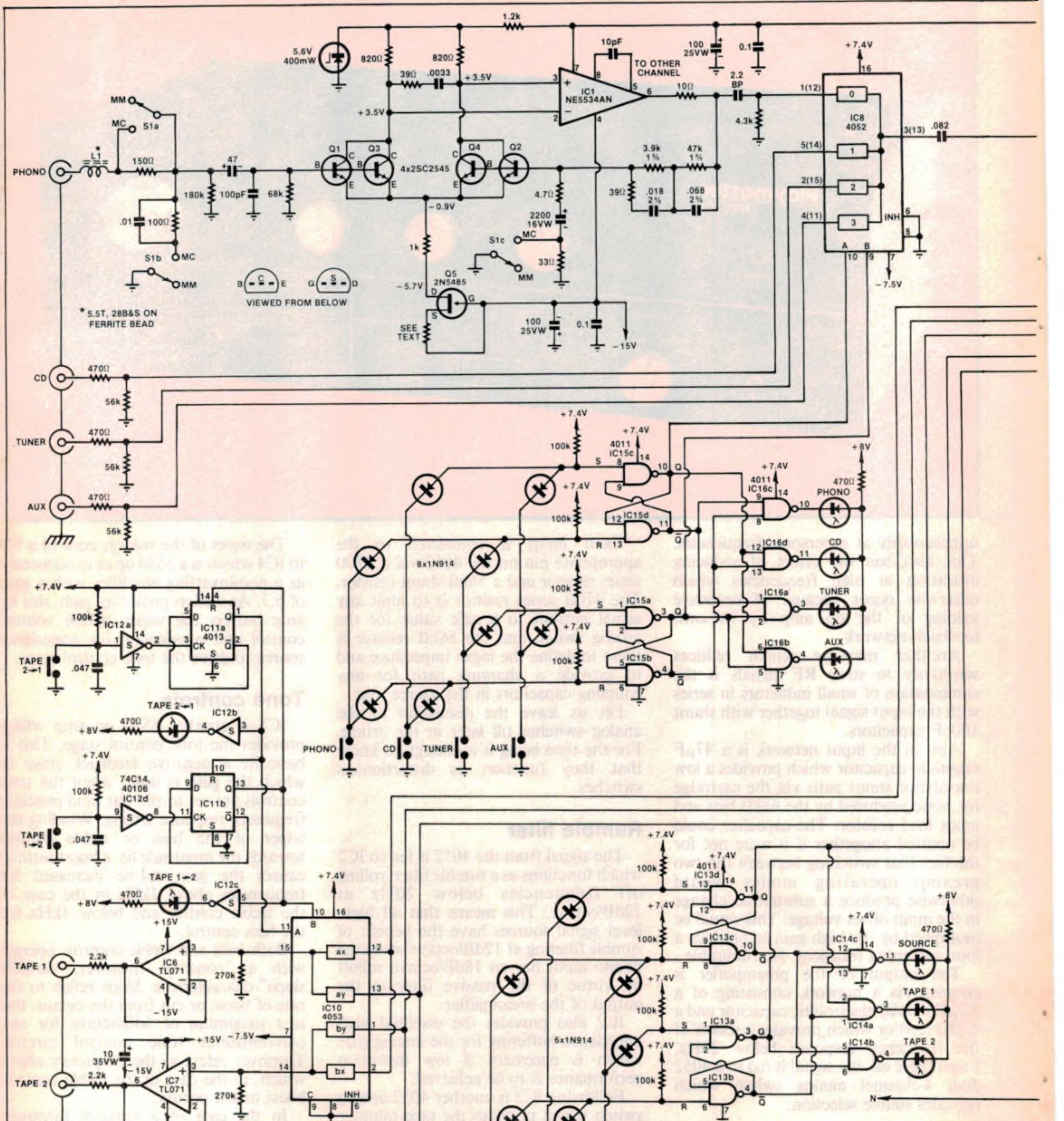
Tone controls

IC5 is another 5534 op amp which provides the tone control stage. This is basically a negative feedback stage in which the gain is unity when the tone controls are set to the flat (mid-position) frequency response setting. Winding the wiper of the bass or treble control towards the input side (ie. a boost setting) causes the gain to be increased for frequencies above 1kHz in the case of the treble control and below 1kHz for the bass control.

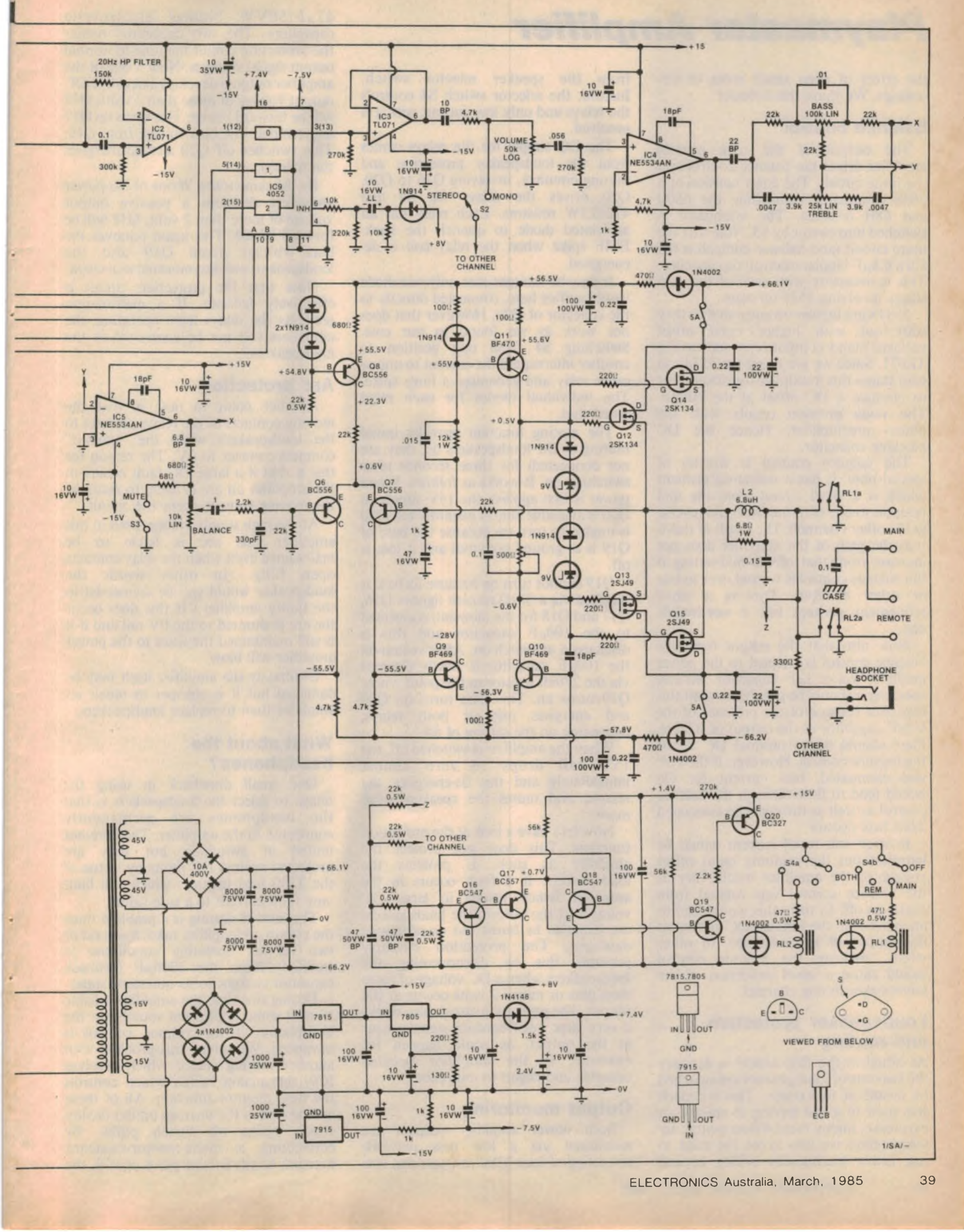
Both bass and treble controls operate with a "constant turnover, variable slope" characteristic. Slope refers to the rate of boost or cut from the circuit; this is a maximum of 6dB/octave for any conventional tone control circuit. Turnover refers to the frequency above which, in the case of the treble control, boost or cut occurs.

In the case of a variable turnover, constant slope control, the frequency below which bass boost or cut (or the frequency above which treble boost and cut) occurs varies with the setting of the control. What this means in practice is that at most boost or cut settings you may not be able to hear any effect.

By contrast, with a constant turnover, variable slope control you begin to hear



PLAYMASTER SERIES 200 STEREO AMPLIFIER


20Hz HP FILTER
IC2 TL071
IC3 TL071
IC4 NE5534AN
IC5 NE5534AN
IC9 4052
VOLUME 50k LOG
STEREO
MONO
S2
TO OTHER CHANNEL
BASS 100k LIN
TREBLE
25k LIN
MUTE
S3
BALANCE
10k LIN
Q6 BC556
Q7 BC556
Q8 BC556
Q9 BF469
Q10 BF469
Q11 BF470
Q12 2SK134
Q14 2SK134
Q13 2SJ49
Q15 2SJ49
Q16 BC547
Q17 BC557
Q18 BC547
Q19 BC547
Q20 BC327
1N4002
1N914
1N4148
2x1N914
4x1N4002
L2 6.8uH
RL1a
RL2a
RL1
RL2
MAIN
REMOTE
CASE
HEADPHONE SOCKET
OTHER CHANNEL
S4a
S4b
OFF
BOTH
REM
7815
7805
7915
7815.7805
IN
OUT
GND
VIEWED FROM BELOW
ECB
10A 400V
+66.1V
-66.2V
0V
+15V
-15V
+7.4V
-7.5V
+8V
1/SA/-

Playmaster Amplifier

the effect of even small boost or cut settings. We think this is better.

Balance control

The output of the tone control amplifier drives the balance control and the mute circuit. The latter consists of a 20dB attenuator comprising the 680Ω and 68Ω resistors. The attenuator is switched into circuit by S3. Note that the mute circuit (and balance control) is fed via a 6.8μF bipolar electrolytic capacitor. This is necessary with each of the gain stages involving 5534 op amps.

5534's are bipolar op amps so that they start out with higher input offset voltages than Fet-input types such as the TL071. Since we are using the 5534's in gain stages this multiplies the offset error to produce a DC offset at the output. The same problem occurs with the phono preamplifier. Hence the DC blocking capacitor.

The balance control is worthy of special note. It has a resistance element which is a short circuit from the mid position to one extreme (with the reverse in the other channel). The result of this is that the gain of the amplifier does not increase from that of the mid-setting if the balance control is wound over to one or other extreme. This is a small refinement perhaps but a worthwhile one.

Note also that the output from the balance control is coupled to the power amplifier via a 1μF capacitor. Strictly speaking it should be possible to omit this capacitor because of the presence of the 6.8μF capacitor at the output of IC5, ie, there should be no residual DC across the balance control. However, if the 1μF was eliminated, bias current for Q6 would tend to flow through the balance control as well as through the associated 22kΩ bias resistor.

In itself this small current would be harmless but the resulting input offset voltage to the amplifier would vary as the balance control was rotated from centre to off. In turn, this would lead to an increase in the residual DC voltage at the output of the amplifier. In other words, rotating the volume control would cause a small deflection of the loudspeaker in one channel.

Loudspeaker protection and muting

As noted in the first article in January the two sets of loudspeakers are switched by means of two relays. This approach was used to avoid having to specify an expensive, highly rated 4-pole switch. By using relays we also avoid the need to run heavy loudspeaker wiring to and from the speaker selector switch. Instead, the selector switch S4 controls the relays and only low current wiring is involved.

The DC supply for the relays comes from the loudspeaker protection and muting circuitry, involving Q16 to Q20. Q20 drives the relays via S4 and 47Ω/0.5W resistors. Each relay has an associated diode to quench the back-EMF spike when the relay coil is de-energised.

It may be thought that only one diode would suffice here, connected directly to the collector of Q20. However that does not work as we found to our cost. Switching S4 from one position to another interrupted the current to one or other relay and generated a huge spike. The individual diodes for each relay cured that.

The muting function provides initial muting of the loudspeakers (ie, they are not connected) for three seconds after switching on. It works as follows. When power is first applied, the 15V supply to Q20 is available almost instantly but Q20 is unable to turn on because the base of Q19 is at ground potential and it too, is off.

Q19 cannot turn on because its base is supplied via a 56kΩ resistor (ignore Q16, Q17 and Q18 for the moment) connected to the 100μF capacitor and this is discharged at switch-on. After switch-on the 100μF capacitor is slowly charged via the 270kΩ resistor to the point where Q19 turns on. This then turns on Q20 and energises one or both relays, depending on the setting of S4.

When the amplifier is switched off, the 15V rail drops to zero almost immediately and this de-energises the relay(s) and mutes the speakers once more.

Now let's have a look at the protection function. This does not protect the amplifier as such. It protects the loudspeakers. If a fault occurs in the amplifier which results in large DC voltages at the output, the loudspeakers are liable to be burnt out or otherwise damaged. The protection circuitry prevents this by disconnecting the loudspeakers when a DC voltage of more than plus or minus 2 volts occurs at the output. The protection circuit also works if very large low frequency signals occur at the output, as could happen for example, if the amplifier became unstable and began to motorboat.

Output monitoring

Both power amplifier outputs are monitored via a low pass network consisting of four 22kΩ resistors and two 47μF/50VW bipolar electrolytic capacitors. The two capacitors render the protection circuit immune to normal output signal voltages. Now if one of the amplifier outputs develops a negative DC output voltage of more than 2 volts, Q16 will be forward biased. This turns on Q17 and removes the bias voltage from Q19. This switches off Q20 and de-energises the relay(s).

By the same token, if one of the power amplifiers develops a positive output voltage of more than 2 volts, Q18 will be forward biased. This again removes the bias voltage from Q19 and the loudspeakers are disconnected as a result.

Note that the protection circuit is effectively fail-safe. If a malfunction prevents the relays from operating, the amplifiers will not be connected to the loudspeakers.

Arc protection

Another point to note is that the moving contacts of the relays connect to the loudspeakers while the "unused" contacts connect to 0V. The reason for this is that if a large DC fault occurs in the amplifier an arc is likely to result as the moving contact opens the circuit.

At the high supply voltage used in this amplifier this arc is liable to be maintained even when the relay contacts open fully. (In other words the loudspeaker would still be connected to the faulty amplifier.) If this does occur the arc is shunted to the 0V rail and if it is still maintained the fuses to the power amplifier will blow.

Ultimately the amplifier itself may be damaged but it is cheaper to repair an amplifier than to replace loudspeakers.

What about the headphones?

One small drawback in using the relays to select the loudspeakers is that the headphones are permanently connected to the amplifier. They are not muted at switch-on but they are protected against DC faults by virtue of the 330Ω feed resistors which will limit any fault current to a safe value.

The lack of muting is a problem since the phono preamplifier takes a second or two for its operating conditions to stabilise (while the 2200μF feedback capacitor charges to its quiescent state).

During this time the amplifier is liable to emit some unpleasant sounds via the headphones if the volume control is advanced. We solved this problem with another muting circuit which involves IC9, the analog switch which controls the tape monitor function. All of these analog switch ICs have an inhibit facility which opens all switch paths. By connecting a diode-resistor-capacitor network to the inhibit pin 6 of IC9, the

preceding circuitry is muted for a second or two at switch-on.

The mute circuit works as follows: at switch-on the 10μF capacitor connected to pin 6 of IC9 is a virtual short-circuit. This means that pin 6 is pulled high, opening all switches in the IC. Then, as the capacitor charges via the 220kΩ resistor, pin 6 is pulled low again, unmuting the circuit.

Switch circuitry

As noted above, the source selector, tape monitor and tape dubbing functions are taken care of by digitally controlled analog switches, type 4052 and 4053. These are arranged so that the supplies to the analog switches are plus and minus 7.5 volts DC. This defines the maximum signal that can be handled without distortion by the gates as 15 volts peak-to-peak. In practice, the maximum signal can be expected to be less than about 2.5 volts RMS or 7 volts peak-to-peak.

Meanwhile the control voltages for the switches swing between 7.5V and 0V. By applying either a high (7.5V) or a low (0V) onto the A and B control inputs of the 4052 and 4053, we can select which particular analog switch conducts and which are open circuit. For example, a low voltage on both the A and the B control inputs of IC8 will select the "0" switch (the phono input).

IC8 and IC9 function as 2-pole, 4-way switches. One pole is used for the left channel and the other pole for the right channel. The pin numbers (in brackets) on the circuit refer to the left hand channel.

The 4053 IC used for the dubbing control functions as a 2-pole, 2-way switch and separate ICs are used for the left and right channels.

Control circuitry for the 4052 analog switches comprises cross-coupled NAND gates which function as RS flipflops. The RS flipflops have two outputs, one complementary to the other and these are called the Q and Q-bar outputs. They remain latched in one state with one output high and the other low provided the Set(S) and Reset(R) inputs to the latch are held high.

The Q output from the first flipflop connects to the A control input of the 4052 while the second flipflop output connects to the B control input. Switches for input selection (IC8) and tape monitoring (IC9) are connected to their respective flipflop inputs via isolating diodes. Normally each input is held high via the 100kΩ resistor at its input. When, for example, the phono switch is pressed, a low is applied to the Reset inputs of each flipflop. This forces the Q output of each flipflop to go low and consequently we select the "0" switch on the 4052 IC.

Similarly, when other switches are pressed, a different code will be applied to the A and B inputs of the 4052 to select a different analog switch.

LED indication

Four NAND gates are used to decode the outputs from the flipflops for the input selector control circuitry and three for the tape monitor circuitry. Note that use has been made of both the Q and Q-bar outputs of each flipflop and this allows us to use this simple NAND gate decoding. The output of each NAND gate drives a LED to indicate the analog switch selected in the 4051.

Control logic for the tape 2-1 and tape 1-2 switching with the 4053 IC is performed by a 4013 dual-D flipflop. Basically, each flipflop is connected to change state each time the clock input is brought high.

The Q output from IC11a connects to the A input of the 4053 and the Q output from IC11b connects to the B input. Whenever the A input is high, the ay switch is selected and we have connection from tape 2-1. The ax switch is off. Conversely, when A is low, the ax switch is connected and we have normal tape 1 output. In this case the ay switch is off.

Similarly, with the B input. When high we have tape 1-2 selection and when low, normal tape 2 output.

Note that IC6 and IC7 are buffers to reduce loading on the analog switches. Consequently they can drive the tape inputs without distortion.

Returning to the clock inputs of the flipflops, Schmitt triggers provide switch contact debouncing via an RC delay. When, for example, the tape 1-2 switch is pressed, the .047μF capacitor is discharged and the output of the Schmitt goes high, toggling the flipflop. When the switch is released, the capacitor begins charging to the power supply rail via the 100kΩ resistor. The Schmitt then goes low ready to accept another low signal from the switch.

Another Schmitt trigger drives a LED to indicate when the Q output is high or alternatively when tape 1-2 is selected. Similarly, the LED lights when 2-1 is selected.

The Reset of IC11b connects to the Q output of IC11a while the Reset input of IC11a connects to the Q output of IC11b. This cross connection makes it necessary to switch off the tape 2-1 selection before the 1-2 selection can be made. Conversely with the tape 1-2 selection, it is necessary to switch off the 2-1 selection first.

Power supply

Power for the main amplifier is provided by a 300VA centre tapped 45VAC toroidal transformer. A 10A 400V bridge rectifier feeds four 8000μF capacitors to derive well-filtered balanced supply rails.

An extra winding, which needs to be hand wound on top of the 45V windings, provides a 15VAC centre tapped output. This is full wave rectified and filtered with 1000μF capacitors to give plus and minus 21V rails. Separate positive and negative three-terminal regulators provide fully regulated +15V and −15V rails for the operational amplifiers.

For the negative 7.5V rail required for the CMOS analog switches, a simple resistive divider is used. The two 1kΩ resistors in series give the required −7.5V and this is decoupled with a 10μF capacitor. It is possible to use this method since the current drawn by the CMOS ICs is only about 100μA and this has negligible loading on the resistive divider.

The positive supply rail is required to supply far more current simply because of the LED indicator current. Therefore a 7805 regulator has been used. The 220Ω resistor between the output and ground terminal of the regulator has about 23mA flowing through it and this current in conjunction with the 15mA flowing out of the GND terminal impresses about 3V across the 130Ω resistor. This has the effect of increasing the output voltage from 5 to 8V.

A decoupling capacitor is used at the output of the regulator and between the GND terminal and the 0V rail. These ensure transient response and stability of the regulator.

The regulated 8V output supplies the indicator LEDs while the diode following this voltage provides 7.4V for the CMOS switch and logic control circuitry.

Standby power

Two nickel-cadmium batteries are used to supply standby power for the CMOS ICs. These provide just sufficient voltage on the flipflops so that they retain their settings when the main power is off. The diode between the LED supply and CMOS supply ensures that the LEDs are not powered by the battery. Note that the minus rail is not powered by the battery. This is because we are only interested in keeping power to the logic supply, since this holds the status of the CMOS analog switch selection.

When the mains power is on, the battery is trickle-charged via the 1.5kΩ resistor in series with the 7.4V rail and the battery.

That completes the circuit description. Next month we shall describe the construction.

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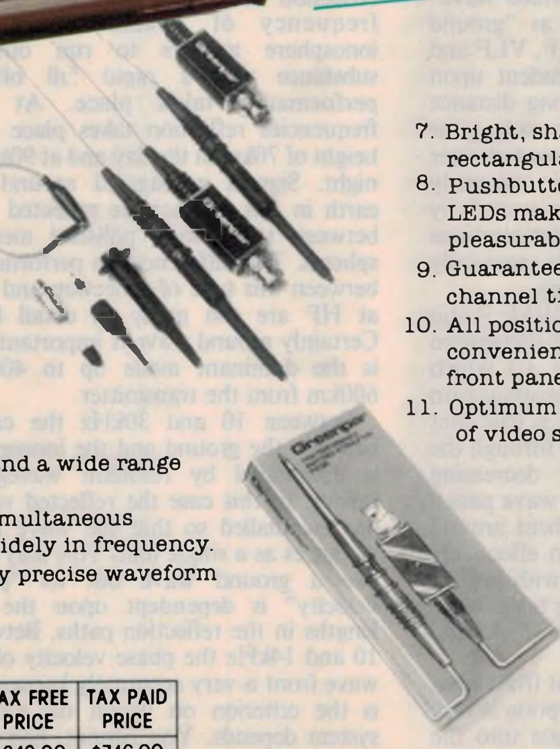

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Letters to the editor

Radio wave propagation & engineers

There has been a lot of stirring, re engineers, in your magazine lately so I may as well take the opportunity and put in my two pennyworth. I don't think that in any other field of technology do people come up with so many misconstrued ideas as in radio communications. I can view this situation as a somewhat independent observer since I am in the electrical field and have had some contact with the communications profession. Also I take the technical side of amateur radio rather seriously. I don't intend to justify this most sweeping statement at this stage except to take you to task over a major error in your December magazine in the article "Radio Wave Propagation".

The statement that low frequencies and very low frequencies are propagated over long distances by "surface wave" (more traditionally known as "ground wave") is totally incorrect. LF, VLF and even ELF singals are dependent upon ionospheric reflection for long distance propagation! I cannot take only your magazine or even the author to task over this, as this misconception is extremely widespread and commonly quoted by many people in the communications field. I intend to spend a little space only on enlarging on my statement.

My main reference is to "VLF Radio Engineering" by A. D. Watt (Pergamon Press), in particular chapter 3.3 which discusses ionospheric propagation between 10 and 200kHz. It is true that absorption of signals passing through the ionosphere increases with decreasing frequency. At HF the radio wave passes into the ionosphere and is bent around and returned to earth by an effectively decreasing refractive index with height. This "reflection" or bending takes place gradually over a considerable vertical distance.

This is completely different from what happens at LF. At LF, absorption is very high, and signals do not pass into the ionosphere. In this case reflection takes place at the discontinuity between the ionosphere and the atmosphere (the D region). This type of reflection of radio signals is totally different from that which takes place at HF and is similar to reflection of all types of radio signals from the ground. It is also similar to the reflection of light from an unsilvered glass surface.

Reflection from a discontinuity can only take place when an appreciable change in conductivity exists over the distance of a wavelength. This type of discontinuity exists between the ground and the atmosphere for all radio frequencies and between the atmosphere and the ionosphere at frequencies between about 10 and 300kHz.

The efficiency or "reflection coefficient" of this reflecting boundary is dependent upon the rate of change of conductivity over the distance of a wavelength and the actual conductivity at the boundary where reflection takes place. Therefore as the wavelength becomes longer the discontinuity becomes relatively sharp, and the reflection coefficient improves until a frequency of 12kHz where the ionosphere appears to run out of substance and a rapid fall off in performance takes place. At low frequencies reflection takes place at a height of 70km in the day and at 90km at night. Signals propagated around the earth in this manner are reflected as if between two poorly polished metallic spheres. The differences in performance between this type of reflection and that at HF are too many to detail here. Certainly ground wave is important and is the dominant mode up to 400 to 600km from the transmitter.

Between 10 and 30kHz the cavity between the ground and the ionosphere is dominated by resonant waveguide modes. In this case the reflected waves are marshalled so that the wave front advances as a single unit. This may look like a ground wave but its "phase velocity" is dependent upon the ray lengths in the reflection paths. Between 10 and 14kHz the phase velocity of the wave front is very accurately known and is the criterion on which the Omega system depends. You cannot, however, use the system within 500km of the transmitter because of mixed modes including the ground wave. How do I know this? Actually I read it in your magazine in an excellent article by Dr G. A. Baley, EA January 1970.

J.A. Adcock,
Oak Park, Vic.

Selectadyne Three antique receiver

Fired up by the recent "build-it" articles on 1920 type wireless sets in EA, I dug deep into the junk box (I really must sort out that stuff one day) and into the memory crevices for some ideas. If a two valve set, circa 1925, why not three? Three valves opens up the possibility of loudspeakers and the using up of various ancient odds and ends.

So, a good starting point seemed to be the triple spiderweb coils from Technicraft in Katoomba, as per your mid '84 "one valver". Next, how to fit in some very elderly single gang tuning capacitors — sorry — condensers, the old "Emmco Puratone" audio transformers, dial drive, some strange surface mounted sockets, old screw terminals, an "All American Radio Frequency Coupler" (a jam-tin-sized bakelite-cased wooden former with cotton covered wires in a "conventional" Reinartz configuration — the whole thing filled with gum resin), and other things.

Valves? Well, how would a line up of a 14, a UX201A and another 14 look — very good I thought. But I couldn't find a vintage type 4-pin (Brit.) socket for the second 14. So, coming across an octal surface mounting job, a 1L4G tube looked the part. It's really only 40 plus years

Old valves on offer

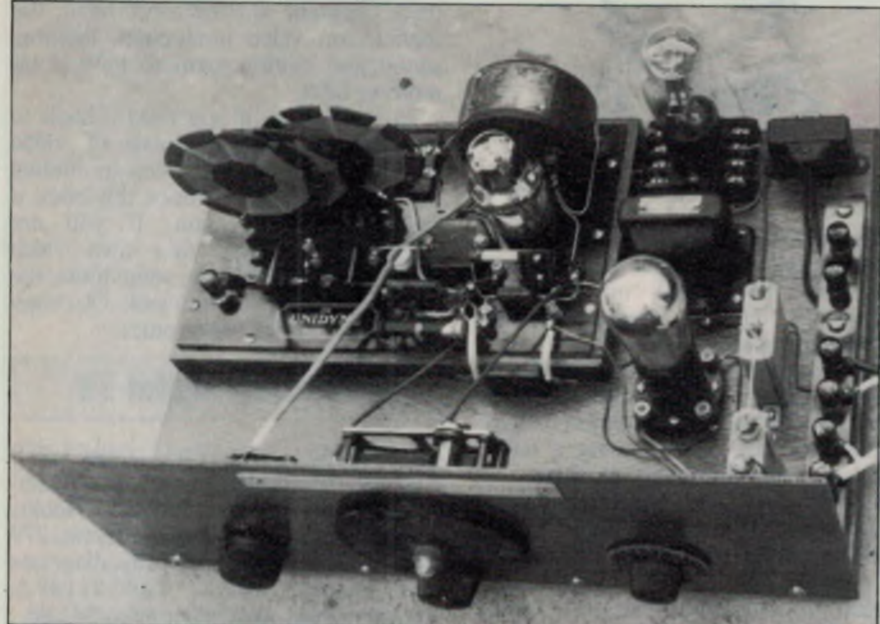
I have been reading E.A. for more than 12 years now. I read each issue from cover to cover, even if it is 4 or 5 months after publication. I must thank EA's staff for an informative and educational magazine.

My main reason for writing is valves; I am a laboratory technician at an Institute of Technology, where a clean-out has been on. I rescued about three dozen valves of various types. I am led to believe that all are in working order.

I was hoping that you could inform me of any organisation club, or society that might want the valves. My alternative is to throw them on the tip.

B. McCarthy,
1/8 Henry St,
Boronia, Vic 3155.

Comment: Thank you for your favourable comments on the magazine. We have included your name and address so that anyone interested in the valves can contact you directly.



The Selectadyne Three 'antique' receiver.

old, not 50 plus, but oh heck, so what?

The result: circuit diagram and photographs of the "Selectadyne Three" are enclosed. The name, incidentally, stems from the use of coils switched into the circuit by a knife switch to tune differing parts of the spectrum. Three aerial terminals are also part of the deal. By using the tuning gang as the spiderweb capacitor, it is possible to tune from about 400kHz to 2.25MHz. Also the variable capacitor doubles as a "find tune" in the spiderweb mode! Aerial terminals are selected as necessary.

Output is more than adequate for "family listening" (I wonder what that is?) on all local AM stations. The circuit diagram shows a power supply, but this would not be easily duplicated since the transformer would bring a puzzled frown from the Dick Smith counter assistant. However, it provides 9V at 0.25A plus 90V at 12mA.

Oh, I didn't mention that the Selectadyne Three does need a reasonable aerial — preferably 25 feet or so of insulated wire chucked, via a stone tied on first, over the backyard mango tree (mango tree!?).

Well, for better or worse, that's the device, inspired by your two articles.

B.M. Byrne,
Indooroopilly, Qld.

Surface wave propagation

I wish to correct a popular misconception which has again surfaced in the article by Elmo Jansz (E.A. December 1984). The tilt of a surface wave which propagates over a conductive earth depends only on the local earth properties. Fig. 5 is an incorrect representation; the tilt is not dependent on the distance from the transmitter. Certainly "power is lost to the ground as the surface wave moves forward" but the resultant effect is that both the vertical and horizontal components of the electric field which define the wavefront are both attenuated in proportion. This has been shown in the laboratory using microwave models of a curved earth, theoretically and experimentally. In fact one geophysical prospecting technique uses tilt measurements to derive the local conductive properties of the earth.

I am uncertain where this misconception started but certainly diagrams like Fig. 5 have appeared in a number of textbooks. If you wish to have the appropriate references then please contact me and I will dig them out.

D.V. Thiel,
Griffith University, Qld.

Books & Literature

Circuit Design Programs

CIRCUIT DESIGN PROGRAMS FOR THE APPLE II: by Howard M. Berlin. A Blacksburg Continuing Education Series. Published by Howard W. Sams & Co, Inc Indiana USA. Soft covers 215 × 280mm, 131 pages, illustrated with drawings of circuits, monitor screen tracings and number line plots. ISBN 0-672-21863-1. Recommended retail price $14.95.

The programs in this book are designed to reduce the calculation burden of the electronic circuit designer by giving the computer the relevant calculation details. Not only will the computer perform these mundane calculation tasks, but it will also provide a printout of the results.

All of the programs listed in the book are written in BASIC for an Apple II "Plus" or an Apple II having the Applesoft firmware card installed. There should be 32K of RAM at the very least. Although difficult, the programs could be translated to integer BASIC to run on the PET and TRS-80 computers.

There are eight chapters which include programs to solve simple statistical data, RMS and average values, Fourier series of a periodic waveform, inverse Laplace, Fourier and other network transforms, design of matching pads, attenuators, active filters, heatsinks, 555 timers, zener regulators and bipolar transistor circuits. There are also solutions for simultaneous equations with real or complex coefficients, damped oscillations and polynomial roots.

The plot routines are written in HiRes graphics, to provide high clarity on the screen. Incidentally, the program listings in the book are printed using a daisy wheel printer and are very readable.

A short explanation is given before each program so that newcomers to the particular calculation will understand the program operation. An example run of each program is given and the results are printed onto a simulated screen layout exactly as would appear on a genuine monitor.

Overall the book appears to provide some very useful programs and information that any Apple owner would be pleased to own.

Our review copy came from Jaycar Electronics, 7-9 Rawson Street, Auburn, NSW 2144. (J.C.)

Video Fundamentals

VIDEO FUNDAMENTALS: by Welby A. Smith. Published by Prentice-Hall Inc, USA 1983. Soft Covers, 235 × 175mm, 186 pages illustrated with diagrams and photographs. ISBN 0-13-941930-6. Recommended Australian retail price $22.95.

The author intends this book to be a video primer. It is aimed at people considering entering the video field for the first time. Consequently it is very elementary, beginning with a chapter on choosing a VCR. This is followed by chapters on how your VCR works, playing back video tapes and sound. Later chapters concentrate on making your own video movies, editing, production and camera techniques.

The book includes a glossary of video terms and a list of resource publications. The main drawback of this list, as with the rest of the book, is its strong American slant. This is a particular problem in the technical descriptions because only the American NTSC transmission system is described.

In fact the technical side of the book is fairly weak, so much so that we feel that the typical reader of *Electronics Australia* would not gain much from these chapters. On the other hand, the sections on video production, lighting, sound and editing seem to have a lot more to offer.

In conclusion, if you need a book to introduce the fundamentals of video technology or are interested in finding out how your video works, this book is probably not for you. If you are considering making your own video programs, and could use some hints, the book is certainly worth a look. Our copy came from Jaycar Electronics.

Servicing Digital TV

SERVICING DIGITAL CIRCUITS IN TV RECEIVERS by R. Fisher. Published by Newnes Technical Books, London. Soft covers, 165 x 233mm, 270 pages. Illustrated with circuits, diagrams and graphs. ISBN 0 408 01149 1. Recommended Australian price $42.00.

Until recently, TV servicemen had to deal with equipment which used analog technology throughout. With the advent of digital tuning, Teletext, remote control and so on, this has changed. Most TVs coming onto the market these days have at least some digital circuitry and the average serviceman is straining to keep up.

This book, written by a lecturer in microprocessor and video techniques at the Plymouth College of Further Education, is an attempt to help in this area. The book assumes that the reader is familiar with television principles and semiconductor fundamentals but no knowledge of digital techniques is assumed.

Beginning with a comparison of digital and analog systems, the book progresses through combinational and sequential logic, storage and display devices, data transmission and on to microprocessor fundamentals. These sections of the book are very well written, and cover the material thoroughly.

Following chapters of the book describe the digital systems commonly found in today's television sets — Teletext decoders, digital tuning, remote control and Viewdata. The chapters on Teletext are very helpful and the others are of a similar, high standard.

All in all, this book does an excellent job. It is well organised, thorough and contains enough theory to be useful, without being impossible to read. We can thoroughly recommend it to anyone interested in digital techniques in television receivers.

Our copy came from Butterworth and Co, 233 Macquarie St, Sydney. (A.L.)

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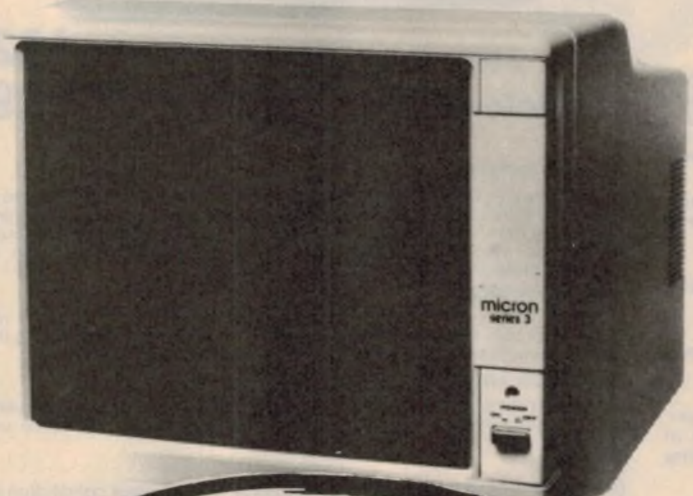

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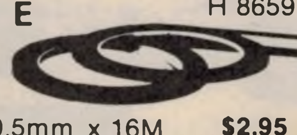

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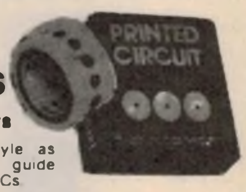

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Up to 150 messages can be recorded, using a C60 leaderless cassette and based on an average message time of 12 seconds per call.

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Your Callmaster endless loop cassette gives a 20 sec. announcement, optional cassettes are available in lengths of 12, 15, 30, 45 or 60 seconds. (If required, your machine can be modified to use 120 seconds outgoing message cassettes.)

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Standard Model A 0510 $229

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Callmaster is designed especially for Australian telephone conditions and precision manufactured in Japan, assuring unequalled performance and reliability.

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DOC Permit RFM E002/026
Telecom Permit C83-35-9

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Sensitivity for 20dB Signal to Noise		0.5uV
Adjacent Rejection	+ 15KHz	50dB
	—15KHz	50dB

REMOTE TRANSMITTER:

Frequency (Single Channel)	40.025—40.225MHz

REMOTE RECEIVER:

Frequency (Single Channel)		1.725—1.785MHz
Sensitivity for 20dB S/N		0.5uV
Adjacent Channel Rejection	+ 15KHz	50dB
	—15KHz	50dB
Consumption Current		
Stand-by	less than	8mA
ringer	less than	20mA
during conversation	less than	50mA

RECHARGEABLE BATTERIES (REMOTE):

Nominal Capacity	250mAH
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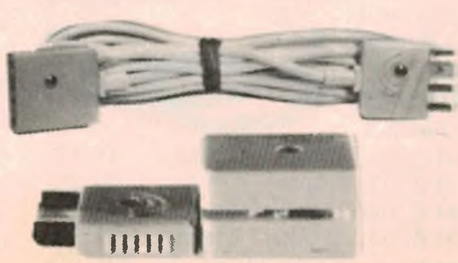

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Pages: 1952 **Year: 1982**

B 1010 .... **$15.00**

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LINEAR SUPPLEMENT

The 1984 Linear supplement provides the most recent information on Nationals new linear products. This supplement also provides a comprehensive index published in the Master Databook. New products designed are indicated by an Asterisk and in bold type. Revised data sheets are listed in bold type. Nationals supplement databook system allows you to make product selections of their latest product offerings.

Pages: 566 **Year: 1984**

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National's new Logic Databook covers five of their logic families: TTL (54/74) Schottky (54S/74S) low power Schottky (54S/74S) high speed (54H/74H) and low power (54L/74L). The Logic Databook— especially organised for quick and easy referencing—offers two complete functional indices and selection guides, one for SSI and one for MSI devices. In addition, it includes over 100 connection diagrams and test waveforms to help speed the design-in cycle. All in all, it's probably the most comprehensive collection of practical information ever assembled on such a broad line of practical components.

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Page: 256 **Year: 1984**

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Pages: 792 **Year: 1982**

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National Semiconductor has added many new transistors and product families since publication of the last databook. Many have already been widely acclaimed by users. In addition to small-signal, power-bipolar and field effect transistors that have been the mainstay of our catalog, there is a section for multiple-field-effect transistors. More part numbers will be added as market needs expand. To keep current on all new National transistors, please contact your National sales representative or franchised distributor and ask to be placed on the customer mailing list.

Pages: 558 **Year: 1982**

B 1050 .... **$9.95**

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CMOS DATABOOK—1984

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Pages: 1520 **Year: 1984**

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Page: 336 **Year: 1982**

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Over the last few years, House Break-ins have increased dramatically—a check of recent police statistics is simply horrifying! The recovery rate of stolen goods is very low. This is partly due to the sheer difficulty in identifying goods as well as the incredible volume of property stolen.

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* Alarm has 8 separate input circuits—8 sectors can be monitored independently.
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* Two Inputs provided with an entry delay (between 10-75 sec)
* Alarm is disabled by front panel key switch
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* Unique circuit detects automatically when any N/O or N/C loops are either open circuit or dead short **e.g. someone trying to bridge reed switches etc.**
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* Switched output can be used to send a silent alarm through an auto-dialler circuit or similar.
* Full battery back up provided via. 12V—1.2Ah battery
* Alarm will operate for approx. 2 days with mains disconnected.
* Supplied in an attractive functional security case.

K 1900 A Mere **$139.00**

Suggested Alarm Accessories for use with the Multi Sector Alarm System

Weatherproof Horn Speakers

5 and 10 watt

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C 2010 **$9.50**
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10W
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Weatherproof Siren Horn

12V DC
Deafening
Siren Wail

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Similar to "Sonalert" type. Absolutely ear piercing sound. Recommended voltage 5—15V DC. Ideal for almost all audio signalling applications i.e. Fire, water and gas signalling, computer alarms, etc.

S 5166 **$4.95**
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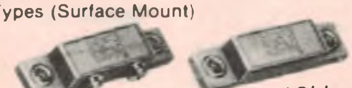
10Up **$17.50**ea

Reed Switch and Magnet Sets

3 Types (Surface Mount)



			10Up
S 5155	N/C SW	**$2.50**	**2.20**
S 5156	N/O SW	**$2.95**	**2.10**
S 5153	SPDT	**$2.98**	**2.59**

Changeover type

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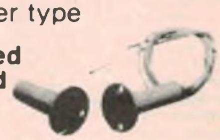

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Fig '8' Cable

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Security Key Switches

Standard Type
Includes 2 Keys

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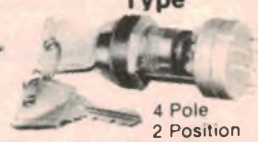

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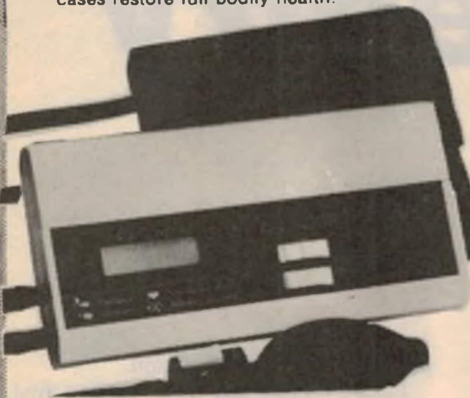

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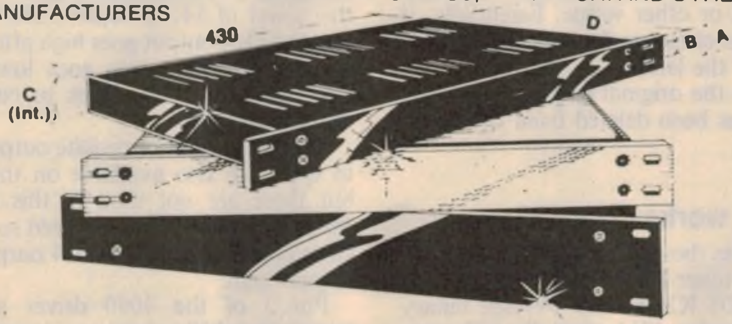

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with balanced

Mic Input and Muting

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2 year Warranty

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Don't trip over the dog! Build the

Driveway Sentry

There's no need to trip over the family dog when you come home late at night. Activated by your car's headlights, this Driveway Sentry Mk. 2 automatically turns on an outside light so that you can make it safely into the house.

by COLIN DAWSON

Our original Driveway Sentry was described in December 1982 and became a popular project. Unfortunately, the circuit provided readers with quite a few headaches as it was prone to false triggering. The Driveway Sentry Mk.2 employs a completely new circuit that very effectively eliminates this problem.

In developing this new circuit, our aim was to make it as easy as possible for readers to upgrade to the new design. The new Mk.2 version uses the same case, transformer, relay and sensors as the original version, so the cost of the upgrade is relatively cheap. All the constructor has to do is assemble and substitute a new PC board that uses a handful of low-cost parts.

For those readers who didn't see the original article, let's briefly recap on the basic concept. Most of us, when we arrive home late at night, are faced with the problem of negotiating our way from the garage to the house in total darkness. Along the way, there is always the chance of tripping over an unexpected toolbox, bicycle or dog before we've reached a lightswitch.

Of course, some readers may face more serious problems once inside the house but these problems are usually of a more personal nature.

The Driveway Sentry can't solve your personal problems but it can stop you from tripping over the dog. It uses a light dependent resistor (LDR) to detect your car's headlights and then it automatically switches on an exterior light. At the end of a four minute period, it switches the light off again.

Operation of the Driveway Sentry is completely automatic. A second LDR is used to sense the level of ambient light so that the circuit is inhibited during daylight hours. The circuit is powered, via a transformer, from the same supply as the exterior light and consumes minimal power in the untriggered state.

A useful feature of the circuit is the external trigger switch. This can be mounted remotely and used to turn the exterior light on so that you can walk from your door to the car. The Driveway Sentry will then automatically turn the light off after you have driven away.

The manual switch is also handy for brief nocturnal excursions to the garage, verandah or other venue. Essentially, it causes the circuit to function as a simple timer for the lamp.

Unlike the original circuit, the cancel switch has been deleted from this latest design.

How it works

Whereas the original design was based on a 555 timer IC, the Mk.2 version uses two CMOS ICs: a 4060 14-stage binary counter and a 4011 quad NAND gate. This overcomes the difficulties experienced with the earlier version which were due to reset problems within the 555.

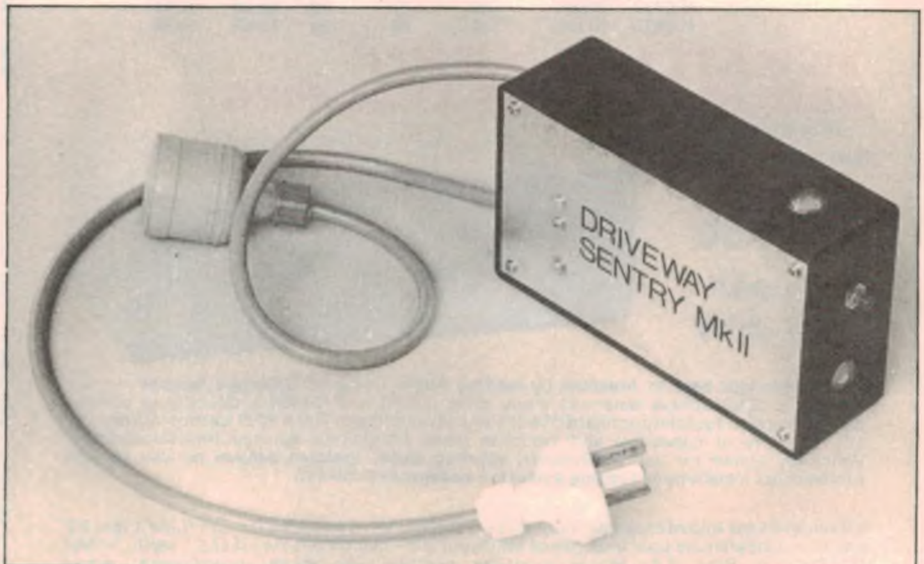
Essentially, the circuit can be broken into two distinct sections, each based on one of the two ICs. The 4011, in company with two light dependent resistors (LDRs), provides detection and control triggering while the 4060 provides the timing function.

Let's examine the timer section first. The 4060 CMOS IC is ideally suited to this role. Basically, it divides the clock pulses on its pin 11 input by 2 raised to the power of 14, or 16,384. This means that the Q14 output goes high after 8192 clock pulses and then goes low again after another 8192 pulses to complete the timing cycle.

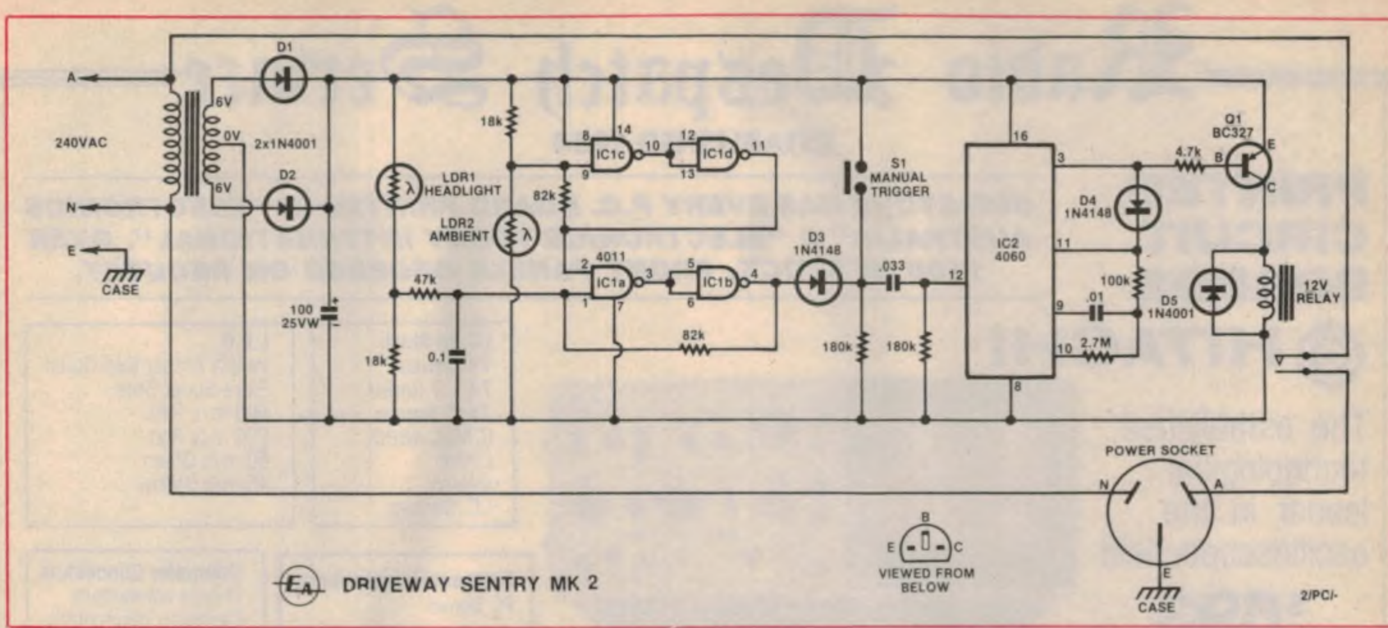
A number of intermediate outputs (Q4 to Q13) are also available on the 4060 but these are not used in this circuit. Instead, the 4060 is configured so that it stops counting after the Q14 output (pin 3) goes high.

Pin 3 of the 4060 drives a PNP transistor which, in turn, controls the relay. This means that the lamp is on while ever Q14 is low; ie, from the start of counting until the positive transition of Q14.

Included in the input circuitry of the 4060 are several inverter stages with outputs available at pins 9 and 10. This is a particularly useful feature as it enables the input section to be configured as a 2-gate oscillator to provide clock pulses



The Driveway Sentry Mk.2 uses the same case, transformer, relay and sensors as the original version. Note mounting arrangement for the LDRs.



IC1 and the two LDRs provide detection and control triggering while IC2 provides the timing function.

for the counter circuitry.

The 0.1μF capacitor and 2.7MΩ resistor on pins 9 and 10 are the timing components for the clock. These set the clock frequency to about 32Hz which means that pin 3 of IC2 (4060) goes high for just over four minutes.

Note the diode (D4) connected between pin 3 and the clock input (pin 11). When pin 3 of IC2 goes high, this diode pulls pin 11 high and stops the clock. This step is necessary otherwise IC2 would continue to count, with pin 3 alternately going high and low at four minute intervals.

The only way another timing cycle can be initiated is to reset IC2 by momentarily pulling the reset pin (pin 12) high. This is the function of the detection and triggering ciruitry based on IC1.

Detection and triggering

Light detection is performed by the two LDRs which are connected in series with 18kΩ resistors across the supply rails. The voltage at the midpoint of each divider (ie, at the resistor-LDR junction) thus varies in proportion to the amount of light falling on the LDR. When LDR1 senses the headlights, the voltage at the junction goes high.

Conversely, when LDR2 senses a high ambient light level, the voltage at the junction is pulled low.

During daylight, the ambient light detection circuitry inhibits the headlight detection function. Let's assume, however, that LDR2 is in darkness and that pin 2 of IC1a is high.

IC1a functions as the detector for the headlight sensor. Note, however, that the voltage divider output is not applied directly to IC1a. Instead, it first passes through a delay circuit consisting of a 47kΩ resistor and a 0.1μF capacitor. This circuit provides sufficient delay to prevent the circuit from triggering on lightning flashes.

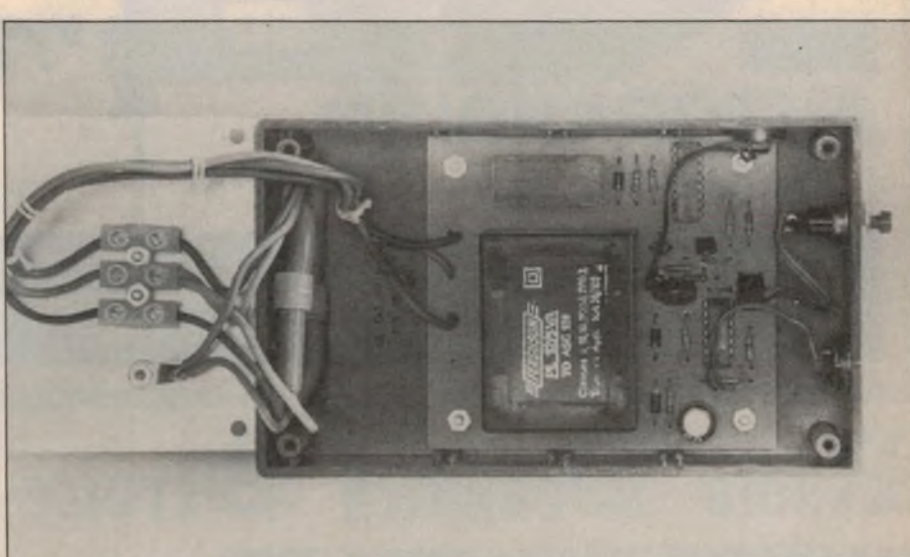
Ideally, the detectors monitoring the voltage dividers would consist of devices using Schmitt trigger inputs. This form of detection is necessary to prevent erratic operation when marginal triggering or inhibit conditions exist. Unfortunately, Schmitt input NAND gates have become rather scarce lately so the Driveway Sentry uses ordinary NAND gates set up to operate as Schmitt triggers.

To make ordinary NANDs operate as Schmitts, they need to be provided with positive feedback. Since NANDs are inverting gates, positive feedback cannot be arranged simply by connecting the output back to the input. Instead, another inversion of the NAND output must be carried out and this signal fed back to the input.

IC1b performs this second inversion for the headlight sensing circuit. Its output (pin 4) is connected back to the input (pin 1) via an 82kΩ resistor to provide about 200mV of hysteresis.

Operation of the detector circuit is quite simple. When LDR1 detects the car's headlights, pin 1 of IC1a goes high, pin 3 goes low and pin 4 of IC1b goes high. This high is applied via D3 to a differentiator network (.033μF and 180kΩ) which delivers a positive-going pulse to pin 12 (reset) of IC2.

Diode D3 serves to isolate IC1b from the manual trigger switch (S1). When operated, S1 connects the differentiator input to the positive supply rail to simulate detection. The second 180kΩ resistor (connected to the input of the



View inside the completed unit. The manual trigger switch may be mounted remotely at some convenient location, or deleted if not required.

Driveway Sentry

differentiator) discharges the .033μF capacitor after each pulse.

Pin 2 of IC1a serves as a control for the headlight detector. Whenever this pin is taken low, IC1a is inhibited and the headlight detector is disabled. This brings us to the operation of the ambient light-sensing circuitry which controls the state of pin 2.

IC1c and 1d are configured in a positive-feedback detection circuit similar to IC1a and 1b. In this case, however, there is no delay for the input signal. The divider voltage, which decreases in response to increasing light level, is fed directly to pin 9 of IC1c.

The other input of IC1c (pin 8) is tied to the positive supply rail so that this IC is permanently enabled. When the ambient light exceeds the critical level, the output of IC1d (pin 11) switches high and the headlight detector circuit is disabled.

All this means in practice is that the circuit is automatically disabled during daylight hours. Note, however, that the manual trigger function operates at all times.

Power for the circuit is supplied from a centre-tapped transformer with either a 12V or 15V secondary. This transformer drives a full-wave rectifier circuit (D1 and D2) while a 100μF capacitor provides the necessary filtering. The resultant DC supply will be either about 10V for a 12V transformer or about 12V for a 15V transformer.

The transformer, by the way, is a PC-mounting type. Any one of the following types may be used: Ferguson PL12/5VA, Ferguson PL15/5VA, Arlec AL7VA/12 or Arlec AL7VA/15.

Construction

All the circuitry, with the exception of the LDRs and the manual trigger switch, is accommodated on a printed circuit board measuring 94 × 86mm and coded 85pc1. As with the original version, this is housed in a plastic case measuring 150 × 90 × 50.

No special procedure need be followed when assembling the PC board although the job will be easier if the smaller parts are mounted first. Note carefully the orientation of the semiconductors and the electrolytic capacitor. The transformer and relay can be salvaged from the old PC board if you are upgrading from the earlier version.

Once the PC board has been completed, attention can be turned to the final assembly. The mains cords enter through grommetted holes at one end of the case and are anchored using cord clamps. The other end of the case carries the manual trigger switch and the ambient sensing LDR.

As previously mentioned, the manual trigger switch can be mounted remotely if desired (or it can be deleted altogether). The PC board is mounted at the end of the case adjacent to LDR2 and S1 using machine screws and nuts.

The headlight sensing LDR is mounted on one side of the case so that it faces in a different direction to the ambient sensing LDR. We fixed the

We estimate that the current cost of parts for this project is approximately

$40

This includes sales tax.

PARTS LIST

- 1 PC board, code 85pc1, 94 × 86mm
- 1 PC-mounting transformer, 12V or 15V centre-tapped (see text)
- 1 12V SPST relay with 5A/240V contacts
- 1 plastic utility case, 150 × 90 × 50mm
- 1 3-pin mains plug and mains cord
- 1 in-line mains cord socket
- 2 rubber grommets
- 2 mains cord clamps
- 1 3-way mains terminal block
- 1 SPST momentary contact switch
- 1 solder lug

Semiconductors

- 1 4011 CMOS quad NAND gate
- 1 4060 CMOS 14-stage counter
- 1 BC327 PNP transistor
- 3 1N4001 diodes
- 2 1N4148 diodes

Capacitors

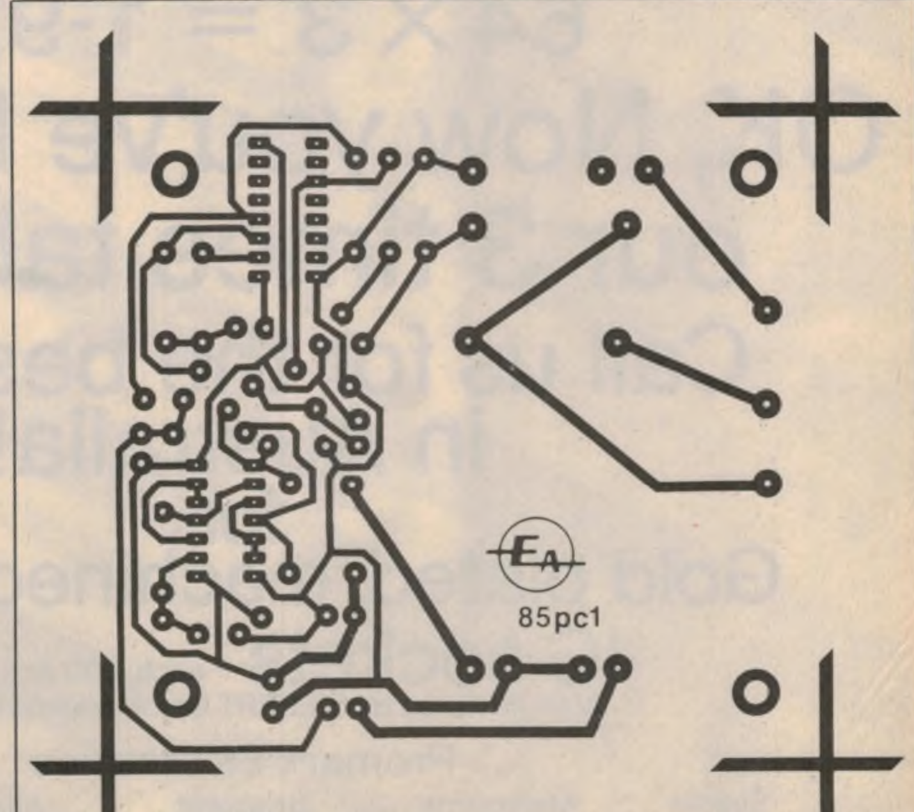
- 1 100μF 25V electrolytic
- 1 0.1μF metallised polyester (greencap)
- 1 .033μF greencap
- 1 .01μF greencap

Resistors (¼W, 5%)

1 × 2.7MΩ, 2 × 180kΩ, 2 × 82kΩ, 1 × 47kΩ, 2 × 18kΩ, 1 × 4.7kΩ, 2 × ORP12 light dependent resistors

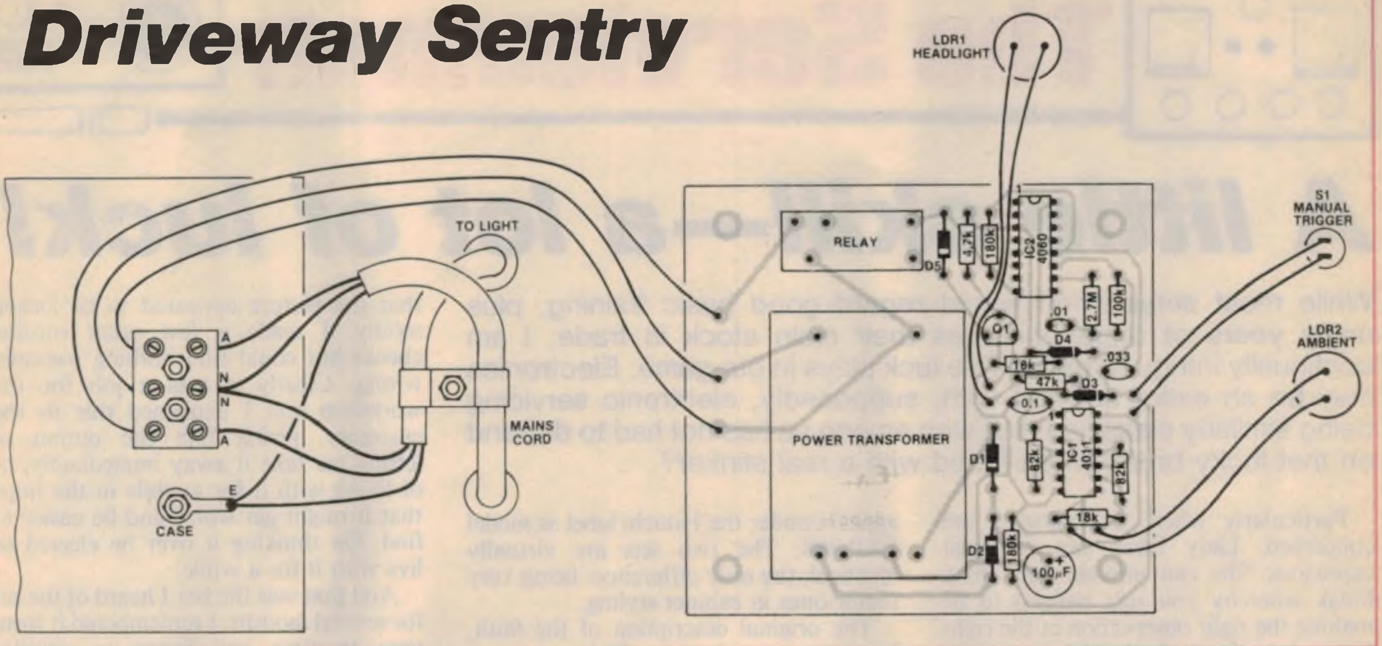
Miscellaneous

Rainbow cable, mains-rated hookup wire, machine screws and nuts, solder.



Here is an actual size reproduction of the PC artwork.

Driveway Sentry



Parts layout and wiring diagram: take care when installing the semiconductors and the electrolytic capacitor.

LDRs in position using epoxy adhesive.

The lengths of the mains cords will depend on your chosen location for the Sentry. It must be protected from the weather but, at the same time, be located so that LDR1 will fall within the car's headlight beam. If these two requirements prove incompatible, it may be necessary to mount LDR1 remotely from the rest of the circuit.

The 3-way terminal block is secured to the metal lid and should be positioned so that it sits about half way between the transformer and the end of the case. This will prevent the possibility of pinching the wires when the lid is fitted. The earth lead (green/yellow) is soldered to an earth lug adjacent to the terminal block.

Make sure that you use mains-rated cable for the connections between the terminal block and the PC board. Connections to the two LDRs and to the trigger switch can be run using rainbow cable.

The output cord is terminated with an in-line mains socket for connection to the external light fitting. Take care to ensure that the socket is correctly wired. Fig.1 shows the correct wiring terminations for the mains plug and socket.

Testing

To test the Driveway Sentry, connect a lamp to the power socket and temporarily cover the two LDRs with black masking tape. The Sentry can now be checked for correct operation by briefly uncovering the headlight sensing LDR. If the ambient light level is not high enough to trigger the circuit, try shining a torch directly on the LDR.

Note that the circuit will not cancel, even after the expiry of its timing cycle, if the headlight sensing LDR is not covered again after triggering has occured.

If the circuit functions normally thus far, uncover the ambient sensing LDR and check that it inhibits circuit operation in high ambient light levels. The manual trigger switch should initiate a timing cycle whenever it is pressed.

During the test procedure, it may be more convenient to use a much shorter period than the normal four minutes. This can be arranged by reducing the value of the timing resistor. Connecting a 10kΩ resistor in parallel with the 2.7MΩ resistor, for example, will reduce the period to a few seconds.

Installation of the Driveway Sentry should be relatively straightfoward, although some experimentation may be necessary to find a position where it is triggered by your car's headlights but not by passing traffic or by street lamps. In extreme cases, it may be necessary to recess the ambient LDR or to provide some form of shielding for it. Any mains wiring, other than that described here, should be carried out by a licensed electrician.

The Serviceman

A little skill—a lot of luck!

While most servicemen would regard good basic training, plus many years of experience, as their main stock in trade, I am continually intrigued by the role luck plays in our game. Electronics may be an exact science with, supposedly, electronic servicing being similarly classified, but who among us has not had to depend on that lucky break when faced with a real stinker?

Particularly where intermittents are concerned, Lady Luck can be most capricious. She can provide that lucky break whereby you just happen to be making the right observation at the right time when the fault decides to appear. But, by the same token, she can be just as fickle in the other direction; the fault which was nearly driving the customer up the wall suddenly vanishes when the set moves onto the work bench, and can stay that way for weeks on end.

The story I am about to tell falls into this category. I wouldn't be so immodest as to deny that my skill and experience played a vital role in tracking down the culprit but, in the end, it was the lucky break that saved the day.

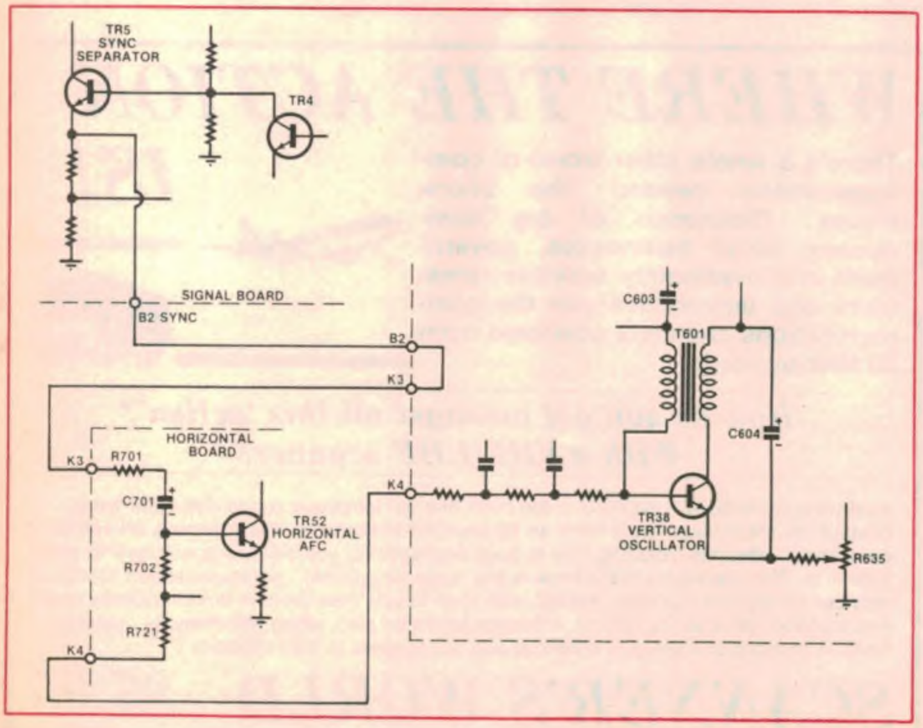
The story concerns a fault in a General Electric TC20Tl colour set. This model is about eight years old and also appears under the Hitachi label as model CEP-288. The two sets are virtually identical, the only differences being very minor ones in cabinet styling.

The original description of the fault, by phone, was pretty garbled and it was only when I visited the customer and quizzed him in greater detail that the real story emerged. It transpired that the set was prone to bouts of rolling. There was no pattern as far as the customer was concerned, except that it was always in the middle of a favourite program. It would start for no apparent reason, last anything from seconds to minutes, then vanish just as abruptly, possibly for days or even weeks.

Needless to say there was no evidence of the fault while I was present. I checked the vertical hold control and found that it had plenty of range and that the picture appeared to be locked solidly. I made a few other routine checks but could find nothing basically wrong. Clearly it was a job for the workshop and I explained this to the customer, giving him the option of letting me take it away immediately, or of living with it for a while in the hope that it might get worse and be easier to find. On thinking it over he elected to live with it for a while.

And that was the last I heard of the set for several months. I remembered it from time to time and began to wonder whether anything I had done could possibly have cured the fault even though, deep down, I knew I was kidding myself. Then the owner was on the phone again with the news that things were still pretty much as they were before, except that everybody was now heartily sick of the problem.

On the bright side was the fact that they were going on an extended holiday and would be away for several months, so there would be no great hurry to get the set back. This was fine by me because I had a nasty feeling that it could be a long job.



Simplified diagram of the vertical sync pulse path. Note the link between B2 and K3

The battle begins

And so the set was duly installed in the workshop. It performed perfectly at first and I simply let it run while I attended to other jobs. Then, after a day or so, it suddenly let go and rolled quite violently for several seconds, but not long enough for me to get to grips with it. It repeated this a few more times in the next few hours and I noted that it sometimes rolled upwards and sometimes downwards.

From these few brief observations I formed the theory that there was a fault in the vertical oscillator; a fault which was causing the oscillator to drift violently up or down in frequency, and well beyond the scope of the sync pulses to control it.

The vertical oscillator is a very simple arrangement; a single 2SC1213 transistor (TR38), a feedback transformer (T601), a vertical sub hold pot (R635), the vertical hold control proper (R630), and a few resistors and capacitors. I went over the circuit with a meter, checked all the voltages and found them to be virtually spot on, measured the resistors without finding anything to worry about, and narrowed my suspicions to the transistor or a couple of electrolytics.

Purely on a hunch I decided that the transistor was the most likely culprit and, since it was readily accessible, I changed it. Then I switched on and tried again. The picture came up locked and stayed that way for the rest of the day. It was the same the next day, the day after that, and so on for the next fortnight.

Not so lucky

By now I was mentally rubbing my hands together and congratulating myself on having picked it in one. But pride goes before a fall and the next thing I knew it was rolling again. So, back to square one. More particularly, I had to ask myself whether it really was a vertical oscillator fault, or whether it was a sync fault.

I had initially favoured the oscillator theory on the grounds that there were no horizontal sync problems, which suggested that at least the sync separator was functioning correctly. But now I had to consider the possibility that the vertical pulses were going astray somewhere between the sync separator and the vertical oscillator.

The path between these two points is rather devious. The sync separator is a single 2SA15V transistor (TR5) on the main signal board and the separated sync is taken from its emitter and runs to a test point B2. From here it runs to the board carrying the vertical oscillator — plus the video chain and lot of other things — coming in on terminal B2.

However, it leaves the board almost immediately, being linked directly to output terminal K3. From here it runs to the horizontal board, coming in on terminal K3 and emerging on K4, from whence it is coupled to the vertical oscillator board, coming in on K4. It's a real round-the-world-for-sixpence job, and took quite a bit of tracing.

In between its entry into and exit from the horizontal oscillator board it passes through a simple network consisting of three resistors (R701, 702, 721) and a capacitor (C701). This appears to be a differentiating network to pick off the horizontal pulses before passing the vertical pulses on to the vertical oscillator and its associated integrating network. From the junction of capacitor C701 and resistor R702, a tap is taken to the base of a 2SC458 transistor (TR52), part of the horizontal AFC network.

My first check was at point K4, just ahead of the integrating network and vertical oscillator, TR38. Unfortunately, the circuit diagram does not give any waveform for this point, the only sync waveform given being at test point B2 at the output of the sync separator, and even here it shows only the horizontal pulse details.

So I was largely on my own but the pulse at K4 at least looked reasonable and I tentatively accepted it as normal. In fact, I went right over the sync line from B2 right through to K4 and, as far as I could tell, everything was normal. Unfortunately the set stubbornly refused to misbehave during this time so purely on spec, I changed the two electrolytic capacitors, C603 and C604, in the vertical oscillator circuit.

From this point on, for the next several weeks, the set behaved faultlessly and I was beginning to wonder whether the new electros had really cured the problem. On the other hand, having seen how the set could behave like this, then suddenly go berserk, I was still highly suspicious. And, since the owners were still on holidays, I decided to be ready in advance, if another failure should occur.

In particular, I felt it essential to know whether it was a sync pulse failure or a vertical oscillator failure. To this end I decided to set up a dual trace CRO to continuously monitor both the vertical oscillator and the sync pulses being fed to it, one on each trace. (I am fortunate in having two CROs available, the older one being a bit limited in features and bandwidth by modern standards, but more than adequate for this job.)

And so the arrangement was duly set up, the sync pulse being taken from the point K4 and the vertical oscillator signal from the emitter of TR38. I also arranged matters so that the CRO was locked to the sync pulse, which I felt would give the more meaningful display when the fault occurred, even though it would have been easier to lock it to the much higher amplitude oscillator signal.

More precisely, I wanted to be sure that I would be able to observe the sync pulse in detail when the fault occurred. If the CRO was locked to the vertical oscillator, and this drifted, it would take the CRO timebase with it, displaying a locked vertical oscillator, and a drifting sync pulse display. And since the rolling was very rapid the sync pulses would be moving far too fast to permit accurate observation of their amplitude and, more particularly, their shape.

Which was all very scientific and almost guaranteed to provide some kind of answer immediately the set misbehaved. The only snag was the set wouldn't misbehave. It sat in its corner of the bench, day after day, for over a month and never once did it so much as flicker.

So had I fixed it or hadn't I? The owner was due home shortly and I had reached the conclusion that I would have to take it back to him, admit that the situation was inconclusive, and leave it to him to call me if it appeared again. In the meantime I had at least collected a fair amount of data and experience which would be invaluable in such an event.

A change of luck

And it was then that Lady Luck smiled on me. I received a call from another customer, an elderly lady, who had just acquired (second hand) the Hitachi version of the same set. There was nothing wrong with it as far as she was concerned; she simply wanted me to install it for her, set it up, and make sure it was working correctly.

In fact, it wasn't working correctly. I could hardly believe it when I realised that it, too, had a quite pronounced tendency to roll, and much more frequently and erratically than the GE set. It also transpired that it was not locking nearly as readily as it should, the setting of the vertical hold being relatively critical.

So was it the same fault? And if so, was it going to be as elusive as the one in the GE set? Hopefully not, since it seemed to be much more pronounced. But, in any case, it had to be found. An immediate snag was that the old lady had no other set to use, and I had no loan set immediately available. And, since she lives alone, the TV set is a major source of entertainment.

I explained the situation and suggested that she put up with the problem for a few days until I could organise a loan set. Then, hopefully, (I told her) I would need her set for only a couple of days. Privately, I wasn't quite so confident.

In due course all this happened and I had the Hitachi on the bench. As before, I confirmed that it was much more prone to the problem than the GE set, so I decided to transfer the CRO from the GE to the Hitachi in the same configuration. And that provided the first clue, though not in the manner I expected. It was immediately obvious that the sync pulse level, even when the picture was not rolling, was less than half the amplitude of that in the GE set.

So I let the set run and it wasn't long before the picture rolled and gave me the next clue. The cause, at least in this set, was quite definitely loss of sync pulse amplitude, the level drifting between one which would just lock the picture and a lower one where the picture rolled.

So why was the amplitude down and why was it varying? There was probably one answer to both questions; all I had to do was find it. I moved the CRO probe back to test point B2, out of the sync separator, and found that the amplitude was quite normal here, virtually the same as for the GE set. So where was it being lost? I moved on to point K3 at the input to the horizontal board, where it was still normal, then to K4 at the output of this board, where it was down.

Well, we were getting close now; there wasn't much in between these two points, just three resistors and a capacitor. A quick check showed that all three resistors were well within tolerance, leaving only the capacitor C701, a $1\mu F$ 50V electrolytic. And seeing that low value electros are one of my pet hates, I had it out and replaced in short order.

The only snag was that it didn't fix the problem. The set behaved exactly as it had before. So what did that leave? As I mentioned earlier, there is a tapping between C701 and R702 which feeds the base of TR52, part of the horizontal AFC circuit. Could there be a fault in the transistor which was loading this tap? It seemed like a long shot, inasmuch as the horizontal AFC circuit was obviously still functioning.

But stranger things have happened and, clutching at a straw, I pulled it out and replaced it. And that was it; the sync pulse amplitude shot up to match that of the GE set, and remained rock steady. Similarly the vertical locking range now matched that on the GE set, and the set itself was performing faultlessly.

I let it run for the next couple of days and it never missed a beat, something which, in the light of its previous behaviour, was pretty conclusive. I reckoned that one was in the bag.

But what about the GE set? Could it possibly be a parallel case, even though the symptoms were not exactly identical? Feeling that there was little to lose I started by spraying TR52 with freezer, but this had no effect. Then I tried mechanical pressure, pressing it gently sideways, first one way then another.

There was no response to this either, at first, but suddenly, when I pushed in certain critical direction, the sync amplitude dropped and the picture rolled. I released the pressure and the picture locked but, having found the critical direction of pressure I found I was able to provoke the fault quite reliably. "You naughty transistor," I thought — or words to that effect!

Said transistor was duly replaced, both sets given a few more days running on the bench, then returned to their owners. That was several weeks ago, and a recent check indicated that they were working perfectly. I reckon I can write both of them off.

But see what I mean about luck? Without the timely intervention of the Hitachi set, with the same fault but in worse condition, I would have been forced to return the GE set, hoping that it was fixed when, in fact, it wasn't.

Which would have meant that I would have had to start all over again at some later date, with little more chance of success than when I first started.

Thank you, Lady Luck, that's one I owe you.

Tales of England

To change the subject, here are a few lighter comments from my colleague on the NSW South Coast. They were prompted by some contributions in a recent issue (February, 1985) concerning the damage people do to electronic devices when the latter deliver a message which displeases them. (I am reminded of the nasty habit of some ancient kings who, when they received a message containing bad news, were just as likely to draw their sword and slay the poor innocent messenger.)

Both these stories come from England, where my colleague worked in the early 1970s to gain experience in colour circuits before entering the colour scene in Australia. In fact, he worked for one of the very well known hire firms, TV rental being a big thing in that country. He has many stories to tell, many of them involving the conflict between his free and easy Australian attitude and the conservative British approach, particularly where "upper class" customers were concerned. They were all just "blokes" to my colleague.

But the following stories are in a different category. On one occasion the boss handed him a service card belonging to a particular customer, with the request that he answer a service call. The service card listed all previous calls to the customer, with brief details of the nature of the fault and the subsequent repair.

Glancing through it my friend noticed that the set had had no less than two cabinet replacements over a relatively short period. When he mentioned this to the boss the latter grinned. "Oh yes, I meant to warn you about that. Don't be surprised if you have to replace another cabinet. This fellow is a karate expert and when a program displeases him he is just as likely to put the side of his hand through the top of the cabinet!"

My friend went off shaking his head and muttering "this I've got to see." Unfortunately for his curiosity, the fault turned out to be a quite routine and purely electronic one, so he never did see what a screaming karate chop can do to a cabinet.

An axe murder

The next story is a much more extreme case. The company rented a range of fairly conventional colour sets, mainly of the Philips and Thorn brand. They also rented some deluxe type sets, particularly some Philips 22in and 26in (as they were then known), designated K70 and K80 respectively. The sets themselves cost nearly double the price of a conventional set and, as a result, the rental was also about double the normal charges.

In addition, British government regulations at that time required that persons renting colour sets had to pay at least 12 months rental in advance. (For some funny reason, the government was doing all it could at that time to restrict the sale and use of colour sets. Nobody seemed to know why.)

Anyway, this particular customer arranged to hire a colour set and indicated that he wanted the best and was prepared to pay for it. So, after suitable identity checks and other formalities had been completed, a technician was instructed to deliver a K80 to the customer's home and install it. This he duly did and, as he recalled later, it was a very nice home and the customer appeared to be a quiet, well to do, person.

Because of the advance rental requirement, little or nothing was heard of the customer for many months. Then one day a policeman (hullo, hullo, hullo) entered the office and asked if the company had rented a set to such and such a person at such and such an address — the customer in question. When this was confirmed the policeman said, "Well, you'd better send someone around to collect the set, there's been a bit of trouble there." And, in the cryptic manner of constabulary gentlemen, he intimated that the customer was "... helping them with their enquiries."

So a technician was duly despatched to collect the set. And, because it was an expensive cabinet, he went to some trouble to find a spare carton for that model set, so as to protect it in transit. As it transpired, it was just as well he did, but for a quite different reason.

When the technician walked into the customer's lounge room there was no TV set, as such, to be seen — just a heap of junk. For some reason, which was never officially explained, the customer had attacked the set with nothing less than an axe which, according to the story, was still at the scene. Significantly, nothing else in the room appeared to have been damaged.

But it was the extent of the destruction which really rocked the technician. There were very few pieces of the set — cabinet, chassis, and all — which were larger than a clenched fist. So all he could do was fetch the carton and load the heap of bits and pieces into it for transport back to the office.

Here, in spite of being quite shocked by the incident, he couldn't resist having his own little joke with the manager.

"Did you get the TV set Jack?"

"Yes boss, I got the set all right."

"Right, you'd better bring it in."

So Jack lugs in the carton, dumps it on the floor alongside the manager, and opens the top. By all accounts, the look on the manager's face, as he gazed at the mess, was in the once-seen-never-forgotten category.

Naturally, the story went the rounds of the various branches and that was how my colleague first heard about it. There was a fair amount of scepticism expressed about the story, particularly regarding the amount of damage. But it so happened that my colleague visited the branch some months later. The carton of bits had been put to one side on the assumption that they might be needed either for insurance assessment, or as evidence in the event of legal action.

In the event neither situation arose and by the time my colleague saw them the set had been written off. So my colleague asked permission to go through the mess and try to salvage any specialised components which could be used in the service department, many of which were in short supply.

And, as he put it, "It was only then I realised just how thoroughly it had been destroyed. There was hardly anything worth salvaging; the only thing I recall saving was the delay line. Otherwise it was just scraps of board with, for the most part, a few ordinary components not worth salvaging."

The full story was never uncovered. The most favoured explanation was that the person was drunk, or on drugs, or both, and had simply gone berserk, probably triggered by some particular program.

After which the bloke who attacked the speaker cone of his portable radio, when the "dead certainty" ran up a lane, would appear to be a nice quiet well balanced type.

TETIA Fault of the Month

Hitachi PAL3A chassis
Symptoms: thin band of horizontally torn picture wanders up and down the screen. Picture jitters badly whenever band reaches top of screen.

Cure: C750 & C751, both 33μF/160V electrolytics, open circuit. These capacitors bypass the last traces of mains hum from the B+ supply to the horizontal oscillator and the vertical drive output.

Reader contributions are welcome. Please post to J. Lawler, TETIA, 16 Adina St, Geilston Bay 7015.

VCR Hifi Sound Explained — Pt. 1

Further insight into the operation of PAL format hifi VCRs is provided by a training manual issued recently by Matsushita of Japan for the National model NV-850, currently on sale in Australia. While the design represents the approach of one particular VHS manufacturer, it should be sufficiently representative to acquaint readers with what to expect in this type of equipment.

by NEVILLE WILLIAMS

On receipt of the manual, our first reaction was to reproduce it as received, but language difficulties in the text and the space required for the multiplicity of diagrams made it impractical to do so. In consequence, the material has been adapted to our own style, hopefully without doing injustice to the original text. We have deliberately retained abbreviations like LPF (Low Pass Filter), VCA (Voltage Controlled Amplifier) &c, as part of the jargon to be expected in articles dealing with this subject.

Background

The sound quality from domestic VCRs in all formats has been limited to date by the relatively low linear speed of the tape — typically 23.4mm/s for the standard speed VHS PAL format and 18.7mm/s for Beta PAL; this, compared with 45.2mm/s for the familiar audio compact cassette. The available track width is also significantly less: 1.00mm or 1.05mm for VCR mono mode, compared with 1.5mm for compact cassette mono.

In view of these figures, it is not surprising that performance specifications for the audio soundtrack of domestic VCRs have been unimpressive, typically:

Frequency response — 80-8000Hz.
Harmonic distortion — up to 3.0%
Dynamic range (without NR) — 44dB.
Signal/noise ratio — 44dB.
Wow and flutter — 0.1%.

If the track is split to provide separate left and right stereo channels, or the tape speed is halved to provide longer playing time, audio performance is further compromised.

A new approach

Hifi VCRs overcome this problem by frequency modulating the audio soundtrack signals (normally in stereo) on to twin HF carriers in the range 1-2MHz. As with the video information, these are recorded obliquely across the tape by means of heads mounted on the video drum, spinning at 1500rpm. Because the relative head/tape speed is increased by about 200 times (to 4850mm/s in the case of PAL VHS decks) vastly improved audio performance becomes possible, approximating that from a normal FM broadcast service.

Performance figures attributed to hifi VCRs are typically as follows:

Frequency response — 20-20,000Hz.
Harmonic distortion — 0.3%.
Dynamic range and S/N ratio — 80dB.
Wow and flutter — less than .005%.

Somewhat fortuitously, in the original NTSC Beta format, Sony found it possible to accommodate the two FM sound carriers in a relatively unoccupied frequency segment between the video chrominance and luminance signals. By simply feeding the audio carriers to the existing video heads, along with the video information, both could be recorded simultaneously on the tape. During playback, they could be recovered in the same way and separated by suitable bandpass filters. Very neat!

Unfortunately, the video frequencies involved in the PAL system, for both Beta and VHS, proved to be less accommodating and a different approach had to be devised. Twin FM sound carriers are still used but they are imposed on the tape and subsequently recovered during playback by an extra pair of R/P (Record/Play) heads on the video drum.

While there is some overlap between the FM sound carriers and the video chrominance and luminance sidebands, mutual interference is minimised by providing the audio heads with much greater gap azimuth angles than the video heads: typically 30 degrees, as compared with 6 or 7 degrees.

As a further measure, the signals are recorded to a different depth in the magnetic coating on the tape — a system described as D-MPX (Depth Multiplex) recording.

In practice, the audio is recorded just ahead of the video, the audio head gap and signal drive being adjusted so that, effectively, its field penetrates to the full depth of the coating. The video drive is preset to a lower level, sufficient to penetrate only to about one-third the

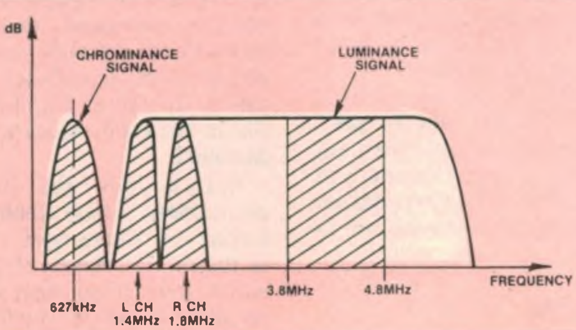


Fig. 1: The frequency spectrum involved in a VHS hifi VCR. Chrominance and luminance signals are unchanged but the two FM sound carriers are additional.

depth. Thus, even though the video recording tends to erase some of the audio pattern, the audio heads, with their different azimuth angle, are able to read through the video recording and recover the audio signal underneath.

Facts and figures

Fig. 1, from the National manual, shows the standard frequency distribution of signals for VHS/PAL hifi VCRs, as recorded on the tape. As in all VHS/PAL decks, the FM chrominance (colour) signal is centred at 627kHz, while the FM luminance signal is concentrated between 3.8 and 4.8MHz, but with sidebands extending, hopefully, from about 1MHz to beyond 5MHz. The additional FM sound carriers are centred at 1.4MHz and 1.8MHz, sharing spectrum space with the lower luminance sidebands, as mentioned.

Fig. 2 shows (a) the physical arrangement of the DD (Direct Drive) rotating head system, and (b) the rotating transformers at top and bottom which couple the signals from the rotating heads to fixed windings feeding the rest of the circuitry.

The video heads, designated in Fig. 2c as L and L'R, are respectively single and dual heads, first introduced by National a couple of years back as a then-novel and efficient way of providing jitter-free still frame and slow motion pictures. In terms of video circuitry and performance, the NV-850 remains essentially similar to the earlier NV-777 and NV-370.

Fig. 2c also shows the disposition of the additional audio heads AR (Audio Right) and AL (Audio Left). What it doesn't show is provision to adjust the height of the audio heads during installation, to ensure that the audio tracks occupy a very precise position on the tape, relative to the video tracks.

Fig. 3, reproduced from the National Training Manual, illustrates in a step-by-step fashion how the pairs of tracks are laid obliquely across the tape. It is drawn as if looking at Fig. 2b from the front, with the tape moving from left to right, and the tracks being imposed progressively upon it in the same general direction: from lower left to upper right.

In (a), the double shaded portion at the right-hand end shows where head AL has earlier recorded a 26μm +30 degree audio track deeply into the coating. This has been overlaid by a much wider surface-recorded video track shown as VR, 70μm, −6 degrees. Abutting this is another deeply recorded audio track laid down by head AR: 26μm wide and −30 degrees azimuth.

At the point in time depicted by Fig. 3a, head VL is a little more than halfway into its next pass across the tape, erasing the trailing edge of the nominal 70μm

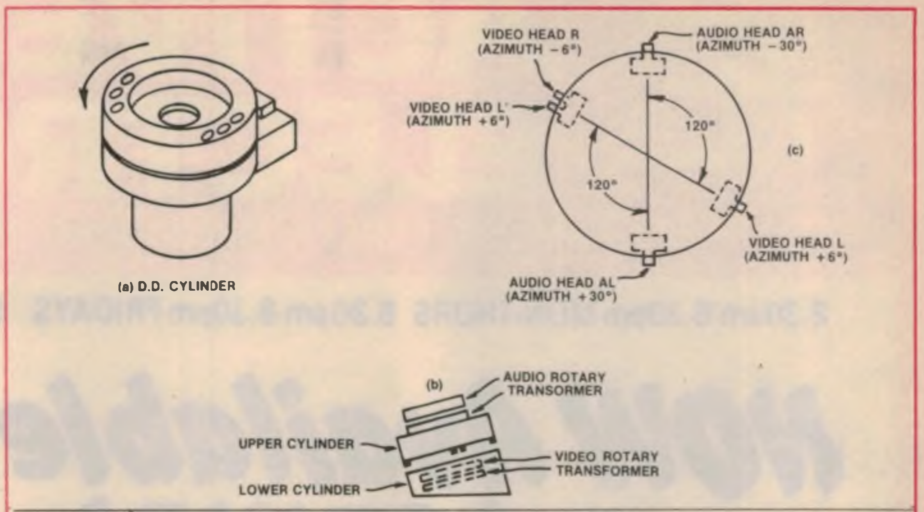


Fig. 2: The direct drive (DD) video drum of a VHS VCR (a), the disposition of the extra audio heads (c) and the rotary transformers (b) which couple signals from the spinning heads to the fixed circuitry.

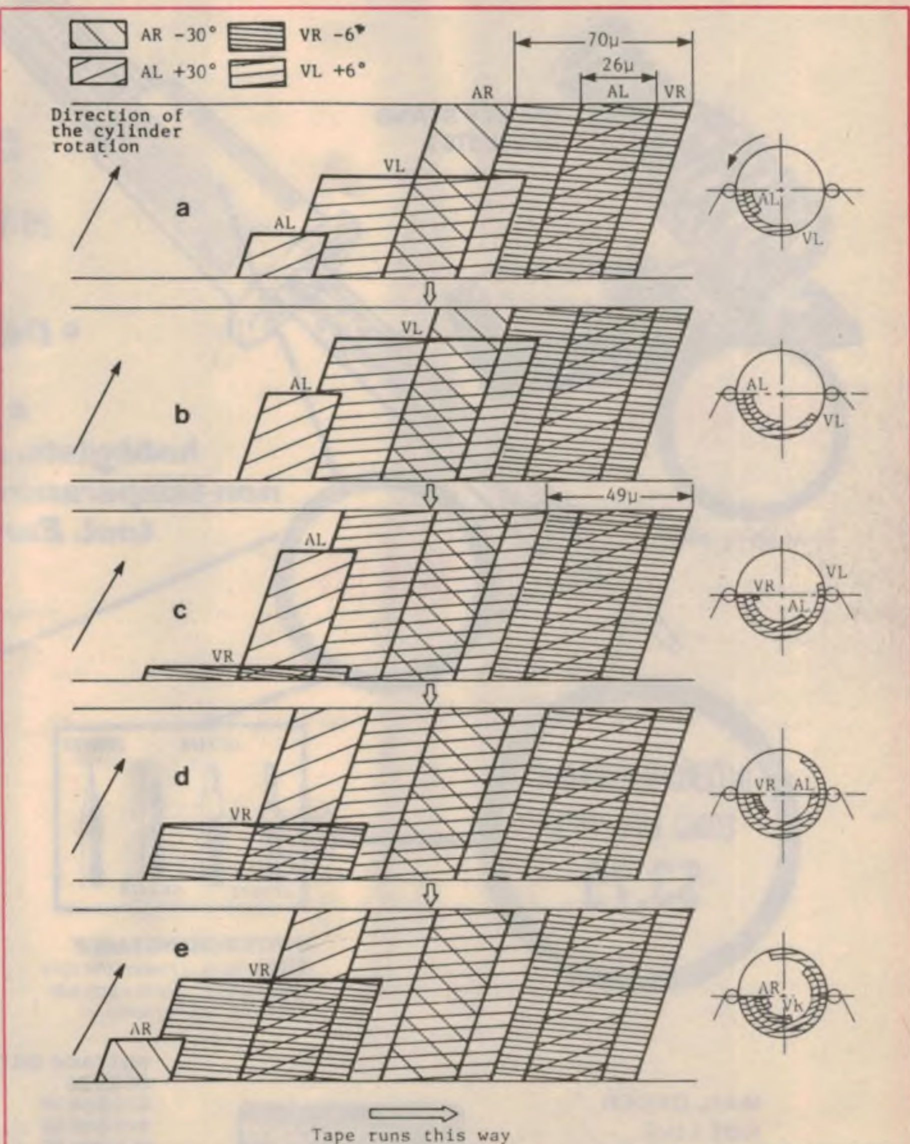
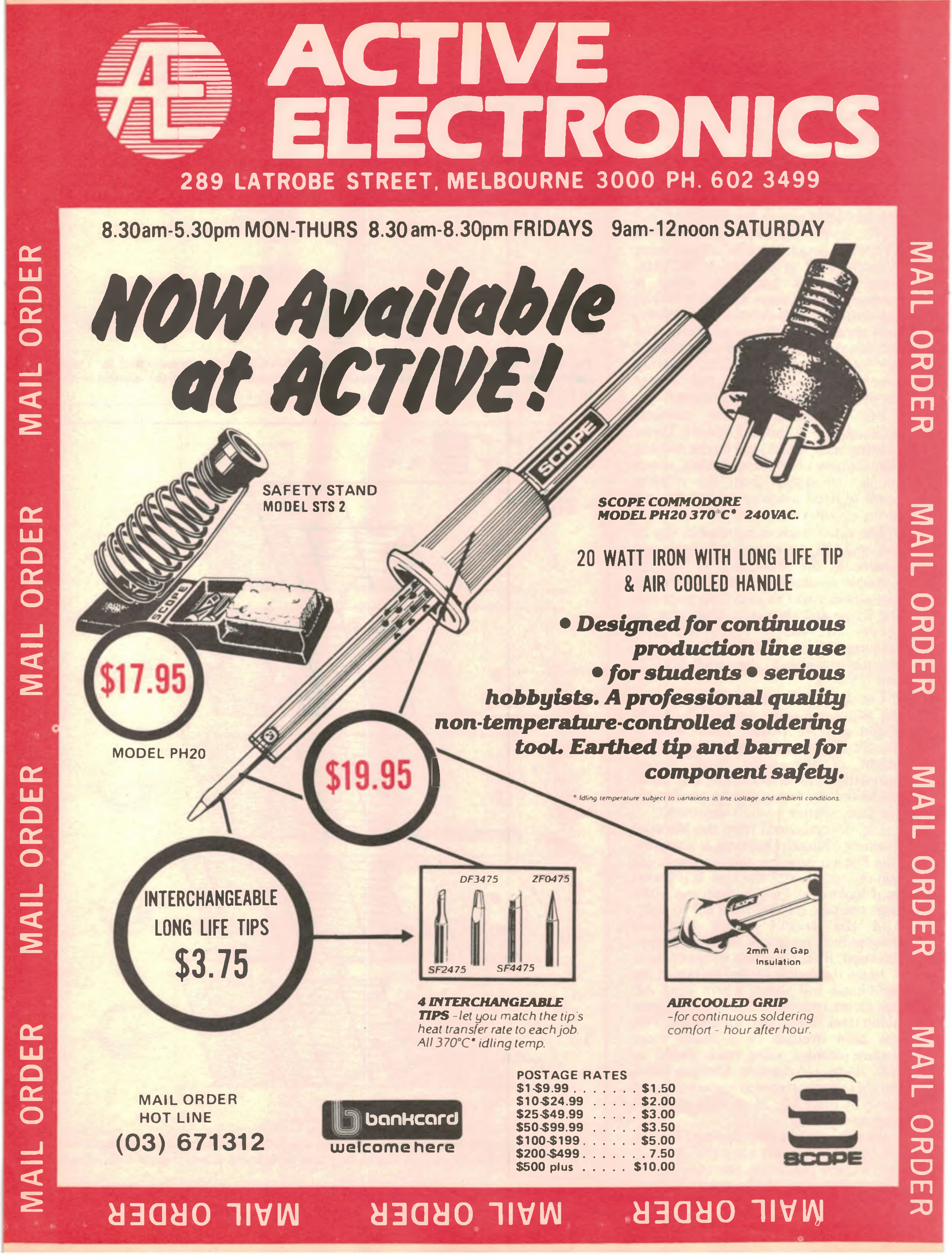


Fig. 3: This diagram indicates the sequence in which the various tracks are laid down in a VHS hifi VCR. For the sake of clarity, they have been drawn at only a slight inclination to the tape.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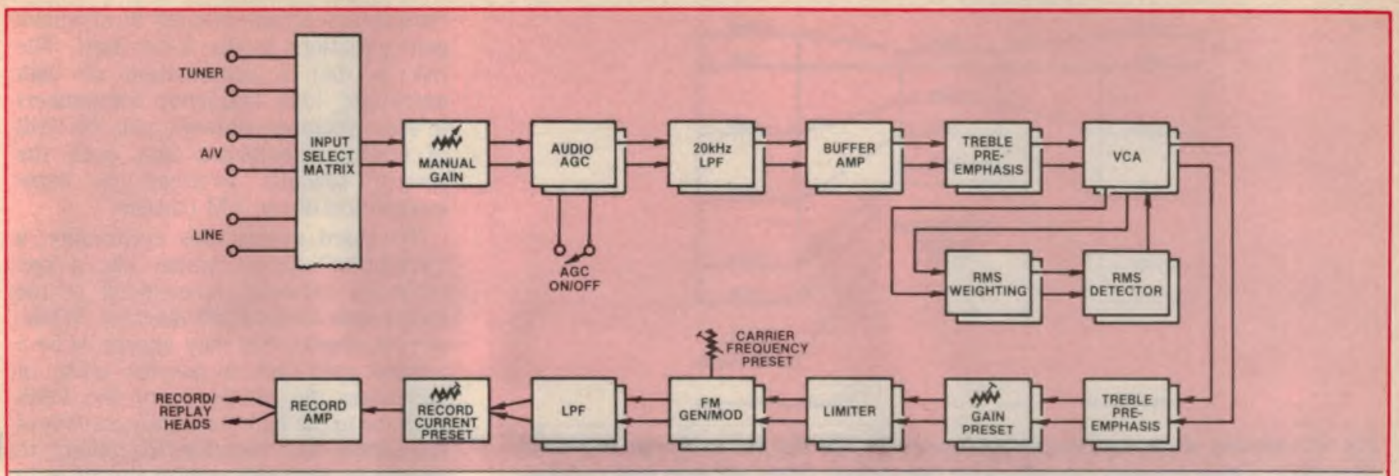


Fig. 4: This block schematic diagram gives some idea of the very extensive signal processing involved in the FM sound recording system of a typical VHS hifi VCR. It has been rendered practical mainly by the development of dedicated ICs.

VCR Hifi Sound

VR track and reducing it to the VHS standard play width of 49µm.

Following 60 degrees behind it, head AL has just commenced its next pass, slightly overlapping (and erasing) the edge of video track VL.

Diagrams 3b to 3e follow the process through to the completion of tracks VL and AL and the commencement of the following tracks VR and AR.

What ultimately remains on the tape is the standard succession of video tracks VR and VL, each 49µm wide and with azimuth angles of −6 and +6 degrees. As such, they can be reproduced by any standard play VHS VCR, ensuring system compatibility.

But, in addition, a deeply recorded 26µm wide audio track (AL and AR) runs down the centre of each video track, ignored by conventional VCRs but resolved by hifi decks carrying the requisite audio heads with their 30-degree azimuth gaps.

In common with most other PAL hifi VCRs, the National NV-850 provides only for standard single-speed operation, on the apparent assumption that this will meet present-day needs, without the cost, complication and possible compromises of a double-play system. No less to the point, virtually all pre-recorded cassettes are for standard speed only. Hifi sound is nevertheless possible in the VHS double-play mode but the geometry would be different from that shown in Fig. 3.

To retain compatibility with existing equipment and software, both VHS and Beta hifi VCRs also record an audio soundtrack along the edge of the tape in the normal analog format, in mono or stereo, according to the model. If necessary, the analog track can be re-dubbed — a facility which is not available with the hifi track. Once recorded and overlaid by the video signal, it cannot be erased or modified, without also erasing or compromising the video recording.

Fig. 4 depicts in block schematic form the processes to which the incoming audio signals are subjected before being imposed on the tape as twin FM carriers. Some of the electronics depicted are also used in the playback mode but this will be discussed later.

At the top left, the required source signal (tuner, camera, line, &c) is selected by an electronic switching matrix involving an IC (integrated circuit) which reacts to the DC control voltages from panel switches, &c.

The selected stereo input signals pass to a manual recording level control and then on to a two-channel audio AGC (automatic gain control) system, controlled by an AGC off/on switch.

With the switch in the AGC position, the manual control is rendered ineffective and the recording level is controlled by the audio AGC. In this mode, the NV-850 operates in the same way as conventional VCRs to date, with automatic circuitry looking after the audio signal level being fed through the system and on to the tape.

However, while this is convenient and satisfactory for casual medium-fi recording, it can be a limitation in a system expected to record and play back high-quality stereo sound. In particular, the AGC will tend to decrease the dynamic range of a performance by automatically raising the level of soft passages and depressing that of loud passages.

Accordingly, hifi VCRs are normally provided with an AGC off/on switch, a manual gain control and some form of signal level indicator to enable the operator to monitor and control signal amplitude, much as happens in a good quality audio cassette deck.

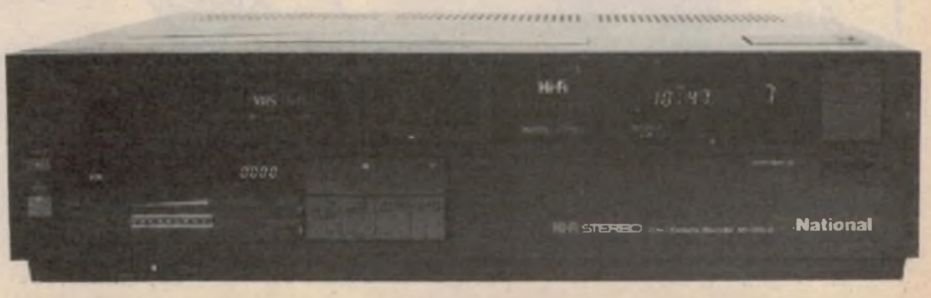
Noise reduction

While hifi stereo VCRs owe their performance predominantly to the use of twin FM carriers recorded at a tape/head speed of nearly 5 metres per second, the dynamic range and signal/noise ratio also owe something to the use of signal pre-emphasis and de-emphasis, to bandpass filtering and, in the case of the VHS format, to the use of a dbx (or substitute) noise reduction system.

Fig. 4 shows the signal to be recorded passing through an LPF (Low Pass Filter) intended to cut off sharply above 20kHz — the rated upper limit of the system.

This is followed by a buffer amplifier and a treble pre-emphasis network, referred to in the Matsushita manual as "Pre-emphasis I". The relevant curve

Below: The National NV-850 hifi stereo VCR.



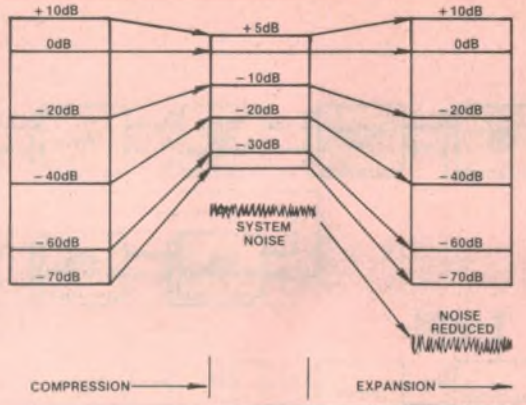


Fig. 5: A familiar diagram illustrating the operation of the dbx noise reduction system. In this context it helps to reduce the audibility of tape dropout effects and audio head switching transients (dbx is a registered trademark).

VCR Hifi Sound

indicates a response rising from reference at around 200Hz to +10dB at 2kHz, followed by a rounded peak of +12dB at 5kHz, falling back to +10dB at 20kHz.

At this point in the NV-850, the pre-emphasised signal passes to a dbx noise reduction system, involving a special VCA (Voltage Controlled Amplifier) and an equally special RMS detector — both concentrated in a dedicated IC.

The function of the RMS detector is to continuously measure the RMS value of the incoming signal and to feed the resultant as a control voltage to the VCA. In recording mode, an increase in signal level, and therefore in detector output, progessively reduces the gain of the VCA, thereby compressing the dynamic range of the signal being processed.

As illustrated in Fig. 5, the system has the capability of compressing dynamic range, expressed in decibels, by a factor of 2:1, prior to recording, and subsequently to expand it by the same ratio during playback. In so doing, system noise which may be introduced during the record/replay process is pushed well down towards the limits of audibility, as shown.

Incidentally, Fig. 6, from the Matsushita Manual, seeks to make the point that the RMS (or "effective") value of a complex waveform is the only one not influenced by relative phase shifts which can occur in the process of recording and playback.

While the VCA and RMS detector can provide accurate 2:1 compression and expansion across the entire audio band, difficulties can arise when, as here, the signal has been subjected to treble pre-emphasis as a general precaution against noise and/or to minimise possible "breathing" effects created by dynamic gain variations in the VCA itself. The risk is that a combination of high amplitude, high frequency components in some program material, plus 10-12dB of treble pre-emphasis may push the system towards overload or over-modulation of the FM carriers.

To guard against this eventuality, a "weighting" circuit, rather like a pre-emphasis network, is included in the signal path to the RMS detector. While, at first glance, this may appear to be a curious provision, it has the effect of increasing the sensitivity of the RMS detector to the high frequency content of the signal and therefore its ability to selectively limit the gain of the VCA in the presence of excessive high frequency energy. Because of the special qualities of the RMS detector, the "dynamic" compression can be mirrored accurately by complementary expansion during playback.

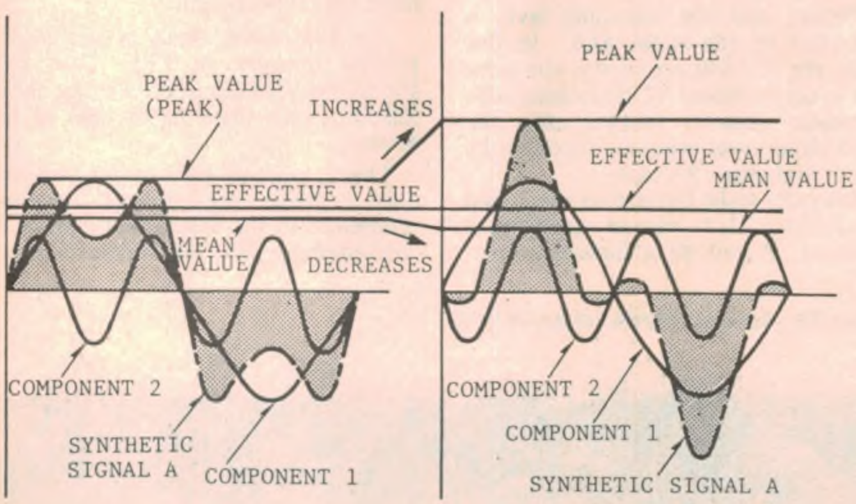


Fig. 6: When the components of a complex waveform vary in relative phase, the shape of the waveform (shaded) changes considerably and, with it, the peak and mean values. Only the RMS or "Effective" value remains the same.

FM carriers

Following the VCA, further pre-emphasis in the signal path ("Pre-emphasis II") provides the appropriate characteristic for the now-compressed audio (L&R) to be imposed on the respective carriers. However, a preset level control and diode limiters ensure that unexpected signal peaks do not cause overmodulation and the production of signal components likely to interact with the video playback function.

An IC voltage controlled oscillator (VCO) system generates the required carriers centred at 1.4 and 1.8MHz. At the same time, they are frequency modulated by up to plus and minus 150kHz, according to the instantaneous amplitude of the respective left and right channel audio signals.

However, before being fed to the recording amplifier and R/P (Record/Play) heads, the modulated carriers are passed through 2-stage LCR filters, rolling off somewhat above the respective 1.4 and 1.8MHz carrier frequencies. Their function is to attenuate higher order harmonics which might otherwise penetrate the video replay system.

Following the filters, the carriers are commoned by means of an RC mixing network, with a preset potentiometer to adjust the drive current to a common recording amplifier. Its output is fed in parallel to the audio heads, which impose their tracks in sequence as they sweep obliquely across the tape.

It now remains to recover and reconstitute those magnetic imprints for reproduction, hopefully, through a high quality domestic stereo system.

(To be continued)

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PROJECT 2

Elementary Electronics

Perfect for toy cars! A realistic

Hee-Haw Siren

How about this for a natty idea? — it's a simple electronic circuit which, when fitted to a toy car or tricycle, will provide a realistic "hee-haw" siren sound and flashing lights.

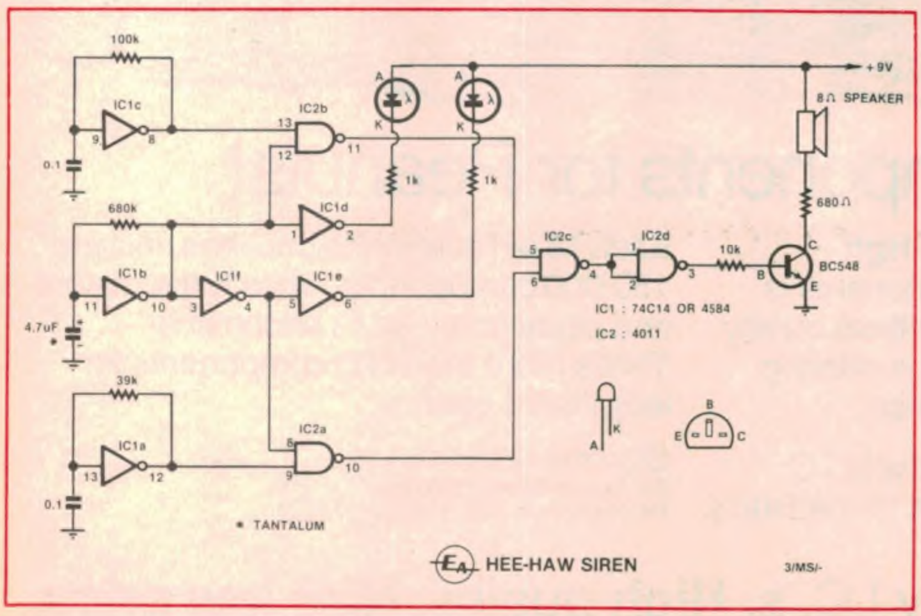
Of course, our new Hee-Haw Siren is not limited for use in toy fire engines and police cars. It can also be used in more serious applications, such as car or boat burglar alarm systems, or in any other situation that requires an attention-grabbing alarm sound. We're sure that many readers will already have their own application in mind.

In all fairness, though, we should give the reader a few words of warning. The sound produced by our Hee-Haw Siren is a true hackle-raising "hee-haw, hee-haw, hee-haw, hee-haw . . ." It's absolutely guaranteed to turn even the most docile, peace-loving adult homo-sapien into a murderous Neanderthal in the space of five minutes (or less).

So unless you are a particularly tolerant type, we suggest that you fit a normally off pushbutton switch in series with the supply rail to the siren. That way, the alarm will sound only when the child has his finger on the button. As well as providing you with some welcome intervals of peace, this feature will also serve to increase battery life.

How it works

There are two types of IC used in this circuit — one is an inverter "package" and the other a NAND. It is appropriate to use the term "package" because each IC contains more than one functional unit. In the case of the 74C14, there are actually six independent inverters contained in the IC and for the 4011, there are four independent NAND gates. For those not familiar with the expression NAND, it is simply an abbreviation for Not And. This refers to its logic configuration — all of the inputs must be low before the output will go high. There are many other types of gates available which have different logic configurations.



The circuit uses two ICs and an NPN transistor to drive the loudspeaker.

The circuit is really very simple and consists of three audio oscillators (IC1a, IC1b and IC1c) which drive the LED display circuitry and a small audio amplifier. The two tone oscillators, IC1a and IC1c, are set to run at the desired audio frequencies to give the "hee' and "haw" sounds, while rate oscillator IC1b determines the switching rate of the two tones.

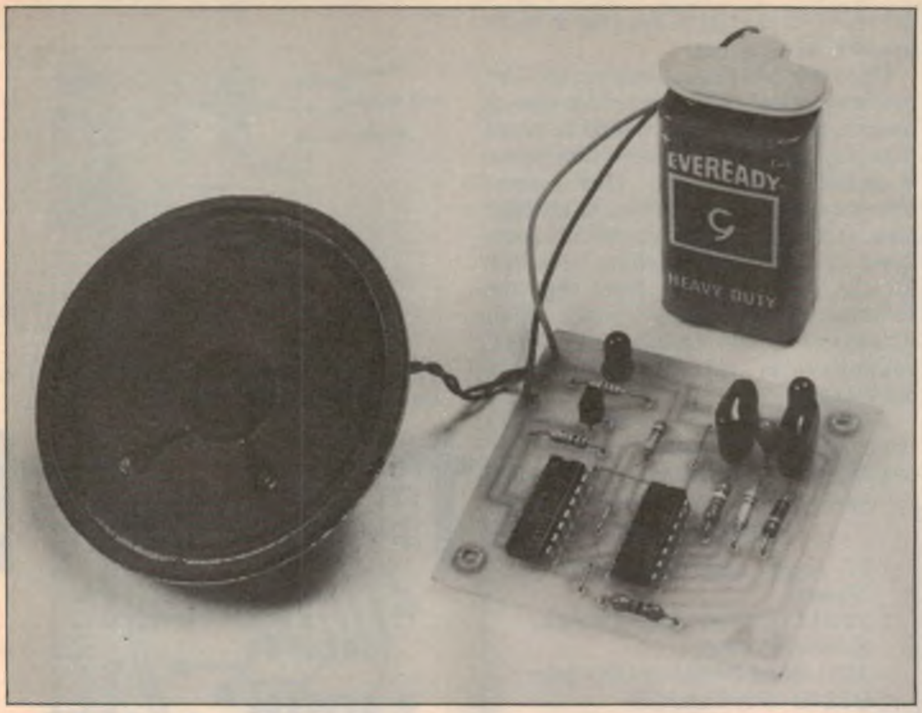
Each oscillator is based on a single inverter from a 74C14 hex Schmitt inverter IC package, together with two external components — a feedback resistor and a capacitor. These external components set the oscillator output frequencies.

So how does the oscillator work? Well, a Schmitt trigger is a device with two widely spaced trigger voltages — an upper trigger voltage and a lower trigger voltage. The output of the device changes state only when the upper trigger voltage is exceeded at the input, or when the applied input voltage drops below the lower trigger voltage.

Applied input voltages between the two trigger points cause no change at the output, an effect referred to as hysteresis. A Schmitt trigger exhibits a considerable amount of hysteresis, and it is this characteristic that enables the construction of an oscillator using just one inverter.

As can be seen from the circuit diagram the feedback resistor is connected between the input and output, while the capacitor is connected between the input and ground. What you have to remember now is that the input and the output of an inverter are always 180° out of phase; ie when the input is low, the output will be high, and vice versa.

Let's initially assume that the input of the inverter is low and that the output is high. The capacitor on the input will now charge via the feedback resistor until it reaches the upper trigger voltage and switches the output of the inverter low. At this point, the capacitor discharges via the resistor into the output until its voltage reaches the lower trigger point. The inverter then switches over again, and so on indefinitely.



The Hee-Haw Siren can be fitted to a child's toy or used in a burglar alarm system.

As already mentioned, the resistor and the capacitor values set the oscillator frequencies. For the prototype, the values shown give a high tone frequency of 1kHz, a low tone frequency of 385Hz, and a rate frequency of about 2Hz. These frequencies result in a sound similar to that produced by a police siren. Note that the frequencies will actually vary from one IC to the next.

You can change the various oscillator frequencies simply by changing the values of the feedback resistors. Some constructors may even prefer to replace the fixed value resistors with trimpots so that they can adjust the sound just the way they want it. Suitable trimpot values would be 100kΩ for the two tone oscillators and 1MΩ for the rate oscillator.

The output of the high tone oscillator is fed to one input of NAND gate IC2a while NAND gate IC2b is fed by the low tone oscillator. The remaining input to each of these two gates is connected to the rate oscillator, directly in the case of IC2b and via inverter IC1f in the case of IC2a. Inverter IC1f ensures that only one tone is gated through at any given time.

In practice, this means that the high tone oscillator output is gated through to IC2c during negative half cycles of the rate oscillator, and the low tone oscillator output is gated through during positive half cycles.

The output of the mixer gate, IC2c, is fed to both inputs of IC2d (used here as an inverting buffer) and from there to a small audio amplifier. Strictly speaking, IC2d is not really necessary. It is good practice, however, to use a buffer between stages when there is a spare gate available.

The amplifier is about as simple as you can get and consists of a single BC548 NPN transistor wired in common-emitter configuration. A 10kΩ resistor limits the transistor base current, while a 680Ω resistor and an 8Ω loudspeaker form the collector load. Power output is less than 1mW but this

Siren

should be sufficient for most purposes. If not, reduce the value of the 680Ω resistor but remember that this will increase the current drain.

Finally, we have made provision on the circuit for two LEDs which flash on and off in sympathy with the rate oscillator. These are driven from the output of the rate oscillator via the two remaining inverters in the 74C14 package, IC1d and IC1e. Thus, whenever the output of the rate oscillator goes high, the output of IC1d will go low and the LED corresponding to the low tone will be turned on. Similarly, when the rate oscillator output goes low the LED corresponding to the high tone will be turned on.

Construction

Construction of the unit is simple and straightforward. As can be seen from the photograph, the unit is built up on a small PC board coded 80hhs6 and measuring 59 x 56mm. This board accommodates all of the circuitry except for the battery and the speaker. Make sure that you solder the ICs into circuit with the correct orientation.

Note that although we have shown the two LEDs mounted directly on the board, there is nothing to stop you from connecting them via short lengths of hook-up wire. In fact, it will probably be necessary to do this if the unit is to be installed in a toy car.

Once construction is complete the unit can be switched on and tested for correct operation. The low tone should be heard from the speaker the moment that power is applied to the circuit. After a short time the siren will switch over to the high tone, at which point the circuit will settle down to the proper switching frequency for the rate oscillator. Note that the switch-on tone lasts longer than subsequent tones because the 4.7μF capacitor is initially completely discharged.

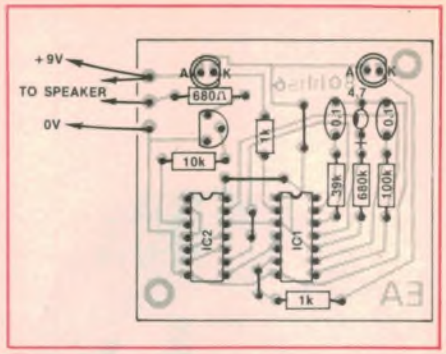
Assuming that all is well, it only remains to fit the unit to that toy fire engine or police car. Happy hee-hawing!

PARTS LIST

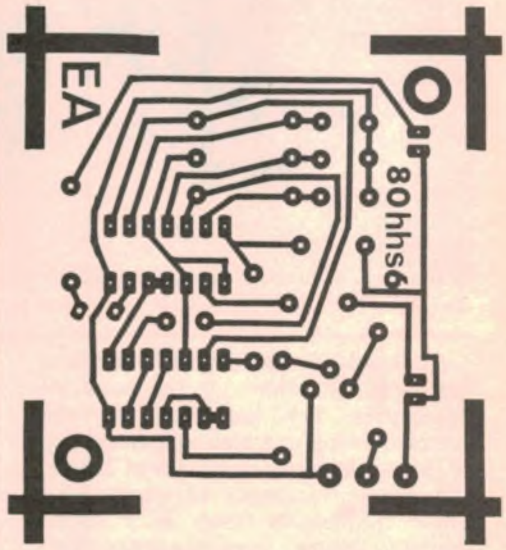
1 PC board, code 80hhs6, 59 x 56mm
1 74C14 or 4584 or 40106 hex Schmitt inverter
1 4011 quad 2-input NAND gate
1 BC548 NPN transistor
2 red LEDs
1 type 216 9V battery and battery clip
1 miniature 8Ω loudspeaker
1 on-off switch (optional)

Capacitors
1 4.7μF/16VW tantalum
2 0.1μF metallised polyester

Resistors
1 x 680kΩ, 1 x 100kΩ, 1 x 39kΩ, 1 x 10kΩ, 2 x 1kΩ, 1 x 680Ω



This wiring diagram shows the PC board from the component side.



Above is an actual size reproduction of the PC board.

Elementary Electronics Explained

WHAT'S A TRANSISTOR?

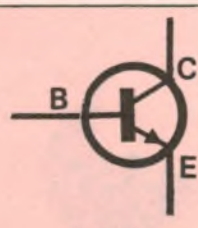
Although there are several different types of transistors, they all have certain characteristics in common. Generally there are three terminals. A small signal applied to one of the terminals is used to control the current passing between the other two. In other words, the transistor can be regarded as a variable resistor. In fact, the very name transistor is derived from the term "transfer-resistor".

Let's consider the bipolar transistor first. This is the most popular transistor type. As shown in the diagrams, it has three terminals designated base, collector and emitter. A small control current is fed into the base, allowing a much larger current to flow through the reduced resistance between the collector and emitter. The ratio of the current flowing in the base circuit to that of the collector circuit is called the gain or beta of the transistor and can be anywhere between 10 and 1000 depending on the type of transistor.

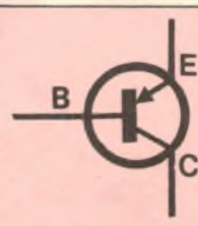
Bipolar transistors can be either NPN or PNP types (P stands for positive and N for negative). This refers to the internal construction of the device. In the case of an NPN transistor, the emitter is connected to the negative side of the circuit and the collector to the positive. The base must be made positive with respect to the emitter for the transistor to present a low resistance in its emitter-collector circuit (this is referred to as biasing the transistor on).

PNP bipolars need to have the emitter connected to the positive side of the circuit and the collector to the negative. The base has to be made negative with respect to the emitter for the transistor to be biased on. For either type of bipolar transistor, the collector-emitter resistance will be low when the emitter to base voltage is 0.6 to 0.7V (for a silicon type).

Other types of transistors include field effect transistors (FETs) and unijunction transistors. These will be considered separately in a future issue.



NPN



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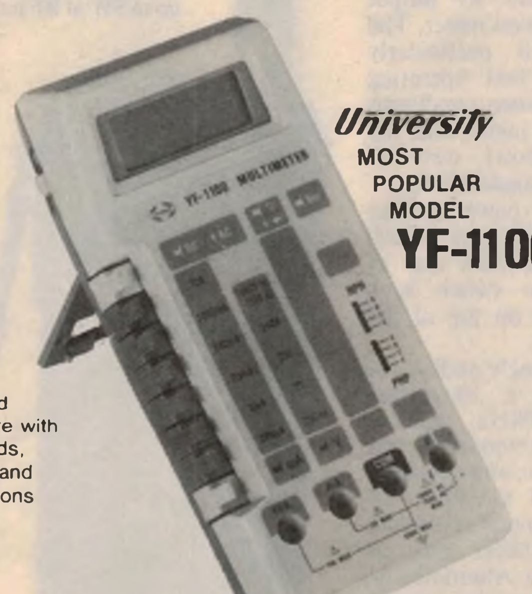

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Yaesu Musen FT-209RH 2-metre Transceiver

Recently submitted for review by Dick Smith Electronics is the Yaesu Musen FT-209RH hand held two-metre transceiver. As well as a very wide range of operator facilities the FT-209RH offers quite a high RF output — up to five watts — for a hand held unit. A slightly lower power unit, the FT-209R, is also available.

by Philip Watson

Both the FT-209R and the FT-209RH are available with a choice of two nickel-cadium battery packs; the FNB-3 at 10.8V, 425mAh, and the FNB-4 at 12.2V, 500mAh. The choice of voltage controls the RF power output which, for the FT-209RH, is 3.7W with the FNB-3 pack and 5W with the FNB-4. For the FT-209R it is 2.7W with the FNB-3 and 3.7W with the FNB-4.

Both battery packs are designed for use with a conventional 14-hour charger, or a suitably designed fast charger. For the latter the packs are fitted with internal thermostats, brought out to separate contacts to protect the cells from excessive heat. The FNB-3 can be charged in one hour and the FNB-4 in one and a half hours.

There is also a dry cell battery pack available, designed to take six 1.5V "AA" size cells, preferably heavy duty types. At this slightly reduced voltage RF power is down by about 20% on that from the FNB-3.

Case dimensions are approximately 65 × 168 × 34mm (W × H × D) with the FNB-3 battery fitted, and the weight is 557g. The case is slightly higher (188mm) with the FNB-4 pack, and weighs 616g.

The set covers the full 4MHz of the two-metre band and, in fact, somewhat more, apparently to accommodate the American MARS facility, which is only of academic importance in Australia. Frequencies can be selected in 5kHz steps and are presented on an LCD display in 6mm high numerals. Other operating data, such as repeater offset, reverse offset, etc, are similarly displayed but in smaller characters.

The set has the normal internal speaker and microphone, together with sockets to extend these facilities to external units. Two Yaesu accessories are available for use with these sockets. One is a speaker/microphone unit (MH-12A2B), complete with PTT switch and an earphone socket. The other is a headset with boom microphone (YH-2) which works in conjunction with an internal VOX system and is selected by a press switch on top of the set. Two orders of VOX sensitivity are available.

A miniature edge-type meter provides three functions: "S" meter, RF output meter, and battery condition meter. The "S" meter function is particularly valuable, enabling the best operating position to be selected when conditions are marginal. Both the meter and the adjacent LCD readout can be illuminated via a spring-loaded switch.

A high or low RF power output switch is provided, the low power level being approximately one-tenth that of the high position. The switch is a locking-type pressbutton on top of the case.

The set boasts a seemingly endless list of facilities. There is a 10-position memory, standard 600kHz repeater offset, + or −, any non-standard offset the user cares to nominate, and a scanner which may be directed to either the memory bank or the general spectrum, operating in 5kHz or 10kHz steps, as selected, in the latter case. Alternatively, either the memory bank or the general spectrum may be incremented or decremented, one step at a time.

The scanner may be set to pause briefly on an occupied channel, to enable it to be captured, to scan without stopping, or to pause on the first unoccupied channel. It may also be set to

The FT-209RH fits easily in the palm of the hand yet boasts up to 5W of RF power output.

skip channels known to be occupied, but in which the user is not interested, then pause on the next occupied channel. The scanner may also be programmed to scan only between selected memory channels, rather than the whole of the memory bank.

There is a power saver feature whereby the set, when on standby, will monitor the selected channel for brief periods only, with power saving pauses in between. The duty cycle may be varied from 1/1 (300ms off/300ms on) to 10/1 (3000ms off/300ms on) in 10 steps. In this latter condition, standby battery consumption (squelched) is reduced from 45mA to 11mA.

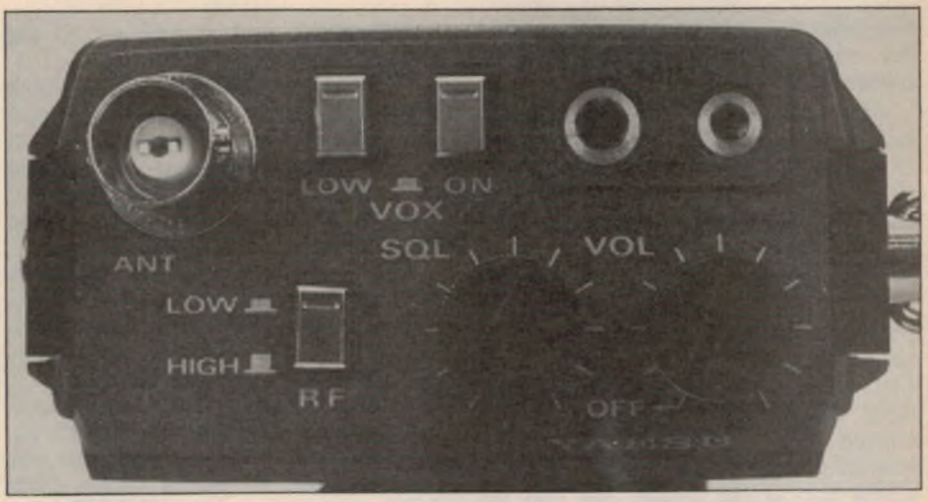
There is a priority feature whereby any frequency in memory may be checked for a fraction of a second, approximately every five seconds, and the channel captured should a signal appear at that frequency. A variation on this is a facility to instantly recall channel "0" from the memory bank, on the assumption that this can be assigned to a priority or calling frequency. A further refinement provides for multi-channel priority scanning, whereby several nominated frequencies may be checked sequentially at regular intervals.

All data in memory, or otherwise set up, are retained, even if the battery pack is removed. This is by means of a lithium cell in the body of the transceiver and which the makers claim should have a life of at least five years.

All these features, and many more, are the result of applying microprocessor techniques to communications equipment, and very clever it is too. But there is a price to pay for all this elegance and refinement, and not just in dollars and cents. One has to learn to drive the thing; to work out how all these marvellous functions can be commanded and, hopefully, remember it all when, or if, the need arises to use them.

The manual makes some acknowledgement of this. It says, "While the variety of functions can seem formidable at first glance, basic operation is not complicated and requires only a few moments with the transceiver in hand." Well, that may be true for those already well versed in equipment of this kind, in other brands, and who merely need to convert to this one. But for the old hand wishing to upgrade from three thumbwheel switches, or a 23 position rotary switch, it is not nearly as easy as that.

A more realistic approach would be to pack the wife and kids off to an understanding relative for the weekend, stock the fridge with junk food, take the phone off the hook, and settle down for a couple of days of hard study. An exaggeration? Well, maybe it is, but no more so than the "few moments" claim in the manual.



Close-up view of the controls on the top panel. Features include high/low VOX sensitivity and switchable high/low RF power output.

The truth lies somewhere in between. At the very least be prepared to spend several hours trying to put the instructions into practice, with the possibility of having to repeat this several times. It may become your pride and joy eventually, but you'll hate it long before you learn to love it!

This criticism is levelled not so much at this particular set, but at the current generation of equipment made along these lines. Is everything getting too complex? Is the amateur being made to pay for a lot of facilities which he will probably never need, or will need so seldom that he won't remember how to use them when he does? These are questions many amateurs are asking these days.

But, if there is a place for this kind of set, then at least it deserves an adequate instruction manual, and this is a major criticism of this particular package. This is not the old story about Japanese English because, in fact, there is very little evidence of this and the grammer is of a very high standard.

It must also be conceded that all the information needed is contained in the manual, and that it is quite accurate. But it fails on two counts; the information is too scattered, requiring a lot of searching to clarify some functions and, while it is accurate, it is not always sufficiently informative. In this respect the writers suffered from a common problem; they were too close to the subject and could not visualise the confusion such a complex piece of gear could create for a stranger.

As an example, the intent of some functions was not immediately obvious from the manual. It was not until they had been set up and tried that it became apparent what the manual was trying to convey. In short, the instructions made sense only when the answer was already known.

Further confusion was caused by mention in the manual of four different models, "A", "B", "C" and "E", without

SPECIFICATIONS

Receiver (@10.8V)	
Circuit type:	Double conversion superheterodyne
First IF:	10.7MHz
Second IF:	455kHz
Sensitivity:	0.25μV for 12dB SINAD: 1 μV for 30dB (S+N)/N
Selectivity:	±7.5kHz (−6dB), ±15kHz (−60dB)
Audio output:	450mW into 8 ohms for 10% THD, or better
Transmitter (@ 10.8V)	
RF input/output:	See text
Modulation:	Variable reactance
Deviation:	±5kHz
Maximum bandwidth:	16kHz
Spurious response:	−60dB or better
Microphone:	electrostatic

any indication as to which applied to this set. After some consultation DSE advised that it is a model "A".

Most of the operating functions are controlled via a 20-button keypad, 19 of which are dual function keys with the primary function shown on the key itself, and the secondary function above it. The remaining key (F) is the "shift key" to provide the secondary function.

Two aspects of using the keypad proved disconcerting, one of a temporary nature, the other more permanent. The first one is the fact that, in feeding in some instructions, the impression is created that the frequency already selected is being erased or altered. It isn't, unless this is the intent, but can be disturbing until one gets used to it.

The second problem concerns the "F" (shift) key. When this is pressed an "F" will appear in the LCD display after a fraction of a second and will remain displayed for approximately one second. The required secondary function can be keyed in only during this one second period and one has to be nimble fingered in some cases to avoid keying in the primary function instead.

Whether this has been done from choice or necessity is not apparent but, if there is a choice, then a fixed shift, as found on most scientific calculators, would make operation a great deal easier.

But once the monster is finally tamed, one can get down to assessing its primary function; that of getting signals between points A and B. And in this role it must be admitted that it is a delightful little set to use. Receiver performance is much as would be expected from the specifications, and is well up to the current state of the art.

It is the transmitter, however, which makes the real impression. The mere fact that one can carry upwards of 5W, at 2m, in a breast pocket must be regarded as a major technological achievement; something which, a few years ago, would have been strictly Dick Tracy stuff.

And the extra power really is worthwhile, even with the 3.7W version under review. From this reviewer's favourite southern Sydney high spot, using a quarter-wave vehicle antenna, it was possible to trigger the High Range repeater and obtain an "R5" report. By comparison, a 1W hand held unit will not even look at such a circuit. (The 3.7W represents a gain of 5.7dB over 1W, and 5W almost 7dB.)

The extra power would also be useful if it was planned to use the set with an afterburner, for base station operation, in conjunction with a suitable power supply.

The overall physical design and finish of the unit is quite impressive. Beauty may be only skin deep but, once having satisfied themselves regarding the technical specifications, most users would prefer a set which both looks and feels professional, and this unit qualifies on both counts.

The case is diecast aluminium, finished in slightly iridescent dark grey with control labels, etc printed in light grey. The set fits easily in the hand, with the PTT switch falling naturally into place. The battery pack slides smoothly into place and snaps home with a neat locking action.

A soft plastic protective carrying case is provided, with shoulder strap. It is provided with all the necessary openings and cut-outs to allow operation of the set, while giving a large degree of protection against handling, the elements, etc.

The price structure is as follows: FT-209R, $359.00; FT-209RH, $399.00. These prices are for the basic unit without battery pack. The FNB-3 battery pack is $59.00, and the FNB-4 $69.00. The dry cell pack is $11.00.

A battery charger will also be required, either constant current mode at 45 to 50mA, for a 14 hour charge, or some form of fast charger. A suitable fast charger may be available at a later date.

Further details from Dick Smith Electronics, Lane Cove and Waterloo Rds, North Ryde, NSW 2113, or their various stores in all states. (P.G.W.)

This 20-button keypad controls most the operating functions, provides a seemingly endless list of facilities.

Easy to build unit connects to your hifi

Stereo TV Sound Receiver

Featuring inbuilt VHF and UHF tuners, this stereo TV sound receiver provides video and modulated RF outputs, loudspeaker outputs, and audio line level outputs for connection to your hifi system. A prealigned tuner module makes construction and setting up a breeze.

by ANDREW LEVIDO

Up until now, the only way to listen to the new stereo TV broadcasts was to buy a complete stereo TV receiver. Unfortunately, stereo TV receivers are expensive with prices for the larger screen models generally in excess of $1000. Despite the obvious benefits of stereo sound, few of us can justify trading in an existing receiver that's still in good working order.

Now there's an alternative way to go. Designed by staff at Dick Smith Electronics, this new Stereo TV Sound Receiver will provide you with stereo TV sound for just $249. It can be used as a stand-alone unit or, more commonly, teamed with an existing TV receiver and hifi system.

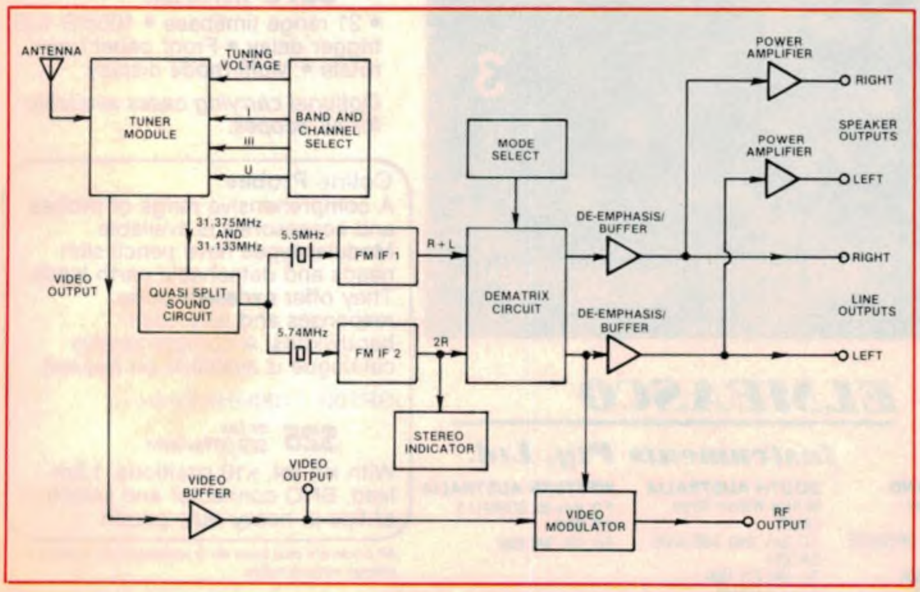
In use, the unit is connected between the existing TV antenna and the TV receiver. Both RF and composite video outputs are provided, the latter allowing the existing tuner and IF strip to be bypassed.

In most cases, a direct video connection will not be possible and the modulated RF output will have to be used. The RF output is tuned to channel 1 on the VHF band while the video output delivers the standard 1V p-p into 75Ω.

Channel switching is by means of a rotary switch which allows any of six pre-tuned channels to be selected. These channels are tuned by means of multi-turn potentiometers which have integral 3-position switches. Both the VHF and UHF bands are covered and the unit features full AFC (automatic frequency control).

Other facilities on the front panel include a volume control, a mode selector switch (Mono A, Mono B, Stereo), a power on/off switch, and mains and stereo indicator LEDs.

The rear panel carries the audio line output sockets (RCA), two pairs of screw-type speaker terminals, and a stereo headphone socket. The line outputs are capable of delivering 300mV p-p into 4.7kΩ, while the speaker level outputs are rated at 1W into 8Ω. Also on the rear panel are a 75Ω coax antenna socket and the video and RF output sockets (RCA).



Here is the block diagram of the stereo TV sound receiver.

Transmission modes

The stereo transmission standard in use in Australia (see panel) provides for bilingual transmissions as well as mono and stereo transmissions. The system includes pilot tones which, together with the necessary decoding circuitry, provide for automatic switching between the various modes (Mono B, Mono A and Stereo).

Instead of using this feature, Dick Smith Electronics has elected to use manual mode switching. The stereo indicator LED comes on when a stereo or bilingual program is being transmitted, and the viewer is then left to make the appropriate switch selection for himself.

To explain further, Mono A selects the normal L + R (mono) signal, while Mono B is used only for bilingual transmissions (not yet broadcast in Australia). The Stereo mode is self-explanatory.

Before moving on to the circuit description, there are a couple of other points that are well worth mentioning. First, for those who don't own a VCR, the unit can be used to provide a video input signal for the Teletext Decoder described in August and September 1984. Second, the unit can be used to provide UHF reception capability for a VHF only TV receiver.

Over the next few years, many new services will commence operation on the UHF band, making a UHF capability highly desirable.

How it works

The complete circuit for the Stereo TV Sound Receiver is of, necessity, quite complex. To make the job of understanding how the circuit works as easy as possible, we've presented a block diagram of the circuit and a panel describing the transmission standard and general receiver principles.

This panel should be read before proceeding further.

Refer now to the block diagram of the stereo receiver. The tuner module accepts the RF input from the aerial, and outputs a video signal and a modulated sound signal. Tuning and band selection is accomplished by means of a system of switches and multiturn pots, as mentioned earlier. At this point, the sound signal consists of two modulated carriers at 31.375MHz and 31.133MHz (assuming a stereo transmission is being received).

This signal is fed into the quasi-split sound circuit which contains the first IF limiter amplifier and a linear multiplier to generate the intercarrier frequencies. The output of this circuit is split into two paths and passes via ceramic resonators (5.5MHz and 5.74MHz) to separate IF strips, each containing an IF amplifier and a demodulator.

So that dual carrier transmissions are still compatible with conventional mono receivers, the carriers are modulated in such a way that the total audio information appears on sound channel 1. Thus this channel is modulated with L + R information, and the second carrier with R only. Simple dematrixing is required to produce the separate left and right audio channels.

In the case of a bilingual broadcast, the main language is transmitted on the first carrier while the secondary language is transmitted on the additional carrier. The dematrixing and mode select circuitry contains switching to select either language.

The dematrixing circuit is followed by a pair of buffer stages which provide the required $50\mu s$ de-emphasis. The power amplifiers are included to drive the headphone and loudspeaker outputs.

A stereo indicator circuit is used to detect the presence of program material on the second sound channel, and lights a LED to show that stereo reception is possible.

The video output from the tuner module is buffered and applied to the video modulator. Sound obtained from one channel only is modulated onto the RF signal. This means that the mode selector switch should be set to Mono A if the sound is to be monitored via the set's internal loudspeaker (otherwise you will not get the full L + R information).

Circuit diagram

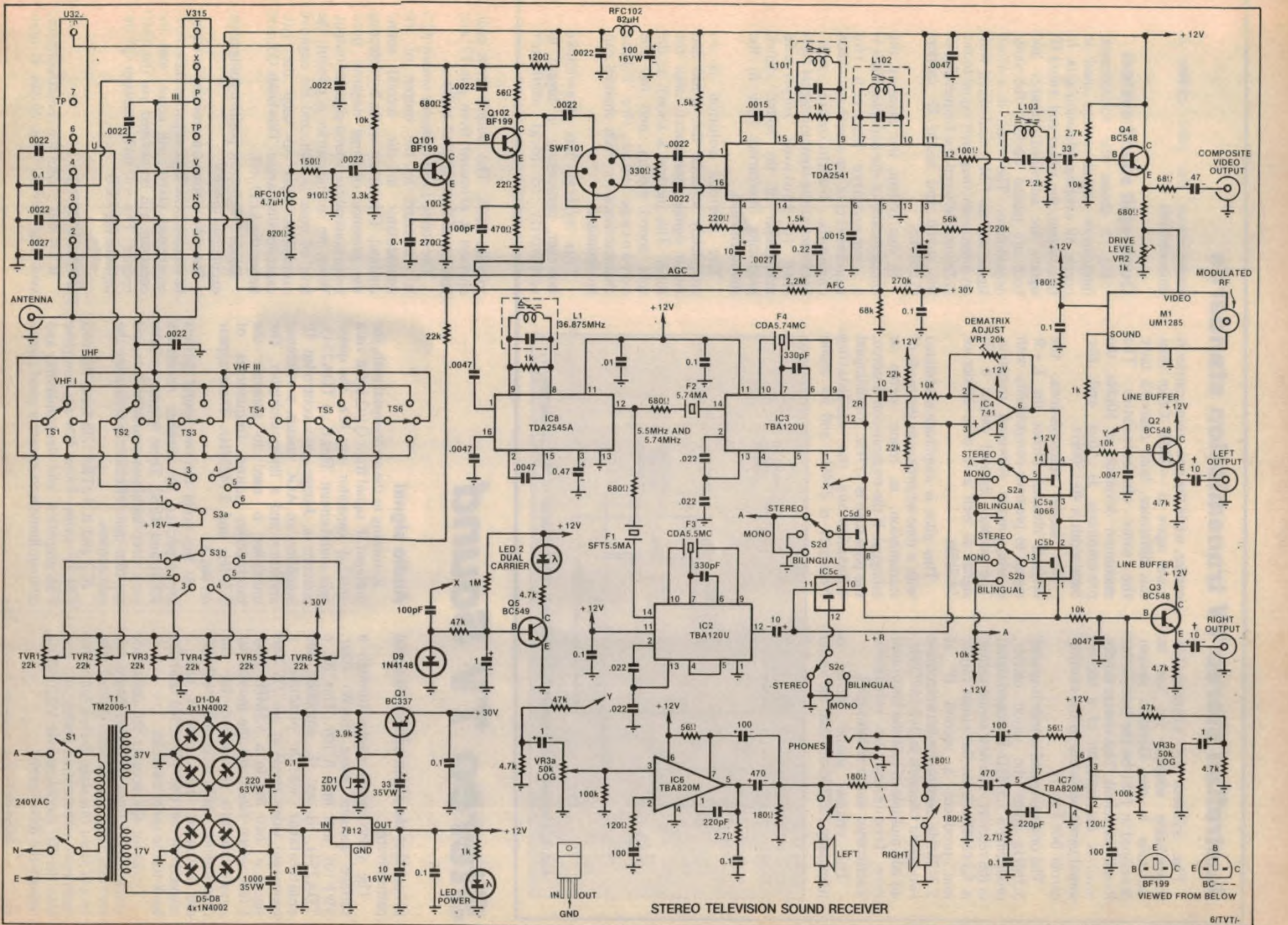
Refer now to the complete circuit diagram. Each of the blocks mentioned above will be discussed in some detail.

The tuner board is dominated by two prealigned front ends contained in shielded metal cans. These are varactor type tuners, meaning that they are tuned by means of a variable control voltage. Module V315 covers the VHF spectrum in two bands (I and III), while U322 covers the UHF channels.

The required band is selected by means of the 3-way switches incorporated in the switch pots SP1-SP6, while the tuning voltage is derived from a voltage divider arrangement formed by the potentiometers. These set the tuning control voltages over the range 0-30V.

Channel selection is by means of S3 which selects the switch pot outputs to control the tuning. S3a is used to select the band while S3b selects the tuning voltage.

The IF output from the VHF tuner (vision carrier 36.875MHz, sound carrier 1 31.375MHz, and sound carrier 2 31.133MHz) is fed to an amplifier formed by transistors Q101 and Q102. It



STEREO TELEVISION SOUND RECEIVER

Australian stereo TV transmission standards

The system of stereo TV transmission adopted for use in Australia is the German system developed in 1981 by the Institut fur Rundfunktechnik. This system simply involves the addition of a second sound carrier adjacent to the existing carrier (see Fig. 1).

The original sound carrier is spaced 5.5MHz from the vision carrier, producing a 5.5MHz IF sound signal in the receiver. The new sound carrier is 5.742MHz from the vision carrier and produces a second IF at 5.742MHz. Separation between these two sound channels is 242.1875kHz, an odd multiple of half the horizontal line frequency to minimise interference to the vision signal.

The original sound carrier is nominally 13dB lower than the vision carrier, while the new sound carrier is lower again at −20dB. Other than this difference, both channels have the same characteristics. The maximum deviation is 50kHz, the pre-emphasis is 50μs and the bandwidth is 40-1500Hz.

For stereo transmissions, the original channel carries the L+R signal to preserve compatibility with existing mono television receivers. The second channel carries a 2R signal as well as a pilot carrier of 54.7kHz.

This pilot is amplitude-modulated with a tone according to the mode of transmission; ie, mono, stereo or bilingual. If the transmission is stereo, the pilot tone is 117Hz. For bilingual transmissions the modulating frequency is 274Hz, and for mono transmissions the pilot carrier is unmodulated.

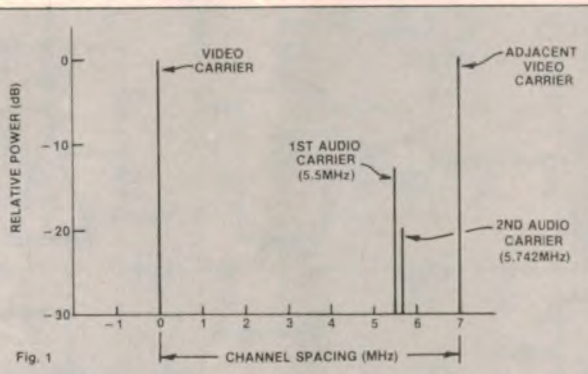


Fig. 1: a second sound carrier (5.742MHz) is added adjacent to the existing carrier.

Quasi-split sound system

Fig. 2 shows the conventional intercarrier sound system used in nearly all existing television sets. In this system, the vision and sound IF signals are amplified together and both are passed through the same demodulator. The result is a video signal and an FM sound signal with an intercarrier frequency equal to the difference between the frequencies of the sound and vision IF carriers (5.5MHz).

In this system, the shape of the characteristic of the bandpass filter is a compromise between the requirements of the sound and vision channels. Furthermore, non-linearities in the common signal path lead to spurious amplitude modulation of the sound signal, producing intercarrier buzz in the sound channel.

The obvious solution is to completely separate the sound and vision signals immediately after the tuner. This method is known as the split sound system, and has the advantage that the filter characteristics for each channel can be optimised.

This system has drawbacks however, particularly in regard to sensitivity to local oscillator

Stereo TV Sound

is here that the vision and sound signal paths diverge.

The video signal passes through a surface acoustic wave (SAW) filter, SWF101, and into IC101. This IC, a TDA2541, is an IF amplifier and demodulator which produces a composite video signal at pin 12. This signal is then fed to a 5.5MHz trap, L103, which filters out the intercarrier sound signals produced by the demodulator. AGC and AFC voltages are extracted from pins 4 and 5 respectively of the TDA2541 and fed back to the tuner modules.

Transistor Q4 accepts the composite video output from the tuner board and provides buffering and level shifting. The output from this stage is then fed to the composite video output socket and also into the RF modulator via VR2 (which adjusts the drive level).

Audio signal

Returning to the audio signal path, the buffered IF signal from Q102 is fed via a .0047μF capacitor into IC8, the quasi-split sound circuit. This IC, a TDA2545, contains a 3-stage gain controlled IF amplifier, an AGC circuit, a reference amplifier, and a linear multiplier. The multiplier is used to generate the intercarrier sound frequencies of 5.5MHz and 5.742MHz. These appear on pin 12.

At this point the two sound carriers are separated by ceramic resonators RES1 and RES2. These resonators have very steep bandpass characteristics and are thus quite effective in separating the two carriers.

IC2 and IC3 (TBA120) form the two FM IF strips. These ICs are complete FM amplifiers and demodulators, and contain limiters to ensure a good signal-to-noise ratio. The output from each channel is extracted from pin 12 and consists of demodulated audio.

The stereo LED indicator circuit (Q5) is connected to the output of the demodulator in the second sound channel. This circuit works by detecting the presence of large negative noise excursions on the sound channel output. When no second carrier is present, the level of noise is high, and the negative excursions work to keep the 1μF capacitor discharged. This holds Q5, and hence the LED, off.

Diode D9 clips the positive-going noise excursions to 0.6V.

Should a station transmitting in stereo be received, the large negative excursions mentioned above will cease, and the capacitor will be charged via the 1MΩ resistor. This will turn transistor Q5 on, lighting the LED.

Dematrixing

ICs 4 and 5 form the dematrixing and switching circuit. This circuit is quite

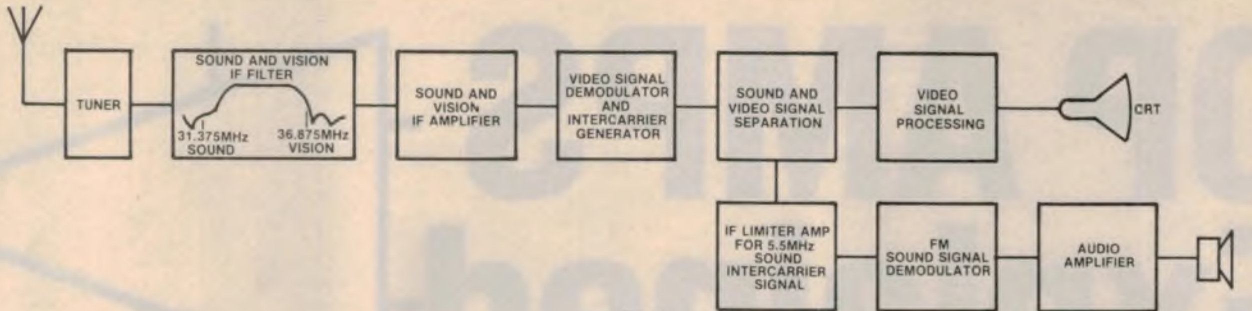


Fig. 2

Fig. 2: conventional intercarrier sound system as used in existing mono television sets.

instability.

A more practical solution is illustrated in Fig. 3 and is known as the quasi-split sound system. Again, the sound and vision channels are split immediately after the tuner so that filter characteristics can be optimised. This time, however, the sound bandpass filter has a modified characteristic with two peaks. One of these peaks is centred on the audio carrier and the other on the video carrier. Both the sound and vision demodulators have a reference frequency of 36.875MHz, and a deep sound trap in the vision channel minimises sound interference in the picture.

The sound channel filter is followed by an intercarrier generator and an IF limiter amplifier. Demodulation of the sound signal is carried out by a linear quadrature demodulator in order to produce low harmonic distortion.

The system described above could be applied equally to mono or stereo systems, and provides superior audio quality compared with the conventional system in either case. In the case of a stereo receiver, the intercarrier generator will produce two FM signals, one on each of the intercarrier frequencies mentioned above. These are fed via suitable bandpass filters to separate second IF limiter amplifiers and demodulators to produce two audio signals ready for dematrixing.

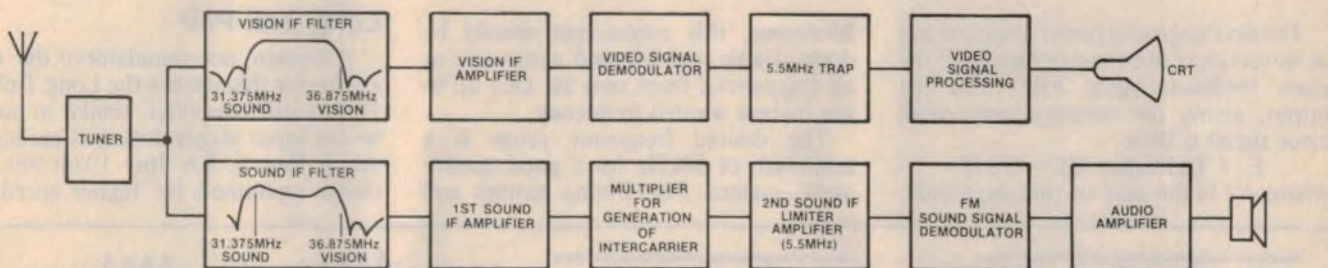


Fig. 3

Fig. 3: quasi-split sound system. The sound and vision signals are separated immediately after the tuner.

complex, so each mode of operation will be considered in turn.

When Mono A is selected (S2), CMOS switches IC5a and IC5d open and thus isolate the second sound channel from the line buffer output stages (Q2 and Q3). At the same time, the audio signal from the first sound channel passes via IC5c to the right line buffer and also via IC5b to the left line buffer.

Thus, in the Mono A mode, the mono L + R signal is fed to both outputs.

When the second language of a bilingual broadcast is required, S2 is set to the Mono B position. In this position, IC5a and IC5c will be open, while IC5b and IC5d will be closed. Thus the signal from the second sound channel will be fed to both output buffers.

If the stereo mode is selected things become a little more complicated. IC4 is configured to have a gain of 2 for signals applied to the non-inverting input, and a gain of -1 for signals applied to the inverting input. Since the L + R signal is connected to the former and the 2R signal is connected to the latter, the output of the op amp is 2(L + R) — 2R = 2L.

With S2 in the Stereo position, IC5a is closed and IC5b is open. This means that the 2L output from the op amp will be fed to the left channel line buffer only. As well, IC5d will be closed and IC5c open, meaning that the 2R signal from the second sound carrier will be fed to the right line buffer only.

As a result, the right output contains right channel information only while the left output contains left channel information only.

The line buffers are identical and employ emitter follower stages Q2 and Q3. A 10kΩ resistor and .0047μF capacitor in the base circuit of each transistor provide the necessary 50μs de-emphasis. This is to complement the 50μs pre-emphasis imposed on the signal before transmission.

The two output signals are also fed via the volume control potentiometer, VR3, to two audio amplifiers based on TBA820 ICs (IC6 and IC7). These amplifiers are capable of producing 1.3W into an 8Ω load. Signal drive to the headphone socket is derived directly from the amplifier outputs via 180Ω dropping resistors.

Two regulated DC supply rails are used in the Stereo TV Sound Receiver: a +30V rail for the varactor tuners and a +12V rail for the remainder of the circuitry.

The supply uses a conventional mains transformer with two secondary windings to drive separate bridge rectifier/filter capacitor combinations. These provide unregulated DC rails of about 45V and 20V. The latter drives 3-terminal regulator IC1 to produce the +12V rail, while the +30V rail is derived from a series pass regulator consisting of transistor Q1 and zener diode ZD1.

Power on/off indication is provided by LED 1 and its associated 1kΩ resistor wired in series across the +5V rail.

To be continued

OP AMPS Explained

PART 12

Most power op amps consist of an input differential stage, a driver amplifier, a bias network and a power output stage. In this chapter, we take a close look at the first three stages.

by BRYAN MAHER

The first stage of a power amplifier has as its real objective the subtraction of the main feedback signal FB1 from the intput, giving the (usually) very small error signal E thus:

E = [A1(Input M) − FB1]

where A1 is the gain of this stage only. Moreover, this subtraction should be done cleanly, quickly and accurately at all frequencies from zero (ie, DC) up to the highest wanted frequency.

The desired frequency range is a minimum of 20kHz for a good quality audio system. For driving motors and other such loads, wanted frequencies usually extend only up to about 10Hz. As discussed last month, this stage should not overload easily on the occasions when feedback is late arriving (due to loop delays). This would leave the stage momentarily at the mercy of a large fast input signal with no matching FB to be subtracted, leading to Transient Intermodulation Distortion, TIMD.

Long Tail Pair

Although not mandatory, the usual choice for this stage is the Long Tail Pair Differential Amplifier, similar in essence to the input stages discussed earlier (Op Amps Part 5, EA July 1984) but with design optimised for higher speed and

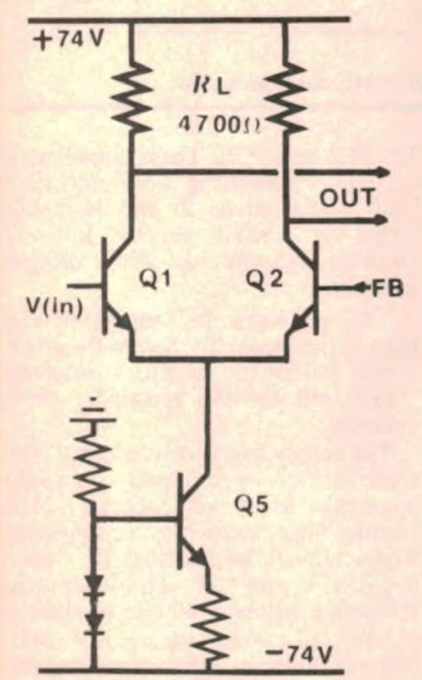


Fig. 1-A

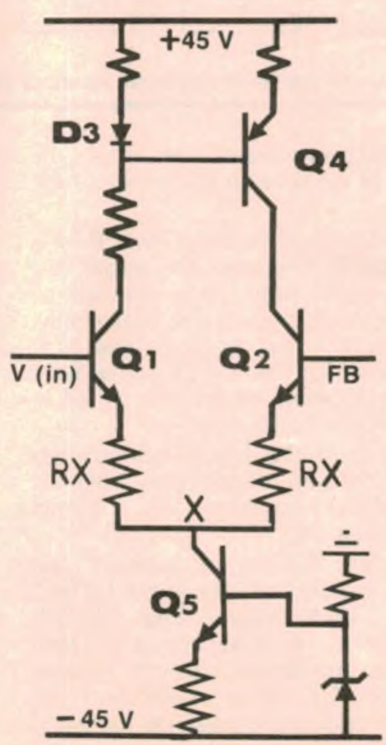


Fig. 1-B

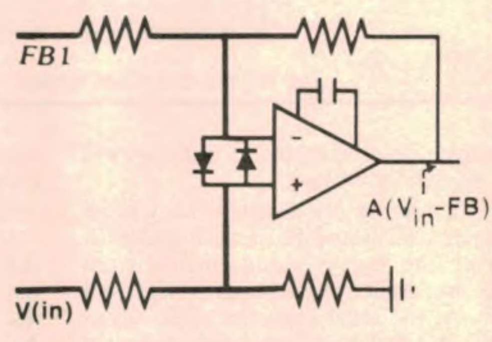


Fig. 1-C

Fig. 1: examples of differential input stages. In each case, Output = A(Vin − FB) where A is the closed loop gain of the stage. (A) uses simple loads RL; (B) uses current mirror load Q4/D3; and (C) uses an integrated circuit.

larger signals. Figs. 1 a, b and c are three alternative examples showing the essential ideas. Input applied to Q1 and feedback FB1 applied to Q2 are subtracted and the difference multiplied by moderate gain A1 to give

Error E = A1(Vin — FB1)

Accuracy, low drift and high common mode rejection ratio (CMRR) are enhanced by the active loads D3 and Q4 (Fig. 1(b)), and the active tail Q5. Both these features are usually included in IC1 (Fig. 1(c)) whatever your choice of integrated circuit.

Both Figs. 1(a) and (b) achieve the desired low-to-medium stage gain (to reduce the possibility of overload) but by different techniques. In Fig. 1(a) the low value resistor loads RL produce low or medium stage gain, and the use of output signals from both collectors is an option open to the designer. An alternative would be to use FETs here, and a further possible design choice could be to turn Fig. 1(a) upside down and use all PNP transistors, as for example in the Playmaster Series 200 (EA Jan 85, p27).

Fig. 1(b) initially achieves high (open loop) stage gain by using the high impedance "current mirror" load Q4, acting with D3 and the associated resistors. This works by forcing equal current through Q1 and Q2 at all times. If at any signal level these currents are unequal, the diode and resistors change the bias on Q4 to return to the condition of equal currents; ie, Q1 and Q2 currents are "mirrored" in each other. By virtue of the high impedance tail Q5, currents [i(Q1) + i(Q2)] add up to a constant, i(Q5). These two statements together mean that i(Q4) is also constant, which implies that Q4 represents a high impedance load, enabling high gain and high signal-swing capability. Sometimes D3 is replaced by a transistor connected as a diode, and occasionally Q3 and Q4 are a single transistor with two collectors.

Now what's all this rot about achieving high stage gain in Fig. 1(b) when we all know the requirement here is low-to-medium gain? Do not fret, gentle reader, the aforesaid high stage gain is the "open loop" gain of this stage only. We are going to apply "local negative feedback" to just this stage to bring the gain down to a moderate figure, raise the stage speed, bandwidth and input signal capacity and so discourage any overload condition.

But how can we apply local feedback? Easy — just add a resistor in series with each emitter lead of Q1 and Q2, as shown as RX in Fig. 1(b). By virtue of these resistors, signal currents develop an extra bias voltage which tends to reduce

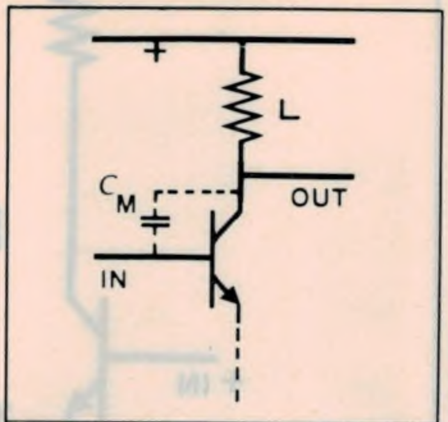


Fig. 2-A

Fig. 2: the driver stage must have very large signal swing capability and, for the complete amplifier to be an operational amplifier, must also have high gain. Therefore, L must be an active very high impedance load. The simple circuit (A) is unsatisfactory as Miller capacitance C reduces the bandwidth. Better alternatives are the cascode (B), Rush (C) and long tail pair (D). — see p84.

signal current, ie it is local negative feedback. This is really current feedback and is also known as emitter degeneration.

Power operational amplifiers for driving DC loads like motors, lamps, heaters and such only require a small bandwidth, often DC to about 10Hz. As well, they are not too fussy about a little distortion. For such applications, Fig. 1(c) makes a simple, cheap, quite satisfactory difference stage, and may work from the usual supply voltages such as ±15V. If Fig. 1(c) is used for audio work, then a fast high voltage integrated circuit would be a good choice except that it may be quite expensive.

Driver amplifier

Having deliberately opted for a low gain difference stage and forecasting that the output stage might be emitter followers (or FET source followers), each of approximately unity gain, the only place left to design for considerable gain is the middle stage — the driver amplifier.

The designer's choice here may be to use a single transistor, or some multiple combination. Single transistor stages, such as Fig. 2(a), are plagued by the Miller capacitance effect wherein collector-base capacitance is effectively multiplied by (1 + gain), which reduces the bandwidth drastically. Alternatives are possible, such as the cascode amplifier of Fig. 2(b), stolen from TV front end VHF amplifiers of triode valve days and from VHF transmitters. The bandwith is much improved because no

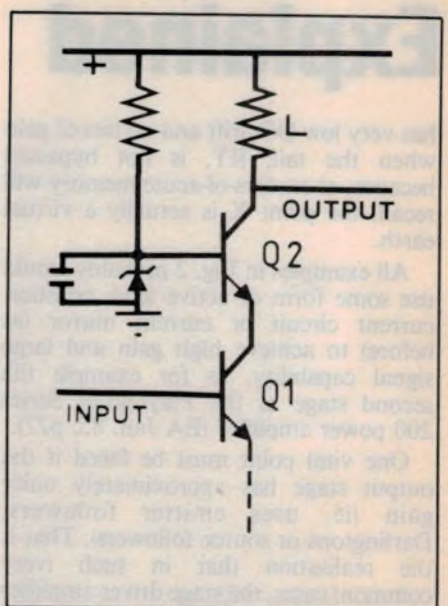


Fig. 2-B

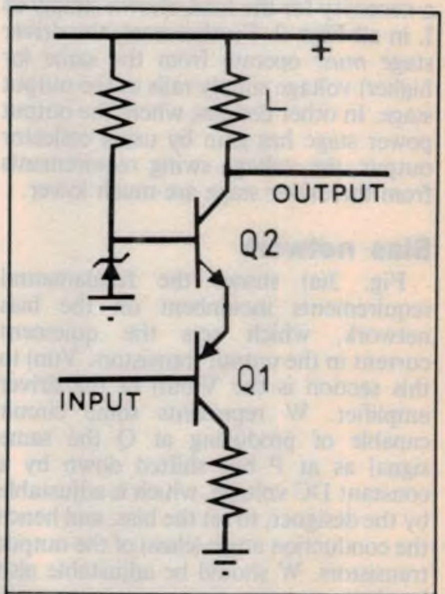


Fig. 2-C

Miller effect occurs in Q2 as its base is at AC ground, and almost no Miller effect occurs in Q1 because the loading on Q1's collector by the very low impedance looking up into the emitter of Q2 shunts the collector-base capacitance.

Fig. 2(c) shows a further improvement (used by C. J. Rush in 1964) which has higher gain by reason of the improved impedance match between Q1 and Q2. Here Q1 is partly an emitter follower whose low output impedance is a good match for the low input impedance of Q2's emitter.

Another alternative could be the balanced long tail pair of Fig. 2(d) which

OP AMPS Explained

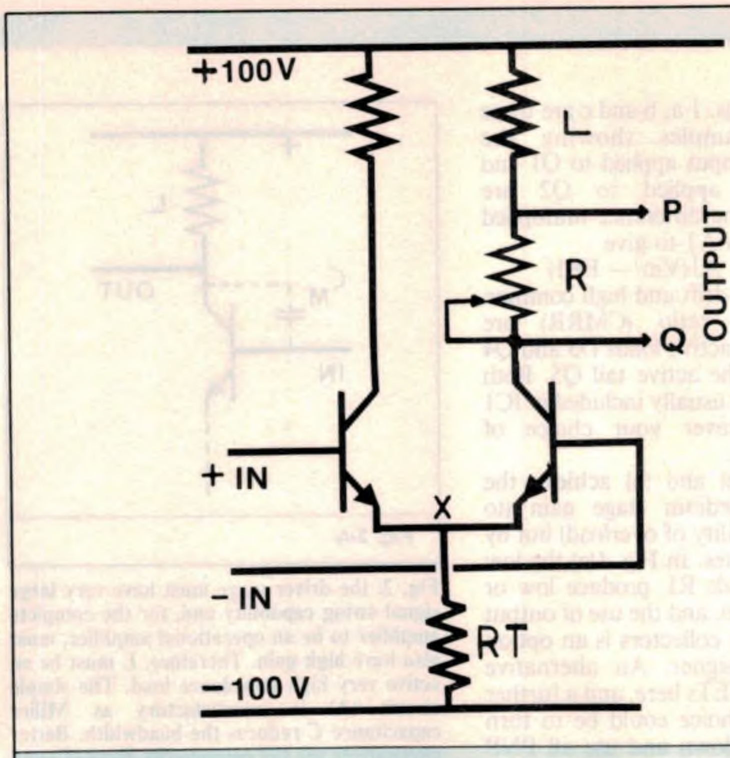


Fig. 2-D

has very low DC drift and no loss of gain when the tail, RT, is not bypassed because, as readers-of-acute-memory will recall, the point X is actually a virtual earth.

All examples in Fig. 2 probably would use some form of active load, constant current circuit or current mirror (as before) to achieve high gain and large signal capability, as for example the second stage of the Playmaster Series 200 power amplifier (EA Jan. 85, p27).

One vital point must be faced if the output stage has approximately unity gain (ie, uses emitter followers, Darlingtons or source followers). That is the realisation that in such (very common) cases, the stage driver amplifier must provide even more voltage swing than the power stage output! This is why current mirrors or other active loads are a necessity for the load, shown simply as L in all Figs. 2. Furthermore, the driver stage *must* operate from the same (or higher) voltage supply rails as the output stage. In other designs, where the output power stage has gain by using collector output, the voltage swing requirements from the driver stage are much lower.

Bias network

Fig. 3(a) shows the fundamental requirements incumbent on the bias network, which sets the quiescent current in the output transistors. V(in) to this section is the V(out) of the driver amplifier. W represents some circuit capable of producing at Q the same signal as at P but shifted down by a constant DC voltage, which is adjustable by the designer, to set the bias, and hence the conduction angle (class) of the output transistors. W should be adjustable also by the power transistor temperature, as for the same conduction angle, transistors need different bias V(BE) at different temperatures.

In the very basic circuit of Fig. 3(a), P and Q are "two junction voltages" apart, where "one junction voltage" for a silicon junction transistor is about 0.7 volts DC. Signal swing at P must appear also at Q without loss, but simply shifted in DC level. "Level translation" is the proper term.

If W were simply a resistor, that would not do; it might produce the correct DC translation, but being a resistor would incur some loss in signal swing. We must be more clever than that. Smarter-than-the-average-bear type readers will immediately exclaim that W should in fact be some circuit element which has constant DC voltage drop no matter what the current through it! How about a diode? That has about 0.7V across it for a wide range of currents. So for "two junction voltages" drop, what if W were simply two diodes as in Fig. 3(b)? Looks good at first sight doesn't it? And if the Darlington output of Fig. 3(c) is used, how does four diodes grab you?

So why the fuss? What's all the problem, you say?

Well there are three problems in Figs. 3(b) and 3(c):

(1) Diode voltage drops are not *exactly* equal to base-emitter voltage drops. This results in unpredictable bias on the output transistors, thus unknown standing current. We cannot foresee what class our amplifier will work in.

(2) Diode voltage drops are not adjustable. You just take what you get.

(3) The circuits of Figs. 3(b) and 3(c) offer a very low impedance for V(in), ie, they take a lot of driving.

Problems (1) and (2) could be allieviated by replacing one diode by an adjustable resistor, as in Fig. 3(d). The signal loss would not be too serious as there are so many diodes. The adjustable resistor could be set so that its voltage drop added to the other three diode voltage drops gave exactly the right DC bias between P and Q. We could choose the bias such that the output transistors at no signal are:

(a) on the verge of conduction (Class B); or

(b) (by applying more bias voltage) are conducting hundreds of mA, (Class AB); or

(c) are conducting many amps (Class A).

That fixes problems (1) and (2), does nothing for (3), but adds an extra problem:

(4) The signal loss in that variable resistor means that the signal at Q will be a little smaller than the signal at P, resulting in even and odd harmonics.

To satisfy objection (3), the low circuit impedance, we could:

(a) Use triple emitter followers (thus higher input impedance).

(b) Use power FETs as output stages (their gates are fairly high impedance).

(c) Put up with the low impedance and drive those diodes with an emitter follower.

All of the solutions of (a), (b) and (c) are in fairly common use. Now how do we do something about problem (4), the signal loss across a resistor? Fig. 3(e) shows a driver transistor Q1 and a very high impedance active load L in series with a much lower variable resistor RR. Due to this impedance ratio, the signal voltage across RR is extremely small, yet it does have a considerable adjustable constant DC voltage drop across it. P and Q are the drive points to the output transistors, and (so as not to load down these high circuit impedances) the output transistors should be FETs.

Another method is shown in Fig. 3(f) where Q1 is the driver transistor and Q2 functions as an adjustable constant voltage source. Q2 then provides the bias voltage to the output transistor bases (or

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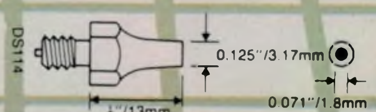

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OP AMPS Explained

gates) connected to P and Q.

Q2 is actually known as a "Vbe multiplier" since it multiplies the voltage appearing between its base and emitter by the ratio R1:R2. By setting R1 so that it is three times the value of R2, the voltage between P and Q will be four times the Vbe of the transistor.

It is normal practice to attach Q2 to the heatsink for the output transistors so that it is directly affected by the changes in temperature. Note that this then compensates for the temperature coefficient of the base-emitter voltage of the output transistors (2mV per degree Celsius) but does nothing to compensate for the increases in gain of the output transistors as they become hotter. The latter effect is normally compensated for by adding small resistors in series with the output transistor emitters to provide current feedback.

Next month we will deal with the remaining aspects of power operational amplifiers: output stages and feedback systems. Bye for now.

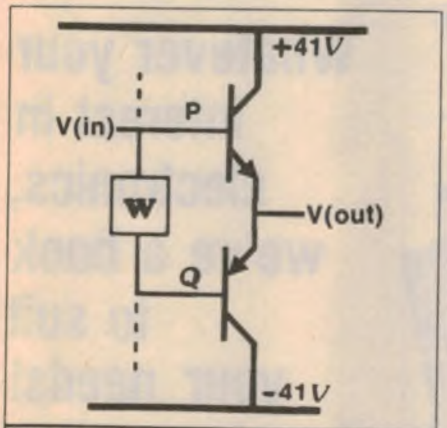

Fig. 3-A

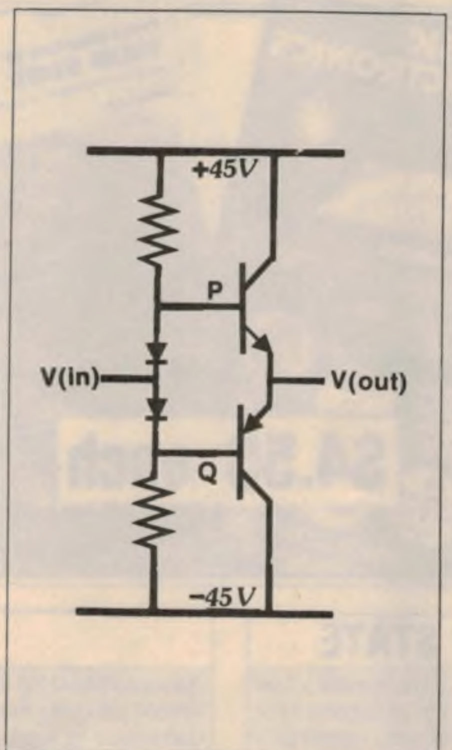

Fig. 3-B

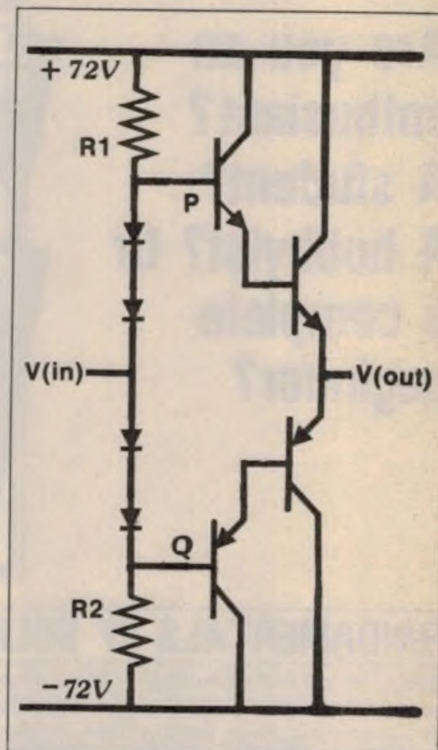

Fig. 3-C

Fig. 3: several methods for producing the bias voltage required by the output transistors to set their class (or conducting angle) and reduce distortion. (A) shows the required DC voltage separation W between drive points P and Q; (B) shows a rough method for setting W using two diodes; (C) shows how four diodes are used for Darlington output stages; (D) substitutes variable resistor RR for one diode in (C) to make DC offset P-Q adjustable; (E) uses driver transistor Q1 and a high impedance active load in series with a much lower variable resistor RR for negligible signal loss; (F) uses transistor Q2 to produce DC offset from P to Q without signal loss.

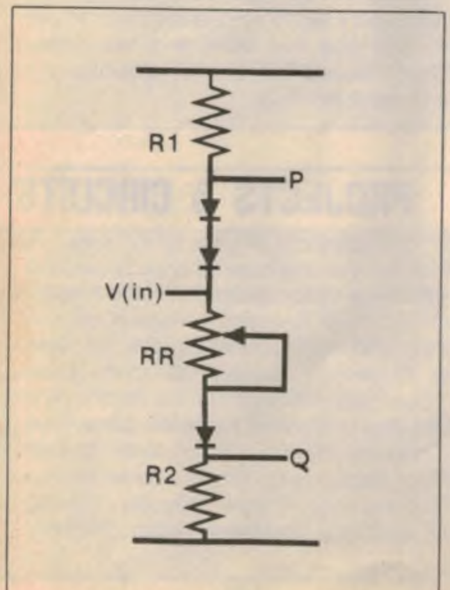

Fig. 3-D

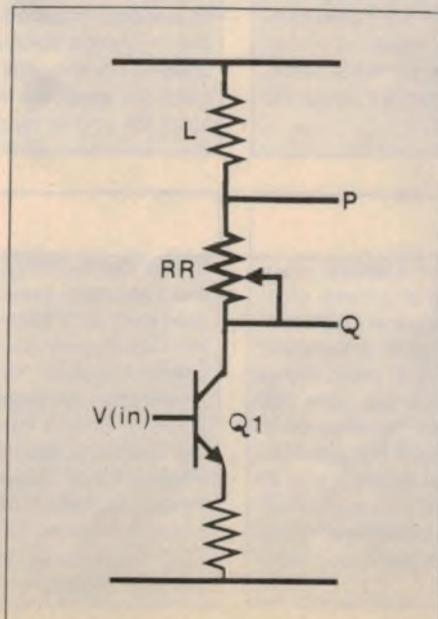

Fig. 3-E

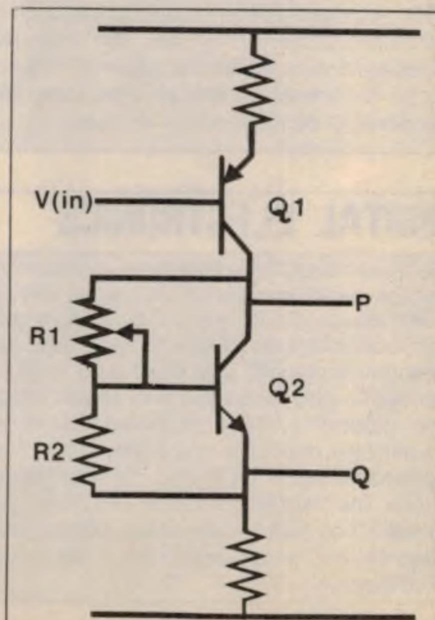

Fig. 3-F

ELECTRONICS AUSTRALIA HANDBOOKS

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FUNDAMENTALS OF SOLID STATE

Now in its second reprinting — which shows how popular it has been! It provides a wealth of information on semiconductor theory and operation, delving much deeper than very elementary works but without the maths and abstract theory which make many of the more specialised tests heavy going. It begins with atomic theory, diode types, unijunction, field effect and bipolar transistors, thryistor devices, device fabrication and microcircuits. A glossary of terms and an index complete the book. Fundamentals of Solid State has also been widely adopted in colleges as recommended reading — but it's not just for the student, it's for anyone who wants to know just a little bit more about the operation of semiconductor devices.

BASIC ELECTRONICS

As a basic text for the electronics enthusiast, Basic Electronics is almost certainly the most widely used manual on electronics fundamentals in Australia. It is used by radio clubs, in secondary schools and colleges, and in WIA youth radio clubs. It begins with the electron, introduces and explains components and circuit concepts and progresses through radio, audio techniques, servicing test instruments, television, etc. If you've always wanted to become involved in electronics, but have been scared off by the mysteries involved, let Basic Electronics explain them to you. Easy-to-understand diagrams and text make this the perfect book for you. We've even included five simple electronic projects for you to try your hand at building!

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Electronic equipment now plays an important role in almost every field of human endeavour and every day, more and more electronic equipment is "going digital". Even professional engineers and technicians find it hard to keep pace. In order to understand new developments, you need a good grounding in basic digital concepts, and Introduction to Digital Electronics can give you that grounding. Tens of thousands of people — engineers, technicians, students and hobbyists — have used the previous editions of this book to find out what the digital revolution is all about. The new fourth edition has been updated and expanded, to make it of even greater value. No previous knowledge of digital electronics is necessary — the book covers all basic concepts from scratch.

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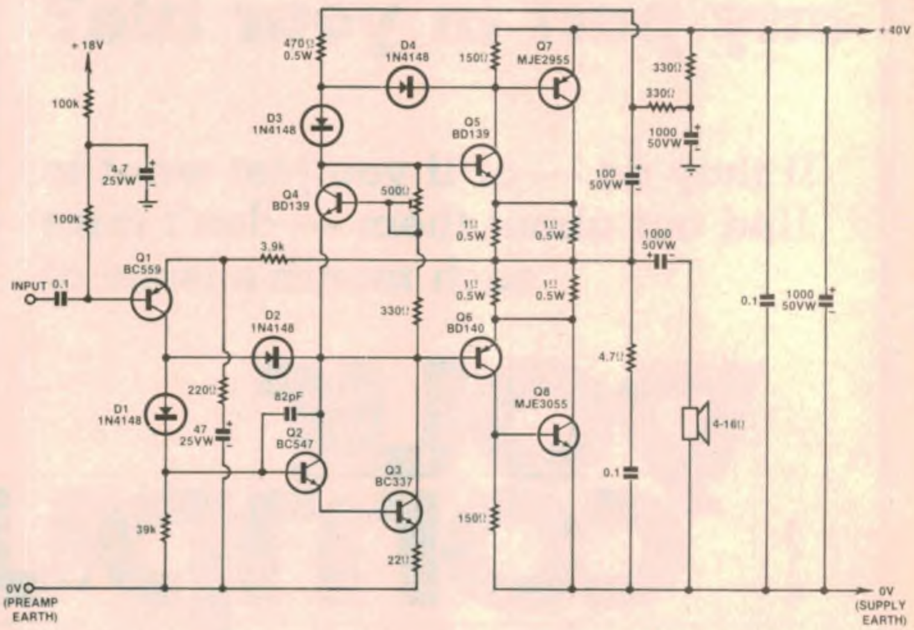
Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

Power amplifier



This amplifier circuit will deliver about 20 watts into an 8Ω load and has been designed to give good rejection of power supply ripple. The input stage consists of a single PNP transistor, Q1, driving a Darlington pair, Q2 and Q3. This then drives the output stage which consists of complementary Darlingtons Q5, Q7 and Q4, Q6.

Quiescent current in the output stage is controlled by the Vbe multiplier Q4 which is adjusted by the 500Ω trimpot. Q4 should be thermally coupled to Q5 or Q6. In the prototype, Q4, Q5 and Q6 were bolted together with Q4 in the middle and all three insulated from each other by mica washers, heatsink compound etc. Q7 and Q8 should be mounted on a suitable heatsink.

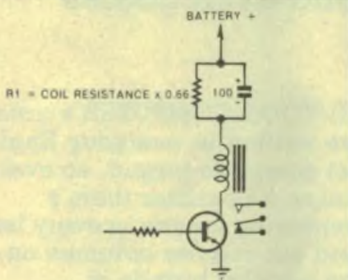
The collector load of Q2, Q3 is bootstrapped by the 100μF capacitor connected from the output of the amplifier to the 470Ω resistor. At the same time, the supply to this stage is decoupled by the 330Ω resistor and bypassed by the associated 1000μF capacitor.

Frequency compensation is provided by the 82pF capacitor connected between base and collector of Q2 and there is also a Zobel network comprising the 4.7Ω resistor and series 0.1μF capacitor, to ensure stability.

Diodes D1, D2, D3 and D4 are included to prevent possible saturation of Q2 and Q5 under overdrive conditions.

H. Nacinovich,
Gulgong, NSW.

$25



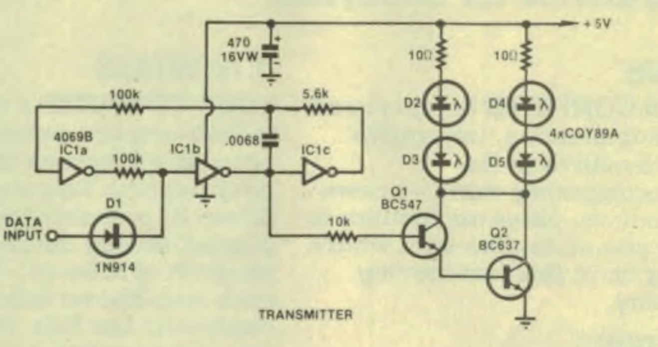
Low power relay energisation

To remain energised, most relays require only about 60% of the initial pull-in current. A simple RC circuit can be used to take advantage of this characteristic to extend battery life.

When switched on, the current through the coil is limited only by the relay coil impedance until C1 is charged. This should be long enough for the relay to pull-in. Then only a small holding current will then be needed and this is supplied by R1.

J.R. Dean,
Fitzroy, Vic.

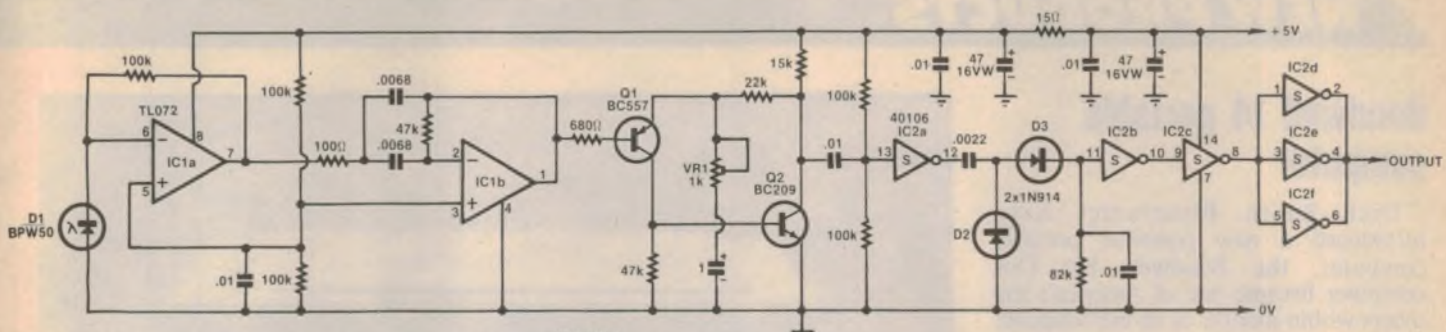
$8



300 baud infrared data link

This device was originally designed for use with a microcomputer system to enable the keyboard to be completely portable. The transmitter is located in the keyboard case and the receiver is connected to the micro's serial ASCII input. The sensitivity of the receiver is such that the keyboard can be used anywhere in the same room as the receiver.

The transmitter circuit is based around a hex inverting buffer, IC1. This is configured as a free-running oscillator with a nominal frequency of 10kHz. The data input signal gates this oscillator on and off through diode D1. The actual frequency of operation of the oscillator may be trimmed by altering the value of the 5.6kΩ resistor. Ideally, the frequency of oscillation should be equal to the centre frequency of the bandpass filter in the receiver.



RECEIVER

Transistors Q1 and Q2 form a Darlington pair which drives the infrared LEDs. With the supply voltage shown, the LED current is about 140mA.

The receiver uses a BPW50 photodiode to detect the infrared radiation emitted by the transmitter. IC1a forms a buffer amplifier for this diode, and IC1b a bandpass filter. This filter is necessary to remove spurious signals generated by sources of infrared radiation such as fluorescent lights etc.

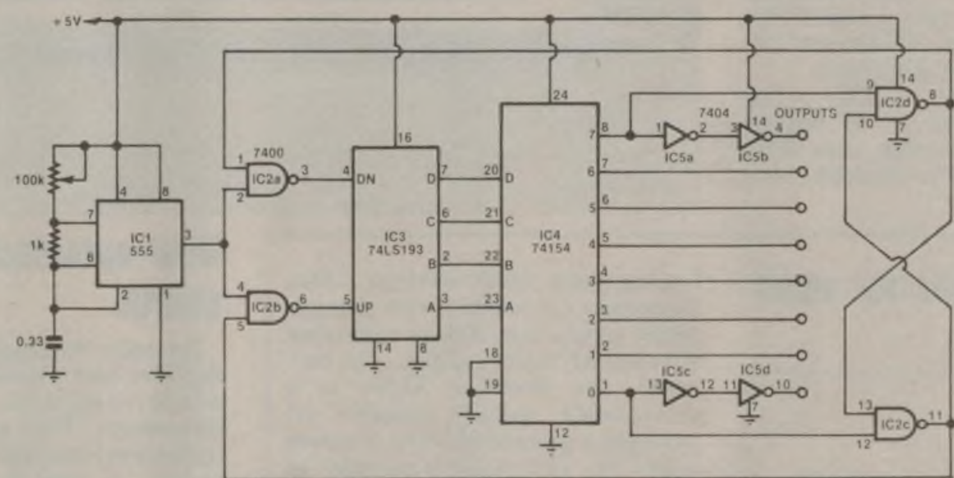
After filtering, the signal is amplified by the stage comprising Q1 and Q2. The gain of this amplifier can be adjusted by means of trimpot VR1.

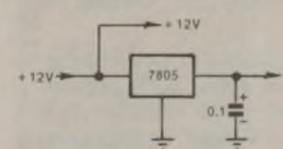
Schmitt trigger IC2a squares up the waveform, while the detector circuit, comprising diodes D1 and D2, the .01μF capacitor and the 82kΩ resistor, integrates the resulting signal. After squaring up and buffering by the remaining gates of IC2, the original signal is reproduced.

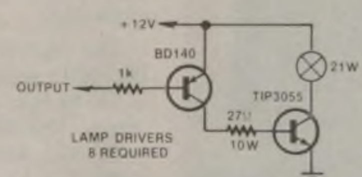
One point to note about this circuit is that at high signal levels, ie, with the transmitter very close to the receiver, the bandpass filter can saturate, causing distortion of the recovered signal. It is also necessary to house the receiver in a metal box to minimise interference.

A. Sinton,
Taupo, New Zealand. **$30**

Knight Rider scanner light







This circuit has been designed to emulate the red scanning light on the car Kitt, in the Knight Rider TV show. The circuit will drive eight standard automotive lamps. The wattage rating of the lamps depends on the type of output transistors. The transistors used here would allow lamps rated at up to 30W to be used.

More or less than eight lamps can be used, simply by shifting the connection on pin 8 of IC4 to a higher or lower counter output, and adding or subtracting output stages.

The flash rate is controlled by the oscillator formed by IC1 (555) and associated components. The output of this oscillator is gated into either the up or down counter inputs of IC3 by the NAND gates IC2a and IC2b. IC4, a 4-line to 16-line decoder, is clocked up or down by IC3. When either the 0 or 7 count is reached, the flipflop formed by IC2c and IC2d toggles, and the count direction is reversed.

The driver stages are connected to the decoded outputs of IC4, except for the first and last stages which are connected via a buffer. This was found to be necessary because of the extra load applied to these stages by the NAND gates.

A three terminal regulator provides the 5V supply necessary for the TTL ICs.

Craig Terry,
Berwick, Vic. **$15**

Bondwell 14 portable computer

Dick Smith Electronics have introduced a new powerful portable computer, the Bondwell 14. This computer became one of America's top sellers within months of its introduction.

The computer features 128K of inbuilt user RAM, twin 5¼ inch slim line, double sided, double density disk drives, a 9 inch amber monitor capable of displaying 80 columns and a 91-key keyboard.

The Bondwell 14 runs user friendly CP/M version 3.0, ensuring a wide variety of software will be available. Dick Smith are providing WordStar, CalcStar, MailMerge, DataStar and ReportStar — over $1200 worth — at no extra cost.

A special feature of the machine is an inbuilt printer buffer allowing continuation of work while printing out — useful for increasing productivity. Standard parallel and RS232 ports are included, as is a voice synthesiser.

With a price tag of $2295, this computer is expected to be popular among business and home users alike. Further information is available from Dick Smith stores.

Power supplies for small computers

Leading power supply specialist Amtex Electronics has added a new multiple output supply to its already wide range of computer power supplies. The new model, the Boschert XL80, is a switchmode supply capable of providing a genuine 80 watts of power in free air. This rating is extended to 100 watts if forced air cooling is employed.

The unit is available in two models, the 4601 and the 4603. Both provide +5V at 8A, and ±12V rails for disk drives. The 4601 provides an additional −5V rail, and the 4603 an additional isolated +12V rail.

Physical dimensions are 210 × 113 × 64mm. The supplies feature all of Boschert's standard features, such as input surge protection, user selectable 110/240V operation, over voltage protection on the 5V output, and short circuit protection. The supplies comply to UL478, CSA C22.2, VDE 0781 and IEC 380 safety requirements.

Further information is available from Mr Jim Kuswadi, Amtex Electronics, 36 Lisbon Street, Fairfield, NSW. Phone (02) 728 2121.

New optoelectronic source

Ritronics Wholesale have announced that they have sourced a new supplier of phototransistors and infrared components. They have three of these components available, each intended to replace an already popular existing device.

The first of these is the PD633 silicon infrared photodiode, intended as a substitute for the BPW50 photodiode. It has the same physical configuration and electrical characteristics as the Philips device.

The second device is the IR333. This is an infrared emitting diode similar to the familiar CQY89. The diode is available in a standard 5mm LED type package.

The third device which Ritronics wholesale has available is the PT202C. This is an infrared phototransistor electrically similar to the FPT100. Mechanically the two devices are quite different, the PT202C being encapsulated in a standard 3mm LED package.

For further information and data contact Ritronics Wholesale, 425 High Street, Northcote, Vic 3070.

Pre-packaged home security kit

Efco Manufacturing Pty Ltd have recently released a complete home security kit. Efco have been involved in the professional security field for many years, and this kit is their first venture into the consumer market.

Based on the company's proven 4-sector control panel, the kit provides all the necessary components to put together a high quality home security system. Included in the kit are: the control panel, a passive infrared detector, a siren, two reed switches, an emergency (panic) switch, a backup battery, a 100m roll of two core flex and a comprehensive installation and instruction manual.

The manual contains details of installation, including diagrams and instructions, as well as operating advice and suggested options which can be included to expand the system.

As it stands the Efco home security kit provides adequate protection for the average sized house, while the addition of a few accessories enables the sysem to be used in very large homes, shops and offices.

Details are available from Efco Manufacturing, 108 Princes Highway, Arncliffe, NSW. Telephone (02) 597 6600.

Low-cost tacho probe

Warsash Pty Ltd has announced the release of a unique device for use with rotary machinery.

The Tachoprobe is a non-contract device which utilizes visible light and a single lens sensing system. It is very simple to use and indicates rpm measurements directly on the display of a digital multimeter. It can also be used with most analog multimeters.

A visible light beam, produced by the instrument is aimed at a reflective target previously attached to the rotating object. The optical system detects the reflections from the target and converts then into electrical impulses.

The Tachoprobe is supplied as standard with a pack of reflective tape, a coiled cable terminated in 4mm test plugs and 4 AA batteries. All instructions are clearly printed on the instrument.

Warsash Pty Ltd, PO Box 217, Double Bay 2028. Phone (02) 30 6815.

Micro-controlled manometer

Just released in Australia by ANI Perkins is a four range micromanometer, the MP3KDS. It features an on-board microprocessor which can continually process the output from a pitot-static tube, perform the necessary arithmetic and display the velocity directly on a 3 1/2-digit LCD, as well as providing a remote output.

Duct velocity measurements from less than 1m/s to over 70m/s are performed with a resolution of 0.1m/s. Accuracy over the whole range is better than 1% +/− one digit.

The instrument is based on the patented type 1172 capacitance transducer and its capabilities are fully exploited by the three pressure ranges. These cover differential pressures from 3000 Pa full scale (4000 with reduced linearity) right down to 0.1 Pa.

Warburton Franki, 7 Birnie Avenue, Lidcombe, 2141.

Sepac modules

Sepac Industries have announced the release of their Australian designed and manufactured S720 and S722 "Private Call" signalling modules.

When the base station is fitted with the S240 Status and Indentification Console, it has total control over all the communications within the network. Either two way mobile radios or partyline equipment can be fitted with the module.

Communication between mobile and base is totally private from all other units unless they are specifically enabled by the base.

The modules are based on Sepac's field proven 8002 signalling microprocessor which allows the selection of any one of six international signalling formats. They are housed in compact, sturdy cases ready for external interfacing to most communications systems.

Sepac Industries: 134 Beach St, Frankston, Vic 3199. Phone (03) 781 3144.

Integrated circuit storage frame

Hales and Rogers Pty Ltd have just released an integrated circuit storage frame that solves the problem of storing a quantity of integrated circuits in their tubes. Up till now it has been difficult to store ICs in a manner which gives easy access to stock, does not consume a large amount of space and is low in cost.

The Hales and Rogers storage frame can easily hold up to 9000 16-pin ICs in their tubes. It has 60 easily labelled pigeon holes, each capable of storing six tubes of ICs. The frame is quite small, measuring only 460 × 460 × 410mm (W × H × D). It is of sturdy wire construction, light weight, and is easy to move around.

Probably the most attractive feature of the frame is its low price of $28.00 (ex tax). Hales and Rogers will deliver one anywhere in Australia for $4.00.

Hales and Rogers Pty Ltd, 17 Mobbs Lane, Carlingford, NSW 2118. Telephone (02) 85 7540.

PCB level selcall by Sepac

A new PCB module has been added to Sepac's constantly increasing range of selective calling products. The S370 PCB is small enough to fit internally in most two way radios, allowing selective calling on either a fleet or an individual address basis.

Based on Sepac's SI8002 microprocessor signalling IC, this module allows normal quiet operation of the mobile or base station, until individually addressed.

Programming of all five tones of the receive and transmit codes, selection of tone periods, lead in delay, tone format and other variables, is achieved by simple solder bridging of the code matrix. This eliminates the necessity to cut tracks or add components as in other inexpensive selcall add-ons.

For further information, contact Sepac Industries (Australia) Pty Ltd, 134 Beach St, Frankston, Victoria, 3199.

Data link simulator

The PAS 9100 DLS data link simulator released by Professional Australian Systems is designed to cut development costs, particularly for long haul satellite users. It simulates a terrestrial or satellite communications link by introducing delays or inserting errors to enable link users to simulate the effect of these characteristics on their system.

The unit is able to simulate a total transmission facility, including the modems and telephone lines. The DLS is totally transparent to system protocols and can simulate either half or full duplex mode. A unique feature of the unit is its ability to simulate satellite one way propagation delays for data rates up to 64,000 bits per second.

Professional Australian Systems, 338 High St, Thornbury, Vic 3071. Phone (03) 429 2977.

New security products from GRM

Three new products have been recently added to GRM's range of alarm system components.

The IFM-120 passive infrared detector features a 12 metre range over the entire 90° field of view, a compact, attractive case and simple mounting. DC current consumption is typically 12mA at 12V and the unit features a very wide operating temperature range.

Also stocked is a range of detectors from C and K, combining both passive infrared and microwave detectors in the same unit. This is claimed to reduce the incidence of false alarms considerably. The unit comes in various configurations, is tamper proof and RF shielded.

The third product, from Protection Technology in the US, is a microwave detector using stereo microwave technology. The system works by sensing the distance a target moves, rather than sensing the speed and size of the target as in conventional units. The distance a target must move before causing an alarm may be preset by the installer.

Further information on all of these products is available from G.R.M. Wholesale Pty Ltd, 15-19 Boundary St, Rushcutters Bay, NSW. Phone (02) 332 3999.

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SPECIFICATIONS
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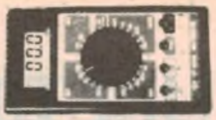

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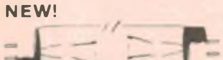

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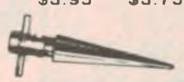

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Ideal for modem connections.

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Plug	Cat. Y1601	**$3.95**
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Why pay more??

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TO3 HEATSINK

1-9	10+	100+
$1.00	$0.90	$0.75

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Make your own presensitized PC Boards. POSITIVE PHOTO RESIST for using 1:1 tapes and pads on clear film for one off or prototypes. Resist 50ml bottle for apprx. 1500 sq cm of pcb

Cat. P85500 **$6.95**

DEVELOPER: 70 gms of crystals to mix with 2 lt of water, enough to complement 50ml of resist

Cat. P85504 **$3.25**

NEGATIVE PHOTO RESIST for using normal negative PCB images
Resist: 50ml bottle for apprx. 1500 sq cm of pcb

Cat. P85508 **$5.45**

DEVELOPER: 500ml bottle enough to complement 50ml of resist. No dilution reuqired

Cat. P85510 **$8.50**

ETCHANT: 400gms of crystals to mix with 1 to 1½ lts of HOT water

Cat. P85512 **$3.25**

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VHS and Beta available. A professional head cleaner, employs 'double sided' cleaning action. Just insert the cassette 'play' for 30 seconds and the job's done!

VHS CAT. A11456 **$17.50**
Beta Cat. A11457 **$17.50**

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Dual cone, wide range, 200mm (8 in.) 10 W ideal for public address, background music etc.

	1-9	10+
Cat. 1200	**$9.50**	**$8.50**

CAR REPLACEMENT SPEAKERS

Cat. C10757	5x7" Oval	**$5.95**
Cat. C10746	4x6" Oval	**$4.95**
Cat. C10705	5" Round	**$4.50**
Cat. C10706	6" Round	**$5.95**

All are rated at 4 OHM, 5 WATT

MINI STEREO HEADPHONE

Low cost hi-fi sound! Light and comfortable, as easy to wear as hair!

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3 ½" MAGNIFYING GLASS

Ideal for close inspections of solder joins etc

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PIN VICE

It's infuriating when all you need to do is drill one hole a little big bigger and haven't got a drill that fits in your tool box. Buy one of these for drilling circuit boards. Will hold drill bits, taps, files, etc. up to 3mm

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Cat. C14950 **$29.50**

JVC video camera

JVC, one of the forerunners in video camera technology, have released yet another new model — the GX-N7E. JVC claim to have automated all major camera functions, allowing the user to devote himself entirely to the creative side of video.

As well as being able to operate in light levels as low as 10 lux, focus, white balance and exposure controls are totally automated. Importantly, the GX-N7E is able to continuously adjust itself to compensate for colour temperature changes. This ensures accurate colour reproduction in most light conditions.

Versatility is another highlight. The 6:1 zooms lens included with the camera can easily be removed and replaced by standard lenses for 35mm cameras. Adaptors are available for lenses from Canon, Nikon, Pentax, Olympus and Minolta.

The GX-N7E is available from Hagemeyer (Australia), 5-7 Garema rcuit, Kingsgrove, 2208. Phone (02) 750 3777. The recommended retail price of the camera is $1399.

New record care products from Goldring

Three new products have been recently added to GRM's range of alarm system components.

The IFM-120 passive infrared detector features a 12 metre range over the entire 90° field of view, a compact, attractive case and simple mounting. DC current consumption is typically 12mA at 12V and the unit features a very wide operating temperature range.

Also stocked is a range of detectors from C&K, combining both passive infrared and microwave detectors in the same unit. This is claimed to reduce the incidence of false alarms considerably. The unit comes in various configurations, is tamper proof and RF shielded.

The third product, from Protection Technology in the US, is a microwave detector using stereo microwave technology. The system works by sensing the distance a target moves, rather than sensing the speed and size of the target as in conventional units. The distance a target must move before causing an alarm may be preset by the installer.

Further information on all of these products is available from G.R.M. Wholesale Pty Ltd, 15-19 Boundary St, Rushcutters Bay, NSW. Phone (02) 332 3999.

In-car entertainment from Pioneer

Pioneer Electronics have announced the release of their latest range of in-car audio products. The new "Centrate" range is aimed at a small number of hifi buffs who want the ultimate in car sound.

The system is based around Pioneer's FEX-90 preamp tuner deck combination. DIN sized, and with the latest smooth-faced design, the FEX-90's focal point is a pictographic function display door which conceals the cassette entry.

The FEX-90 has many features usually associated with top-of-the-line home audio gear, such as a 4-motor cassette mechanism, Dolby B and C, auto reverse, music search, quartz PLL tuning, automatic tape selection, separate bass, treble and volume controls, attenuator, digital clock and a cordless, infrared remote control.

The Pioneer EQ-003 seven band preamp equaliser and optional GTX-X80 subwoofer controller can also be included. Pioneer recommends two amplifiers for use with the Centrate system, the GMA120 (60W per channel) or the GMA200 (150W per channel). Both of these amplifiers are mounted remotely — say in the boot.

A number of speaker options are also available for use with the Centrate range of products.

Pioneer claim that they are not looking for volume sales with the Centrate. With the retail price for a complete system likely to approach $2500, the Centrate range is likely only to appeal to car audio enthusiasts. Further details can be obtained from Pioneer Electronics, PO Box 295, Mordialloc 3195. Phone (03) 580 9911.

New Pioneer CD player for cars

Camera works in moonlight

Security cameras that "see" in the dark — even when light levels are no better than average moonlight — have been released by the Video Systems division of GEC Australia Limited. The WV-1900 camera, produced by Panasonic and marketed in Australia by GEC, has been named the "Moonlight". The camera incorporates a highly sensitive 25mm Newvicon tube with an image intensifier to produce pictures even under moonlight conditions.

Tests of the camera have shown that it can clearly picture the detail on a belt buckle at 50m during normal moonlight conditions. Low blooming and low image retention are also features of the Newvicon tube.

The camera, which can operate effectively in light levels as low as .0003 footcandles, features a series of automatic functions such as automatic beam control, automatic electronic focus, automatic black clamp and automatic light control.

The Moonlight camera also has automatic internal/external sync switching, built in protection circuitry for the tube and image intensifier and a rugged diecast chassis to protect it from rough handling in normal usage.

For further information contact GEC Australia Ltd, 22 Giffnock Ave, North Ryde 2113. Telephone 887 6222.

JVC compact disc player

JVC has released a new compact disc player, the XL-V300B, which features random access play of up to eight tracks. A newly developed low pass filter is incorporated, as is a two speed search facility and a multifunction display.

The player is a front loading type, measuring 435 × 92 × 294mm and weighing 5.1kg. The specifications are well up to the high standard which is typical of these players.

With a price tag of $699.00, the XL-V300B is competitively priced. Further information can be obtained from Hagemeyer (Australia), 5-7 Garema Circuit, Kingsgrove, 2208.

Designed as part of the Centrate range of car audio components, Pioneer have introduced a compact disc player known as the CDX-1. While this player can only be used in conjunction with the Centrate range, Pioneer are currently working on a CDX-P1 version of the player which includes the necessary preamp to allow the player to be used with other systems.

Pioneer claim to have overcome the problems with vibration, heat and dust that have held up the transfer of digital disc technology into the automotive environment. In doing this they have split the compact disc player into two parts. The first, containing the mechanism and display, mounts in the dashboard. The electronics is mounted in a separate module intended for location inside the dashboard or under the front seat.

All the control features included in Pioneer's top-line PD-70 home compact disc player are included in the CDX-1. Among these are skip-search, music scan, track repeat, time remaining, elapsed time and others.

The CDX-1 will sell for around $1000. The CDX-P1, to be released in March of this year, will be similarly priced. Further information can be obtained from Pioneer Electronics, PO Box 295, Mordialloc 3195. Phone (03) 580 9911.

Speech synthesiser for Commodore 64

The time has come for the Commodore 64 to speak for itself! With the Currah Speech 64, your Commodore will have an extensive vocabulary, two voices and some extra Basic commands — all for just $69.

by FRANCO UBAUDI

Talking computers are not new — systems with limited vocabularies have been available, at a price, since the 1960s. What is new is the low cost and versatility of allophone speech synthesisers.

The Currah Speech 64 is an allophone speech synthesiser, which means that it uses individual speech sounds strung together to make intelligible speech. Unlike some speech synthesisers which have a fixed vocabulary, the Speech 64 can synthesise any word in the English language.

Apart from the challenge to experimeters and the fun of speaking computers, voice synthesis has some serious applications. Obviously, speaking computer terminals are useful for conveying information to a user who cannot sit with eyes glued to the screen.

Speech can also provide computer facilities to the blind and visually handicapped, and there are a number of talking calculators available for this purpose. In fact the uses for speech synthesisers are probably only limited by the imagination.

The Currah Speech 64 comes as a small neat unit measuring approximately 70x73x20mm which plugs into the cartridge expansion port on the back of the Commodore 64. As well, a DIN socket needs to be plugged into the Audio/Video socket of the computer. Once plugged in, the system is ready to go. No software needs to be loaded, and only one command is needed to start the system.

Initialisation

Once the command INIT is entered into the Commodore 64, the Speech 64 will "voice" any key which is pressed. This is a useful learning aid for young children when this feature is combined with some intelligent software. If you type faster than the keys are voiced the system will simply try to speak the last key pressed.

Two voices are available. To enable the low voice the command KON0 need only be entered and to return to the high voice the command KON is required. The default voice is the high voice.

To disable the keyvoices the command KOFF should be entered. Conversely, to re-enable the keyvoices, the KON command is used. Once the keyvoices are disabled you are free to use the Text to Speech Interpreter without having every key voiced. Now to have a word/s or phrase/s spoken the function SAY is used. Any text submitted by SAY is automatically converted to speech sounds by the internal software of the Speech 64.

For example, to have the word "hello" spoken, enter: SAY "hello".

It's as easy as that!

In normal speech, punctuation plays an important role. With the Speech 64, punctuation marks (commas, apostrophes, colons, periods) are all interpreted as pauses of various length but where a period occurs before a digit (eg, 3.4) it is spoken as "point".

Text interpreted by the Speech 64 is held in a buffer capable of holding 256 allophones (or approximately 30 seconds worth of speech) at any moment, and if Speech 64 finds that there is no room for a new word or phrase to be added, the phrase will be ignored. You can get around this by using a delay loop in your program or by examining the buffer.

If you break into a program while it is running, any speech in progress is stopped and the buffer automatically

TABLE 1

Mnemonic	Sounds like	Mnemonic	Sounds like
Letters a-z	"phonetic"	(ar)	"ar" in arm
(excluding	like a in "cat"	(aer)	"air" in repair
q and x)	"b" in "tab" etc	(ch)	"ch" in church
		(ck)	"ck" in clock
(aa) or (ay)	"ay" in hay	(ear)	"ear" in clear
(ee)	"ee" in see	(eh)	"ar" in wary
(ii)	"i" in hive	(er)	"er" in leader
(oo) or eau)	"o" in stove	(err)	"ur" in purr
		(ng)	"ng" in tongue
(bb)	"b" in bat	(or)	"or" in sore
(dd)	"d" in do	(ou)	"oo" in root
(gg)	"g" in got	(ouu)	"oo" in food
(ggg)	"g" in big	(ow)	"ow" in now
(hh)	"h" in hoe	(oy)	"oy" in boy
(ll)	"l" in let	(sh)	"sh" in ship
(nn)	"n" in no	(th)	"th" in thin
(rr)	"r" in ruin	(dth)	"th" in then
(tt)	"t" in to	(uh)	"oo" in took
(yy)	"y" in yeah	(wh)	"wh" in which
		(zh)	"z" in azure

' (apostrophe)	very short pause
SPACE	pause between words
, (comma)	pause between phrases

The double-letter allophones (bb) to (yy) inclusive are used where extra emphasis is required eg, at the start of words.

The above table lists the available sounds (or allophones) which can be produced by the Currah Speech 64. Any word in the English language can be synthesised.

The Speech 64 plugs into the cartridge expansion slot on the back of the Commodore 64.

is known in every day terms as accent, is achieved by "bending" the frequency of the speech output up or down slightly to give it inflection. The output from the speech processor is in fact a high frequency digital signal which has to be processed by a filtering network before it can be outputted to the Commodore 64.

The second IC is an 8K byte ROM (Read Only Memory) which contains all the instructions necessary for Speech 64 to perform all functions. Key voicing, text to speech conversion and operating system are all stored in this IC. Having all this software on ROM means that Speech 64 is ready to use immediately the computer is switched on.

The third IC is a Gate Array, or Uncommitted Logic Array, containing 500 gates. This "semi-custom" chip supervises all the hardware functions, such as looking after the speech chip's timing signals and ensuring that Speech 64 and the host computer communicate properly.

emptied. This is to ensure that you will not have to wait for the buffer to empty itself; 30 seconds of unwanted speech can be quite tedious!

The advantage of having interpreted text stored in a buffer is significant to say the least. Because the text is interpreted and saved for use by the Speech 64, the Commodore is free to do other useful work as soon as its task of transferring text to the Speech 64 is complete. Therefore the Commodore could for example update a graphics display while the Speech 64 continues to speak text stored in its buffer.

Using allophones

Turning text into speech is quite a difficult procedure as there are many spelling-pronunciation irregularities. For instance, "plough" and "cough" are spelled similarly but the "ough" component is spoken differently. Speech 64 uses a rule-oriented system which can cope with most common spelling/ pronunciation irregularities, but there are words which it cannot cope with as they do not obey any logical rules.

However, it is still possible to get Speech 64 to say correctly many illogically pronounced words. For example, suppose you wanted the Speech 64 to say "Hawaii". Therefore you would type in:

SAY "HAWAII"

to which the unit would respond with something sounding like "Haway-i". One way of getting the correct pronunciation would be to deliberately misspell Hawaii. Another possibility is to use allophones directly. When using allophones directly the string to be spoken must be enclosed in square brackets. To make the sound "ai", the allophone mnemonic is (ii) and to get the correct "e" sound the allophone mnemonic (ee) is used.

So by stringing the following together:

SAY "[haw(ii)(ee)]"

it is possible to get quite a good sounding approximation of Hawaii.

Intonation is also available on the Speech 64 system. Intonation is useful for adding a degree of expression and "life" to what is otherwise rather flat robotic speech. However due to the complexity of the text-to-speech routines, you can only use intonation when you are using the allophones directly. Intonation is accessed by using upper and lower case letters for mnemonics (upper case is intoned UP, whilst lower case is not intoned).

It is worth mentioning that machine code programming of speech is available in Speech 64, provided you have an assembler module for the Commodore 64. We were unable to obtain such a module to try this feature.

Inside the Speech 64

Inside the Speech 64 module there are three integrated circuits and a few passive components. The first IC is the SP0256-AL2 Speech Processor which generates the 64 individual speech sounds (allophones). (See table 1 for a list of Allophones) it does this by applying a digital multi-pole filter to the output of a digital noise source.

Intonation, or voice modulation which

How understandable?

Considering intelligibility is difficult. If you are typing in a sentence to be spoken, you know what's going to be said and this naturally affects your judgement. You need to have the judgement of someone who does not know what to expect. When subjected to this test there were problems but in many cases the listeners were able to receive the correct message. There was just as much correct interpretation as not.

When I typed in a sentence, I was able to understand what the Speech 64 was saying 99% of the time. However, the more I played with the system the more understandable the speech became to me.

Therefore, Speech 64 like many of the less complex speech synthesisers, is effective for people who work sufficiently with them to become accustomed to their accent. In situations where the unaccustomed are likely to be involved, only words which prove to be easily understood should be used by the system.

Conclusion

For people interested in adding speech to computers, the Speech 64 can prove to be a very interesting and enjoyable learning experience. At its selling price of $69 it is certainly a very effective and inexpensive unit.

For those who have a VIC-20, a similar system is also available. Called Speech Synthesiser, it costs $66.50.

For further information on these products, contact Dolphin Computers Pty Ltd, 99 Reserve Rd, Artarmon NSW 2064. Phone (02) 438 4933.

Learning to love the home computer

Children want personal computers for playing Space Invaders. But they do have another application. As the author quickly discovered, one of the few real uses of a home computer is word processing.

by JIM LAWLER

When Neville Williams wrote about *An important role for "useless" small computers!* in the August edition of EA, I tried hard to believe him but couldn't.

The article discussed two families, each facing the purchase of a computer and each trying to justify the expense. The father of one family had ultimate need for a business computer and he thought he would learn about "driving" it from the domestic model.

The other family thought their children would become more computer literate if they had a machine at home. A modicum of thought and a little observation would show that both families are in for a rude shock.

Father number one will eventually buy his business computer, together with a business software package reasonably suited to his needs. He will either employ a professional programmer to alter the software to suit his business or, more likely, alter his business to suit the software.

The second family will buy a small domestic type computer and hopefully the children will become quite adept at operating it. However, they will be little better equipped to face the quite different school computers than those children whose parents could not or would not buy them a computer.

Just think of it. Father number one might become the best programmer in Commodore Basic in his street. But how will he fare with the business program written in Pascal or Cobol, or worse still, in machine language? Let's face it, there is little similarity between a business type computer and a domestic model. Anyway, most businessmen are not interested in programming computers; they are too busy running their businesses.

As for the children, five minutes in any high school or college computer department will show why kids want a computer. There is a roaring trade in pirated games on disc or tape, and the monitor screens are full of killer gorillas or pacmen. With few exceptions children only want to learn about programming so that they can write bigger and better games. Precious few students go on to more serious programming.

Everything written in August *Forum* can be justified, but so can a lot of other things if you really want to justify them. I imagine that even criminals at some time imagine that they are doing the right thing.

No! The justification for a domestic computer is not to be found in the August *Forum*. But the November article *This was written on a "useless" small computer* is another story altogether. A word processor is surely the one application of a microcomputer that can justify its position in any home.

When my youngest son asked if he could spend his hard won savings on a computer I initially put my foot down. We were not going to have space invaders beeping their way around our lounge room and that was that!

However, I think the lad might make a good salesman because he left various computer magazines around the house, each opened casually at the page advertising the BBC microcomputer. When tackled about the books, he mentioned that his older brother was using the BeeB at college and the same machine was used in the computer department at his high school. It was the versatility and expandability, etc that made it the machine to buy.

One aspect of the BBC caught my eye. It was a word processor in ROM that was claimed to have almost all the features of a professional word processor at only one tenth of the cost. It could hold more than four thousand words and had all kinds of whizz-bang editing commands. Experience would later show that one can't believe every claim made by the software publicists. (See Leo Simpson's editorial, December 1984).

So, Son the Younger received permission to buy the computer, provided that Dad could use it for word processing. It might be mentioned here that Dad had to buy the printer, disk drive and the word processor ROM, as well as provide a modified TV for a monitor. Everything that follows refers to the BBC micro but can just as easily refer to any of the middle price range of domestic micros.

The equipment arrived and was set up in the lounge room. I got the ROM fitted without any trouble, and the screen began to produce all the expected characters. It was not until I started to use the printer that I came unstuck.

In the words of the old comic song, it went "whirrrr" when it worked and "brrrrr" when it stopped and "click" when it stood still. I do not know just what it does and I guess I never will.

Fortunately, the word processor manual had detailed instructions for laying out pages, setting margins etc, so that part of the operation was straightforward enough. But getting the printer to produce the different type faces and to follow the desired layout was another story.

The printer is controlled by "embedded commands" which appear on the monitor screen but not on the printout. So the first word in a line may not appear in the expected place on the screen, being displaced by the embedded commands for format or typeface control. The word processor has a preview facility which helps to get print into the right place on the page, but there are still problems.

On one occasion I set the printer for "condensed" print and ran off a few lines. I then cancelled the condensed mode and reset for double width letters. Unfortunately, the "condensed cancel" command was ineffective and the original "condensed start" command was lost but still active somewhere in the system. The printer thereafter insisted on printing condensed characters, despite and in addition to the control codes for other modes added with new material.

In fact, the characters which should have been double width were coming out as condensed double width and appeared almost normal so that for a time I was not aware that anything was amiss. It was quite infuriating to input the correct commands and get out a wrong response. Son the Younger solved the problem by inputting the apparently missing command ahead of the new material.

Another difficulty came about when using double width or condensed letters. The printer took no notice of the typeface in use and tried to put 70 or so letters into every line. With condensed print, each line ended in the middle of the page. With double width type, half the letters slid off the right hand side of the paper.

With perseverance we have learned how to use the word processor and have mastered many of the printer tricks. We are now using it to prepare all kinds of written material. For pages with a critical layout, it takes lots of trial and error and many sheets of paper to get everything spot on, but at least we now know how to do it.

As the state secretary of a national organisation, I have to write quite a lot of letters, many of them repetitive to a greater or lesser degree. I am now building up a file of standard paragraphs from which I can select to compile any required letter. Even personal letters can be built up in this way, although it mightn't pay to circulate standard paragraphs among too many family members.

I have used the word processor to create a mailing list of some 60 names to whom I send a newsletter each month. The newsletter itself is prepared on the processor, and I have found that the printer, with its ribbon removed, will cut a very creditable stencil for our old duplicator.

I recently made a recording of an amateur orchestra in the Hobart Town Hall. I wrote the details on the insert supplied with the cassette, but it looked decidedly amateurish. So I sat down to the computer and designed a more stylish layout. By using several type styles the insert was made to look almost professional.

I have used the word processor to write labels for my record collection, although the collection itself is not yet computerised. I have used it to design letterheads for private and business purposes. I have printed some decorative birthday greeting cards and Son the Younger has produced a Christmas Greeting card to deliver to his paper round customers on Christmas Eve. All of this, mark you, was executed without having to write a single line of Basic program material.

Another advantage of the word processor is its ability to produce a "final draft" whenever desirable. Three months ago this article would have involved first some hand-written notes then a double spaced typed draft. After amending this over and over again, I might have typed

The BBC microcomputer with disk drive and monitor.

a second draft but more likely would have gone on to a final copy.

This article is over 1800 words long and typing it twice is quite a chore — never mind typing it three times. With this word processor I have already done five "final" drafts and can continue, without difficulty, through as many "final" drafts as I need to get the work into the form I want.

It would be nice to be able to add graphic decoration to my work, and a dot matrix printer can be made to produce quite elaborate decorations. Unfortunately this feature is not available in this word processor and at present my sons are needed to program any graphics that are required. Later I will get graphics and printer control ROMs that will enable me to work these features into the word processor output.

No doubt the boys can get more from the equipment with their better knowledge of programming. But I feel that I have more than justified my investment in the computer. The old Remington has not been uncovered for over three months and I doubt that I will ever willingly use a conventional typewriter again.

The word processor used by Neville Williams for the November article was a basic system at a basic price. Ours cost three times as much and we hope it will do three times the work. Be that as it may, it's in use for several hours each day, hard at work processing the words that may never have been written but for the home computer.

Footnote: After printing the "final" final draft of this article, I pressed the wrong button and lost all traces of my copy. Re-entering it into the computer was tedious but did reveal to me several wrong words, spelling and punctuation errors that had been missed in many earlier readings. So the final draft is never really final. The best work can always be polished a little brighter and the word processor is just the tool to polish with.

MOUSSORGSKY

Pictures at an Exhibition. (A stroll round a picture gallery). Chicago Symphony Orchestra conducted by Carlo Maria Giulini. DGG Stereo Analog Disc 410 838/1.

This performance was originally recorded some years ago but was very successfully reprocessed last year. It is not digital but a first class analog with a very wide but always tolerable dynamic range. The makers apparently thought the work was so well known that the only information about it is on the label which gives just the titles of the various pictures hanging in the gallery.

Giulini projects the subjects of these paintings so graphically that I thought I'd give my subjective reaction to them to help those unfamiliar with the music.

Gnomes. Twisted little, and somehow old-sounding themes. The analog sound has a wonderful bloom on it and exactly the right resonance.

The Old Castle. Ancient, weary, decaying but still defiant, it has settled immovably into its surroundings. With a little thought one can imagine its glorious memories.

Tuileries Gardens. This is a green stretch near the Louvre with a pond, a favourite spot for nannies to bring their charges. The kids whine and nag them into reasonable but kindly protest which grows gradually more imperative as the kids keep on. A really fine example of the very best kind of analog recording.

Bydlo. A Polish ox waggon with solid wooden wheels slogs its way cumbersomely past, and disappears round the next corner.

Ballet of the Little Chickens. They chirp and peck and walk stiff-legged.

Samuel Goldenberg and Schmuyle. In this gem you have an imperious rich jew expansively refusing a loan to a small cadger. The latter whines away to no purpose until his lordly dismissal. This is so vivid that one can almost put features to the portraits.

Limoges Market. Busy buyers and sellers with not a moment to lose.

Catacombs follows straight on as if you'd fallen into a pit. Here is a quite wonderful trumpet crescendo and the Promenade theme — the little tune that binds the pieces together — follows with matching sombreness.

The mischievous sprite Baba Yaga comes next, the unusally slower tempo adding to his malice and leads straight to the wide-flung Gates of Kieff which brings the series to a glorious victorious close. Very highly recommended.

The pieces were originally composed for piano solo and transcribed for orchestra by Maurice Ravel. (J.R.)

MAHLER

Symphony No. 4 in G major. Concertgebouw Orchestra of Amsterdam conducted by Bernard Haitink. Philips digital disc 412 119/1.

Above, I wrote of my lack of enjoyment in Solti's over-expressed treatment of Mahler's lightly structured Fourth Symphony. In the First Symphony though, the work's sturdier construction can respond without mutilation to the ardour of Solti's embraces.

But the Fourth is a different matter and I think Haitink's more reserved approach comes closer to what in my mind is the ideal performance — by Szell and the Cleveland, recorded many years ago. Szell made every tempo change, however slight, sound like the result of a stern decision. Discipline under his baton was mandatory.

Haitink comcs close to this perfection with a performance of well controlled warmth. There are plenty of tempo changes but these are always dictated by the score. It is for the most part playful music from the opening sleigh bells through the continuously transparent orchestration. The digital recording offers much richness of detail with, alas, the over-wide range of dynamic variation.

Even so, the various undercurrents and cross currents flow easily under the always amiable surface. The recording has spacious separation but with timpani now and again a shade too demonstrative.

The second movement, a gracefully accented 3/4 scherzo, is delicately handled in the same spacious style. The liederlike opening of the slow movement, though unruffled, is always sensitively inflected. I have never found music in this movement very interesting though it has its moments — if you wait for them. The sound here has a tendency to compact at very high levels of fortissimos. I always find it too long and however good the reading my mind wanders.

In the Finale, the "Wunderhorn" song about a childish idea of paradise is delivered in a fresh soprano voice by Roberta Alexander. But she too, like Kiri de Kanawa in the Solti version mentioned above, sounds a wee bit too grown up, so sophisticated that the result is contrived. But her natural production makes her always pleasing to listen to. On the whole this recording is well worth having. (J.R.)

BRAVURA

Violin recital of short pieces by Sarasate, Falla, Rachmaninov, Mozart, Schumann, Kreisler and Wieniawski. Cho-Liang Lin with pianist Sandra Rivers. CBS Digital Disc IM 39133.

This record is made up of odds and ends, some of them used in former days as encores and others used to appear on violin recitalists' programs a couple of generations ago. Then, to pay lip service to the "classics", a baroque sonata by Corelli or Tartini or some other baroque bore would at least be included.

Cho-Liang Lin dedicates the disc to his Australian teacher, the late Robert Pikler. Now I knew and admired Pikler who was a sound, no nonsense musician with respect for purity of style. I was therefore all the more surprised when I heard his former pupil — who, by the way has won a considerable reputation of sorts overseas — play in an overinterpreted style suitable to a restaurant fiddler wandering from table to table.

He undoubtedly has a fine technique and a dead sure sense of intonation. But he uses them in a trumpery exhibition of soulful outpourings. His accompanist, Sandra Rivers, provides the required pretty backgrounds which often encroach flashily on her principal.

Cho-Liang Lin entitles his recital Bravura, and bravura it certainly is while his accompanist sticks as close to him as a stamp to an envelope. His discful of well-worn favourites would nowadays appeal to only the least common denominator of musical taste and even the record is illiterally labelled "de Falla". It is Spanish custom to use the participle "de" only when the full name, both Christian and surname are used. Otherwise only the surname is used without the participle and by the way the Spaniards pronounce his name Fallya, not Faiyah.

The recital might make a good tape for Muzack. (J.R.)

CHOPIN

Piano Concerto No. 2 in F Minor.

SAINT-SAENS

Piano Concerto No. 2 in G Minor. Cecil Licad with the London Philharmonic Orchestra conducted by Andre Previn. CBS Digital Disc IM 39153.

This record enchanted me. Although just entering her 20s the young soloist already shows astonishing maturity and authority. Her technique is impeccable, her interpretations sensitive but never overexpressed. Here is no boudoir tinkling, elbow wagging Chopin but a brilliant young mind expressing itself coolly and expressively. She has a lovely touch and her playing sounds quite effortless even in the most difficult passages.

The only point I could find to criticise in the whole exercise is a tendency to reverberation in the recording which otherwise does full justice to the performers. Despite the firmness of her approach Licad gets just the right flexibility into the rubatos. Previn and the LPO give her an impressive introduction and all through Previn nurses her like a parent.

The style throughout is distant from the old idea of Chopin as a pretty pretty composer. Today's best soloists avoid self-indulgence and for the most part play straighter than their predecessors. Licad's runs go with exquisite smoothness, her rhythm, especially in the ¾ movement, compels participation, her speed in the last movement is scarcely believable. Yet she remains completely unruffled.

Great late pianist Arthur Rubinstein would have adored her. She is visiting Australia this year. Don't miss her. Her physical beauty matches her playing.

The Saint-Saens Second makes a nice unusual coupling but it is not in the same class as the Chopin. It has its own merits — perfect workmanship with great fun in the middle movement. Licad carries over her authoritarian style in her almost pugnacious attack in the intro. All the superlatives I used about her playing of the Chopin apply equally to her performance of this.

Her reading is again strictly personal and an occasional tempo unusual. For instance she takes the second subject of the scherzo slightly faster than conventional but with fine effect. And she continues just as briskly. There are rare moments when you can feel her keeping Previn up to tempo. She rattles off the Finale at a speed that threatens disaster in every bar. Nothing happens and there is never a falter. It is a bracing exhibition of pianism.

She passes over mountainous difficulties with the serenity of a balloon in a nice wind. She is adventurous but never flashy. I am not exaggerating when I write that her playing completely bewitched me. (J.R.)

BARTOK

Concerto for Orchestra. Concertgebouw Orchestra of Amsterdam conducted by Antal Dorati. Philips Digital Disc 411 132/1.

The digital processing of this work results in a very wide dynamic range but one that is still tolerable, unlike some of its brothers. It works well for the swaggering rising theme with its large intervals in the opening sequence and just as well in the tiny contrasting intervals of the second. The first has the vigor of Strauss, but be warned, don't look for any Rachmaninov largesse of melodies in this concerto. It is not an easy work for beginners who must wait till the Finale before they get a whistleable theme.

Antal Dorati brings the first movement to a bravura end with the great Concertgebouw Orchestra at its best. Fine toned side drums announce the second movement and give foretastes of delights to come. Everywhere is impressive clarity. It is all very merry but still stiffly formal in strict time.

There is beautiful speaker separation in the slow movement, while at the end the piccolo fades slowly until it enters silence. The fourth is characterised by a jaunty theme affectionately played. This is a more approachable movement than its predecessors and has an Offenbach gaiety unusual in Bartok. Then comes another little scherzo and the Finale, hurrying busily. An important tuba contribution — after all this is a Concerto for Orchestra — stands out with rich overtones.

It all has a fairlike atmosphere. Then comes the inevitable fugue. All through the scrubbed sound is so clear it might come from an empty box.

Of the Two Portraits that make the fill for the second side the first is ardent, obviously someone dearly loved. There is a lovely sense of stretching relaxation at the end. By contrast the second is almost pugnacious. It's all very positive and down to earth. There is some self-questioning but never a doubt. The two make an attractive distych and show the softer side of the composer for a moment. (J.R.)

SIBELIUS

Sibelius, Symphony No.5 in E-flat major, Op.82. Night-Ride and Sunrise Op.55 played by the philharmonia Orchestra conducted by Simon Rattle. Compact disc, EMI CDC-7-47006-2.

The booklet notes that accompany this disc could double as a mini essay on the symphony, as such. Examples are quoted to show that, around the turn of the century, prominent composers were tending to reject the traditional form and to favour variants of their own. Tchaikovsky's "Pathetique" (1893) was a case in point.

A professed admirer of the traditional symphony, Sibelius at first resisted change, although he was certainly not lacking in originality. His first symphony, the E-minor, was introduced in 1899 and well received but this present No.5 was marked by a great deal of uncertainty on his part.

As a concept, it more or less coincided with the outbreak of the 1914 war and Sibelius was in two minds whether to go on with it. But he did and introduced it as a four-movement work in 1915 — only to be thoroughly dissatisfied. He revised the score in 1916 and again in 1919, finally merging the four movements into two: Allegro moderato (13' 47") and Allegro molto (17' 48").

It qualifies, nowadays, as probably the most popular of his seven symphonies and, as such, features prominently in the catalogs, with notable performances by Bernstein, Karajan and Ashkenazy — the lastnamed on Decca compact disc, also with the Philharmonia orchestra. This present recording, featuring Simon Rattle as conductor, reputedly bears comparison with any of them and I certainly found it very satisfying, both musically and technically.

As a "fill", preceding the symphony, EMI offers the tone poem "Night-ride and Sunrise" (14' 23"). Designated as Op.55, it was composed in 1907, between the third and fourth symphonies. The theme had been suggested to Sibelius six years before, when a military crisis forced a sudden flight from Rapallo to Rome. It pictures an "average man" riding alone through the forest, sometimes glad to be alone, at other times conscious of the strange sounds of the night. But, at last, dawn breaks and the sun theme welcomes the new day. Here, too, the sound texture and quality are excellent.

It's an apt fill, adding up to a disc that is well worth considering for your collection. (W.N.W.)

REJUVENATED JAZZ

Chicago. Jazz Classics in Stereo, Volume 2. ABC Records L-38212.

That Australian broadcaster and recording engineer, Robert Parker, is skilfully revitalising old 78rpm jazz recordings is no longer news. We described his process in detail in the September '84 issue and have referred to it since in other reviews.

What is news are the periodic additions to the repetoire, such as this musical encapsulation of the Chicago Jazz scene in the period 1926 to 1933. Importantly, the recordings were made after the introduction of electrical technology (circa 1925) and, as such, respond surprisingly well to modern playback and noise reduction treatment. For all practical purposes, there is no noise and certainly no loss of response due to over-filtering.

The album comes in a colourful double-fold jacket, with specific information on each of the 16 bands (pun intended). If you're at all interested in traditional jazz, there's plenty to read and plenty to listen to. You'll be intrigued by the old (but then standard) car Klaxhorn on track one, by Kid Ory's jazz tuba on track two and Earl Hines' piano on track three.

There are two pioneering big bands on seven and eight, on side Two, there's a 19-year-old Bennie Goodman, "Pinetop" Smith and his 1929 Boogie Woogie piano, and Eddie South's 1933 jazz violin — shades of Stephane Grapelli, if ever I heard them. In short, top value for jazz devotees. (W.N.W.)

GUITAR CONCERTO

Rodrigo: Concierto de Aranjuez; Fantasia para un Gentilhombre. Played by Carlos Bonell and the Orchestre Symphonique de Montreal, conducted by Charles Dutoit. Compact disc, Decca 400 054-2.

If you sense a certain multinational flavour in the above title, it's what you'll encounter if you buy the disc — plus the fact that it was manufactured in Germany!

When Joaquin Rodrigo composed his Concierto de Aranjuez in 1939 — he was born in 1901 — he faced a problem that no other composer had come to grips with up to that time: namely to create a concerto in which an acoustic guitar could be heard well enough to rise above and lead a modern orchestra.

In his booklet notes, the soloist Carlos Bonell explains how Rodrigo solved the problem:

"At various times the guitar . . . is accompanied by the bassoon, cor anglais, oboe, flute and clarinet, while the strings provide an underlying rhythmic and harmonic web of sound, playing pizzicato or pianissimo. The strings find their full voice in the tutti at the beginning of the first movement and after the solo cadenza in the middle movement, when they unleash a passionate recapitulation of that wonderful movement's theme."

The success of Rodrigo's approach is attested by the fact that his "Aranjuez" features freely in the catalogs, with various couplings. It is characteristically and essentially Spanish, with three movements: Allegro con spirito, Adagio, and Allegro gentile. All provide pleasant listening but the Adagio is normally the focus of attention, framed by the other two.

"Fantasia para un Gentilhombre" is quite different in character, being based

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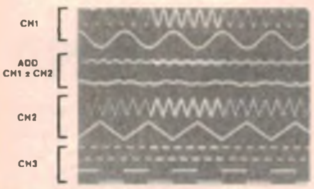

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on six Spanish airs and dances taken from a collection of guitar pieces by Gaspar Sanz (1640-1720), a guitarist and tutor attached to the Court of Charles II of Spain. Unaccompanied passages for guitar, taken up and developed by the orchestra, provide an informal and relaxed sound which can be enjoyed on that basis, if such is your mood.

Without seeking to make comparisons between guitarists, orchestras and couplings, I found no reason to criticse this new Decca release, either in terms of the performance or the recording. My tip is that you would find it a very acceptable addition to your growing collection of compact discs. (W.N.W.)

OUTSTANDING DISC

Schubert Symphony No. 9 ("Great C-Major"). Klaus Tennstedt conducting the Berlin Philharmonic Orchestra. Direct metal mastered stereo LP, EMI ASD-1436621.

In his quite lengthy jacket notes, Richard Wigmore points out that this symphony was slow to win acceptance. Schubert was in his prime as a composer when the symphony began to take shape, in Austria, during 1825. It was essentially complete in 1826 but further revised in 1927.

Schubert died, however, before it was performed and it was left to Schumann to discover and enthuse over the manuscript in 1839. But few shared his enthusiasm and even Mendelssohn abandoned a plan to present it in London when the orchestra treated it with derision, reflecting earlier opinion that it was too long and too difficult.

Another 30 years elapsed before George Grove, in England, successfully championed the cause of Schubert's orchestral music and the once neglected symphony became "The Great". Nowadays, according to one report, something like 20 different performances are listed in the catalogs.

Even so, some who are not familiar with the work might still harbour the impression that it is difficult and tedious but this is certainly not the case with this version by Tennstedt and the Berlin Philharmonic.

From the outset, Tennstedt establishes a firm, crisp tempo, resisting the temptation to linger by the way. He includes none of the repeats, except for the one in the Scherzo. Overall, the performance occupies 28 minutes for side 1 (Andante, Allegro ma non troppo and Andante con moto) and 23 minutes for side 2 (Scherzo and Finale) — a manageable total of 51.

The Berlin Philharmonic responds magnificently to Tennsted's unremitting drive, with seemingly effortless playing and wide, unforced dynamics. No less to the point, the performance is captured quite magnificently on EMI/Teldec's metal mastered pressing. Again I am prompted to remark on the continuing "fight back" qualities of the traditional analog disc.

This really is quite a recording and one that I Can recommend without hesitation. (W.N.W.)

CELEBRATING 200 YEARS

A Heritage of Hymns. Festival Chorus and Philharmonic Orchestra, conducted by Terry Price and Bill Pursell. Stereo LP, Light LS-5832. From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135. Phone (03) 729 3777.

According to the credits on the jacket — there are no notes, as such — this album was commissioned by the Plymouth Park United Methodist Church in Irving, Texas, to mark the bicentennial of Methodism in America. It features the Church's own Festival Choir, presenting 14 hymns from the pen of Charles Wesley, six of them in two specially arranged medleys.

The Choir is backed by the Westminster Philharmonic Orchestra of London, England, which prompts the immediate question: how?

Again, according to the credits, the orchestra was recorded at the EMI Studios in London with Raymond Mosley as concert master. The choir was recorded quite separately in a studio in Dallas, Texas, the mix and mastering being done later in Nashville, Tennessee. With the special arrangements used, the dynamics, the variations in tempo and the key changes, one does wonder how they managed to get it all together; but they did, and very effectively.

The track titles: Jubilee Medley — Jesus, Lover of My Soul — Come, Thou Long Expected Jesus — Jesus, United by Thy Grace — Christ the Lord Is Risen Today — Spirit of Faith Medley — O For a Thousand Tongues to Sing — O Love Divine, What Hast Thou Done — Love Divine, All Loves Excelling — Rejoice, The Lord is King.

As a memento of an historic occasion, and a rendition of favourite Wesley hymns, it's an interesting recording but I do have to register some reservation about its technical quality. The orchestral sound is fine, as it should be, emanating from the EMI studios. But there is a noticeable edginess, at times, about the massed voices — a common enough problem which has probably been aggravated by the (presumably) non-digital double recording.

While I must mention the effect for the sake of hifi buffs, it would certainly not prevent an average listener, with average hifi equipment, from enjoying the music and the occasion. (W.N.W.)

50 and 25 years ago...

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

March 1935

A hot one! We were vastly amused recently at a factory technician who sighted one of his own power transformers on a bench in our lab.

"You evidently know a good transformer when you see one," he remarked.

Before he could stop himself, he picked it up, and automatically smelled it cautiously.

The company who witnessed the incident voted it as the best joke for months.

In the gutter: Up Newcastle way they have to push sets pretty hard to make sales. It is said that one dealer was so insistent about leaving a set for a demonstration that he practically forced open the front door and deposited the set inside. But when he came around next day he was stunned to observe it standing in the gutter. When the irate householder returned from work he was so annoyed by the pestering tactics adopted that he dumped it out. It speaks volumes for the honesty and integrity of the inhabitants of the neighbourhood that not even a valve was stolen from the set.

Phone dial: Selecting any one of ten frequencies by merely twirling a telephone dial, waiting an instant for the dial to return and automatically put the carrier on the air, is a feature of the latest radio transmitter designed for aviation ground stations and for coastal and ocean-going vessels.

The frequency shifting device resembles a miniature telephone board serving ten dial telephones. Automatic control is so complete that the user's voice may be made to put the transmitter on or off the air instantly or to shut it down completely after an interval of from one to fifteen minutes.

Wireless with pictures: Opinion varies as to the practical value of television experiments; but there is no doubt that advances have been made. At a recent demonstration in the offices of the Baird Television Company, London, moving pictures of men boxing, horses jumping, etc, were received from the Crystal Palace.

Heil and Farewell!: Radio programmes in Germany close down with "Heil Hitler" instead of "Good-night." Notices at the entrance doors of the Berlin station instruct visitors to greet residents with "Heil Hitler" instead of "Good-day" or "How do you do?" Foreigners are in a quandary how to respond to "Heil Hitler" from German acquaintances. Some say merely "Good-day"; others reply "Heil Roosevelt," etc, according to the nationality.

March 1960

New power stations: The first of two 100,000 kilowatt electric generators — the largest to operate in Australia — will be commissioned at Tallawarra Power Station, near Port Kembla, NSW, during 1960.

At Wangi Power Station (on Lake Macquarie) the last of six generating units will be installed, while a new section of Wallerawang Power Station (near Lithgow) will be opened about the end of the year.

These three major new steam stations have been built by the Electricity Commission on the NSW coalfields for the economic production of large quantities of electricity for the State supply system.

Who's looking: Staff engineer of NBC, Jarrett L. Hathaway, has registered some 30 patents in the broadcasting field in the past 30 years. His most recent invention is a system for finding out how many television sets are tuned to which programs at any hour of the day. His method uses a truck with receiving equipment which can detect radiation from home receivers and compare it with radiation from a number of local TV stations. By driving down the street in anybody's home town, the truck can tell who's looking at what.

Television kitset: As supplied, the kit includes a standard Mark V IF strip, ready wired and aligned, together with a complete turret tuner, matched and aligned to the particular strip. No further alignment should be necessary after assembly.

The cabinet supplied is made from wood and is available with either blue or tan PVC covering, as required. Safety glass and a simple mask are also provided.

On test, the receiver showed excellent sensitivity, picture and sound being available in an average area on all channels with the aerial connection merely held in the fingers.

TV "too good": The only problem of watching television 30,000ft above the earth is that reception is so good that the programs of widely separated stations using the same frequency occasionally overlap. Normally the picture from a station as far away as 200 miles comes in bright and clear on TV sets installed in Continental Airline's Golden Jet Boeing 707s.

Each of these luxurious jet airliners, flying between Los Angeles and Chicago nonstop or with a single stop at either Denver or Kansas City, has a television set in the forward first-class lounge. The sets are portable and weigh about 40lb each.

Entire newspaper by radio: Until recently, Japan's "Asahi Shimbun" had a distribution problem in the northern island of Hokkaido, 500 miles from the head office in Tokyo. Flying newspaper supplies into the island was not always possible and the population usually had to wait for their papers to come by boat and rail, which took nearly two days. With new Muirhead tele-photo apparatus, the "Asahi Shimbun" can now be on the news stands in Sapporo, the biggest place on the island, in just over an hour after it has appeared on the streets in Tokyo.

MITSUBISHI DISK DRIVES

M2896-63
Slimline 8" Disk Drive Double sided Density No AC Power required. 3ms track to track. 1.6 Mbytes unformatted, 77 track side 10⁻¹⁰ bit soft error rate.
Cat. C11916 **$550**
Case & Power Supply to Suit
Cat. X11022 **$159**

M2894
Standard size 8" drive. Double
Cat. C11914 **$630**
Case & Power Supply to Suit
Cat. X11011 **$89**

M4854
Slimline 5¼" disk drive. Double sided, double density, 96 track/inch, 9621 bit/inch, 1.6 Mbyte unformatted, 3ms track to track access, 77 track/side.
Cat. 11904 **$350**
Case & Power Supply to suit.
Cat. X11011 **$89**

M4853
Slimline 5¼" disk drive, Double sided, double density, 1 Mbyte unformatted, 3ms track to track, 80 track/side, 5922 bits/inch.
Cat. C11903 **$260**

M4851
Slimline 5¼" disk drive. Double sided, double density 500K unformatted, 40 track/side. Steel band drive system.
Cat. C11901 **$225**
Case & Power Supply to suit.
Cat. X11011 **$89**

M4855
Slimline 5¼" disk drive, double sided, double density, 96 track/inch. 2.0 Mbytes unformatted.
Cat. C11905 **$385**

MF353
3½" Standard size disk drive. Double sided, double density, 1 Mbyte unformatted.
Cat. C11923 **$265**

MF351
3½" Standard size disk drive Single sided, double density.
Cat. C11921 **$225**

VERBATIM DISKS

"Lowest" price possible for "Highest" quality

	1-9	10+	100+
MD525-01	3.95	2.75	2.60
MD550-01	4.50	3.95	3.75

VALUE LIFE Box of 10 $22.95

★ ★ ★ ★ ★ ★

IBM* COMPATIBLE COMPUTER

$1,990
Including Tax!
*IBM is a registered trademark

★ ★ ★ ★ ★ ★

SWIVEL BASE

Makes life easier, normally $29.50
Cat. D11100 **$22.50**

APPLE* COMPATIBLE DISK DRIVES

1-9	10+
$189	**$179**

(*Apple is a registered trade mark.)

PRICES SLASHED ON DISK STORAGE BOXES!

Efficient and practical, these disk storage boxes protect your disks from being damaged or lost.

50's. Features smoked plastic cover with provision for a lock. High impact ABS plastic base.
Cat. C16025 **$23.50**

50's. Features smoked plastic cover Divided into 10 sections, each fan elevates the disks for easy identification and access.
Cat. C16050 **$29.50**

RITRON 1

Our most popular model in a steel cabinet to minimise R.F.I. interference. Prices include tax, so get in quick!

	1-4	5-9	10+
Green, Cat. X14500	$139	$135	$129
Amber Cat. X14500	$139	$135	$129

RITRON 2

Stylish swivel base monitor, available in amber or green

	1-9	10+
Green Cat. X14506	$199	$189
Amber Cat. X14508	$189	$179

COLOUR IS HERE!!

PHOENIX 5

Suits Apple, Commodore, even your VCR!
- Pal and R.G.B
- Normal Resolution
- 13" CRT Dot Pitch 0.65mm
- Horiz. Resol. 320 TV lines
- Vert. Resol. 560 TV lines
- Display Characters 1,000 Ch (40x25)
- 16 Colours (Pal)
- Green text display

Cat. X14522 **$399**

PHOENIX 4

- R.G.B. TTL
- High Resolution
- 13" CRT Dot Pitch 0.31mm
- Horiz. Resolution 720 dots
- Vert. Resolution 240 T.V. Lines
- Display Cahracters 2000 Ch (80 x 25)
- 8 Display colours and intensity
- Green text display

Cat. X14520 **$690**

INCREASE YOUR MEMORY

	1-9	10+
4116	$1.80	$1.70
4164	$4.95	$4.50
2716	$6.25	$5.95
2732	$6.25	$5.95
2764	$8.25	$7.95
27128	$19.50	$18.75
6116	$6.95	$6.75
41256	$24.95	$23.95

Juki Printer

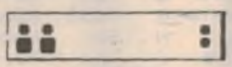
Professional daisy wheel printer 18CPS full incremental mode Diablo 630 emulation. Large range of daisy wheels. 8K internal buffer available.
Was $950 Now $790

KEYBOARD AND CASE

Cat. X11080 **$249**

RITRON (ZETA) DATASETTE

For data loading and saving, the Ritron Datasette suits most home computers and features tape counter, monitor function for audio verification and slide control for output level.
Cat. C14900 **$29.95**



LINE CONDITIONER

Dispose of those clicks and voltage spikes forever. 2 stage output. 2 outlets per stage, rated 1000 W 4A 250V 50Hz. If you want a real computer system, this is for you.
$249.00

REPLACEMENT KEYBOARDS

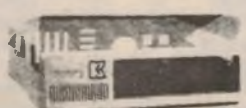
★ NEW ★

- For Apple
- 42 single key BASIC command
- One chip custom design encoder
- Made by ALPS, life time - 10 million operations
- Dimension: L340xW110xH42mm

Cat. KC2001 **$79.50**

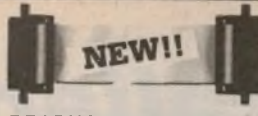
- For Apple
- 45 built in function keys. BASIC and CP/M command
- 45 user defined keys
- Built-in shift lock
- Made by ALPS, life time - 10 million opearions
- Dimension: L340xW130xH42mm

Cat. KC2002 **$99.00**



"IBM TYPE" COMPUTER CASING

Give your kit computer a totally professional appearance with one of these "IBM type" casings, includes roon for 2 5¼ inch disk drives and connection ports. Dimensions 49x39x5cm.
Cat. X11090 **$89.00**



READY MADE CABLES

Serial to serial. 2 m
Cat. P19011 **$18.95**
Parallel centronics to centronics. 2m
Cat. P19013 **$23.95**

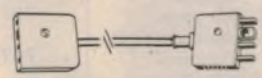
NEW!!

TELECOMMUNICATION PLUG TO 2 SOCKETS.

Ideal for modem connections.
Cat. Y16014 **$12.95**

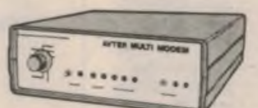
TELECOMMUNICATION PLUG/SOCKET

Plug	Cat. Y16016	$3.95
Socket	Cat. Y16018	$4.95



TELECOMMUNICATION EXTENSION LEADS

Cat. Y16010	5m	$12.50
Cat. Y16012	10m	$14.95

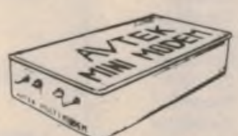


Features Auto Answer!
(Unlike cheaper version)

AVTEK MULTI MODEM

- 300 baud full duplex, 1200 baud half duplex or 600 baud half duplex, answer or orginate
- CCITT and Bell standards
- Plugs straight in (harwired phone)
- Supereior VLSI chip performance works reliably with 4dBM signal with S.N ratio of 6dB Error rate on this is level 10
- Telecom Approval C84/37/1135

Inc. phone, only **$399**



MINI MODEM

- 300 baud full duplex
- Answer orginate
- Plugs straight in (hardwired phone)
- Superior VLSI chip performance (identical to Multi Modem)
- Telecom Approval (C84/37/1173)

Incl. phone. only **$199**

APPLE* COMPATIBLE CARDS

Printer Card	Cat. X17029	$65
Drive Card	Cat. X17019	$80

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Rod Irving Electronics

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NORTHCOTE VICTORIA
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48-50 A'BECKETT STREET,
MELBOURNE VICTORIA
PH (03)347 9251
Mail Order and correspondance
P.O. Box 235
NORTHCOTE 3070

MAIL ORDER HOT LINE
(03) 481 1436

POSTAGE RATES

$1-$9.99	$1.50
$10-$24.99	$2.00
$25-$49.99	$3.00
$50-$99.99	$3.50
$100-$199	$5.00
$200-$499	$7.50
$500 plus	$10.00

Comet road freight is extra.

MB100S

The next generation of "80" type printers. 100 CPS, internal buffer expandable to 4K, Greek as well as italics. The print quality is the same as its forerunner. Square pins and film ribbon make it unbeatable.

1-4	5+
$325	**$299**

STAR GEMINI 10

- 120 CPS logic seeking
- Italics, graphics and down loadable character sets
- Friction and tractor
- 9 x 9 matrix, high res. graphics
- Low cost typewritter ribbon

WAS $430 NOW $360

ENP1091

The latest addition to our range. Has near letter quality mode. 120CPS. Down loadable character set. Graphics. Italics empasized etc.
Was $500 Now $420

COMPUTER PAPER

Top quality at a very affordable price. Blank 11 x 9½", 2,000 sheet, quality 60gsm bond paper.
Cat. C21001 **$29.50**

Errors and Ommissions Excepted

Australian AM-FM broadcasting services

This list of AM and FM broadcasting stations is current for March 1985.

Mediumwave AM Stations

kHz	Call	Class	Power (kW)	Location
531	2MC●	C	5	Kempsey
	3UL	C	5	Warragul
	4KZ	C	5	Innisfail
	5UV	P	0.5	Adelaide
	6DL	N	10	Dalwallinu
540	4QL	N	10	Longreach
	7SD	C	5	Scottsdale
549	2CR	N	50	Cumnock
558	4AM	C	5	Atherton
	4GY●	C	5	Gympie
	6WA	N	50	Wagin
	7BU	C	2	Burnie
567	2BH	C	0.5	Broken Hill
	4JK	N	10	Julia Creek
	6MN	N	0.1	Mt Newman
	6PN	N	0.1	Pannawonica
	6PU	N	0.1	Paraburdoo
	6TP	N	0.1	Mt Tom Price
576	2FC	N	50	Sydney
	2WEB	P	2	Bourke
594	3WV	N	50	Horsham
603	6PH	N	2	Port Hedland
	7ZL	N	10	Hobart
612	4QR	N	50	Brisbane
	6NM	N	0.2	Northam
621	3AR	N	50	Melbourne
630	4QN	N	50	Townsville
	6AL	N	0.4	Albany
	7QN	N	0.4	Queenstown
639	4MS	N	1	Mossman
	5CK	N	10	Crystal Brook
648	2NU	N	10	Tamworth
	6GF	N	2	Kalgoorlie
657	2BY	N	10	Byrock
	8DR	N	3	Darwin
666	6LN	C	1	Carnarvon
	2CN	N	2	Canberra
675	2CO	N	10	Corowa
	6BE	N	0.05	Broome
	8KN	N	0.05	Katherine
684	2KP	N	10	Kempsey
	6BS	N	4	Busselton
	8TC	N	1	Tennant Creek
693	4KQ●	C	5	Brisbane
	5SY	N	2	Streaky Bay
702	2BL	N	50	Sydney
711	4QW	N	10	St George
	7NT	N	10	Launceston
720	2AN	N	0.05	Armidale
	2ML	N	0.4	Murwillumbah
	3MT	N	2	Omeo
	4AT	N	4	Atherton
	6WF	N	50	Perth
729	5CL	N	50	Adelaide
738	2NR	N	50	Grafton
	6MJ	N	5	Manjimup
747	4QS	N	10	Toowoomba
	6LN-T	C	1	Exmouth
	6SE	C	5	Esperance
	8JB	N	0.1	Jabiru
756	2TR	N	2	Taree
	4QA	N	2	Mackay
	6KW	N	0.1	Kununurra
765	2BE	C	3.5	Bega
	2BE-T	C	0.5	Moruya
	6KA-T	C	0.1	Paraburdoo
	6KA-T	C	0.1	Mt Tom Price
	8DN-T●	C	0.25	Katherine
774	3LO	N	50	Melbourne
	4TO●	C	5	Townsville
783	2KA	C	2	Katoomba
	6VA	C	2	Albany
	8AL	N	2	Alice Springs
792	4QG	N	10	Brisbane
801	4QY	N	2	Cairns
	5RM	C	2	Renmark
810	2BA	N	10	Bega
	6WN	N	10	Perth
819	2GL	N	10	Glen Innes
828	3GI	N	10	Sale
	4SS●	C	5	Nambour
	6GN	N	2	Geraldton
837	3CR	C	0.25	Melbourne
	4RK	N	10	Rockhampton
	6ED	N	1	Esperance
	7QT	C	0.5	Queenstown
846	2CY	N	10	Canberra
	4CA●	C	5	Cairns
	6CA	N	0.2	Carnarvon
855	4QB	N	10	Pialba
	4QO	N	10	Eidsvold
864	4GR	C	2	Toowoomba
	6AM	C	2	Northam
	7HO●	C	2	Hobart
873	2GB●	C	5	Sydney
	6DB	N	2	Derby
882	3YB	C	2	Warrnambool
	4BH●	C	5	Brisbane
	6PR●	C	2	Perth
891	5AN	N	50	Adelaide
900	2LM	C	2	Lismore
	6BY	C	2	Bridgetown
	7AD	C	2	Devonport
	8HA	C	2	Alice Springs
918	2XL	C	2	Cooma
	4VL	C	2	Charleville
	6NA	C	2	Narrogin
927	3UZ●	C	5	Melbourne
	4CD●	C	5	Gladstone
	4CD-T-●	C	0.1	Biloela
	6NR	P	2	Perth
936	4AY●	C	5	Ayr
	7ZR	N	10	Hobart
945	3BO●	C	2	Bendigo
	4HI-T	C	1	Dysart
954	2UE●	C	5	Sydney
	4CA-T	C	0.35	Gordonvale
963	2RG	C	5	Griffith
	4WK	C	5	Warwick
	5SE	C	5	Mt Gambier
	6TZ	C	2	Bunbury
972	2MW●	C	5	Murwillumbah
	2DU-T	C	0.1	Cobar
	5DN●	C	2	Adelaide
981	2NM	C	5	Muswellbrook
	3HA	C	2	Hamilton
	6KG	C	2	Kalgoorlie
990	4RO	C	5	Rockhampton
	6PM●	C	2	Perth
	8GO	N	0.5	Gove
999	2NB	N	2	Broken Hill
	2ST	C	5	Nowra
1008	2XX	P	0.3	Canberra
	4IO●	C	5	Brisbane
	6GE	C	2	Geraldton
	7EX●	C	5	Launceston
1017	2KY●	C	5	Sydney
	6WH	N	0.1	Wyndham
1026	3DB●	C	5	Melbourne
	4MK	C	5	Mackay
	6NW	C	2	Port Hedland
1004	2UH	N	1	Muswellbrook
	4WP	N	0.5	Weipa
	5PI	C	2	Crystal Brook
	6BR	N	1	Bridgetown
1053	2CA	C	5	Canberra
	4EB	P	0.5	Brisbane
1062	4TI	N	2	Thursday Is
1071	3CV	C	5	Maryborough
	4SB	C	2	Kingaroy
	6WB	C	2	Katanning
1080	2MO	C	2	Gunnedah
	4MI	N	0.2	Mount Isa
	6IX●	C	2	Perth
	7HT●	C	5	Hobart
1089	3WM	C	5	Horsham
	2GZ	C	5	Orange
1098	4LG	C	2	Longreach
	6MD	C	2	Merredin
	7LA	C	2	Launceston
1107	2UW●	C	5	Sydney
1116	4BC●	C	5	Brisbane
1134	2AD	C	2	Armidale
	3CS	C	5	Colac

NOTES

T	Translator	H	Horizontal
N	National	V	Vertical
C	Commercial	M	Mixed
P	Public	●	AM Stereo

kHz	Call	Class	Power (kW)	Location
	6CI	C	2	Collie
1143	2HD●	C	2	Newcastle
	4HI	C	5	Emerald
1152	2WG	C	2	Wagga Wagga
1161	4MB	C	2	Maryborough
	5PA	N	10	Naracoorte
	7FG	N	1	Fingal
1170	2CH●	C	5	Sydney
	4GC	C	0.1	Charters Towers
1179	3KZ●	C	5	Melbourne
1188	2NZ	C	2	Inverell
	6XM	N	2	Exmouth
1197	4GG	C	5	Gold Coast
	5KA●	C	2	Adelaide
1206	2CC●	C	5	Canberra
	2GF	C	5	Grafton
	6KY●	C	2	Perth
1215	2ST-T	C	0.35	Bowral
	4HI-T	C	0.1	Moranbah
1224	2WS●	C	5	Sydney
	3EA	S	5	Melbourne
1233	2NC	N	10	Newcastle
1242	3TR	C	5	Sale
	4AK	C	2	Oakey
	5AU	C	2	Port Augusta
	8DN●	C	2	Darwin
1251	2DU	C	2	Dubbo
1260	3SR	C	2	Shepparton
	6KA	C	1	Karratha
1269	2SM●	C	5	Sydney
1278	3AW●	C	5	Melbourne
1287	2TM	C	2	Tamworth
1296	4BK●	C	5	Brisbane
	5SE	C	2	Mt Gambier
1314	2WL●	C	5	Wollongong
	3BA	C	5	Ballarat
1323	2GO●	C	5	Gosford
	5AD●	C	2	Adelaide
1332	3SH	C	2	Swan
	4BU	C	5	Bundaberg
1341	2NX●	C	5	Wallsend
	3GL	C	5	Geelong
1350	2LF	C	5	Young
1368	2GN	C	2	Goulburn
	4LM	C	2	Mt Isa
1377	3MP●	C	5	Mornington
1386	2EA	S	5	Sydney
	5AA●	C	5	Adelaide
1395	2LT	C	5	Lithgow
1404	2PK	C	2	Parkes
	VKW	?	0.1	Cocos Islands
1413	2KO●	C	5	Newcastle
1422	3XY●	C	5	Melbourne
	VLU	?	0.5	Christmas Island
1431	2WN	N	2	Wollongong
1440	2CN	N	2	Canberra
1449	2MG	C	5	Mudgee
1458	4LM-T	C	0.1	Cloncurry
	5MU	C	2	Murray Bridge
1467	3MA	C	2	Mildura
1476	2KA-T	C	0.5	Penrith
	4ZR	C	2	Roma
1485	2LG	N	0.2	Lithgow
	4HU	N	0.05	Hughenden
	5LN	N	0.2	Port Lincoln
	2EA-T	S	0.1	Wollongong
1494	2AY	C	2	Albury
	—	?	0.05	Lord Howe Island
1503	2BS●	C	5	Bathurst
	3AK●	C	5	Melbourne
1512	2NA	N	10	Newcastle
1521	2QN	C	2	Deniliquin
1530	2VM●	C	2	Moree
1548	4QD	N	50	Emerald
1557	2RE	C	2	Taree
1566	3NE	C	5	Wangaratta
	4GM	N	0.2	Gympie
1575	2OO●	C	5	Wollongong
1584	2WA	N	0.1	Wilcannia
	2BE-T	C	0.2	Narooma
	5MG	N	0.2	Mt Gambier
	5WM	N	0.05	Woomera
	7SH	N	0.1	St Helens
	4VL-T	C	0.2	Cunnamulla
	2EA-T	S	0.1	Newcastle
1593	4SO	N	0.2	Southport
	5MV	N	2	Renmark
1602	2CP	N	0.05	Cooma
	3WL	N	0.2	Warrnambool
	5LC	N	0.1	Leigh Creek

FM Broadcasting Stations

Freq.	Call Sign	Power (kW)	Class	Location
88.1	2RDJ	0.05	M	Burwood
88.5	2RRR	0.05	V	Ryde
88.7	2BCR	0.1	V	Bankstown
88.9	2RSR	0.04	V	Sydney
89.3	2GLF	0.05	V	Liverpool
89.3	4CRB	16.0	V	Gold Coast
89.7	2RES	0.1	V	Waverly
89.7	2VTR	0.02	M	Windsor Colo
89.7	5PBA	0.25	M	Elizabeth
90.1	2NBC	0.1	V	Narwee
90.5	2BBB/T	0.1	M	Dorrigo
91.5	2NSB	0.08	V	Chatswood
92.1	5ABC	10.0	M	Adelaide
92.1	6UVS	5.0	M	Perth
92.1	7THE	3.0	H	Hobart
92.3	2ARM	0.1	H	Armidale
92.3	2MCE	1.0	V	Bathurst
92.3	3EON	10.0	M	Melbourne
92.5	2NCR	3.0	M	Lismore
92.4	4ABC	50.0	H	Maryborough
92.9	2ABC	50.0	H	Sydney
92.9	5EBI	4.0	M	Adelaide
92.8	6NEW	0.25	H	Newman
93.1	2ABC	10.V	V	Orange
93.3	6ABC	60.0	H	Bunburry
93.3	7ABC	120.0	H	Launceston
93.7	2MWM	0.1	M	Manly Warringah
93.7	3MBS	4.0	H	Melbourne
93.7	4ABC	50.0	H	Rockhampton
93.7	5MMM	4.0	M	Adelaide
93.9	7ABC	27.0	H	Hobart
93.9	—	0.1	M	Norfolk Island
95.1	6ABC	5.0	M	Geraldton
95.3	7RGY	0.01	V	Geeveston
95.5	2YOU	0.02	M	Tamworth
95.5	6ABC	1.5	M	Kalgoorlie
96.1	6NOW	10.0	M	Perth
97.5	6ABC	50.0	H	Perth
98.9	6ABC	50.0	H	Northam/York
101.5	4ABC	65.0	H	Townsville
101.9	2ABC	50.0	V	Canberra
101.9	3FOX	10.0	M	Melbourne
102.1	4ZZZ	6.0	M	Brisbane
102.1	8CCC	0.125	V	Alice Springs
102.3	3ABC	100.0	H	Mildura
102.5	2MBS	5.0	M	Sydney
102.7	3RRR	10.0	M	Melbourne
102.7	4DDB	2.0	H	Toowoomba
103.2	2CBA	5.0	M	Sydney
103.3	4MBS	6.0	M	Brisbane
103.3	7HFC	1.5	M	Hobart
103.5	3GCR	0.05	M	Churchill
103.5	3MBR	0.5	V	Murrayville
103.7	2NUR	3.0	M	Newcastle
103.9	3CCC	2.0	V	Castlemaine
103.9	4TTT	0.05	M	Townsville
104.1	2CHY	0.04	V	Coffs Harbour
104.1	2DAY	35.0	M	Sydney
104.1	4MMM	6.0	M	Brisbane
104.1	5ABC	150.0	H	Mt Gambier
104.1	8TOP	10.0	M	Darwin
104.3	3ABC	50.0	M	Albury Woodonga
104.9	2MMM	35.0	M	Sydney
105.1	5ABC	95.0	V	Loxton
105.3	3ABC	50.0	H	Ballarat
105.7	2ABC	50.0	M	Wagga Wagga
105.7	2JJJ	10.0	H	Sydney
105.7	3ABC	50.0	H	Melbourne
105.7	5GTR	0.25	M	Mt Gambier
105.7	8ABC	10.0	M	Darwin
106.1	2ABC	25.0	H	Newcastle
106.1	4ABC	50.0	H	Brisbane
106.3	3ABC	100.0	M	Bendigo
106.3	3RPC	0.035	M	Portland
107.1	2AAA	0.2	M	Wagga Wagga
107.1	3ABC	100.0	H	Taralgon
107.3	2BBB	0.4	M	Bellingen
107.5	2ABC	50.0	M	Griffith
107.5	2SER	4.0	M	Sydney
107.5	3ABC	70.0	M	Western Victoria
107.5	5SSA	5.0	M	Adelaide
107.7	3PBS	0.1	M	Melbourne
107.9	2ABC	25.0	M	Wollongong
107.9	2REM	0.3	M	Albury
107.9	4ABC-FM	50.0	M	Toowoomba

Information centre

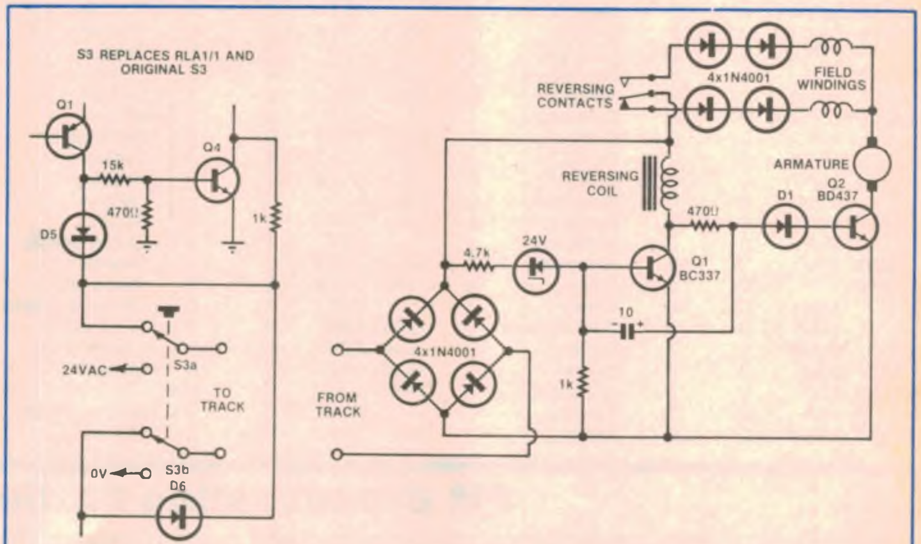
Using the Railmaster with Marklin locos

It was with great interest that I studied your article "Railmaster Pulse-Power Train Controller" in the September 1984 edition of *Electronics Australia*. I possess a Marklin train set which I understand is a big seller in Europe but not as widely known in Australia, probably because of the high cost. Yet if you wished to hand down such a set to your children, this would be the one to buy.

Marklin locos operate using a third rail on 0 to 16V AC, with a pulse of 24V to operate an internal relay for reversing the field windings via changeover contacts. Owning an AC operated train set therefore presents problems in relation to train controllers. I studied the article in EA October 1978 with envy but dismissed the idea on the grounds that this controller was suitably only for DC operated train sets.

I recently purchased a new Marklin loco model 3357 incorporating electronic switching. The first thing I did was to pull it apart to find out how the electronic switching was achieved and, to my surprise, discovered that a full wave bridge was used (see attached circuit). This discovery of course demonstrated that Marklin locos must be capable of operating on DC so I proceeded to construct the Railmaster controller.

The results were very gratifying with very smooth control from all functions. I had to make one modification and this was to provide a double changeover non-locking switch in place of the original "S3" switch and relay. The switch contacts are wired to 24V AC and the controller (see attached circuit). The results were completely satisfactory for reversing operations.



This diagram shows the internal switching circuitry of the Marklin model 3357 loco, together with the modification to the Railmaster controller.

There may have been a better method by feeding the 24V AC through the controller but I opted for the simplest method for expediency. I found the operation of the back EMF amplifier very good on my other locos but naturally this feature was lost on the loco incorporating electronic switching due, I guess, to the diodes blocking the back EMF. Nevertheless, the operation of this loco is still very smooth and completely satisfactory.

I doubt that Marklin will incorporate electronic switching in too many of their models as there is insufficient space to mount the PCB except in the longer models. If a Marklin enthusiast were to construct this controller he would find that his existing transformer is quite satisfactory.

In view of my findings would you please consider publishing whole or part of my report so as to widen the scope of the Railmaster controller and to assist Marklin enthusiasts in making their hobby more enjoyable. (R.B., Sydney, NSW).

● Thanks for the information R.B.

Stereo decoder for AM radios

I refer to the Add-on Decoder for AM Stereo published in the October 1984 issue of EA.

May I compliment you on this project which I intend to add to two of my AM/FM tuners in due course. However, I do not wish to have any of the hassles in lining up the unit and write to ask if you would publish the alternative ceramic resonator circuit for an IF of 455kHz? I am pretty sure that my tuners both have 455kHz IF systems.

For a one or two off situation, the hassle of alignment without suitable equipment (as in my case) is just asking for trouble when this can be averted by use of the appropriate ceramic resonator arrangement. (B.H., Heathmont, Vic.)

● There are two reasons for using an LC circuit instead of a ceramic resonator in the Stereo AM Decoder. First, 3.64MHz ceramic resonators are quite difficult to obtain, so parts availability is a problem. Second, if a ceramic resonator were used, the tuner's IF (intermediate frequency) would have to be virtually spot on 455kHz (with no drift) in order for the decoder to lock onto the signal.

Use of a ceramic resonator would thus have restricted the decoder for use in synthesised tuners. Again, most synthesised tuners actually have a 450kHz IF which will require a 3.6MHz resonator. This is more readily available but only in sample quantities from IRH in Sydney.

Aligning the stereo decoder is a very simple matter with the inductor circuit described. All you have to do is adjust the slug in the coil until 4.1V appears on pin 19 of the IC. There are really no hassles involved.

Automatic brake lamp flasher

I constructed the Brake Lamp Flasher as described in the November 1984 issue. When tested using direct leads from the battery, it functioned as it should have although I had to reduce the 300kΩ resistor to 150kΩ to obtain the correct flash rate. The rearm period was approximately 15s which I deemed acceptable.

I then installed it in the vehicle, taking a lead from the appropriate connection to the brake light. On applying the brakes, all four lights came on, but none flashed. Back to the workbench.

It appeared that pin 16 of the 4017 did not go low enough (even overnight) to rearm the circuit — only by momentarily shorting pin 16 to ground would the lights flash. I tried a lower value (10μF) capacitor but this did not help so I simply connected a 150kΩ resistor from pin 16 of IC2 to ground. This, together with the 10μF electrolytic capacitor, gave a rearm period of approximately 10s which was quite acceptable.

The circuit was then re-installed in the vehicle where it has functioned perfectly ever since.

Not being familiar with the internal circuitry of the 4017 and IC1c, I am unable to explain why the 22μF electrolytic did not discharge sufficiently through the 180kΩ resistor to rearm the circuit as stated in the text. Nor can I explain why the circuit worked when connected directly to the battery but not when connected to the brake light.

I wonder if any other readers have encountered this problem or whether you are able to offer any explanation? (F.H., Ardross, WA.)

● Although we haven't encountered it before, we suspect a reset problem with the 4017 due to the 22μF and .01μF capacitors not discharging completely. If the .01μF capacitor is partially charged, pin 15 of the 4017 will not be pulled high enough for resetting to occur. As you have found, connecting the 150kΩ resistor between pin 16 and ground provides an effective cure.

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ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 227, Waterloo 2017.

Problems with masthead amplifier

I am writing in the hope that you can help me with some problems I have had with your Masthead Amplifier kit. I have built it, but have no way of knowing for sure if it is working or not.

As the OM350 seems the most likely culprit I would change it except for the price of $10 a pop. I have tried inserting it in the line at a TV receiver at my brother-in-law's and have found that it passes a picture but does not improve or degrade it. But I do not know if the OM350 would do this or not if it was a dud.

The setup was: coax downlead from antenna unplugged from set and plugged into the amplifier with a short patchcord to power supply and another short patchcord from supply to TV. The situation I want to use it for is this: the antenna is on top of a hill behind the house. This site has been tested with a portable TV and gives very good reception. The cable run from antenna to house is 150 metres and the cable used is 3C2V with a line loss of 6.2dB per 33m at 200MHz (5C2V is 3.9dB per 33m).

Are the line losses too great with this cable; ie, 24dB loss in cable, 18dB gain in amp (net loss from antenna to set it 6dB). When set-up in this situation the amplifier was getting 12V at the antenna but the picture at the house was snowy and barely discernable. Is this amp unsuitable for such a long run?

Would the 5C2V cable with 3.9dB per 33m help? Can I test the amplifier by watching the signal strength meter on my FM receiver. I fed the FM aerial through the amplifier, expecting signal strength to increase from 2 at present to full scale 5 but no change. Is it working or not? If it is working, but not suitable for my application, would Dick Smith's amplifier with 24dB gain do the trick?

Thank you for an informative magazine. Unfortunately we do not seem to have anyone as inventive as your Serviceman locally or I would not have to write this letter. (S.B., Kyogle, NSW).

● It would seem unlikely that there is any fault with the OM350. If the power supply is working, you can be sure that the masthead amplifier is doing its job provided it is located at the antenna (not at the TV set). If the amplifier is located at the TV set, it will only serve to amplify the existing noise.

The signal strength at the top of the hill must be fairly marginal if the reception is poor at the bottom. This being the case, it would be best to use the lowest loss cable available. Try it first without the amplifier but, if the results are unsatisfactory, try the EA Masthead Amplifier first before investing in a higher gain model.

Problems with voice operated relay

I recently constructed the Voice Operated Relay described in April 1982 but have struck problems. First, the 47μF capacitor used to provide the three seconds delay for the Schmitt trigger is intermittent and the circuit sometimes cuts out without delay. Second, the unit is not sensitive enough. The microphone must be held about 5cm from my mouth for the VOX to operate.

I have removed the 10kΩ resistor and 100kΩ threshold trimpot to slight advantage. Could you please advise me on these two points?

● The two problems are probably related and could be due to one of several causes. First, check the 47μF capacitor on the output of the diode charge pump — if it is leaky, the circuit will lack sensitivity and the three second delay period will be greatly reduced. If in doubt, replace the capacitor.

Similarly, the diodes in the charge pump could be faulty or the Schmitt trigger may not be functioning correctly. Check that the output of IC2 swings from ground to close to the positive supply rail when a signal is applied to the microphone preamplifier.

If you can find no fault, then the hysteresis of the Schmitt trigger can be decreased (ie, the circuit made more sensitive) by increasing the 100kΩ feedback resistor.

Thermistor parts supplier

In your October 1984 issue there was an interesting circuit for a light/heat sensitive switch in the "Circuit & Design Ideas" section. I wish to use the heat sensitive design but have been unable to locate the necessary thermistor for a range of about 0°C to +40°C or so. Could you possibly know of any supplier stocking thermistors? (D.F., Hamilton Hill, WA).

● Radio Despatch Service sells an RA53 NTC thermistor which should be suitable for your application. Their phone number and address can be found in the advertisement in this issue.

Railmaster train controller

Will the Railmaster train controller handle Graham Parish models or similar 'can motors' without serious overheating? An old friend in Sydney (an electronics type) suggested that a more triangular waveform could lessen the heat rise in motors that have a permanent magnetic field.

This is my first note to you people since I first discovered the magazine as a teenager back in '56. Keep up the good work. I really love those stirring editorials — it's nice to know that there are some humanities left in the sciences. (J.H., West Tamar, Tasmania).

● We can see no reason why the Railmaster cannot be used with any locomotive using can motors. In fact, we have used the prototype with a number of HO locomotives which had can motors and can say that the unit worked beautifully.

There is little point in using a triangular wave instead of a square waveform as the motor inductance tends to filter high order harmonics anyway.

APOLOGY

We goofed! Due to a printing error, the Information Centre material published in January was inadvertently repeated in February (this despite the fact that new copy had been prepared). We sincerely apologise to readers for this mistake. Omitted copy to be published April.

Notes & Errata

BUSKER AMPLIFIER (February 1985, File 1/AG/25): There is an error in the component overlay in the vicinity of transistor Q2. The three resistors to the right of this transistor are incorrectly labled. The resistor marked 330Ω should be 1kΩ, the resistor marked 270Ω should be 330Ω and the resistor shown as 27kΩ should be 270Ω. Further, on the circuit diagram, Q6 is shown as a BC437. This transistor is in fact a BC327 as shown in the parts list.

BURGLAR ALARM (January 1985, File 3/MS/112): The circuit diagram and the component overlay incorrectly show IC10 as a 4001. It is of course a 4011. The parts list is correct.

dbx SoundField One: continued from p35

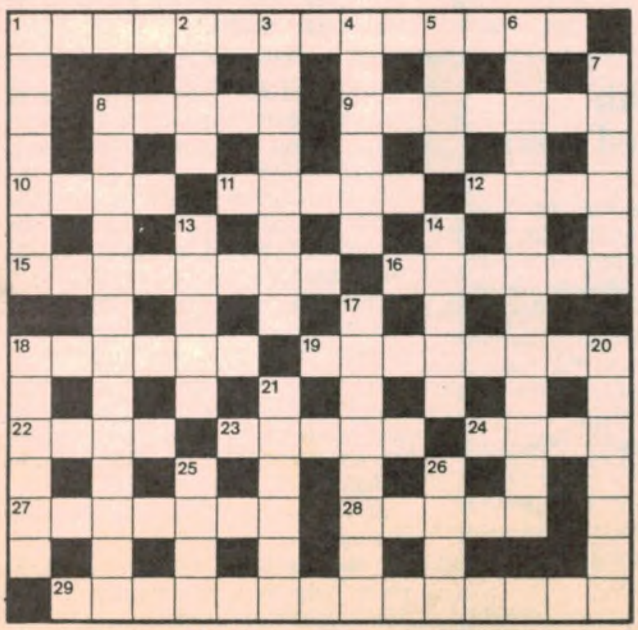
In the future though, the Soundfield One could prove to have been the forerunner of some very significant breakthroughs in a stereo sound reproduction.

Recommended retail price of the Soundfield One system, including the Controller, is $6499, including sales tax. For further information contact the Australian distributor for dbx products, Audio Engineers, 342 Kent St, Sydney 2000. Phone (02) 29 6731. (L.D.S.)

MARCH CROSSWORD

ACROSS

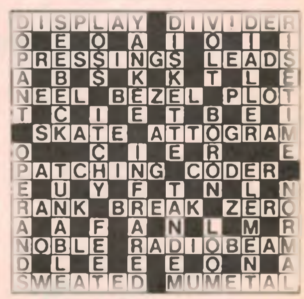
1. Type of filter. (3-4)
2. Airport surveillance radar systems. (1,1,1,1)
3. Design transfer. (8)
4. Kind of switch, etc, controlling all of a circuit. (6)
5. Light-emitting component. (4)
6. Random variations in transistor output. (8,5)
7. Book for the starter with red lead? (6)
8. Pertaining to rest charge. (13)
13. Useful inert gas. (5)
14. Connect components in kits. (5)
17. Telegraphic coding device. (5,3)
18. Possible cause of ionisation. (6)
20. Nichrome does it to current. (7)
21. Precept providing privileged protection. (6)
25. Mode of sound reproduction. (4)
26. Truncated term for tiny. (4)



DOWN

1. Desirable attribute of an oscilloscope. (6,4,4)
8. Type of memory. (5)
9. Element which is compounded with cadmium to form a semiconductor. (7)
10. Reference lines. (4)
11. Type of key. (5)
12. Basic particle. (4)
15. Maximise output. (8)
16. Desoldering device. (6)
18. Line on a magnetic map. (6)
19. Kind of process used in certain semiconductor manufacture. (8)
22. Traditional substance used to demonstrate electrostatic laws. (4)
23. Mathematician whose name was given to a magnetic unit. (5)
24. Materials for projects. (4)
27. Electrode. (7)
28. Type of switch. (5)
29. Rectifying components. (8,6)

SOLUTION FOR FEBRUARY



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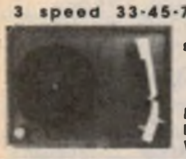

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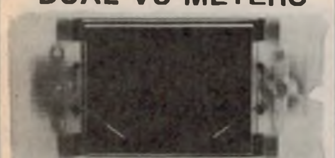

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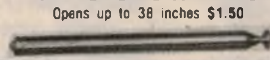

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47 UF 160V	3 for	$1
470 UF 25V	4 for	$1
40 UF 25V	5 for	$1
470 UF 40V	3 for	$1
47 UF 10V	10 for	$1
100 UF 25V	5 for	$1
25 UF 25V	10 for	$1
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220 UF 50V	each	50c
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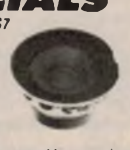

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DS230	$1	BAX18	10 for $1	AT322	4 for $1
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DS130	4 for $1	AN755	10 for $1	2SB405	50c
0404	4 for $1	8279	10 for $1	2SB303	50c
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R0516	$2	2S8405	50c	2SA15	50c
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OC9524	$1	OP57	50c	B544	50c
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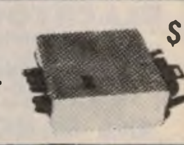

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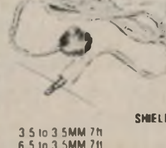

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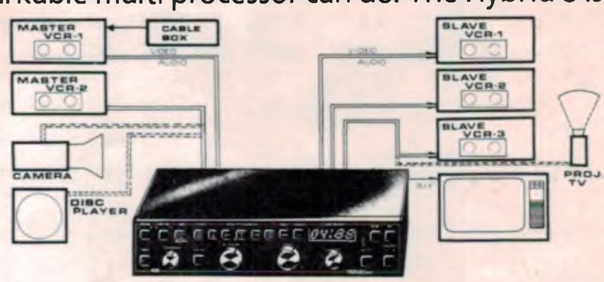

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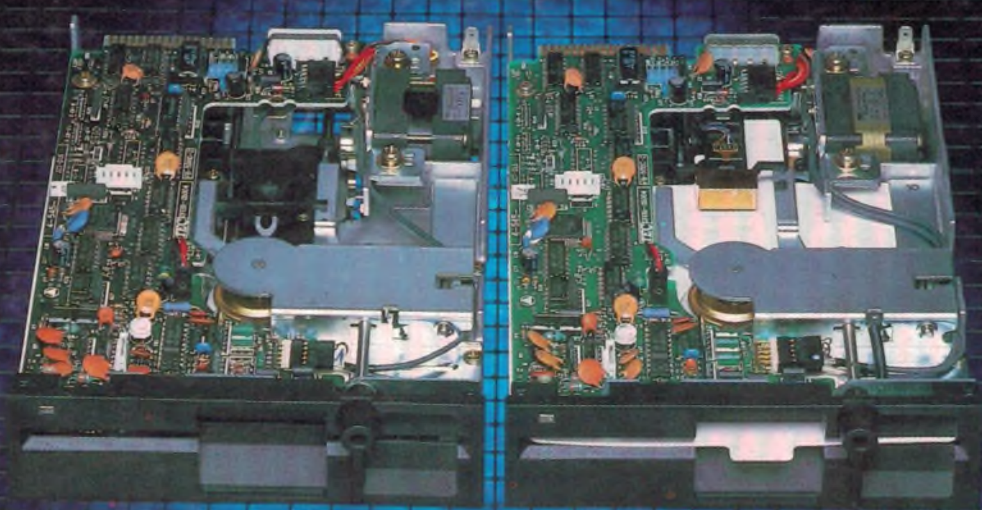

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