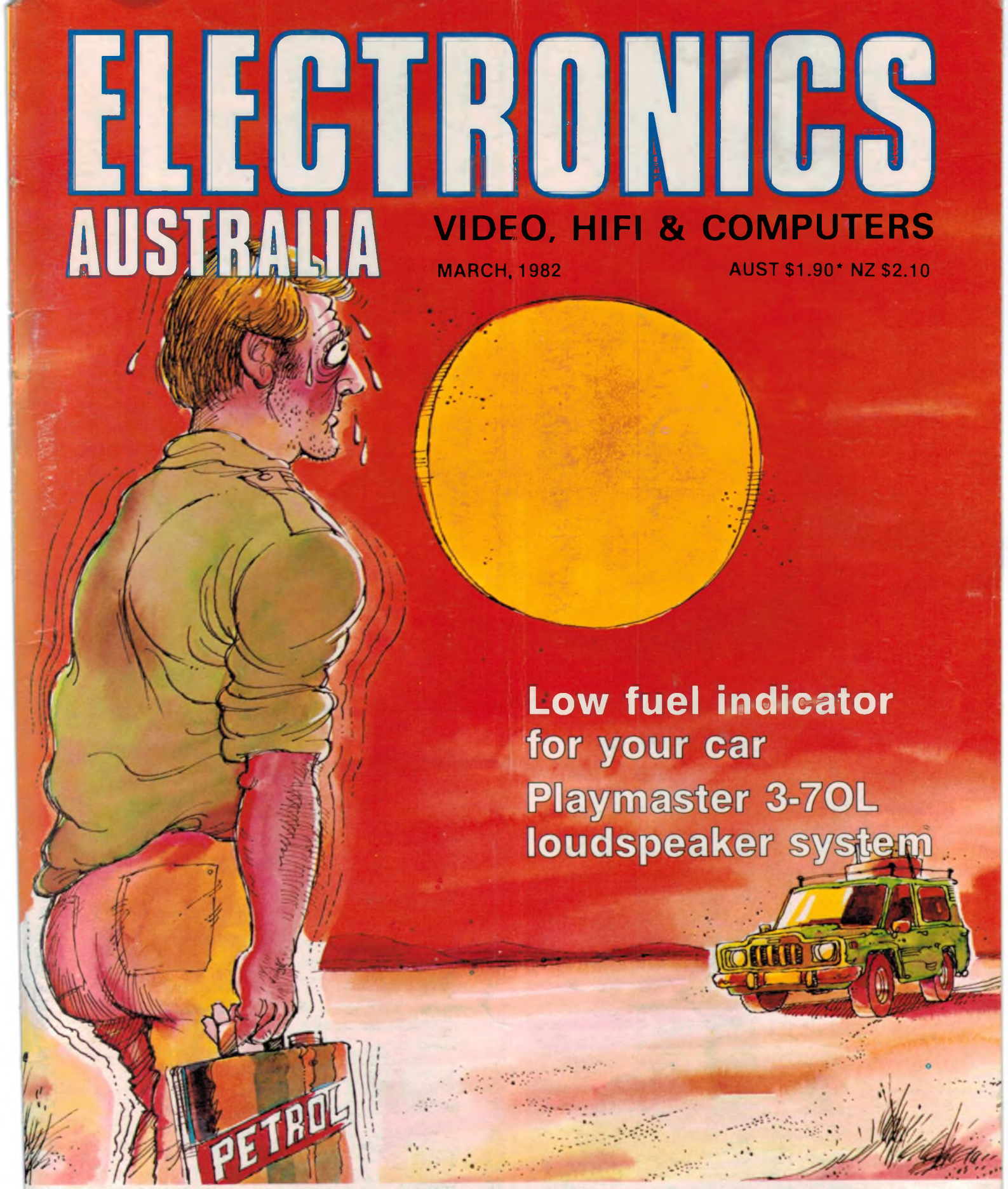
ELECTRONICS AUSTRALIA

VIDEO, HIFI & COMPUTERS

MARCH, 1982

AUST $1.90* NZ $2.10



Low fuel indicator for your car

Playmaster 3-70L loudspeaker system

32-PAGE ALTRONICS CATALOG

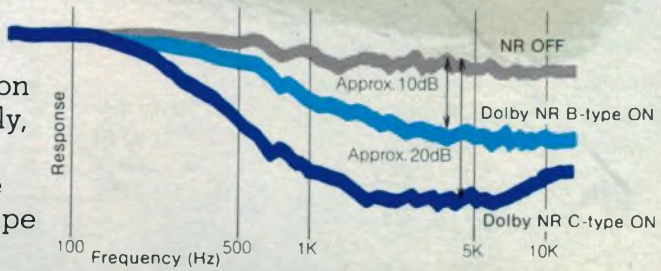
TC-FX6C

Deep C.

Sony presents a dramatic new standard in noise reduction: Dolby C.*

Silence has an indispensable part to play in the reproduction of recorded sound. So naturally, the newest advances in the science of noise reduction are featured on the latest Sony tape decks: TC-FX6C and FX5C.

Dolby C dramatically quiets hiss across the entire audible range, and it is particularly effective in the high frequencies where background noise is most disturbing. At 5kHz and above, hiss is suppressed by 20dB. What's more, an anti-saturation circuit reduces the possibility of over-extending the capacity of tape when confronted with especially high amplitude signals. For example, at 10kHz the saturation threshold is expanded by 4dB.



In conjunction with conventional Dolby (B type), Sony's new "C" decks do not simply cover up unwanted sound debris. They take it all the way down to clean silence.

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*Dolby is the registered trade mark of Dolby Laboratories

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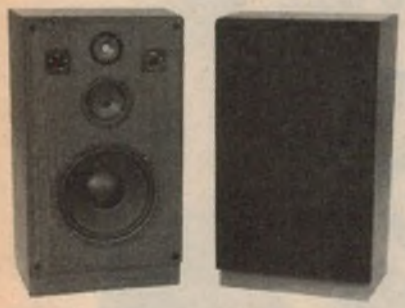
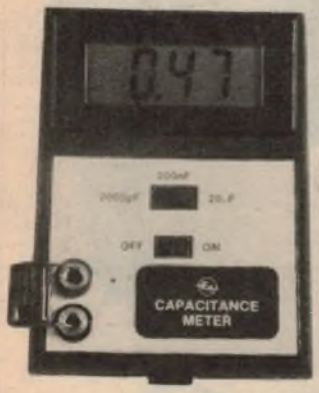
ELECTRONICS AUSTRALIA

Volume 44, No. 3
March, 1982

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE



Want a hifi loudspeaker system that's easy to build? This new design features three drivers, level controls, and impressive performance. Details p38.



This compact digital capacitance meter features a 3½-digit liquid crystal display and measures from 1pF to 19.99μF. Construction begins on p48.

ELECTRONIC AGENCIES *special advertising feature p67-70.*

On the cover

You can avoid the drama of an empty petrol tank with our new Low Fuel Indicator. It sounds a buzzer and lights a lamp to tell you when to "fill 'er up" (see p74). Cover design by Garry Lightfoot.

FEATURES

HIFI, VIDEO AND REVIEWS

PROJECTS AND CIRCUITS

PERSONAL COMPUTERS

AMATEUR RADIO, CB SCENE, DX

COLUMNS

DEPARTMENTS

Some things change...

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ARE 9486

Editorial Viewpoint

This month we are presenting the Playmaster 3-70L, a large three-way loudspeaker system with generous power handling capacity. And while we are sure that many readers will obtain a great deal of pleasure in building and using these loudspeakers, we realise that, to some people, they could be a source of considerable irritation. This is because some builders of these loudspeakers may play them too loudly and thoroughly annoy their neighbours.

In the first flush of enthusiasm, when you have just built or purchased a hifi system or part thereof, there is great temptation to grab a record, slap it on the turntable and "let 'er rip". This is certainly understandable but it is likely that neighbours will not be anything like as enthusiastic if they can hear it too! Unfortunately, now that hifi has become a consumer product which is sold on a large scale, there are far too many instances of people using sound equipment without any regard for other people.

In fact, only recently, a particular brand of hifi equipment was advertised with a slogan along the lines that you could blast your music to the great outdoors. To the average Australian, the "outdoors" is represented by his backyard and, if he decides to "blast his music to the great outdoors", his neighbours are going to cop the full brunt of it! Sadly, the average Australian seems not to realise that loud music does not stop at the back fence but affects other people who may want to rest, or study, or listen to music of their own choice.

Other brands of hifi equipment have been advertised with a message which implies that, if you turn it up, your neighbours will be astounded at the extremely high quality of the sound! In other words, at every turn, the prospective buyer of hifi equipment is encouraged to turn it up to the utmost in order to achieve the greatest enjoyment.

And so it seems that, no matter where one goes these days, you are likely to be greeted with music, whether you want it or not. All large shopping centres and most large buildings have some form of background music (and often it is more "foreground" than background"). Added to that, there seem to be a large number of people who are unable to function at all, unless they have the accompaniment of a blaring radio or cassette player.

Whatever happened to that phrase, "Silence is Golden". By all means let everyone have access to good quality sound and good music, whatever that may mean to the person concerned. But let there be a stop to the idea that hifi must be as loud as possible and can be used without regard to the privacy of others.

Leo Simpson

Registered by Australia Post — publication No. NBP0240.
Printed by Magazine Printers Pty Ltd, of Regent Street, Sydney and Masterprint Pty Ltd of Dubbo, NSW, for Magazine Promotions, of Regent St, Sydney.
Editorial Office
57 Regent St, Sydney 2008.
Phone (02) 699 3622 Telex 25027.
Postal Address: PO Box 163, Chippendale 2008.
Advertising Offices
Sydney — 57 Regent St, Sydney 2008.
Phone (02) 699 3622 Telex 25027.
Representative: Narciso (Chit) Pimentel.
Melbourne — 392 Little Collins St, Melbourne 3000. Phone (03) 602 3033.
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Representative: Sandy Shaw (08) 267 4433.
Perth — 454 Murray Street, Perth 6000.
Representative: Ashley Croft (09) 21 8217.
Subscriptions
Subscription Dept, John Fairfax & Sons Ltd, GPO Box 506, Sydney 2001.
Enquiries: Phone (02) 20944, ext 2589.
Circulation Office
21 Morley Ave, Rosebery, Sydney 2018.
Phone (02) 663 3911.
Distribution
Distributed in NSW by Magazine Promotions, 57 Regent St, Sydney; in Victoria by Magazine Promotions, 392 Little Collins Street, Melbourne; in South Australia by Magazine Promotions, 101-105 Waymouth St, Adelaide; in Western Australia by Magazine Promotions, 454 Murray Street, Perth; in Queensland by Gordon and Gotch (A'asia) Ltd; in Tasmania by Ingle Distributors, 93 Macquarie St, Hobart; in New Zealand by Gordon and Gotch (NZ) Ltd, Adelaide Rd, Wellington.

News Highlights

Telecom builds experimental cable television network

Following directions from the Government, the Australian Broadcasting Tribunal is currently conducting an inquiry into a number of issues related to the introduction of cable television. Major issues include whether cable TV should be introduced to this country, and if so, how the service would operate, who should provide the cable network and who should supply the programs.

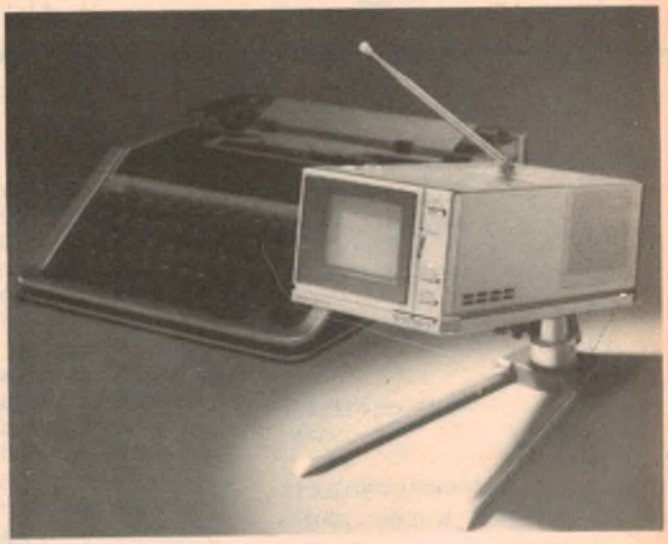
Telecom Australia believes that it has the skills needed to provide the cable network as a common carrier of wideband services. It has made several detailed submissions to the Tribunal in support of its claims, and installed a small experimental network to verify technical details of its proposed system.

Cable television networks exist in many overseas countries and are widespread in North America. They usually consist of coaxial cables which carry signals from a program source to subscribers' homes. It is possible that optical fibres could be used instead of coaxial cable in the future, and two-way services are a definite possibility.

Cable systems often provide more than 40 TV channels, and give subscribers access to a wide variety of information and entertainment programs. To receive the service, subscribers pay a monthly subscription to the cable television operator.

The experimental network has been installed at Telecom's external plant experimental centre at Maidstone, Victoria. Information obtained from the project will assist in deciding whether or not a single network can be used to satisfy the demand for cable television as well as the special video and other wideband links which will be needed in the future.

Telecom's test installation was designed and completed in six months, including the time needed to specify and purchase equipment from overseas suppliers. The installation consists of both aerial and underground cables, and 10 amplifiers and 16 subscriber connections were installed on the 7km network to fully simulate a complete cable television system. Up to 30 TV channels can be carried by the network.



World's smallest, lightest colour TV set made by Matsushita

Matsushita Electric Industrial Co Ltd of Japan has developed what is said to be the world's smallest, lightest colour television set. The new model TH3-W3V measures 115 x 86 x 232mm with a 75mm screen, and weighs just 1.5kg. It operates from the mains, car batteries or optionally available rechargeable battery packs.

The tiny TV is also equipped with terminals for a direct video signal input, so that it can be used as a colour monitor for a video camera or computer. It can also be used as a tuner for a video cassette recorder.

Matsushita developed several new components specifically for the compact set. Besides the new 75mm colour picture tube and new ICs, a new compact flyback transformer and an ultra-thin electronic tuner contribute to the reduced size of the set.

It may be some time before we see the set in Australia however. Sales began in Japan in December of last year, with export to the United States scheduled to start in June this year. Plans for export to other countries have not yet been announced.

Outback pay-TV proposal

A Sydney company, United Entertainments Corporation Pty Ltd, has claimed that "pay television" could be introduced immediately to provide services to up to 350,000 people in Australia's outback areas. The claim was made in the company's submission to the Australian Broadcasting Tribunal Inquiry.

UEC said that it could supply a subscription broadcast TV service within 30 days to 50,000 of the estimated 700,000 remote area residents who are presently without TV services or who receive only the ABC. It said that it would be able to service 350,000 of this group within 12 months.

The subscription service would use low powered transmitters, with coders or scramblers used to ensure that only subscribers (with sets fitted with a decoder) could receive the service.

Marine radios go underground

Where do you use marine radios? — Underground, of course!

Miners at Broken Hill have found a unique new use for marine radios from the Tandy Corporation. They are using them 300 metres below ground, where dense deposits of silver and lead ore make use of other radio frequencies virtually impossible.

The 27MHz radios are used for communicating from level to level within the various shafts and tunnels of the mines, and have been fitted to the cages, or high speed lifts, which ferry men and equipment to the surface. They are also fitted to the ore carrying skips use to transport ore in the mines.

Heat, dust and humidity in the mines is a severe test for any electrical equipment, and the miners are said to be delighted with the performance of the Tandy radios.

Hughes Communications wins contract for Australian satellite

Hughes Communications International, a United States company, has won the contract to supply satellite and ground control equipment for the Australian domestic communications satellite. The award of the contract followed tenders by three other companies, Satcom International (British Aerospace and SA Matra), Ford Aerospace and Thomson CSF.

Aussat Pty Ltd, a company formed by the Government to oversee the satellite system, has been instructed to begin negotiations with Hughes with a view to launching the communications satellite in 1985. Mr Ian Sinclair, Minister for Communications, said that Hughes Communications International was the only company offering a satellite which met all Australian technical requirements.

Telecom, the Departments of Transport and Communications, and Aussat are continuing to evaluate tenders for the supply of earth stations to operate with the satellite system. It is expected that a final decision will be made early next year.

Because of the uncertainty surrounding scheduling of space shuttle flights, two independent launch bookings have been made, one with NASA and one with the European Space Agency using the Ariane launcher.

Logic controller conserves energy

Lighting in the new Monash Primary School in Canberra will cost $1500 less per year thanks to a programmable logic controller introduced in the school by the Department of Housing and Construction's ACT region. Engineers at the Department have programmed the controller to operate school lights, playground bells and hooters and ventilation and heating systems.

Based on current usage figures and taking into account the average seven hours per day that the school is fully occupied, it is estimated that energy costs can be cut by 30% by accurate control of lighting and other services to closely match actual needs. The Programmable Logic Controller is a relatively simple and inexpensive control system which can be easily adapted to school requirements.

Monash Primary School, expected to be opened this year, will be the first school in the ACT and possibly the first in Australia to have fully automatic light switching.

It is said that the PLC is so easy to use that anyone can punch a new lighting timetable into the machine, which uses a keyboard like that of a handheld calculator.

All digital sound effects for "Star Wars" movie maker

Those impressed by the special effects in movies such as "Star Wars" and "The Empire Strikes Back" have an even bigger treat coming. Lucasfilm, the producer of the series, is setting up an all digital sound studio to handle audio production in future films.

As reported by "New Scientist", composer James Anderson gave details of the new studio at the recent International Computer Music Conference in Dallas, Texas. He and his team are developing a studio incorporating all the latest techniques in digital sound processing. Controlled by three computers and linked to disc drives that store 300 million bits of information each, the new system operates in real time to produce all the sound effects of a full scale space war – sizzling lasers, exploding space ships, robot beeps and alarms – as they are needed.

A programmable console replaces the mixing desk to put the full array of digital sound synthesis equipment at the fingertips of the special effects crew. Console controls are re-defined as required by the computer, replacing slide controls, for example, with a computer generated "endless turn" knob.

It's a far cry from the days when a Hollywood sound engineer dropped ripe melons in front of a microphone to produce the sound of a punch on the nose. It is said that in the great days of westerns, Hollywood was the melon industry's best customer!

Job agency for ex-weapons workers

A new employment agency in the United States specialises in finding jobs for scientists and engineers who want to leave military projects, according to a recent report in "New Scientist". Called the XMX employment agency – after the MX missile program – the agency is run by "High Technology Professionals", an anti-nuclear group.

President of the group is Dr Warren Davis, a gravitation physicist at the Harvard/Smithsonian Astrophysics Centre in Cambridge, Massachusetts. Davis gave up military research five years ago, after 10 years in the field, saying that the work he was doing was increasing the threat of nuclear war.

Recently Davis spoke to students at the Massachusetts Institute of Technology (MIT) on "coping with defence related employment". "We want to point out that while it is generally acknowledged that a scientist is better paid if working in defence, there are other considerations – such as the morality of working on weapons."

BHAS Lead insulation

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Around the house, the office or the factory, it's hard to beat lead sheeting for noise insulation.

Lead is efficient, easy to install and economical. It can help make almost any area as quiet as a mouse.

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NEWS HIGHLIGHTS

Dick Smith store for Bankstown

Dick Smith Electronics has opened a new store at Bankstown Square Shopping Centre in NSW. The store is the company's first venture into shopping centres.

Situated on the Terrace Level, the new store will stock a wide variety of telephone accessories, hifi equipment, electronic games and home and business computers in addition to the traditional kits and components. Manager Craig Waterworth and trained staff will be on hand to advise customers

IBM plans electron beam storage ring

If an atomic particle accelerator ever appears as a production line tool, chances are that the first in the field will be IBM. Already Dr James McGroddy, vice-president of IBM's research division for logic and memory chips has plans to build an electron beam storage ring at the company's Thomas J. Watson Research Centre in the United States.

The storage ring will cost about $3 million – about the same price as the electron beam machines now used.

Electron beam lithography is already used by IBM to "write" wiring patterns on silicon chips carrying the equivalent of up to a quarter of a million electronic components. The beam storage ring could contribute to the production of chips with as many as a million components.

The most highly automated IBM plant is at oddly named East Fishkill, north of New York. Three electron beam machines are in use there. Over 9000 people are employed at the plant.

Electron beam lithography is the highlight of the automated plant. With electron beam techniques there is no need for the complex high precision masks normally used in chip manufacture. The design of the chip is stored on a computer disk and is used to scan the beam over the silicon wafer, typically writing, 4000 to 5000 lines on a 4.6mm square chip.

Fine line width is not the only advantage of the electron beam technique. Dr Paul Lowe, manager of the East Fishkill factory, believes that the flexibility provided by the technique is even more important. Complex chip designs can be modified relatively easily to "personalise" chips for different applications, making Very Large Scale Integration (VLSI) economically feasible for even short production runs.

New Jaycar city store

Jaycar Pty Ltd, well-known supplier of kits and components for the electronics enthusiast, is opening a new store this month. The new shop includes a 110 square metre showroom, and is at 125 York St, Sydney.

If that address sounds familiar to Sydney-siders, it should. The new Jaycar shop is immediately above the York St store of Dick Smith Electronics.

New Electronic Agencies shop

York Street, Sydney, is rapidly becoming the heart of the local electronics scene. Bill Edge's Electronic Agencies is also opening a city store. The address is 123 York Street.

With the opening of the new shops, there will be no less than five electronics retailers within a 50 metre frontage on York St. Certainly worth a visit!

Industrial robots a growth area

Industrial robots will be one of the fastest growing industries of the 1980s, according to a new report from Mackintosh Publications. Output in Japan is expected to double in value between 1981 and 1984, and to double again between 1984 and the end of the decade.

Demand for robots in Japan, however, is expected to be so high that even by 1990 only 10% of the Japanese output will be exported, leading to supply shortages in other countries.

Types of robots expected to dominate the scene are numerically controlled machines, fixed sequence robots and playback robots. Each type has its own strengths and weaknesses and is suitable for particular types of manufacturing operations.

Electronic scales for mouse-catchers

An electronic balance so precise that it can accurately weigh a moving mouse will become available in Australia following a visit last month by Mr Ian Taylor, the export manager of manufacturer Oertling Ltd.

The HC 22 balance uses microprocessor technology (what doesn't, these days?). Special filtering circuitry is included which ignores fluctuations caused by movement of the object being weighed (such as the mouse) and records only the weight. The equipment will weigh in two ranges, from 0.1 gram to 2000g and from 0.01g to 200g. Oertling Ltd is at Cray Valley Road, Orprinton, Kent BR5 2HA, England.

Electronics Australia/ DICK SMITH SUPER 80 Computer Kit

Production costs have now been absorbed due to fantastic response — YOU REAP THE BENEFIT!!

NEW SUPER LOW PRICES

was $289.50
NOW
$239.50
save $50

Yes, this makes the full 16K computer with 9K basic on tape, transformer and IC sockets — only — **$287**

SHORT FORM KIT (Cat. K-3600)
Designed for computer applications where 'Basic' programming is not required. Kit supplied with Eprom Monitor and 16K RAM. NOW SAVE $50 WAS $289.50 $239.50
CASE (Cat. H-3200) New and in stock $39.50
Add the following items to make a fully operating computer system to your own requirements.
Transformer to suit M-2325 $22.50
BASIC program (interpreter) on cassette
NOW SAVE $12.00 WAS $24.50 K-3602 $12.50
IC socket set (recom) K-3603 $12.50
BASIC program in EPROM (set of 3 IC's)
NOW SAVE $40 WAS $89.50 K-3604 $49.50
S-100 Expansion K-3606 $19.50
Character Generator (upper/lower case)
NOW SAVE $20 WAS $69.00 K-3607 $49.00
Construction manual SAVE $3.00 WAS $12.50 B-3600 $9.50
BASIC manual SAVE $5.00 WAS $14.50 B-3602 $9.50
48K on board (2 sets of IC's) X-1186 $59.90

Photo shows the basic board with the following options: S-100 expansion, IC sockets and a full 48K of memory.

don't wait until June

Available NOW!

OVER 1300 SOLD!

The SUPER 80 is the proven computer kit with over 1200 sold and it is available ex-stock! Why wait for others – check out our prices with the competition and whilst you are doing that check out the features too! Dick Smith Electronics have reduced the price of the SUPER 80 as the enormous design costs have now been absorbed by the superb sales of this superlative kit computer – read on. . . . .

Check the Super 80 against all others	SUPER 80	OTHER
* IS IT S-100 EXPANDABLE	☑	☐
* DOES IT EXPAND TO 48K ON BOARD	☑	☐
* DOES IT HAVE RF OUTPUT FOR TV CONNECTION	☑	☐
* WAS IT FEATURED IN ELECTRONICS AUSTRALIA – AUSTRALIA'S LEADING ELECTRONICS MAGAZINE	☑	☐
* IS IT AVAILABLE EX-STOCK	☑	☐
* HAS IT SOLD OVER 1300 AND BEEN PROVEN AGAINST TEETHING TROUBLES	☑	☐

CHECK OUT THESE FEATURES: * Relay operates cassette unit automatically * 2K Monitor program supplied * Character generator giving full 64 characters, 32 characters x 14 line screen * Spare IC positions for prototyping and user customising * RF modulator inbuilt, connects to your TV set * Optional S-100 provision * Keyboard can be remotely mounted if required * 12MHz quartz crystal * Optional 9K SUPER BASIC in ROM plug in facility * Full size professional 60 key keyboard * Inbuilt power supply * 16K RAM on board plus provision for on board expansion to 48K * Inbuilt cassette interface

'Sorry Dick, It Doesn't Work'

DUE TO THE VERY LOW RETURN RATE (3%) WE HAVE REDUCED THE SERVICE FEE BY 50% TO ONLY $50!!!

If, after completion your Super 80 fails to operate, you may take advantage of our "Sorry Dick it doesn't work" service.
Our Service Centre will check and repair your Super 80 for the cost of $50. This fee includes necessary replacement of components etc.
If you send your Super 80 to us under the "Sorry Dick, it doesn't work" service it must have been constructed using IC sockets.

7 Day Satisfaction Guarantee

Purchase this kit and inspect it for up to 7 days. If you do not wish to go ahead and construct this kit, simply return to us in the condition supplied and your money will be refunded in full.

This is what Reg Hespe, Technical Officer of Gladesville had to say about 'Super 80'
"I enjoyed building the Super 80 project and felt it worthwhile, of immense educational value and quite easy to construct. It worked as soon as I turned it on and has provided many hours of enjoyment".

SEE OUR OTHER ADVERTISEMENTS IN THIS MAGAZINE FOR THE NEAREST DICK SMITH STORE ADDRESS AND PHONE NUMBER

Very Advanced design – but works with any TV set!

The 'Super 80' offers a specification that we believe just cannot be bettered at the price. It uses the popular Z80 Microprocessor IC, a professional keyboard and has direct RF output so that you can use the computer with any TV set (you don't need to purchase a special video monitor).

Easy to build

Even though we would not recommend this kit to the raw beginner, it is very easy to build. Any person who can use a small soldering iron and can solder neatly should have no difficulty in construction. This is because of the unique double side board design which means there is virtually no other wiring. The board is covered with professional 'solder mask'; this makes soldering much easier without the problems of bridges, etc. Once the components are soldered onto the board in their marked positions over 98% of the construction is completed. Even if you cannot get the completed kit to work, we have a special "Sorry Dick it doesn't work" repair service to assist you.

NEW lower price, higher specification - how is it done?

Most computers sold in Australia are manufactured in the U.S.A. where extremely high labour rates prevail - and you pay dearly for this on built up units. With this computer kit, you provide the labour and therefore save a fortune. And remember, this computer does not have a small toy-like calculator keyboard but a full size professional typewriter keyboard.

Advanced programming capability

One of the most popular computers in the world (the Tandy TRS-80 Level 1) only has 4K of BASIC. The BASIC we have with this unit is a large 9K. When you consider that our popular Sorcerer computer (over 2,000 sold) only has 8K BASIC and sells for over $1,000, it is obvious that by building yourself, you are saving real money.

Electronics Australia/Dick Smith design

This is not a half baked design with no back up. The resources of Electronics Australia, Australia's most popular electronics magazine, and Dick Smith Electronics have combined to design and bring you this kit in the interests of computer enthusiasts actually building and not just buying. The design is fully Australian.

Imagine how much you will learn!

Most computer enthusiasts can program a computer but would have absolutely no idea of how to build one. By building this kit you will learn both the technical side of construction, how it works and then how to program. What a fantastic background for a future. . . . . .

Sectional construction

We have designed this kit not only for the serious computer user but also for first time users like the student or hobbyist. This is why we have a short form kit which may be added to as you build (and as you have the money!). For example, you may build the computer originally and operate it with 'BASIC on tape' and then add 'BASIC in ROM', add the S-100 and provide other parts at a later stage.

Most of the satellites orbiting the Earth have been put there by the world's military forces. Above our heads the superpowers are keeping track of each other's movements with an ever more advanced array of "spies in the sky".

by MARK HEWISH

Superpower rivalry in space

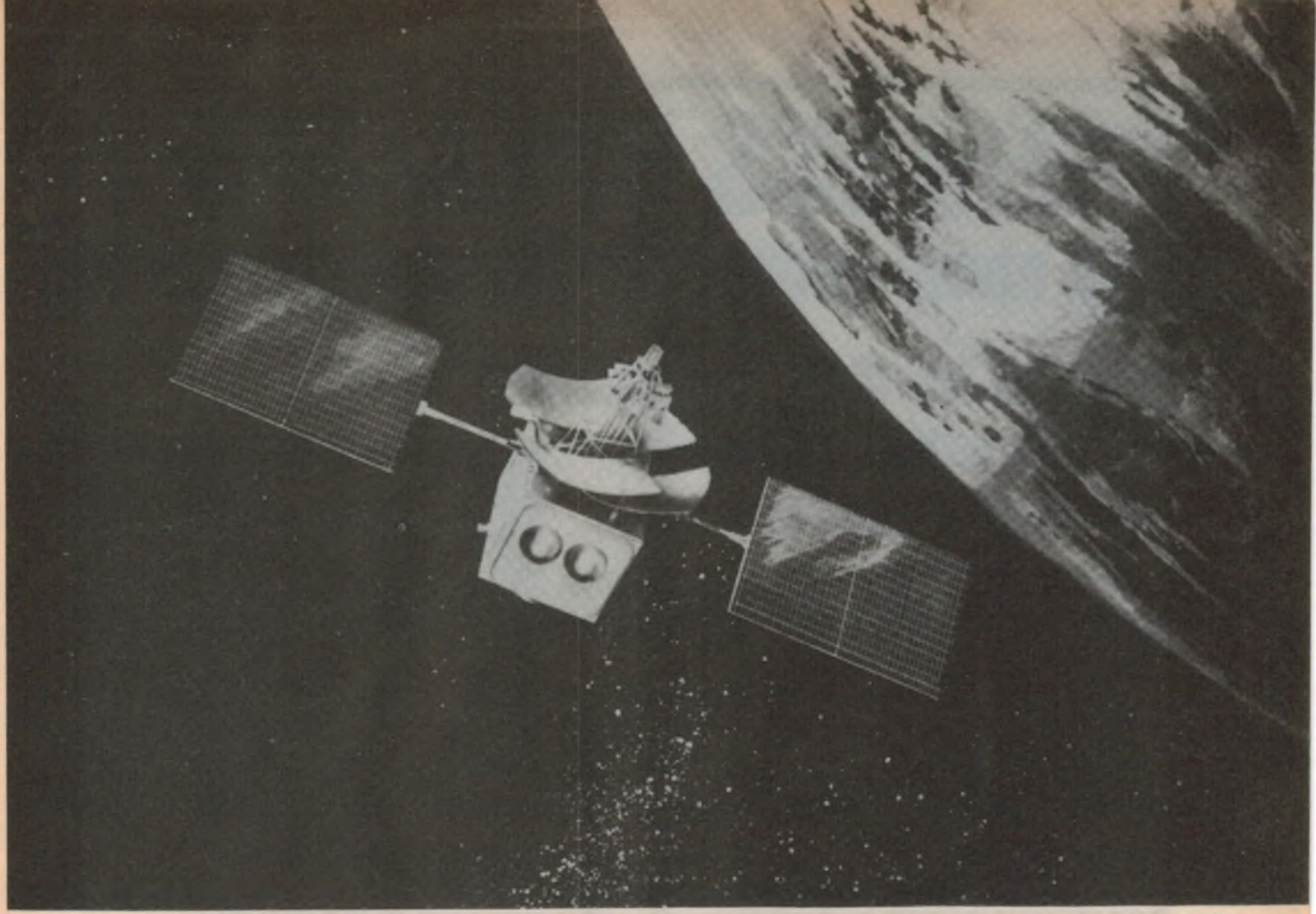
Satellites show a warlike face

SPACE has been described as the battlefield of the future. This is not strictly true: war is already being waged in space, in a cat-and-mouse game played by the superpowers. The era of space battleships armed with lasers and particle-beam weapons is many years in the future. But military chiefs are surprisingly well practised in using a more prosaic kind of spacecraft – satellites – mainly for surveillance. Of the 3000 or so satellites launched so far, about two-thirds have either been entirely military or have fed information into defence projects. Last year alone, the USSR placed in orbit at least 85 military satellites.

As far back as the late 1940s, the US thought about using satellites as high-flying robot spies to complement or even replace manned aircraft. In the 1950s, engineers from both the US and the USSR developed ballistic missiles that flew in space on their way to targets. The engineers quickly gained expertise in the technology of large rockets, guidance electronics and re-entry vehicles -- the latter to protect warheads as they plummet into the atmosphere at many thousand kilometres per hour. Replace the warhead with a spacecraft, use minitature re-entry vehicles to carry film back to Earth, and you have a "spy satellite."

The very technology that made spies in the sky possible also provided the reason for developing more of them. Both superpowers wanted to know the exact locations of the targets for their missiles. And they were desperate to find out about the other side's rocketry developments: satellites could provide both types of information.

The skies are now criss-crossed with a web of surveillance satellites operated by military forces. The vehicles carry film and television cameras, infrared sensors that can see at night, radars to penetrate cloud and bad weather, and listening devices to intercept "enemy" radar and



radio transmissions. The space vehicles are also used in other areas of warfare. In the 1960s, when the US Navy launched its first submarines carrying Polaris ballistic missiles, naval engineers needed to tell the vessels' commanders where their targets were. The original guidance information would become outdated after many weeks at sea. The answer was the network of Transit navigation satellites that is still widely used today.

At about the same time, the commanders of air bases and aircraft carriers wanted to know what the weather would be like over targets to be attacked by their aircraft – so a new breed of military meteorological satellites was born. A large part of the radio traffic between NATO commanders and their forces is now routed via specialised communications satellites. Other spacecraft watch for nuclear attacks, monitor enemy missile tests and measure the effectiveness of new weapons.

Before the 1980s are out, American soldiers in their foxholes in Europe will be able to find out where they are (to within a few metres) by tuning in to a web of 18 NavStar navigation satellites that fly in shoals more than 16,000km above their heads. They will be able to communicate directly from a bunker in Germany to their headquarters in Washington DC – simply by unstrapping a satellite terminal that is small enough to be carried on a man's back. Surveillance spacecraft hovering in geostationary orbit at a height of 36,000km will stare at the Earth with perhaps a million or more individual infrared detectors, looking for the slight rise in temperature that shows up a cruise missile's jet-engine exhaust.

In the days of the Cold War, the Americans in particular had good reason to develop spy satellites. To find out about the US's ballistic missiles, the Soviet Union had only to peruse government documents freely available in Washington, buy good maps of the US and instruct spies to look out for major earthworks. For the US, it was not so easy. No Westerners were allowed anywhere near Russian missile bases, and Soviet maps deliberately showed big towns and other potential targets up to 15km away from their true positions.

A significant event took place in August 1960 – though at the time it seemed prosaic enough. A US Air Force satellite called Discoverer 13 ejected a capsule containing photographic film; the capsule re-entered the atmosphere and was picked up from the sea. This exercise showed that pictures could be taken in space and returned to Earth for analysis. This method is still used today when military officials need high-quality photographs from satellites.

In parallel, American scientists developed a way of obtaining photos more quickly. The film is automatically processed inside the spacecraft and the prints scanned by a narrow light beam passing back and forth across it. The various shades of grey are converted to radio signals and transmitted to Earth, where a similar arrangement in reverse builds up prints with the characteristic lined appearance of wire photos.

In January 1961, the US launched Samos 2, its first operational surveillance satellite that relied on radio transmission. The craft orbited the globe for a month. By mid-1972, a total of 109 US spacecraft had systematically mapped most areas of military interest on the Earth's surface. They have since been succeeded by the aptly named Big Birds – huge 13-tonne reconnaissance satellites – and by the KH-11 craft. The latter are operated by the Central Intelligence Agency rather than the US Air Force.

The KH-11 has a life in orbit of two years or more, compared with five or six months for Big Bird. It sends its pictures back to Earth via a digital data link rather than in film capsules. Engineers can manoeuvre their satellite out of its normal orbit to take a more detailed look at areas in which they are particularly interested – the war zone in the recent fighting between Iran and Iraq for instance.

The US Air Force still has a small number of its earlier close-look satellites,

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known as low-altitude surveillance platforms, which it keeps in reserve for emergencies. These craft fly relatively close to the Earth – as near as 130km, so they fall into the planet's atmosphere and burn up after the short time of 50 to 80 days. The cameras on these space vehicles can distinguish objects only 15cm in diameter. The film is ejected in capsules and snatched in mid-air by C-130 Hercules aircraft.

The space shuttle will play a big part in military surveillance. The US Air Force has only three of the low-altitude surveillance satellites in reserve and will run out of Big Birds in 1983. A new version of the KH-11 providing better-quality pictures will be launched in 1984, but in the future the only way of getting high-resolution pictures back to Earth will be to carry cameras in the shuttle. By placing their faith in manned space vehicles for spying from the sky, the US's military chiefs are returning to a concept which their country once abandoned: Big Bird was assigned high priority only because the Air Force's planned manned orbiting laboratory (MOL), was cancelled in 1969. The laboratory, based on the two-man Gemini capsules that NASA placed in orbit during the 1960s, would have been used for surveillance missions.

Targets will obviously have to be extremely important to risk flying a manned (and very expensive) shuttle over them to take photographs in times of tension. This is especially true once the Soviet Union has perfected its killer satellites – unmanned craft that manoeuvre alongside orbiting vehicles and blow them up with explosives.

Two types of satellites

Satellites can be broadly divided into two types. The first travels in a geostationary orbit around the equator at a height of 36,000km; the second type takes up other available orbits. In a geostationary position, a space vehicle completes one sweep around the Earth in the same time that the planet makes one rotation. It thus appears to hover motionless in the sky. A satellite in geostationary orbit can "see" about one-third of the Earth's surface.

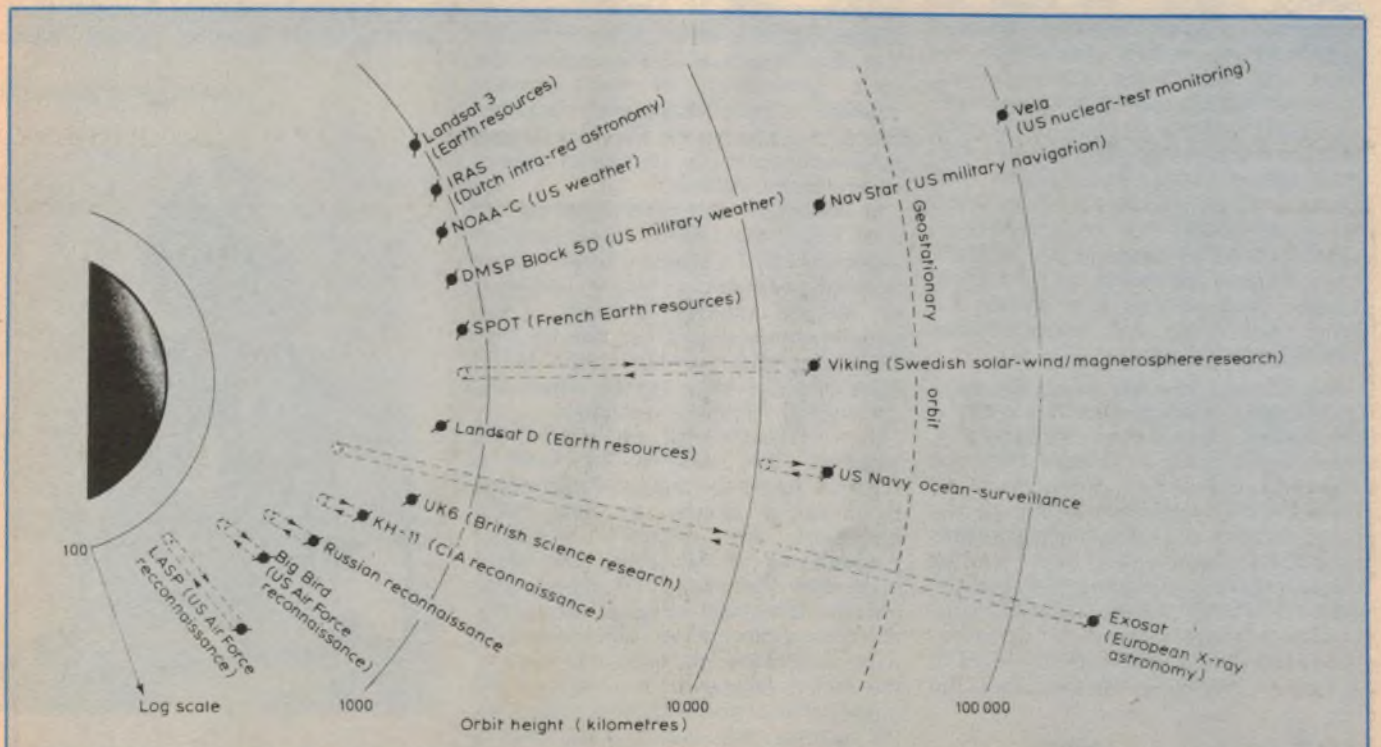
Most communication satellites, such as those in the Intelsat series used by more than 100 countries, are in geostationary orbit — as is a network of weather satellites provided by agencies in the United States, Europe, USSR and Japan. The US has several military satellites in this orbit, in what it calls the Defence Support Program. These craft should warn of attacks by ballistic missiles. With its Rhyolite craft, America also monitors tests of these weapons by Russia and China.

More than 170 communications satellites are already in the geostationary position or are planned. Add all the military satellites, together with those now planned for direct broadcasting of television programs, and the space left for more satellites in this orbit becomes very limited. International agreements ensure that the signals from satellites near each other do not cause interference.

Space nearer the Earth is also very crowded, with 3000 or so satellites jostling for position alongside bits of old rockets and other debris. The vastness of space makes collisions unlikely, but one day the shuttle may have to act as a garbage truck to retrieve space junk or nudge it into a different orbit so that it re-enters the atmosphere and burns up. The band of space from the top of the Earth's atmosphere (70 or so km high) to a height of several hundred kilometres is occupied by satellites that have to get as close a view as possible of what is going on beneath them.

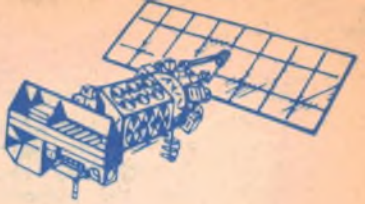
Several types of spy satellite fly very low, brushing through the highest point of the atmosphere, as their instruments strain to pick out the smallest details. As a result, their orbits "decay" very quickly and they may have lives of only a few weeks. Further up are the longer-lived civilian Earth-resource satellites doing a similar job but accepting a correspondingly inferior picture quality. At roughly the same heights are the civilian and military low-orbit weather satellites, which have orbits that take them over the poles.

Scientific research satellites frequently have orbits that bring them near the Earth at their perigee but fling them out into the depths of space at apogee. This shape of orbit may be adopted for various reasons; it helps for instance, in the examination of the magnetosphere.



Low-Earth orbits are primarily the domain of military and scientific satellites.

Satellites show a warlike face



In the late 1980s, American armed forces will concentrate on radar rather than cameras for space surveillance. One type of satellite will track the movements of Warsaw Pact tanks and other armoured vehicles, while the US Navy will use another to watch for warships. The Navy already has its own ocean-surveillance system: this comprises sets of three satellites which fly in clusters on parallel paths. The craft use interferometry techniques: they compute ships' positions from data provided by several antennas which measure the direction from which vessels' radar or radio signals arrive.

In its space surveillance activities, the USSR concentrates on satellites that return film to Earth. Last year the Soviet Union launched 35 such craft, of which seven provided pictures of the Earth for peaceful uses – to find out information about geology or the growth of crops for instance. The rest had military applications. Four of the vehicles were of a recent design. Bigger than most satellites, they are similar to the Soyuz vehicles that ferry crew to and from the Salyut space stations. The Soyuz-type reconnaissance satellites carry solar cells to provide electrical power, giving them twice the two-week life of earlier battery-powered types. At least three Russian satellites of different types observed the early days of the Iran-Iraq war last September.

A military base in space

Military crews aboard NASA spacecraft have brought back information useful for defence purposes, but Russia has pioneered manned missions devoted specifically to military operations. The third and fifth Salyut space stations, launched in 1974 and 1976, carried high-resolution cameras in place of scientific instruments and flew slightly lower than their civilian counterparts. There have been no purely military Salyuts recently, however, so their role may have been taken over by unmanned craft. Both the US and Russia are looking at permanent space stations carrying up to 12 men at a time, and these will have obvious military applications.

The Russians, like the Americans, have specialised in satellites that look solely at the oceans. One of these, Cosmos 954, crashed in Canada in January 1978 and scattered radioactive debris from its nuclear power generator. One of the three Russian sea-surveillance satellites launched last year had similar characteristics to Cosmos 954, but the other two were "ferrets" that listen to radio transmissions. If photo-reconnaissance satellites are the eyes of a modern intelligence service, then the ferrets are its ears. The craft eavesdrop on enemy communications, record them on tape and then replay the messages as the satellites pass over their own ground stations. The US Air Force normally orbits ferrets in piggyback fashion, using the same booster rocket as a Big Bird or KH-11. Last year the Russians launched six of these craft.

One of the US's earliest military space projects was Midas, a network of satellites in low orbits (a few hundred kilometres above the Earth) which were designed to give 30 minutes' warning of a Russian missile attack. This would double the warning time provided by a chain of three ground-based radars, one of which is at Fylingdales in Yorkshire. (The others are in Alaska and Greenland). Midas satellites carried infrared sensors to detect the heat given off by the engines of Soviet missiles – but unfortunately they have failed to work. In 1972, therefore, the US Air Force switched its emphasis to satellites in geostationary orbit with what it calls the Defence Support Program.

One of the satellites in the project is positioned over the Indian Ocean, where it can monitor missile tests in China and the Soviet Union and also warn of an attack on the US by land-based missiles. Another hovers over central America, alerting the US if submarines fire missiles. Replacement satellites are launched as the old ones wear out.

The satellites each carry about 2000 infrared sensors that detect radiation with wavelengths between 3 and 5 micrometres – the type of electromagnetic waves given off by very hot objects such as missile engines. The next generation of early-warning satellites will probably operate between 8 and 13 micrometres. They will be able to detect cooler objects, the jet engines of aircraft for instance.

In 1984, in an experiment code-named Teal Ruby, the US Air Force plans to launch its P80-1 research satellite with an unusual passenger on board – an array of 150,000 infrared detectors. If the experiment is successful, the US may launch another satellite called HALO (high altitude, large optics) which will carry up to 10 million detectors.

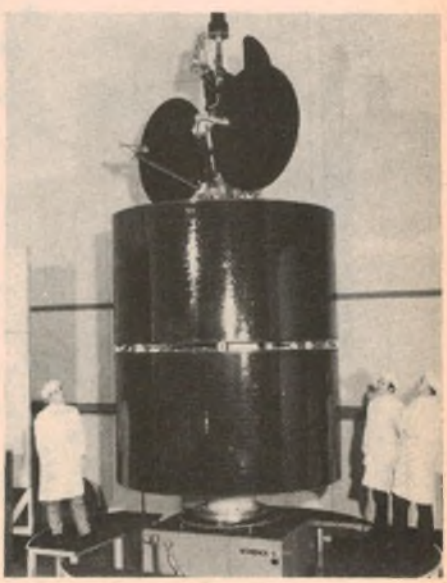
In conventional early-warning satellites, the view of the Earth is scanned across the array of detectors to build up a picture. In Teal Ruby, however, the detectors "stare" continuously at the scene, just like a frog's eye. This change is expected to improve the sensitivity by a factor of five and allows information from the sensors to be updated several times a second. As the rocket engines of an intermediate-range ballistic missile burn for only 30 to 50 seconds, the staring array gives a much better chance of detection.

Satellites also play a part in military communications. The US, Soviet Union, NATO and Britain have all launched this kind of craft. The vehicles operate similarly to satellites such as the Intelsat series used for ordinary international telephone calls. The military vehicles transmit to and from terminals on land, ships and aircraft. The US Air Force, which needs to link people who operate nuclear bombers, missile control centres and early-warning networks, has an unusual approach: it puts its transponders on other people's satellites. The Air Force's AFSatCom system includes 12 channels on each of the US Navy's FltSatCom satellites, with other transponders on commercial spacecraft. AFSatCom may use up to 30 transponders on host satellites by the late 1980s.

A new generation of military satellites is on the way, however, which incorporates technology substantially different from that in its commercial counterparts. General Electric is building a satellite called DSCS III. The electronic circuitry in the craft is shielded to withstand nuclear radiation, and jamming its communications links is much more difficult. If a ground-based jammer locks on to one of the radio channels, the channel shuts down and is replaced by another one with different characteristics.

A major problem with radio links is their limited capacity. And the "footprint" on the ground – the area over which the radio energy is spread – may approach 500km in diameter for a geostationary satellite, giving weak

continued on page 109



Intelsat communication satellite prior to launch. Not all satellites are so benign.

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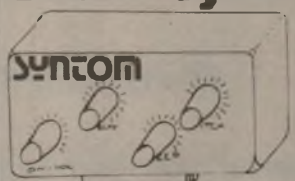

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Video terminals and eyestrain?

Computers in the home and the office mean that an increasing number of people are spending hours staring at little wriggling letters on a television screen. What does it do to their eyes?

The computer revolution is making a man-machine dialogue virtually unavoidable for many people.

Increasingly, this interplay of human and machine intelligence occurs via the console of a video-display terminal – the VDT, and this particular mode of communication has caused a rash of headaches among users. Researchers here and abroad are asking why? To date, most data – hence clues – have emerged from European investigations.

Many of those leading such inquiries convened at the National Academy of Sciences in Washington late last year for a symposium on VDT's and the vision of workers. Conducted under the aegis of the National Research Council's Committee on Vision, it was part of a study being performed for the National Institute for Occupational Safety and Health (NIOSH).

What the two-day meeting makes clear is that there is an epidemic of visual fatigue plaguing VDT-users – particularly clerical workers – and at least the suggestion of possibly more serious and lasting physiological hazards. Complaints have traditionally run the gamut of standard fatigue symptoms – from eyestrain and pain in the head, neck, back, shoulders or hands, to boredom, lethargy and lack of self-esteem. Yet depending on the sophistication of the unit, a VDT console may be no more than an ordinary cathode-ray tube, identical to the television screen illuminating most homes nightly. Why are TV viewers comfortable and ostensibly relaxed by video viewing while VDT workers are apparently undergoing notable stress? And do workers with functions similar to those of VDT users experience similar symptoms? Preliminary investigations have not answered any of these questions definitively.

Research results presented in Washington by Etienne Grandjean of the Swiss Federal Institute of Technology did, however, show a statistical correlation between the clarity and quality of letters printed on eight different VDT screens and reports of eye pain and blurred vision. Complaints were demonstrably higher where VDT-screen characters were unstable (wiggled), flickered, lacked crisp definition and provided less space inside letters – such as O's and R's – to aid their recognition.

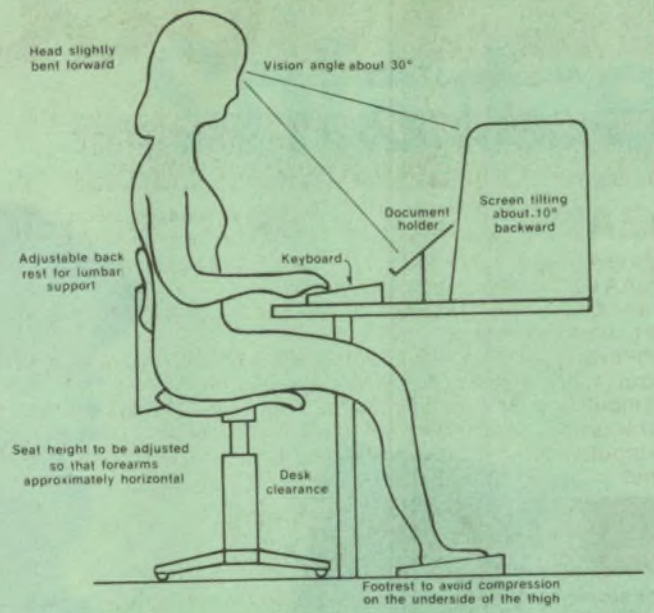
Grandjean's experiments, which used photodetector oscilloscopes and other measuring devices, showed that even new VDT screens did not necessarily meet manufacturer's claims. And two screens with the same average luminosity – 40 candela per square metre – were demonstrated to achieve it differently suggesting why one may be less desirable: One produced a sharp peak in luminance (700cd/m^2) that fell off immediately, eventually reaching near blackness before the screen's characters were "refreshed"; the other tended to maintain a more nearly constant luminosity of 70cd/m^2, refreshing long before characters went black.

According to Marvin Dainoff of NOISH, who has published one of the most extensive surveys of VDT-related eye problems, this was "the most important paper presented." Grandjean physically quantified differences between "good" and "bad" screens – those with neat versus sloppy characters, flickering versus stable letters – and then correlated those qualities with complaints of visual problems. "Now that may sound like a small thing, but it is the first time that anyone has done that."

Olov Ostberg, senior staff environmental officer for the Central Organisation of Salaried Employees – a consortium of roughly 20 Swedish unions – reported on studies he conducted using a laser optometer.

With it he measured how well eyes of air-traffic controllers could "accommodate" (adjust their lenses to focus) – both before and after individuals worked for two continuous hours at their radar's VDT screen. Results

Do video terminals cause eyestrain?



Shown at right is the "preferred work posture" of the Health Commission of NSW, indicating points to consider in the design of any video terminal work area.

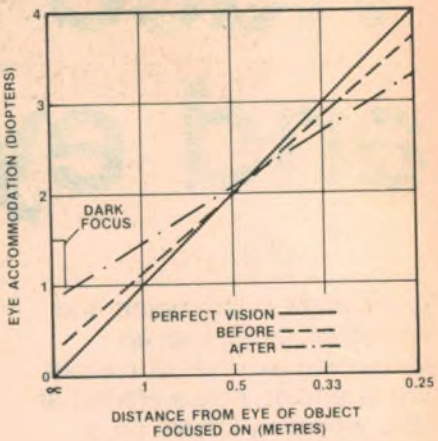


Fig 1: Changes in focussing ability.

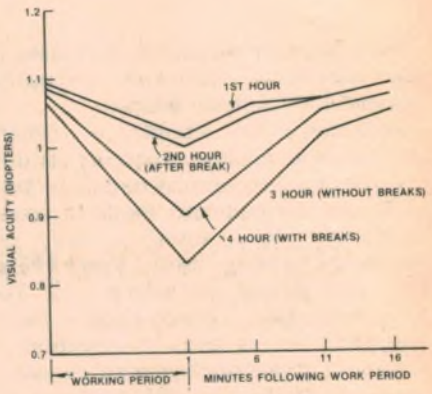


Fig 2: Changes in acuity with work period.

showed that the eyes' lenses were flexible, if a bit lazy, before the work session. Afterward, "this laziness became more pronounced" – accommodating 1/2 diopter too little when focusing on near objects, 1/2 diopter too much for distant objects (see Fig. 1).

While changes were temporary – eyes returned to normal after a 30-minute lunch break – they demonstrate fatigue, Ostberg says. Perhaps more important, changes in eye accommodation translate to changes in depth perception, he explains, and could cause problems if flight-controllers move from VDT work to observational guidance form a flight-control tower at night – something he observed the Swedish controllers do. He recommends that air-controllers unions investigate this further and work toward ensuring that workers get mandatory rest breaks for the eyes if they spend more than two hours at a VDT.

Ostberg says an ongoing study of clerical Swedish telecommunications employees shows similar eye-accommodation problems – what amounts to temporary myopia, or near-sightedness – after two hours of VDT work, although the magnitude changes are not as great as were found in the flight controllers. Workers doing similar office functions without VDT's showed no such change, he says.

Manfred Haider at the University of Vienna noted not only temporary myopia, but also colour-contingent after effects among the small group of VDT operators he studied. All used consoles with coloured displays – either yellow or green. In one study, 14 skilled operators worked continuously for two hours, or for four hours with rest breaks. In another, 13 worked four three-hour stints at a VDT. Wall-chart visual-acuity tests were given before and after each session with other measures gauging changes in colour perception. Average acuity for all was 20:18 prior to video viewing.

Afterward, all groups had declined in acuity and become sleepy, with those in the three-hour no-break sessions faring worst: acuity drops to 20:22 with yellow screens and to 20:25 with green screens. (see Fig. 2) Normal acuity returned in 16 minutes. Clerical workers with similar tasks but no VDT's showed no acuity change. Altered colour perception lasted only several minutes among the tested operators, though there have been reports of it lasting hours.

Finally, the Swedish team of Gunn Johansson and Gunnar Aronsson published results of a study last year noting higher after-work catecholamine levels (which might be viewed as a physiological indicator of stress) among VDT users. Triglyceride levels – a risk factor in heart disease – were also higher among the 95 VDT operators studied than in the controls.

These European investigators emphasise that their findings are tentative. They have been greeted with a generous measure of skepticism. Despite their shortcomings, Dainoff says European studies still offer the best gauge of what VDT operators are experiencing.

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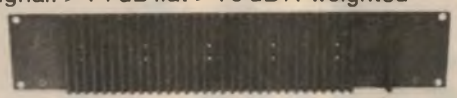

N.B. Picture is only of original heatsink supplied with this project. Our one is tapped from the rear so that no screw heads are visible. New picture next month.

Please note that the "Superfinish" Heatsink for the power amp was designed and developed by Ron Irving Electronics and is being supplied to other kit suppliers. This product cost $1,200 to develop so that your amplifier kit would have a professional finish as well as sound. We also have a new range of rack mounting boxes which will be released soon.

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Power output:	100W RMS into 8 ohms (±55 V supply).
Frequency response:	8 Hz to 20 kHz, +0−0.4 dB 2.8 Hz to 65 kHz, +0−3 dB NOTE: These figures are determined solely by passive filters.
Input sensitivity:	1V RMS for 100W output.
Hum:	−100dB below full output (flat).
Noise:	−116 dB below full output (flat, 20 kHz bandwidth).
2nd harmonic distortion:	<0.001% at 1 kHz (0.0007% on prototypes) at 100 W output using a ±56 V supply rated at 4 A continuous. <0.003% at 10 kHz and 100 W.
3rd harmonic distortion:	<0.0003% for all frequencies less than 10 kHz and all powers below clipping.
Total harmonic distortion:	Determined by 2nd harmonic distortion (see above).
Intermodulation distortion:	<0.003% at 100 W. (50 Hz and 7 kHz mixed 4:1).
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World War I created a group of experienced radio operators who were to have a profound experience on Australia's fledgling radio industry during the next decade. This article, the third of a four part series, highlights the work of the amateur radio movement during the 1920s and sketches the origins of our broadcasting system.

Australia's radio pioneers – 3

by PHILIP GEEVES O.A.M.*

Fellow of the Royal Australian Historical Society.

World War I made unprecedented demands on scientists, hastening the development of the triode valve and its offspring, radio telephony. When the war ended it was clear that vacuum tubes would dominate the future of radio. Another byproduct of the war was a sizeable contingent of experienced radio men, veteran operators from the armed forces and the mercantile marine, some of whom had squeezed more adventure into a few years than most men know in a lifetime. That happy breed included the past doyen of our electronics industry, the late Sir Lionel Hooke, who after serving as wireless operator to Shackleton's 1913/4 polar expedition, donned naval uniform and saw plenty of action in the ensuing years.

The hard school of war produced a generation of operators who had a genius for improvisation and "could read Morse in their sleep, even through a welter of static," the sort of rugged individualists who, before the war, had carried their own crystal receivers to supplement the regulation shipboard "Maggie" – Marconi's clockwork magnetic detector. Later they acquired their own valve receivers and used them wherever they went.

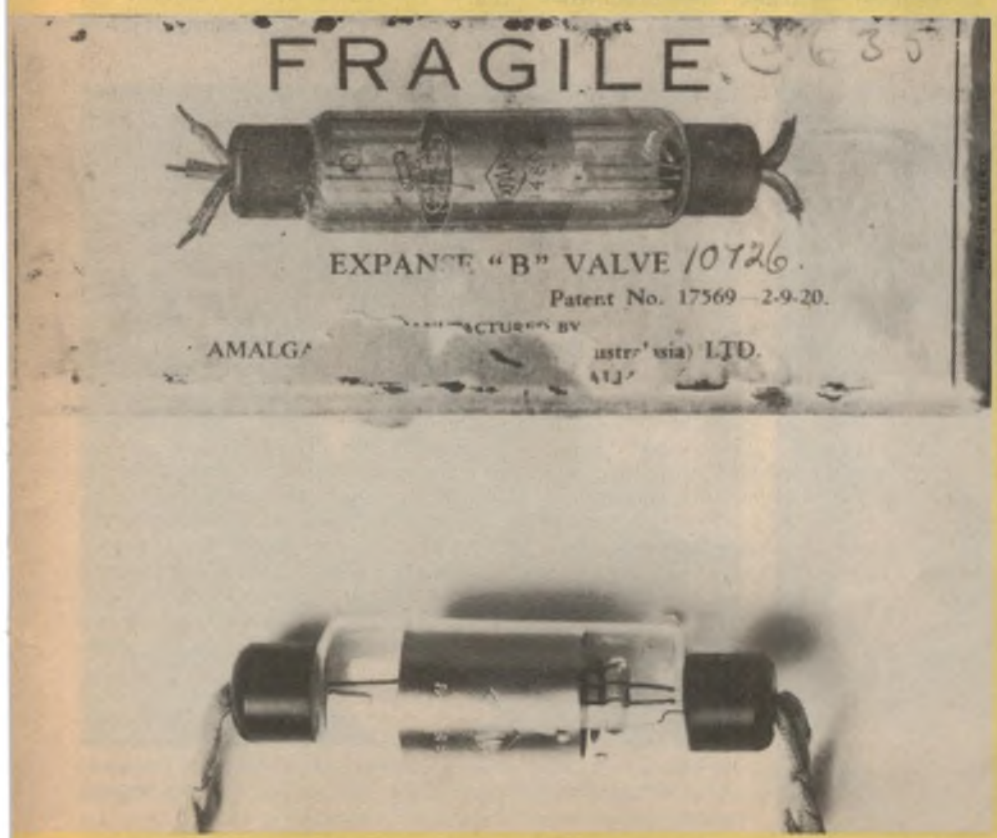
On returning to Australia for demobilisation, many operators brought with them a precious triode valve swathed in cotton wool, because men of that generation never forgot the thrill of their first exposure to radio telephony. Harry de Dassel remembers hearing a 1916 transmission of speech and music from San Francisco when he was operator aboard the "Moana" . . . "the captain swore it was the ships' engineers playing a practical joke."

Early in 1919, AWA decided to test the local potentialities of radio telephony. First it was necessary to build a transmitter, a task assigned to William Bostock, a decorated war veteran who subsequently rejoined the RAAF and became an Air Vice Marshal. Bostock's little transmitter used a single Marconi Q valve. One of the project engineers, Eric Burbury, recalls . . . "the normal anode voltage was about 40, but we gave it 240 volts and hooked it up into an oscillatory circuit. The anode glowed a bright cherry red and the valve radiated quite a bit of power." When tested in coastal vessels, this transmitter amazed the monitoring team by sending clear speech to Sydney from as far south as Gabo Island.

Radio telephony was given its first public demonstration on August 13, 1919, when Ernest Fisk addressed the Royal Society of New South Wales, ending his lecture with a recording of the National Anthem played on a hand-wound gramophone five city blocks away. The tiny transmitter used in the coastal tests was again pressed into service, feeding a T aerial on the roof of "Wireless House." As no loudspeakers were available, a number of Baldwin earphones, hastily fitted with tin horns, were strung along the ceiling of the lecture hall. Everything worked splendidly. For the first time in history an Australian audience stood to attention as a recorded orchestra played the National Anthem by radio. Perhaps the sharpest response came from the Government, which promptly amended the Wireless Telegraphy Act to give the Commonwealth control of radio telephony.

The next step was to convince Australia's lawmakers of radio's capability. Two Marconi 500W speech transmitters were imported from England and one was installed at the Middle Brighton home of AWA's Melbourne Manager, Lionel Hooke. On October 13, 1920, a distinguished audience of parliamentarians and their guests crowded Queen's Hall and listened in awed silence to an entire program from Hooke's drawing room, the first

* Philip Geeves has been awarded the Order of Australia Medal for services in the field of Australian history.



Facing page: the earliest known photograph of an Australian broadcast. 2FC's studio in 1924 with Horace Keats at the piano. This page, top: 2FC's original 5KW transmitter. Centre photograph shows a corner of the transmitter hall at AWA's Pennant Hills radio centre, 1927. Bottom: Australia's first locally made valve, the AWA "Expanse B" of 1920, is now a valuable collectors' item.

Australian broadcast to feature a live artist. Some astute politicians quickly sensed radio's value for dispelling the isolation of outback settlers.

More than a year after the war ended, wireless was still under Navy control and amateur radio was a wasteland. Nor surprisingly, there was mounting pressure for the PMG to take it over. Faced with this loss of authority, the Navy complained that any change in the status quo could result in naval dispositions becoming "known to the enemy at the outbreak of the next war." Despite these protestations, the Postmaster-General resumed control of wireless and the amateur fraternity set about exploring the applications of the triode valve. Australian valve manufacture commenced in 1920, when AWA began making the double filament Expanse B. A "soft" valve, its performance improved measurably when the first filament burned out, thus increasing the vacuum. David Wyles was in charge of the Expanse B project, assisted by chemist Wallace McSkimming.

As the amateur movement gained momentum, many electrical traders began stocking radio components as a sideline and dispensing advice to experimenters. Within a few years some of those traders helped to launch broadcasting. The hobby, incidentally, was not entirely a masculine preserve because Sydney could boast a lady wireless dealer, Miss F. V. Wallace, who was a licensed electrician.

Early in 1921 AWA, using a 500W Marconi transmitter, initiated weekly broadcasts of recorded music for Melbourne experimenters. For a time Sydney Newman ran this "concert service" from his suburban home on 1100, and subsequently 400 metres, using the call letters 3ME. The duration of each concert was about an hour, after which the energising current began overheating the carbon microphone. One wonders if this was the origin of announcers' hoary jokes about slaving over a hot microphone!

A similar service was later provided for Sydney's amateurs from a makeshift studio in AWA's Knox Street factory. It was conducted by Alton Vipan, whose long experience in wireless included being rescued from the torpedoed "Aparima," still wearing his operator's headphones.

Australia's radio pioneers

There was a growing demand, especially among experimenters, for the introduction of broadcasting. The United States was the clear leader, with conservative Britain watching to see what mistakes the Americans made. Australia was blandly content to follow Mother England. Meanwhile, radio telephony demonstrations continued to introduce many people to the medium. Probably the most ambitious broadcast of that era was on March 31, 1922, when Lionel Hooke transmitted a program by top professional artists from the stage of Her Majesty's Theatre, Melbourne, for the entertainment of convalescent ex-servicemen.

Licensed amateurs were rapidly becoming a potent force – Culliver and Howden in Melbourne, Maclurcan and Pike in Sydney, Hume in Adelaide, McDowell in Brisbane and Coxon in Perth. Charles Maclurcan was Australia's acknowledged pacesetter. This pre-war pioneer of spark transmission was converted to radio telephony by C. V. Stevenson, a Sydney electrical trader and the original licensee of 2UE. Maclurcan's station at Strathfield, 2CH, enjoyed a far-flung audience for its regular Sunday night gramaphone concerts, which were advertised in the press. Perhaps Maclurcan's most memorable coup was a broadcast by musical comedy star, Josie Melville.

Other leading amateurs of that period included Ray Allsop, R. R. (Jack) Davis, Oswald Mingay, Otto Sandel and Len Schultz. Sandel was an innovator, as the output of his station 2UW proved, and Schultz quickly graduated to professionalism by helping to build two commercial stations, 2KY and 2GB. He became chief engineer of the latter. The amateur fraternity achieved further recognition in August, 1922, when another experimenter, W. J. Maclardy, established "Wireless Weekly," the first regular radio journal in the southern hemisphere. In the second issue Maclardy trumpeted . . . "wireless telephony is now out of its experimental stages and it is time the authorities came to realise this." The active campaigning for broadcasting was hotting up.

Oswald Mingay, secretary of the Wireless Institute, organised Australia's first radio exhibition in September, 1922, at a Sydney church hall. The function enjoyed a vice-regal opening and gave a host of curious visitors their first audition of radio music.

Other interesting developments of that period were radio clubs, where young men of modest means could pool their skills and resources to build club sets and spend their evenings logging reception of amateur transmissions. By September, 1923, no less than 37 of these clubs were flourishing in New South Wales alone.

Despite endless talk about broadcasting, officialdom seemed in no hurry to introduce it. Someone had to take the initiative. Documents of that era show that AWA served the first volley on November 1, 1922, by formally applying to establish stations. Thereupon the Government issued revised wireless regulations creating a new licence category – "Broadcasting Stations."

The origins of our broadcasting system were publicised widely during the 1973 golden jubilee, so most readers probably know that Australian broadcasting was launched with "sealed sets." In addition to purchasing a Government licence, listeners were required to subscribe to a program service of their own choice, their sets being sealed by the PMG's Department to receive only the nominated stations. Four stations in three States commenced operation under this scheme – 2SB (later 2BL) and 2FC in Sydney, 3AR in Melbourne and 6WF in Perth. The sealed set was short lived. A mere 1400 listeners throughout Australia bought licences, although innumerable others, including a small army of artful schoolboys, built "open sets" and listened to whatever took their fancy.

A change was overdue and in July, 1924, new broadcasting regulations created two distinct categories of stations, A Class and B Class. Payment of a licence fee permitted the public to listen without restriction, and so Australia's dual broadcasting system began. A number of advanced experimenters acquired B Class licences and those with a flair for show business soon made their presence felt. Otto Sandel, for instance, demonstrated considerable resource in his conduct of 2UW and even broadcast the first political programs.

continued on p109

At left, Charles Maclurcan, Australia's acknowledged pacesetter in amateur radio in the 1920s. Above: Eric Burbury shown testing components in the AWA laboratory, 1924.

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FORUM

Conducted by Neville Williams

EQUIPMENT RELIABILITY: More than ever the key to commercial success in the '80s

Mention in these columns of problems with VCRs in the outback has prompted some discussion about the reliability of electronic components through the years. A point that emerged from it is the changed attitude to reliability that has followed the introduction of automation into the manufacture of both components and equipment.

When I first entered the "wireless" industry in the early '30s, the failure rate of components, by modern standards, was frequently little short of appalling.

In one line of receivers, which I recall, the resistors were fabricated on – or in – glass tubes about 6cm long. They were so prone to failure that the standing instruction in the service section was that all such resistors be replaced when a receiver was brought in for attention.

And come in they did, for reasons other than failed resistors: failed capacitors, open-circuit output transformers, faulty valves, dry joints, intermittent controls, shorting gangs, slipping dials and so on.

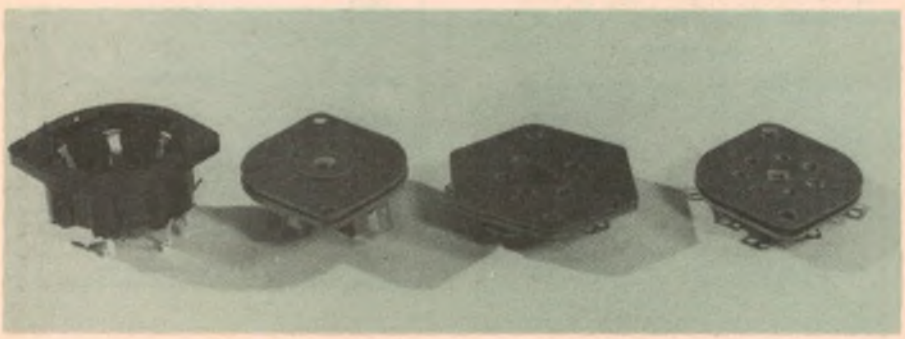
It is not that such failures were peculiar to the brand – just that they happened more frequently, to the dismay of my then employer.

Apart from a rather expensive "metallised" variety, virtually all resistors, in those days, suffered a significant percentage of mechanical failures and all "carbon" types tended to drift in resistance, particularly in the higher values and/or when required to carry anything like their rated current. No one knew this better than the local meter manufacturers, who were trying to use them as multipliers and shunts.

Tubular capacitors were no better. From the moment of their manufacture, chemial interaction between the foil, the paper dielectric, waxes, varnishes and random impurities foredoomed them to a gradual build-up in electrical leakage and, in many cases, to complete breakdown.

I have painful memories, too, of valve sockets, particularly one variety with a single-rivetted single contact for each pin. Subjected to the slightest abuse, they would become so loose that valves would simply fall out if a chassis was inverted!

A rival manufacturer overcame that problem very effectively: they made them so tight that, in plugging valves in for the first time, one stood a good chance of fracturing the cement seal between base and glass. And, if you weren't extra careful in extracting the valve later, you could leave the base behind!



Valve sockets from the "good (?) old days". The one second from the right failed to grip the pins reliably. The one on the right had more elaborate contacts but they could be fatigued and splayed by too vigorous wiggling of the valve!

And as for the valves themselves, well the less said . . .

Some lasted remarkably well but there were many others, particularly high-transconductance types, that failed mechanically, long before their cathodes had a chance to wear out.

Overall, the attitude of the electronics industry was fatalistic: you tried to produce or buy the best components you could – consistent with price – but you expected a fair percentage of breakdowns, anyway.

And, in line with that expectation, the industry trained and sustained an army of servicemen, dodging around the countryside with a soldering iron and a bag full of bits – no different in quality from the ones they were replacing!

The frailty of this do-your-best-but-don't-get-uptight approach was underlined by at least two major situations:

- World War II, which showed the extreme vulnerability of conventional components to jungle heat and humidity, and
- The arrival of television, which multiplied the number of components in a chassis, and therefore the number of potential failures.

Unfortunately, the most visible industry answer in the latter case was to multiply the number of servicemen!

For sure, individual engineers tried hard, with a limited R&D budget, to improve their products but, in toto, it added up to "too little, too late".

Nor did this apply only to Australia. In retrospect, it would seem that the consumer electronics industry in western nations generally has continued to tolerate a significant percentage of component failure as a normal nuisance, to be compensated by a willingness to replace the crook ones under guarantee!

What could be fairer than that? Answer: produce components without a content of "crook" ones!

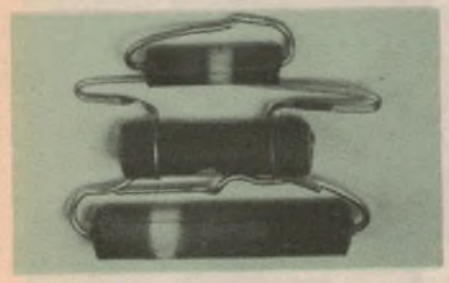
The moment of truth came for the Australian electronics industry when, during the '70s, consignments of Japanese colour TV receivers and modules began to arrive in quantity,

along with the already established intake of hifi gear and tape recorders. It didn't take long for the word to get around: the Japanese imports and modules were far, far more reliable than either the local or the European product!

The result is not surprising: these days, the vast majority of electronic equipment available in this country is Japanese manufactured, sourced or inspired.

If that remark sounds like unashamed adulation of that country, it is not meant as such. It is a simple statement of fact, like it or not! And it is as true of Europe and America as it is of Australia.

In a recent issue of "New Scientist", writer Barry Fox takes a close look at the electronics industry in Britain, in particular at TV receiver production. The story has about it a familiar ring.



Impossible to envisage: modern equipment designed around the bulky resistors of yesteryear. The carbon types were none too rugged, either, and subject to drift.

Time was when Britain had a thriving electronics industry and a reputation for British quality, in the context of the period. But little of that remains – at least in the field of consumer electronics. The picture is not all dark but, by and large, the success stories belong to the so-called Japanese "invaders".

And their success, according to Barry Fox, is basically attributable to a preoccupation with quality and reliability. It involves the quality of the incoming components, the dedication and awareness of the factory operatives, the thoroughness of inspection and stress testing of completed units and the willingness to submit all units to "soak" testing, in the hope of exposing faults before the units reach the public.

Rigid quality control earns goodwill but it costs money and slows production, particularly in out-dated and poorly managed factories. Rather than update, British manufacturers have been prepared to potter along with the values and the methodology of other days, and it has cost them dearly.

So, while British manufacturers have been falling by the wayside, a Sony factory at Bridgend in Wales has been expanding systematically to the point where it can now produce every component required in a TV set, including the Trinitron picture tube. The factory recently received the Queen's Award for export and one of the Japanese factory managers received the OBE!

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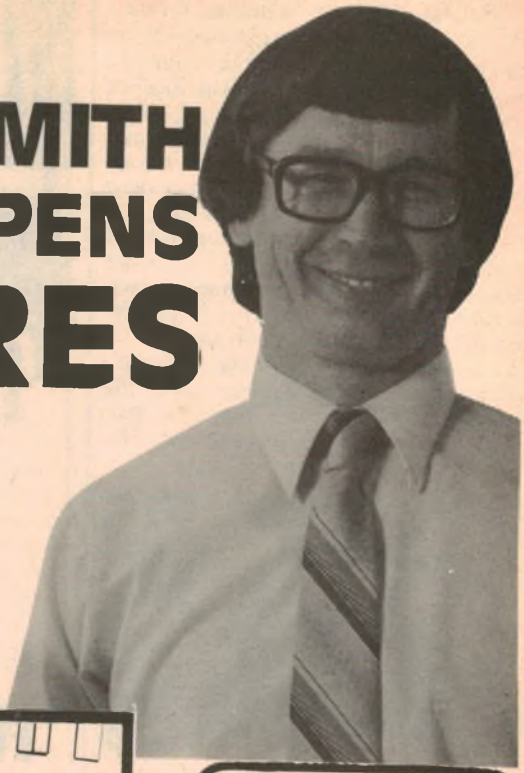

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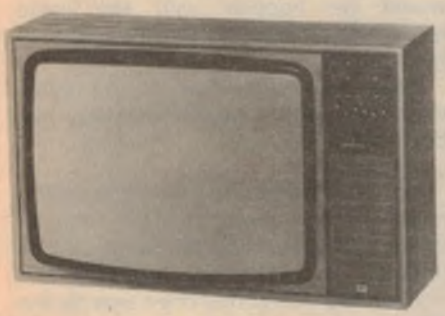
DSE/A183/PAI

Panasonic products, has a factory at Pentwyn, near Cardiff. In 1980, with a staff of 500 local people, the factory had the capacity to produce 60,000 colour TV sets per year. With only another 140 added to the staff, that capacity has since been doubled.

Through the '70s, Rank Radio International at Plymouth was a successful and prosperous company, but one that was ill prepared for the down-hill slide of the colour TV boom. Hopefully, they did a deal with Toshiba but it didn't work out. Now, from the ashes, Toshiba has resurrected an operation that has all the signs of being profitable and secure. But it is a streamlined operation that employs 300 people to produce 10 models, instead of 3000 people involved with as many at 70 different products!



Decca is but a memory at Bridgnorth.

And Decca, once a standard bearer for the British TV industry, is but a memory at its once bustling Bridgnorth factory. It is now operated by Tatung of Taiwan, who have reduced the staff to 700, increased the level of pay by 6%, and increased output of TV sets from 300 to 500 a day.

But all these manufacturers are up against a common problem when they try to use a proportion of European components in their receivers. They are simply not up to the requisite standard and, in modern single-board designs, random faulty components can play havoc with production.

Matsushita, for example, now checks every single component bought from local sources, whereas it is content with sample checking of Japanese components. According to both Matsushita and Sony, Japanese component makers aim to deliver no faulty components, but certainly fewer than 10 faults in a million items. The policy of European firms, on the other hand, is to settle for components that are hopefully good enough to get by!

For sure, they are willing to replace faulty components but that is not the point. The unit value of a faulty component is miniscule when compared with the hassle which results when a complete receiver has to be rejected and side-tracked through an inspect, repair and re-test routine.

On the subject of staff, Barry Fox says that Japanese companies will not accept the fragmented union structure that has plagued British industry. They prefer to talk – and talk straight – to a single union. Discipline is tight but job security is high for those who will accept the Japanese work ethic. Smoking, eating and drinking as the workbench is strictly taboo – practices that are still common in British-run factories.

The implications of this last remark may well be quite profound.

Buried deep in the pysche of many "western" workers is a sense of struggle for hard-won privileges; a suspicion of "the boss"; a sense of confrontation; a feeling that too much effort, too much dedication will merely improve the lot of the "haves".

At worst, some may even see a job not well done as a gesture of defiance; a way of "getting back" at the employer or the system!

Justified or not, the electronics industry could cope with such attitudes, while they were equally shared. But that is no longer the case. Nowadays, in a global environment, the advantage flows strongly to those employers and employees who can somehow manage to substitute common cause for confrontation.

But, industrial attitudes aside, it is a simple fact of life that the high technology electronic products that we all expect to buy in the marketplace have to be produced under disciplined and "clean" conditions. They simply don't mix with laxity, cake crumbs, tobacco smoke and assorted human biological debris.

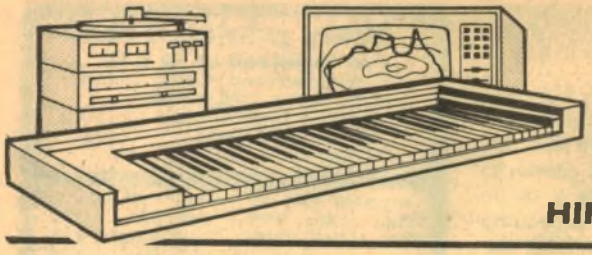
According to "New Scientist", Thorn-EMI is one British company that has learned this lesson such that their factory at Gosport (UK), modernised and reorganised, has cut in half the man-hours necessary to produce a TV receiver. And they are applying maximum pressure on the suppliers who still try to feed them "she'll do" components.

But here's the bottom line: while human resource is essential to the design of high technology components and equipment, there is plenty of evidence to suggest that their actual production should be assigned, as far as possible, to machines – hence my reference at the outset to the connection between equipment reliability and automation.

In fact, it's a salutory thought that, if it weren't for machines and new-look "clean-room" factories, modern high technology electronic equipment would be completely impractical.

Can you image a modern colour TV receiver, or VCR, or hifi system or home computer, with its thousands of circuit elements, but with an individual element breakdown rate that we accepted up to at least the '60s.

The darned things would never work at all!



Audio-video Electronics

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There's more to dynamic range than loud music!

During recent times, we have published and read a good deal about the dynamic range of recorded music and, in particular, whether or not it has already achieved, or exceeded, the practical limit for comfortable home listening. That debate is likely to continue for a while yet but there's another dimension to the whole subject which is highlighted by the recently released Sheffield Lab 14 Drum Record.

Dynamic range has exercised the minds of music lovers since the early days of recording. While the uninitiated marvelled at the sound which could be recovered from spinning discs, more perceptive listeners realised their many shortcomings, including their inability to cope with soft sounds (due to record noise) and loud sounds (due to the primitive mechanics of the system).

But, over the years, these limitations have gradually been pushed back until, today, it is possible to record and reproduce in the home the full dynamic range of a concert hall performance. But, alas, achievement of that long-sought objective has not brought any sense of euphoria.

On the contrary, with the technological barriers largely out of the way, it has become abundantly clear that the home environment imposes its own quite restrictive "dynamic window".

I have made the point in this magazine, as has Julian Russell, that the musical values which apply in a concert hall situation cannot necessarily be translated intact into the average home — which is where recordings are played. One has to re-think the situation when soft passages are blanketed by household noise, or when loud passages lead to squabbles with neighbours or other members of the household.

What's more, the re-thinking process must be shared by everyone involved:

- By musicians: See the Morton Gould interview published last month.
- By engineers: What is achievable may differ from what is desirable.
- By record manufacturers: Whether to settle for the status quo or to encourage new listening concepts.
- The record buying public: A highly amorphous group with an enormous range of musical and technical (non) perception, in a variety of domestic situations, and including both the young with keen hearing and the not-so-young whose perception of whisper-soft sound has been dimmed by advancing years.

In the absence of technical shackles, all these people will have some say in determining the new "norm" for the dynamic range of home recording. But I guess that, in the ultimate, the decisive verdict about what is acceptably loud and acceptably soft will come via the cash register and over-the-counter sales!

A recording of great potential interest for evaluating the peak handling quantities of hifi equipment. Note, however, that it requires a good cartridge to derive the signal in the first place, and a good amplifier to get it through to the loudspeaker system.

In previous issues, we have suggested that the extremes exploited in some digitally sourced discs may already have exceeded the tolerance of many record buyers and that most would be happier with the limits established already by the best analog recordings.

Does this mean that all the effort expended on the new technology has been wasted?

In no way!

The truth is that a conventional analog master tape recorder has very little to spare by way of dynamic range. It can provide the source for a top-flight disc — provided everybody does exactly the right thing!

But, if the overall signal level is a mite too low, tape noise may be noticed behind the softest passages. Yet again, too high a recording level may produce "crushing" on peaks and invite the unwelcome criticism that the quality is "muddy" in the loud passages.

Leaving aside other considerations, it follows that any technique that can extend the dynamic range of a system will reduce the number of such "miscalculations" and increase the yield of good quality consumer recordings.

In short, the availability of wide dynamic range does not compel the producer to use it but it does make it easier to produce the kind of recording that he wants.

All this, however, has to do with the most apparent and most controversial aspect of dynamic range — the contrast between passages of sound (usually music) that are subjectively very soft and subjectively very loud.

The further aspect, which is dramatically illustrated by the Sheffield Drum Record, referred to earlier, has very little to do with subjective loudness. It is concerned with the handling of signal transients of very short duration but very high amplitude. Because they are of short duration, the pulses may not be subjectively loud at all, but they require high dynamic range to accommodate them and surprisingly

high power to reproduce them.

Not all program material contains such transients and not too many recordings preserve them but, when they do occur, and are reproduced, and are within the aural acuity of the listener, they can yield a quality and a sparkle that can set the recording and the system apart.

I was made keenly aware of this some years ago, when invited to look over EMI's then new recording studios in Castlereagh St, Sydney. They had been planned before the emergence of commercial digital mastering but they had been fitted out with hand-picked everything else — including a full-colour graphic display capable of depicting instantaneous signal levels throughout the system, peak overload conditions and, if desired, a spectral breakdown of the signal being recorded.

I made the appropriate appreciative noises, only to be told by the engineer in charge that they had already discovered one sound that they could not successfully record — the sound of an ordinary wooden clapper. Live, over the monitor loudspeakers, he said, the sound was magnificently natural. But, when put through their best master tape recorder, at appropriate level, the explosive first transient had been crushed out of existence, leaving no more than the conventional recorded sound of a clapper.

I took the point, without getting too concerned, however. The man was obviously an ultra-perfectionist and, anyway, how do you feel sorry for someone who has just inherited multiple studios full of top quality recording gear?

But now, out of the blue, comes this drum record from Sheffield — a direct-cut disc, co-produced by Doug Sax. Yes, he's the same Doug Sax that I had a shot at in the February issue for what (I felt) were exaggerated criticisms of techniques other than his own.

But I have nothing but praise for his (and his studio's) efforts on this direct-cut.

Sheffield engineers aimed to capture the best possible recording of a drum kit, because they felt that such a record would be able to reveal the strengths and weaknesses of hifi systems and of components within those systems.

They used Sheffield/AKG microphones feeding through a transformerless all-valve system, directly to a disc cutting lathe. No storage or delay devices were used and no artificial reverberation. Transferred ultimately to the highest quality vinyl pressings, the result is claimed to be the best that can be made available to hifi enthusiasts.

The truth is that it isn't really a musical performance at all, even though the

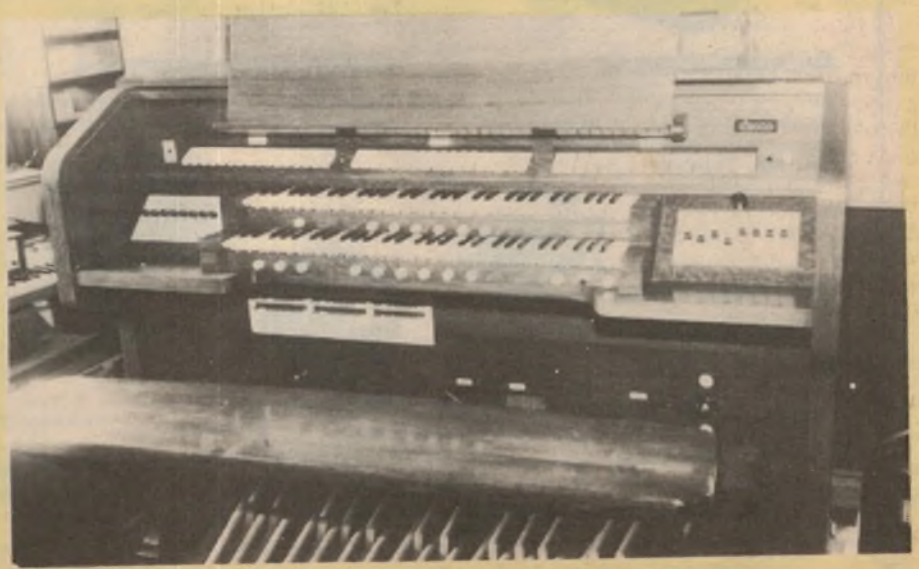
Deoco (N.Z.) electronic organs now represented in Australia

A range of electronic organs currently being produced in New Zealand, should be of considerable interest to readers who are interested in classically based or traditional church instruments. The smallest organ is virtually an electronic replacement for a harmonium; the largest is a 5-five manual design with full concert specifications and voicing.

Deoco Organs (NZ) Ltd has been active in the field for about 10 years and currently has over 70 organs installed in that country, ranging from one to three manual designs. A four/five manual instrument is currently under construction, with 103 speaking stops, as pictured above. It involves 18 power amplifiers with an output of 1500 watts, and 64 loudspeakers ranging from 18in woofers to horn tweeters. Current price of this model is quoted as $100,000 (approx).

Although Deoco have certain basic designs, they are quite flexible and capable of being varied to suit the needs of the particular church. In fact, a letter from John M. Daglish (Director) states that the company is very active in up-dating, re-building and supplementing existing electronic, reed and even pipe instruments, where such work is warranted, and where savings can be effected by so doing. A comprehensive brochure setting out instrument specifications and services offered is available on request.

Deoco Organs (NZ) Ltd is based at Hasketts Road, Yaldhurst, Christchurch 4, NZ. Readers can contact them through PO Box 11-157, Christchurch 4, NZ. Phone 427 315. Australian readers can contact Deoco Organs (Aust) Pty Ltd, PO Box 111, Lidcombe NSW 2141. Phone (02) 871 6946 or (02) 827 2763.



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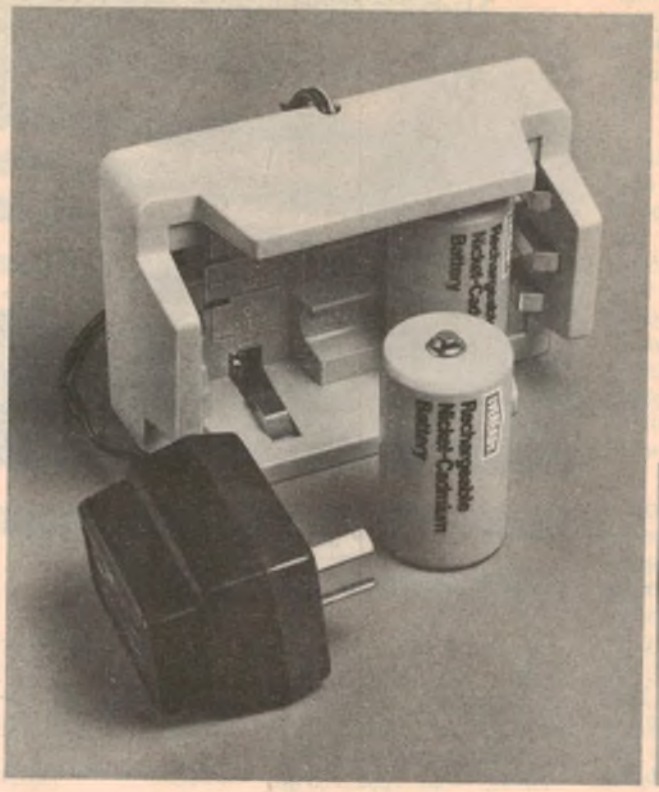

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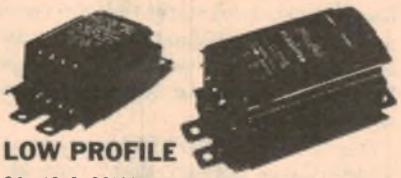

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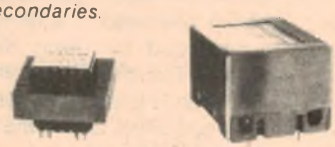

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10-odd minutes on each side is contributed by two top line drummers from the popular field, Jim Keltner and Ron Tutt. But neither engages in the frenetic gymnastics that usually characterise a drum solo. Using deliberately different kits, they improvise rhythmic but very sparse solos — one side each — with the idea that listeners should be able to look for certain qualities (set out in the notes) and use them to differentiate between systems.

At the time of writing, I haven't had to experiment along these lines but I accept that the potential is there. What caught my ear and eye were a number of other things.

The first was the complete silence of the recording — and I mean silence.

The next thing, largely because of the silence, were some tiny, strange sounds in the background of Jim Kelyner's solo – including a cough, just as he finishes. I don't know about the cough, but the other sounds were quite deliberate, as explained in the notes.

The third and most startling observation followed when I happened to glance at the fluorescent output indicators on the amplifier. Although the average level of the drum sound was at no more than ordinary room volume, the impact peaks on Jim Keltner's snare drum were flicking the power meters to full scale — 100 watts per channel! And I emphasise, it wasn't subjectively loud; just ordinary listening volume!

With other music . . .

My loudspeakers are not particularly sensitive and I won't guarantee the accuracy of the power indicators but I do know that, on ordinary orchestral and organ sound, there would be protests from others in the home at well under that indicated power level. Yet here I was — looking at 100W signal peaks, without any sensation of loudness.

I imagine that, without fluorescent indicators, I would never have known they were there.

Curious, I had a look at the tracks under a magnifying glass. They appeared to be of uniform pitch, as one would expect of such a disc, with quite low modulation for most of the way. But there were streaks of high modulation preceded, in many cases, by "S"-shaped deviations that must have come perilously close to colliding with the adjacent grooves.

Presumably, these were the transients that were accounting for the

WHEREVER YOU LOOK . . .

There's a personal hifi portable

Around the pool, at their Sydney hotel (above) members of the visiting West Indian cricket team were delighted to receive a Sanyo M5550 to add enjoyment to their rest periods.

Toshiba's model (right) shows off the new KT-R2 FM-stereo/recorder/player, while the Toshiba RP-700FH (bottom picture) provides AM/FM radio on speaker and headphone FM stereo.

Immediately below is the National RX-1950, an AM/FM stereo recorder/player, one of four new personal hifi models.

Mickey Mouse, something of a symbol for Disney Productions, poses with Walter Lehne, Managing Director of Creative Video Pty Ltd. The latter company is the distributor for Australia of Walt Disney home video cassettes.

output peaks — and about which a warning is expressed in the jacket notes.

And, presumably, transients like this are the ones that tend to get crushed by an analog tape machine, as per the complaint by the EMI engineer.

How well they would fare in a digital system makes for interesting speculation.

But, in the ordinary home playback situation, they could be expected to expose a phono cartridge with poor tracking ability and inadequate compliance, as well as a preamplifier stage given to overload, or a system with latent TIM — transient intermodulation distortion.

And so on.

This is not to say that all music contains transients of this nature all the time, or they are even there on the majority of recordings. The whole point of the record is to demonstrate that they can exist on some recordings and that they can make certain demands on the playback system.

Marantz (Aust) Pty Ltd has announced the release of three new components in the "Gold" range. At the top is the SD3030 cassette deck featuring Dolby-C, variable bias and switchable peak protection. The PM7550DC amplifier (centre) delivers 80W RMS per channel and includes a stereo graphic analyser and moving coil phono preamp. At the bottom is the SR8100DC receiver, claimed by Marantz to be one of the most advanced hifi receivers in the world. It also offers 80W per channel.

COMPACT HIFI SYSTEMS FROM SANSUI

Under the sales title "Hi-Tech Compo", Sansui are offering three equipment formats designed to bring big sound into smaller living areas: a Midi system of compact units that can be accommodated on a shelf: cassette receivers that need only to be connected to stereo loudspeakers; and portable component systems that can be used as an integrated portable or unclipped for spaced-out sound. Illustrated above is the CP-7 portable system offering a quartz-locked AM-SW-FM/stereo tuner, quartz-lock clock, timer and sleep switch, logic-controller cassette deck with automatic program search, and a 13W RMS per channel power amp. It can be powered from mains, a 12V DC source or internal batteries. Sansui is represented in Australia by Vanfi (Aust) Pty Ltd, 297 City Rd, South Melbourne, 3205. Phone (03) 690 6200. Also at 283 Alfred St, North Sydney, 2060. Phone (02) 929 0293.

In short, the Sheffield Drum Record is a research tool for those who want to know more about the dynamic qualities of their system; not its ability to make loud noises, but its ability to handle transient "attack"!

The Sheffield Drum Record is distributed in Australia by Emerson Radio (Aust) Pty Ltd, 106 Belmore Road North, Riverwood, NSW 2210. Phone (02) 534 5266.

In brief:

TDK, AKAI, MAXELL AND TEAC are co-operating in an effort to revitalise the use of open-reel equipment in the sub-professional and home audio situation. BASF has expressed interest in the project, as have at least three Japanese deck manufacturers. While they do not expect to work marketing miracles, the companies are at least hoping to reverse a downward trend in open reel deck sales, which has seen them slip to a ratio of 1:40 in comparison with cassette decks.

Behind the co-operative effort is the fact that cassette tape and hardware manufacturers have developed that system to the point where full hifi standards are conventionally met at a tape speed of 4.8cm/sec. It stands to reason that a new generation of open reel decks could be created, using cassette know-how, to combine open-reel facilities with reduced tape costs at no sacrifice in performance. Thus the current expectations at 38 and 19cm/sec should be met easily at half those speeds.

The new "EE" (Extra Efficiency) tape has about double the coercivity of existing open-reel tapes. Decks will typically have a recording head gap of 10μm, a playback head gap of 2μm, and equaliser turnovers of 3180 and 35μs. The bias level in the decks will be adjustable to cope with possible future developments.

TDK have already released a range of EE audio tapes and specifications can be obtained from TDK (Australia) Pty Ltd, Unit 5, Level B South, 100 Harris St, Pyrmont, NSW 2009. Phone (02) 660 4955.

CONCEPT AUDIO advise that they can now supply the David Hafler DH-500 power amplifier. They have taken this step following the success of the DH-101 preamplifier, and the DH-100 power amplifier, released in Australia a little over two years ago. Intended primarily for rack mounting, the DH-500 is cooled by an automatic 3-speed fan and can deliver in excess of 255W RMS per channel. A bridging kit, which will be available later, converts it to an 800W RMS mono unit. In kit form, the DH-500 will sell for $1398, or assembled at $1498. For details: Concept Audio, 22 Wattle Rd, Brookvale, NSW 2100. Telephone (02) 938 3700.

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Essentially an upmarket stereo radio cassette recorder, the Fisher PH492K is a sophisticated portable unit, which features detachable loudspeakers and a "component-look" layout. It has four broadcast bands (AM, SW1, SW2, and FM), an inbuilt pair of electret microphones and facilities for directly connecting a phono cartridge without requiring an additional equalised preamplifier.

The complete system is attractively styled with a functional appearance. In common with similar devices the interior contains quite a lot of circuitry which has to be spread out over several separate printed circuit boards – some mounted vertically just behind the front panel, the others lying horizontally one above the other. Design and workmanship of the PC boards appear to be of a high standard; although the interwiring between cards is quite complex, possibly making servicing a little difficult. Power transformer, power supply and power output stages are mounted on the rear cover panel, with flying leads to the internal circuitry.

In common with the other Fisher portable audio systems, the PH492K may be operated from any one of three power sources; normal 240 VAC mains supply, 12-15 VDC (eg motor vehicle battery) or 10 "D" cells (located in internal battery compartment). On the rear nameplate power consumption is given as 32 watts. The system is double-insulated (with the international double square symbol on the nameplate) and the two-core mains cable plugs into a socket on the rear panel.

Containing a 20cm woofer and 5cm tweeter, the loudspeaker enclosures are moulded in plastic to match the central "electronics" cabinet which is also moulded in plastic. Dimensions of the complete system are 780mm wide × 352mm high × 190mm deep. Width of the central cabinet is 315mm and each loudspeaker unit is 233mm wide with a depth of 163mm. Fittings on the central and loudspeaker cabinets ensure that the three clip firmly together, so that they may be safely carried by the handle on the central unit.

The loudspeaker units are of 4-ohms impedance, which seems to be normal practice for consumer-oriented equipment. Connection is via 1.2 metre cables and 3.5mm phone plugs. These have the usual tip and sleeve connections and we were a little surprised to discover that not only does the tip carry active audio output, but also the "sleeve" is active (albeit an inversion of signal on the tip). Thus it would appear that the power output stages are connected in a balanced "bridge" configuration.

POWER AMPLIFIERS

We measured the maximum power output at the onset of clipping – with both channels driven – and found it was 8 watts into 4-ohms, and 7 watts into 8-ohms. With only one channel driven, the figures were 10 watts and 9 watts respectively. The nominal power output appeared to be about 5 watts per channel (both driven) into 4-ohm loads. At this level the total harmonic distortion was 0.25% at 1kHz and 0.35% at 10kHz, rising to 1% at 60Hz. Clipping occurred below the 5 watts output level at 40Hz, although at 3 watts output the distortion was somewhat less than 1%. As usual, the above tests were carried out after our standard one-hour preconditioning from a regulated 240-volt AC source.

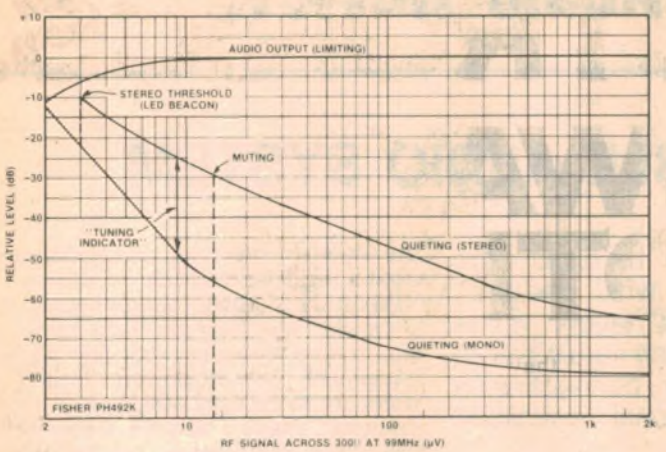
Whilst these power output figures are somewhat less than we have come to expect from the more exotic high fidelity equipment, output powers around 5 watts are more than adequate for most domestic listening situations especially when the loudspeakers are of above average sensitivity, which is the case with the PH492K. So, the undistorted sound output from this system should satisfy all normal usage other than, perhaps, teenage "rock" parties.

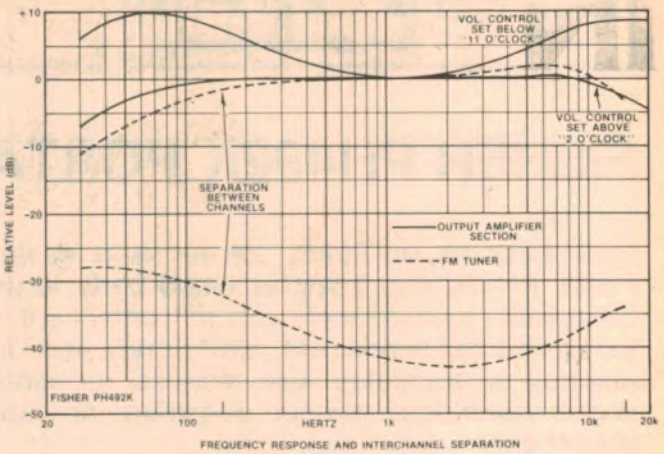
Square wave response was quite good, with rise and fall times around 20μs, and no overshoot. Response to adding parallel capacitance across the load was the best we have encountered. Although the wave shape was "rounded off" with capacities above 2μF, there was no "ringing" nor damped oscillation whatsoever.

Unweighted signal-to-noise ratio on the auxiliary (LINE IN) input measured 63dB below 1 watt output (for 0.25V input), a barely adequate result. However this improved to 70dB as the volume control was turned "off", ensuring an adequate practical performance.

The usual "loudness" facility is incorporated around the volume control, but the response cannot be made "flat" (other than by advancing the volume to exceedingly high levels), since the "loudness" cannot be switched out! In

Fisher PH492K portable audio system





Above are the quieting curves and the frequency and separation between channels response curves of the Fisher PH492K.

addition the amount of compensation is larger than usual; being some 6dB at 200Hz, 10dB at 70Hz, 5dB at 5kHz and 9dB at 15kHz (for other frequencies refer to the accompanying graph).

At high volume settings the response is 3dB down at 50Hz and 2½dB down at 15kHz. The separation between channels is better than 50dB at 1kHz and below, decreasing to 34dB at 10kHz and 31dB at 15kHz – an average performance, more than adequate for the usual stereo sound sources.

The MODE selector includes a WIDE position which increases the apparent separation between left and right channels.

This was checked by applying 1kHz tone to each channel individually, then to both simultaneously, and noting the changes in output level when switching from normal STEREO to WIDE. In the one channel only test, the output level rose by 3½dB; whilst in the both channels driven situation, selection of WIDE decreases the level in each channel by approximately 4dB.

Tone controls are in the form of a simple "one and a half octave" graphic equaliser with the measured maximum boost and cut being at least 10dB at the centre frequencies of 100Hz, 330Hz, 1kHz, 3.3kHz and 10kHz. At maximum boost/cut the circuit Q is about 1.4.

FM/AM TUNER

In common with similar combination systems, the tuner section is situated near the top of the front panel and has just three controls: flywheel tuning knob, band selector and muting switch. There is no stereo/mono selector nor RF signal strength indicator for use on the FM band.

However there is a five LED bar graph which functions in the normal way to show signal strength on the MW and SW bands; but functions as a "centre tuning" indicator on the FM band. The LEDs flash sequentially from left to right (or vice versa) as the station is being tuned in. Moving the tuning knob slightly clockwise (or counterclockwise – according to direction of LED flashing) stops the flashing, and the third (centre) LED remains steadily illuminated to show correct tune. Neat!

The usual stereo "beacon" LED (to indicate the presence of 19kHz pilot tone on the carrier) is provided and is effective on input signals as low as 3μV.

A dial light is provided but is normally off. It is turned on by a momentary action pushbutton. This has obviously been done to minimise battery drain when operating from dry cells.

Audio limiting and quieting curves for the FM band are depicted on the accompanying graph. Note that the ultimate quieting compares very favourably with the up market separate tuners. But quieting performance at low RF input levels is below the average obtained from other tuners. Note also that the only way to achieve "mono" FM reception is from mono FM transmissions, so that in practical use in Australia the PH492K will always be in the stereo mode.

Frequency response of the tuner was within ±2½dB between 100Hz and 15kHz. However the response appears to be deliberately rolled off at low frequencies, being 5dB down at 70Hz and 7dB down at 50Hz. Coupled with a broad 2dB peak in the mid high frequency region, the "loudness" characteristic and (relatively) small loudspeaker units, we thought that the sound quality on FM was a trifle "shrill" and lacking in "real" bass. But it could be somewhat improved with judicious use of the graphic equaliser. Separation between channels is shown on the accompanying graph, and can be considered to be quite satisfactory.

Harmonic distortion – from a simulated stereo transmission – was found to be 2.2% at 100Hz, 1.8% at 1kHz and 1% at 6kHz. Substituting a mono source reduced each of the above figures by approximately 10%, ie only a marginal improvement from the stereo figures.

Naturally the AM facility does not provide high quality reception. Its performance is on a par with that provided by other FM/AM tuners. For those interested it does cover two shortwave bands – from 2.3 to 7.3MHz, and 7.3 to 23MHz.

PHONO EQUALISATION

An MM magnetic cartridge can be directly connected to the phono input sockets for disc playback purposes. Sensitivity is about normal with 2.5mV input at 1kHz producing 5 watts output. Frequency response of this facility is very similar to that of the FM tuner. It is 2½dB down at 100Hz and 6dB down at 50Hz and has a broad 3dB peak in the high frequency region between 5 and 10kHz. Input overload occurred with just over 20mV input at 1kHz, which is dangerously low as program peaks on a "hot" 45 single are often in the region of 25 to 30cms/sec. Using a typical cartridge producing 1mV/cm/sec would result in levels of 25 to 30mV being applied to the phono input sockets – driving the input circuitry well into overload.

Unweighted signal-to-noise ratio on these inputs was 73dB with respect to an input level of 5mV at 1kHz – a good performance.

CASSETTE RECORDER

The cassette recorder section conforms to contemporary design practice for medium-priced front loading decks, having the usual combination record/replay head with switchable electronics and Dolby-B noise reduction circuitry. In common with other combination systems, the function selector must be set to the TAPE position before a cassette can be played. As mentioned in

Continued on page 133

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Playmaster 3-70L loudspeaker system

Five years after the highly successful Playmaster 3-75L loudspeaker system was published, we now present the new Playmaster 3-70L loudspeaker system. While it was developed from the old system, the new system has new drivers, a slimmer, more attractive enclosure with added plinth, and an easily removable grille cloth frame.

by NEVILLE WILLIAMS and LEO SIMPSON

While the actual figures are difficult to quantify, there seems little doubt that many thousands of Playmaster 3-75L loudspeaker systems have been constructed since the article was originally published in May 1977. Part of this popularity must undoubtedly be attributed to the heavy promotion of the system over the years by Dick Smith Electronics, but even so, the basic system has worked very well and has provided a great deal of satisfaction to many thousands of our readers.

Recently, we were approached by Dick Smith Electronics to re-present the system in updated form. The principle reason for this was that the original source of the loudspeakers had now ceased production and Dick Smith Electronics wanted to continue selling his popular system albeit with new loudspeakers. At the same time, DSE planned to re-style the enclosure and use an easily removable grille cloth frame instead of the acoustic foam panel used on the previous model.

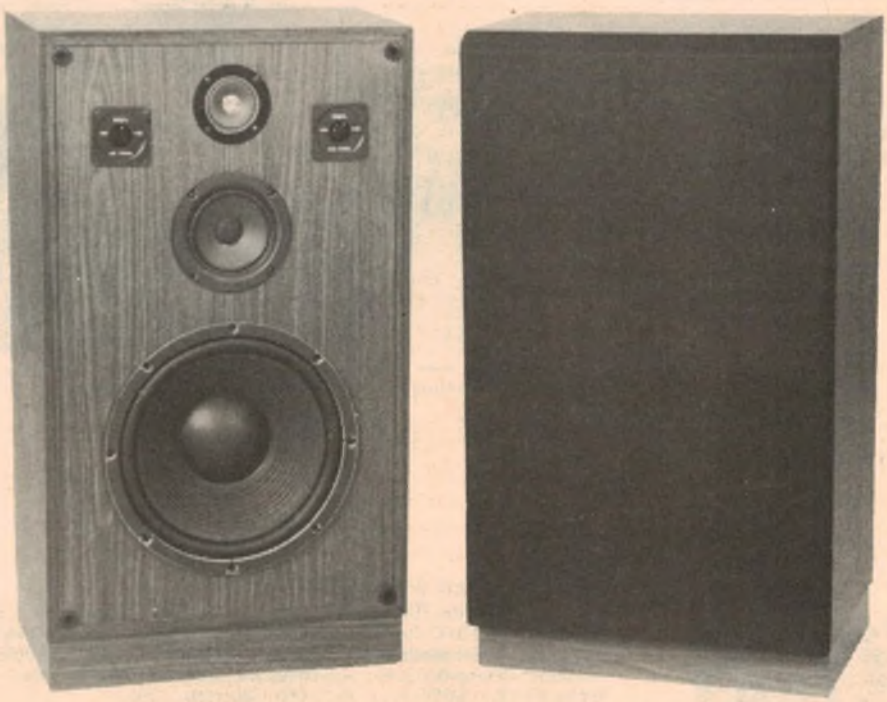
When we agreed in principle, DSE arranged for the supply of three new loudspeakers and the new enclosure. We duly assembled these together and after some hassles involved in making sure that the systems were really airtight, we were pleasantly surprised with the similarity between the original system and the new prototypes.

While the brief outline above really does not give any idea of the time and effort involved by all parties in the production of this new loudspeaker system, the end result represents outstandingly good value for money. Whether you buy it in kit form or fully assembled, we are sure you will be pleased with sound quality. At the same time, the new Playmaster 3-70L has reasonable efficiency and generous power handling capacity so that it can give a good account of itself on virtually any type of music.

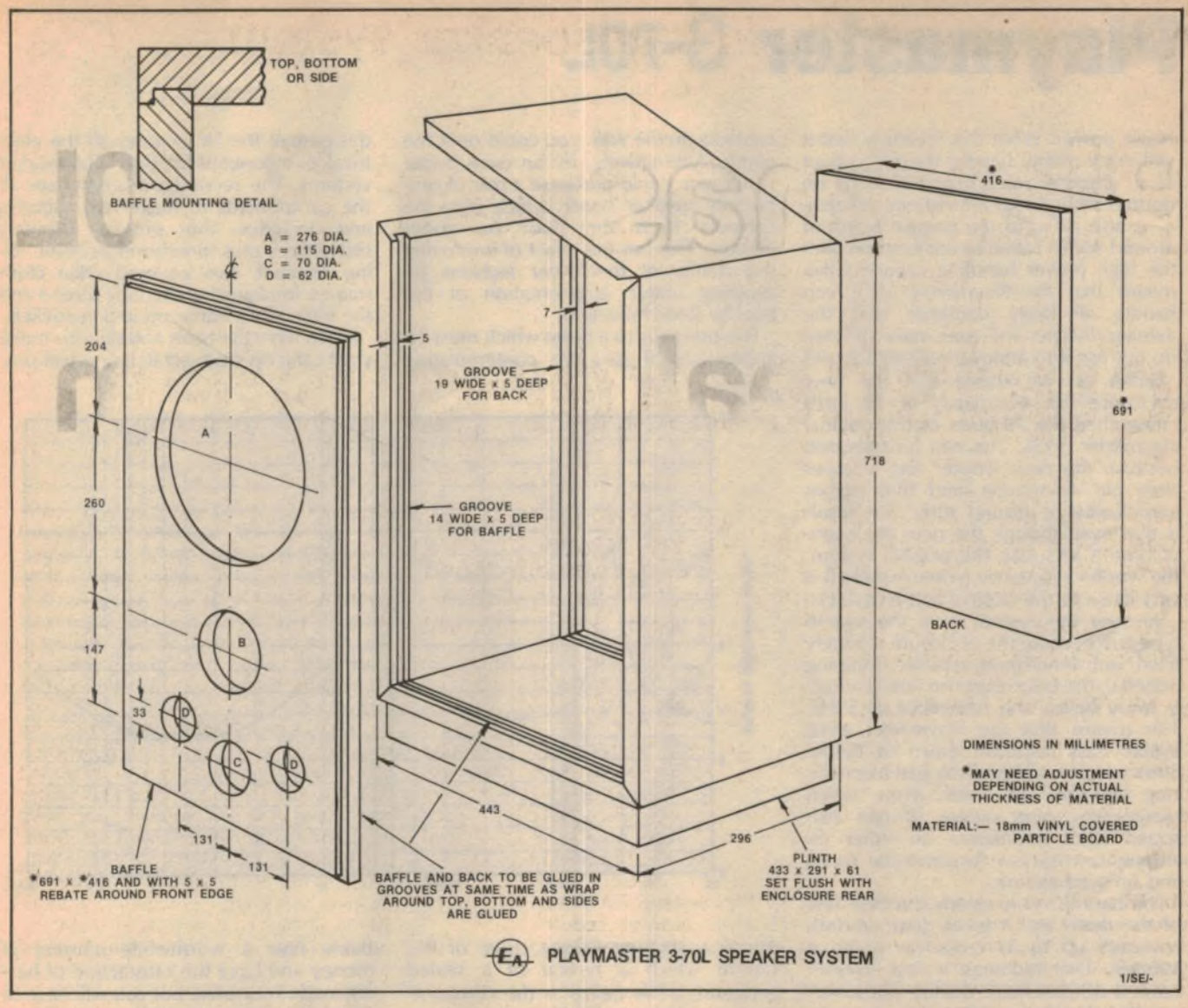
Let us now discuss the details of the new Playmaster 3-70L before going on to the construction procedure.

As might be guessed from the 3-70L designation, the Playmaster is a three-way system with a nominal enclosure volume of 70 litres. The system is sealed rather than vented, which enables it to perform better with a woofer which is really larger than ideal for a vented enclosure of the same size. We will have a lot more to say about the importance of sealing the enclosure later in this article.

The most important loudspeaker in the enclosure is the bass driver or woofer. This is a more impressive looking unit than that used in the original Playmaster enclosure and it appears to have marginally better performance to boot. It has a nominal diameter of 300mm with a heavy ribbed curvilinear cone driven by a voice coil with a diameter of about 50mm. It has a large treated cloth roll surround giving a cone resonance of



Two views of the new Playmaster 3-70L loudspeaker system, with and without grille cloth frame.



Here are dimensional details of the Playmaster 3-70L enclosure, as it comes in kit form, ready for "wrap-around" assembly. Note that that it is drawn in the upside-down position in which it should be put together. A handyman carpenter building an enclosure from uncut sheets should work to the external dimensions, using internal cleats as necessary. The baffle and back panel dimensions would need to be modified to become a slide-in fit.

about 30Hz which rises to around 55Hz when installed in the enclosure. The loudspeaker chassis is of pressed steel fitted with a reasonably large ceramic magnet.

The midrange driver is a cone-type unit with closed-back construction to render it unaffected by back pressure from the bass driver. It has a nominal diameter of 140mm and an effective cone diameter of about 90mm, after allowing for the cloth roll surround.

The high frequency driver or tweeter is also a cone-type unit with closed back construction. It has a curvilinear paper cone with an effective diameter of 55mm. An aluminium dust cap not only improves the appearance but aids in maintaining the high frequency response.

Both the tweeter and midrange unit have level controls. These are not just simple potentiometers but are constant-impedance pads which maintain the accuracy of the crossover points no matter what their setting. Each level control has a range from a nominal +2dB above reference to completely off, so that if desired, it is possible to effectively remove both tweeter and midrange from circuit.

Crossover frequencies are 1500Hz from woofer to midrange and 5kHz from midrange to tweeter. The crossover network is housed in a small plastic box which has push-on connectors for ease of assembly. The network is modest in complexity, giving nominal attenuation slopes of 6dB/octave after the crossover point, without allowing for the rise in driver impedance due to the voice coil inductance, in each case.

Inductors in the crossover network are small iron-cored units while the capacitors are bipolar electrolytic types, signified by the positive signs at both electrodes. This is shown on the complete circuit diagram of the 3-70L system.

The impedance curve of the completed system is quite normal for a sealed system with a modest peak corresponding to the woofer resonance at 56Hz. From there, the impedance rises and falls in predictable fashion over the whole audio range. Nowhere does the impedance (modulus) fall below six ohms, which is a point in its favour as it is not likely to cause any problems with the driving amplifier.

We did experiment with equalising networks which had the effect of improving the attentuation slopes of the crossover network and flattening the overall impedance curve but the net effect was so small as to be not worth the effort.

Power handling capacity of the complete system remains the same as for the original Playmaster 3-75L – 80 watts

Playmaster 3-70L

music power. What this means is that it will comfortably handle the full output of an amplifier rated up to 80 watts on normal music program material. Efficiency is also close to the original figure of around 95dB. Taken in conjunction with the high power handling capacity, this means that the Playmaster 3-70L can handle all likely demands that the average listener will ever make. (Please do not use it to annoy your neighbours!)

Earlier on we stated that the new enclosure has a capacity of 70 litres rather than the 75 litres of the original Playmaster 3-75L. This can be tolerated because the new woofer has a lower "free air" resonance (and thus higher compliance) at around 30Hz. The result is that even though the new enclosure volume is less than the original system, the woofer resonance (when installed) is very close to the original figure of 55Hz.

Because the system is of the sealed type and because the enclosure is largely filled with Innerbond acoustic damping material, the bass response falls gradually away below the resonance at 55Hz. This means that the Playmaster gives usable bass response down to below 40Hz which is adequate to give a convincing account of itself even when reproducing pipe organs. It can also sound most impressive on other instruments with low fundamental tones and on synthesizers.

The bass driver is clearly the best unit of the three and it gives quite smooth coverage up to its crossover point at 1500Hz. The midrange is less smooth but it is of reasonable quality, particularly when its price is taken into account. The same can be said of the tweeter.

All up, the total price for a pair of Playmaster 3-70L loudspeaker systems, will be around $380 in kit form, which represents very good value for money. We understand that Dick Smith Electronics will advertise the enclosure kits at $199 a pair, to which must be added to cost of the speaker kit, at $175, making a total of $374. Further details are given later.

Our close microphone tests with sinewave signals indicate that the on-axis frequency response can be expected to be within about ±6dB from 40Hz to 18kHz, with usable bass response down to 35Hz.

As noted earlier, the styling of the system has been changed to take advantage of the availability of a Japanese manufactured plastic grille cloth frame which has necessitated a taller and narrower enclosure. The height has been further emphasised by the addition of a 60mm plinth which acts as a kickboard to prevent damage to the grille cloth and its frame by large hobnail boots and aggressive vacuum cleaner nozzles.

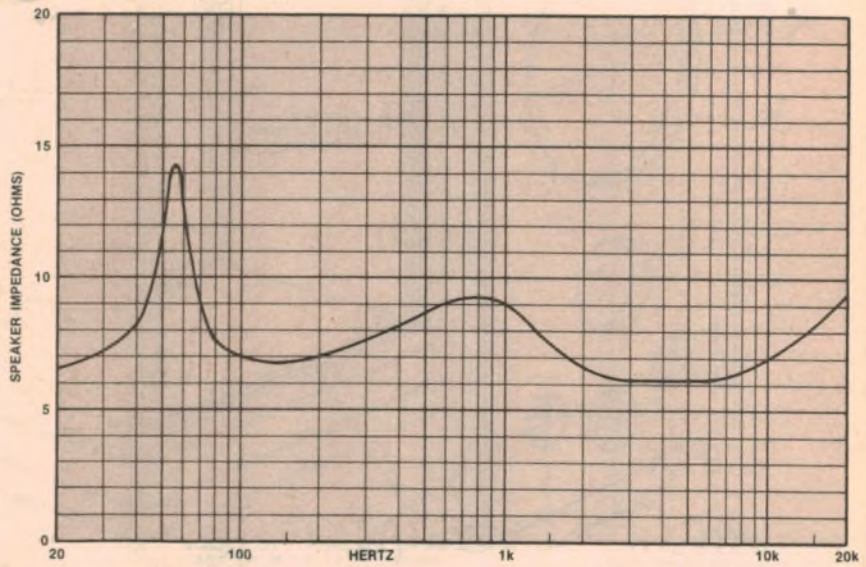
If you elect to install the loudspeaker cabinets on the wall, you could omit the plinth. Alternatively, for an even better result, you could purchase a pair of proprietary speaker stands which raise the cabinets from the floor by about 200mm. This has the effect of improving the clairity of the lower registers by avoiding undue augmentation of the bass by floor reflection.

This brings us to a point which must be appreciated if you are contemplating building or buying these systems. First, because they are relatively bulky, they do require a fair amount of floor space. For best results they should not be placed in corners (nor should any high fidelity loudspeaker) or placed directly against the walls if sitting on the floor. Second, if you are to achieve the low bass response of which they are capable, the systems should not be placed in a small room.

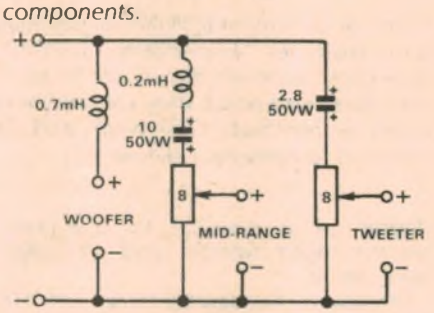
You may buy the kit in two parts. The first includes six loudspeaker drivers, two crossover networks, four level controls, two rear terminal panels and two readymade harnesses. In other words, this part of the kit includes all the electrical components for two loudspeaker systems. The second part comprises all the components to make two cabinets and includes the pre-cut cabinets themselves plus Innerbond acoustic filling material, two covered grille cloth frames, loudspeaker securing screws and the grille cloth frame mounting sockets.

If you have the tools and skills to make your cabinets from scratch you will probably save a worthwhile amount of money and have the satisfaction of having made your own, but you will have to do quite a lot more work.

If you do elect to do it yourself, you can vary the cabinet dimensions provided that the internal volume does not vary from the specified figure of 70 litres by more than about 5% either way. However we understand that Dick Smith Electronics will be making the grille cloth frame available as a separate item, so if you wish to use this the cabinet frontal dimensions should be the same as specified in the accompanying diagram.



Above is the impedance curve of the system which is typical of a sealed enclosure while below is the complete circuit showing the crossover components.



CABINET ASSEMBLY

We understand that the pre-cut cabinet kits will be sold in stereo pairs to minimise packing costs. Each cabinet kit essentially comes in three parts. The sides, top and base are cut from one lenth of vinyl veneered particle board. Ninety-degree grooves are milled where the corner joints will be, leaving the four sections held together only by the vinyl veneer.

An additional groove is milled near each edge of the sides to take the baffle and rear panel. When adhesive is run into the grooves and the sides folded around the baffle and rear panel, a rigid

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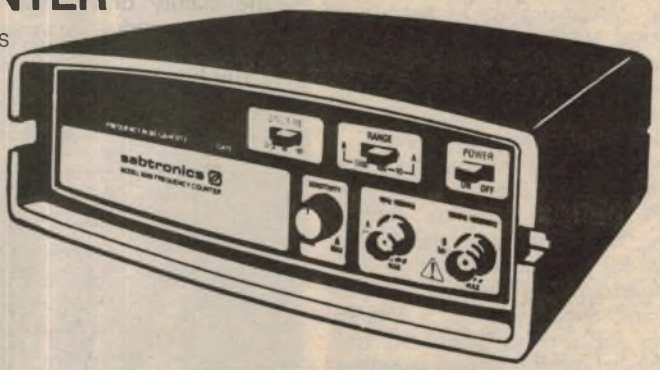

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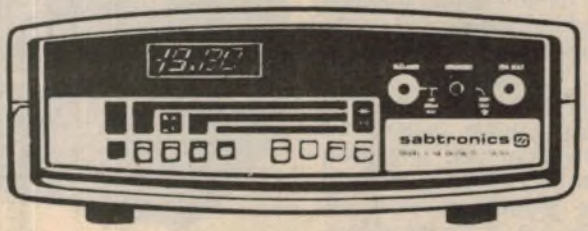

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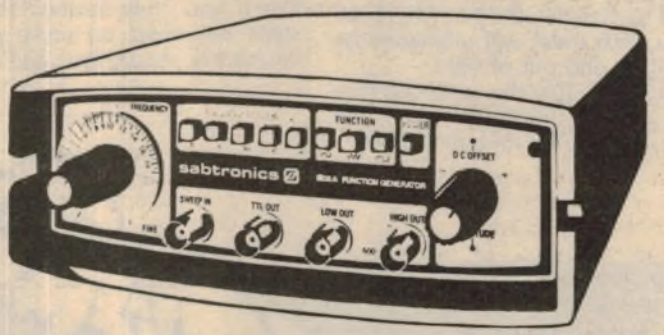

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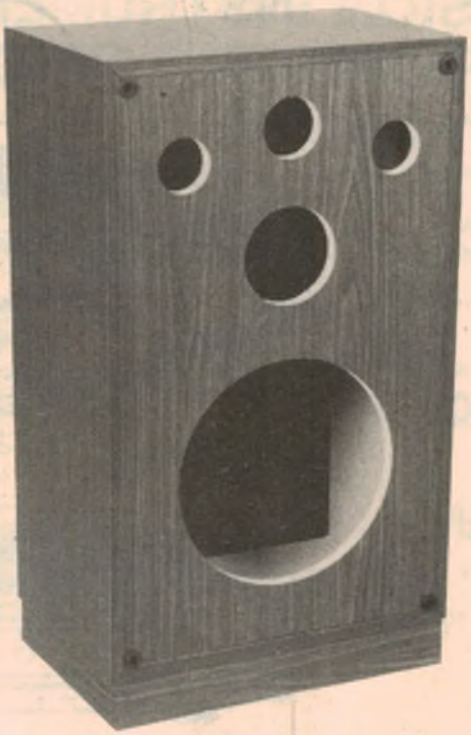
and potentially airtight enclosure is formed.

As we have noted in the past, the vinyl veneer does make an effective hinge which allows the panels to be folded but it should not be idly bent back and forth in a casual demonstration of how it all goes together. While we have not heard of anyone accidentally breaking the "hinge" sections, you would not want to be the first, would you? It could be a trifle embarrassing and inconvenient.

Before starting, make sure that you have available a large tube or plastic bottle of PVA glue such as Selleys Aquadhere. You will need about 100ml of adhesive for the two enclosures. You will also need a roll of masking or packing tape and tools such as a Phillips screwdriver and a hand or electric drill with drill bits to suit the screws supplied. And you can add some clean rags to that list for wiping excess glue from the joints.

Clear a space on the floor and put down newspapers to keep the area clean. Open the cabinet timbers full length upon the floor and tentatively stand the baffle and the back panel in their respective grooves in what will ultimately be the top of the enclosure. When the panels are folded around the baffle and back panel, the join where the two outer ends meet will ultimately be at the bottom and out of sight.

Remember also that the veneered face of the baffle is the front, as is the veneered edge of the fold-up cabinet.

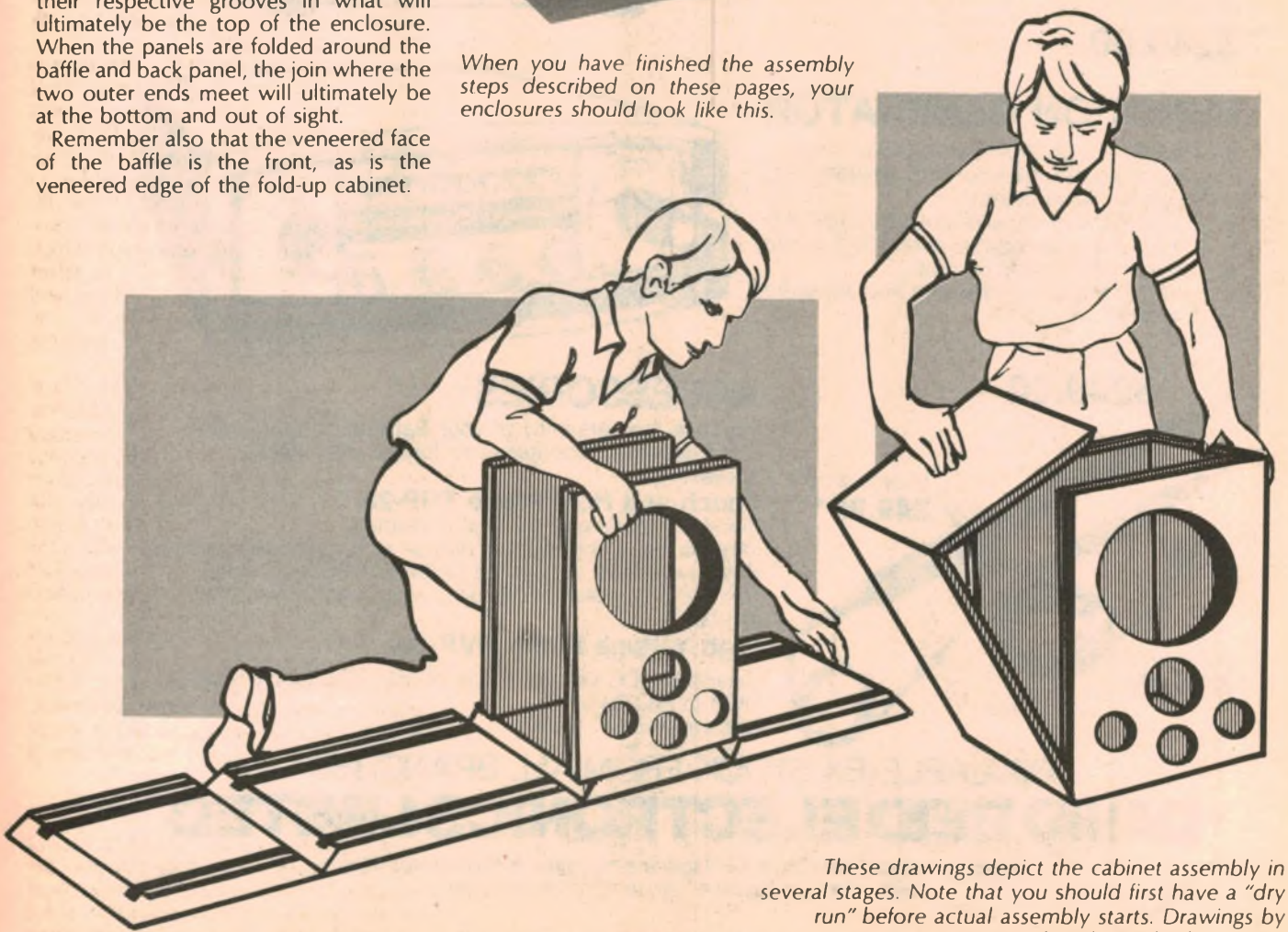


When you have finished the assembly steps described on these pages, your enclosures should look like this.

Having worked out how it all fits together, put the baffle and back panels aside and apply adhesive to all the 45° surfaces of the V-grooves and to all surfaces of the grooves which take the baffle and back panels. Do not apply excessive adhesive but apply enough so that, when spread with your finger, it will wet all the mating surfaces thoroughly and evenly. Just for good measure, run a thin, extra line of adhesive in the bottom of each V and in the bottom of the rectangular grooves.

Now fit the baffle into position, tweeter end down and veneered face to the front, without pushing it too hard into the groove. Now, while you hold the baffle vertical with one hand, place the back panel into the other groove in a similar manner and hold it vertical with your forearm. So while your left hand and forearm hold the panels vertical your right hand can fold up the sides.

The next part is a little tricky and perhaps would be easier if you had a helper, but you can manage by yourself if necessary. Fold up the short side sec-



These drawings depict the cabinet assembly in several stages. Note that you should first have a "dry run" before actual assembly starts. Drawings by courtesy of Dick Smith Electronics.

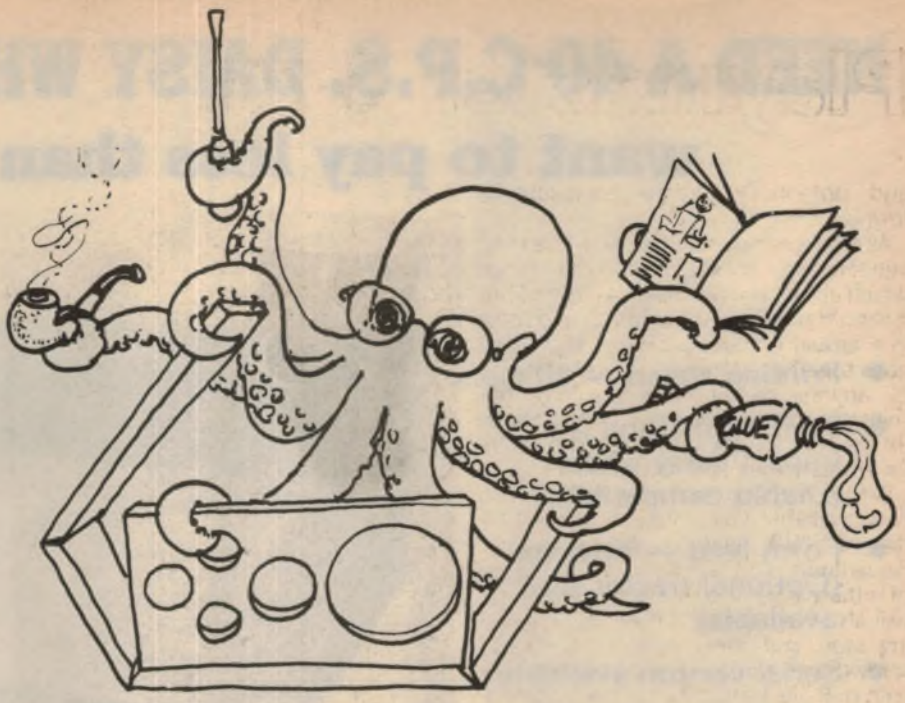
tion so that the baffle and rear panel lock into their respective grooves. Then fold up the other side and top section, allowing the baffle and rear panels to slip naturally into place without straining the "hinges". Bump the panels into place with the ball of the hand, bringing the two free edges tightly together. Finally, hold them in this position by using as many strips of masking tape as seem necessary. Note that when this is all achieved, the veneered face of the baffle and the veneered edges of the cabinet should all face to the front. If that is not the case, pull it all apart quickly before the glue dries and start again!

Use a moistened cloth and wipe away any excess glue which may be visible on the outside of the enclosure. Put the enclosure aside for several hours or overnight to allow the joints to set hard.

The second enclosure can be assembled in the same way.

As a final touch, prop the two enclosures so that they are resting on the mitred joint which is held closed with the tape. Run a line of glue inside the join, bridging the side and bottom. (You will have to do this via the woofer hole in the baffle.) Allow this to dry for several hours, after which you can remove the masking tape.

The plinth is a similar wraparound assembly which is glued together and then glued to the base of the enclosure.



Now where did I put the . . . back panel!

ASSEMBLING THE HARDWARE

The next task is to assemble all the hardware into the cabinets and while this may seem a straightforward and easy task it should not be rushed. The most important facet is ensuring that the finished enclosures are completely sealed.

Each join and each hole in the enclosure which is intended for mounting a loudspeaker driver, level control or terminal panel is a potential air leak which must be sealed.

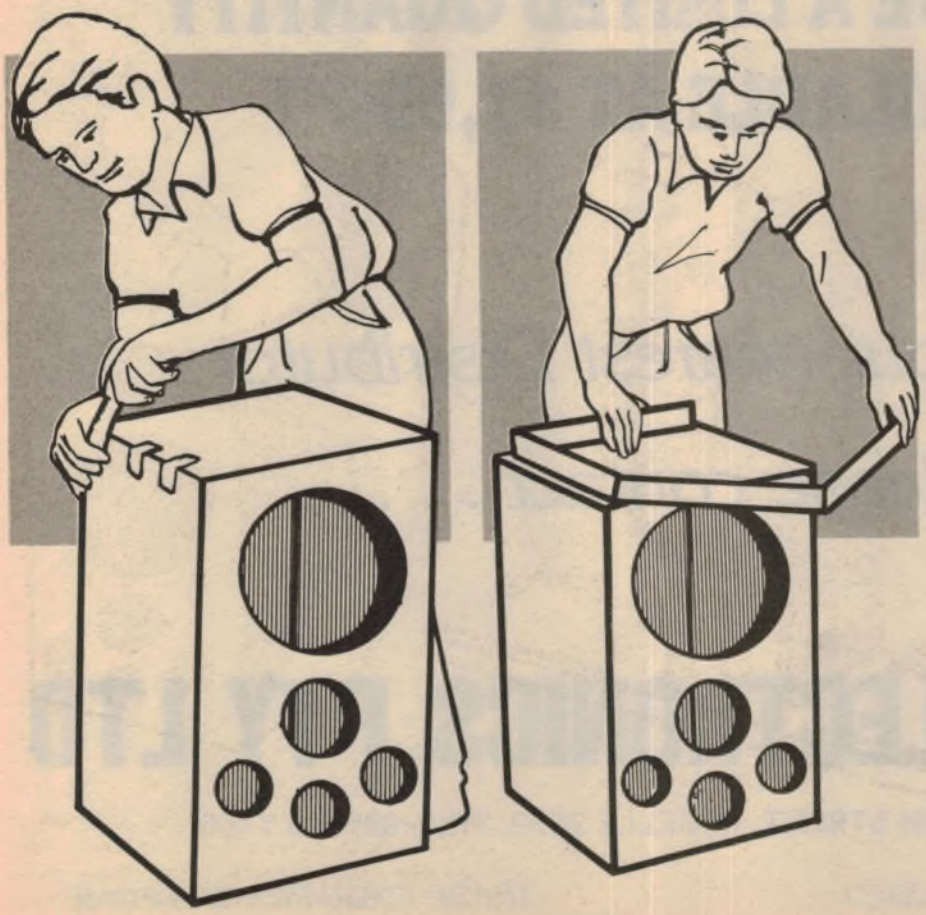
We cannot over-emphasise the importance of sealing and its effect on the final sound quality. We had a graphic demonstration of this with the final prototype enclosure. Having approved a prototype which was built into the old-style enclosure, we were amazed at the difference in sound quality when we compared it with the final prototype which had been quickly assembled. The latter was weak and boomy in the bass and showed marked colouration in the midrange. In fact, the whole balance seemed to be not quite right.

A little investigation soon showed that while the enclosure itself seemed to be airtight, it was leaking like the proverbial sieve around the level controls, the rear terminal panel, the midrange and even through the pilot holes which take the female sockets for the grille cloth frame attachments! Some of these leaks were hissing audibly while the others were just adding their own insidious colouration to the overall sound.

As soon as we carefully fitted gaskets for all the hardware and sealed all the leaks, the sound quality was markedly improved and right up to expectations. So take note of sealing. It is the single most important aspect of the entire project.

DRILLING HOLES

All the holes for the screws to mount the hardware must be drilled by the constructor. Now do not just lay the cabinet on its back, drop the speakers into place and drill right through the mounting



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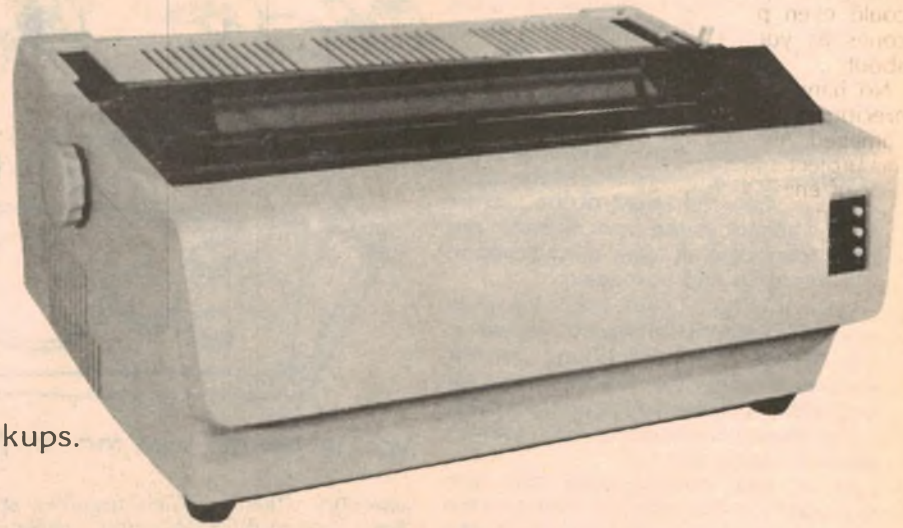

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holes. If you do, you stand a good chance of scratching the speaker frames with the drill chuck as the drill breaks through the particle board. Worse, you could even put a hole in one of the cones as you blithely wave the drill about.

No, handle the speakers as if they were precious jewels, fragile and easily damaged. After all, if you take care with this project you stand to receive a great deal of enjoyment from these speakers for a long time to come.

Lay the cabinet on its back and place all speakers and level controls into their appropriate positions with the mounting holes equally spaced around the vertical centre lines. Then mark the positions of all these mounting holes in pencil, remove the speakers and level controls, and drill the holes. Similarly, drill the holes for the rear terminal panel and the crossover network which should be mounted inside the enclosure on the base panel.

Make sure that you drill the holes slightly smaller than the core of the thread of the self-tapping screws, to make sure that the screws do not pull out of the holes.

SEALING THE ENCLOSURE

As each loudspeaker and level control is installed you must make sure that it is sealed around the periphery. Experience has shown that there is only one really foolproof way of doing this and that is to make up gaskets using a foam-backed adhesive tape such as Engels No 5C draught excluder which is available in five metre packs from most hardware stores. This quantity will be sufficient for two enclosures.

We understand that this foam backed tape from Engels will be included with the cabinet kits.

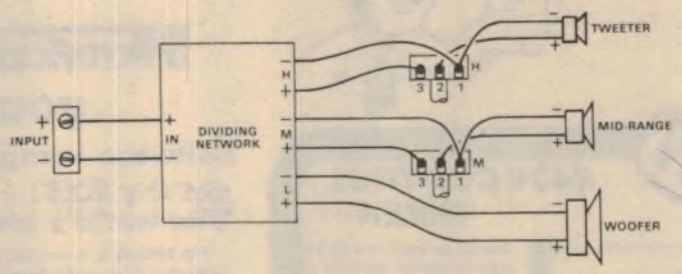
Gaskets made up using this foam-backed adhesive tape have the advantage that they will seal again if the speakers ever have to be removed.

Install the rear terminal panel first, with its gasket and then mount the crossover network inside the enclosure. Then connect the wires of the prepared harness between terminal panel and crossover network. Next, install the tweeter, midrange driver and level controls, making sure to attach the connections before screwing each one into place.

Next, foll up and push the Innerbond material into the enclosure via the woofer hole in the baffle. Make sure it occupies the volume evenly, without dislodging any connections. Finally, fit the gasket for the woofer, attach the connections and screw it into place.

Use both hands when driving the speaker screws home. One hand should guide the blade to ensure that it does not slip off the screw head and possibly damage the speaker cone.

EA staff member Colin Dawson shows the right degree of care when handling the loudspeakers. This step shows the speakers being positioned before marking the mounting holes for drilling.



A prepared harness with push-on connectors is provided for the system wiring.

TESTING FOR LEAKS

The simplest way of testing for leaks is to connect the loudspeaker system to an amplifier and drive it at a low frequency, of around 50Hz, at a volume which is reasonably loud but which is not obviously overdriving the woofer. If you do overdrive the woofer its cloth surround will begin to buzz audibly – a sure sign that you are overdoing things.

With 50Hz signal applied, moisten your palm, cup your hand and pass it over all the likely places where leaks could occur. Go over the back panel as well as all over the corners. Leaks can occur through the female sockets for the grille cloth frame attachments if the pilot holes have not been plugged.

An alternative to the moist palm method is to use a lighted candle but this does present the risk of burn marks on the enclosure.

When your toil is completed, place your speakers in their final positions, give the cabinets a wipe over with a moist cloth, fit the grille cloth frame and put on your favourite record. We know you will enjoy it.

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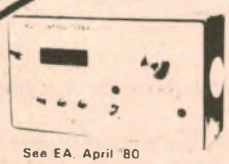

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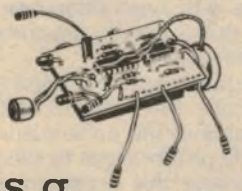

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Measures 1pF to 19.99uF on 3 ranges

3½-digit LCD capacitance meter

by JEFF SKEEN and GREG SWAIN

Here is an inexpensive digital capacitance meter which measures from 1pF to 19.99μF in just three ranges. It features a 3½-digit display with decimal point, runs off a 9V battery, and comes in a handy pocket size.

This LCD Capacitance Meter is the second in our series of projects using the DPM-200 LCD module. Apart from the module itself, it uses just one IC, two transistors and a handful of other components. No adjustments are necessary when taking measurements: you simply connect a capacitor to the test leads, select the range and there is the reading. What could be easier?

The unit is certainly easier to operate than an impedance bridge and has the advantage over both bridges and conventional analog meters in that it will measure down to 1pF. There are three ranges: 0-2000pF, 0-200nF, and 0-20μF. You must remember to subtract the stray capacitance from the reading on the 0-2000pF range though (typically around 30pF).

In addition to non-polarised capacitors, both tantalum and electrolytic capacitors can be measured. The test terminals are actually polarised and, during the test procedure, the capacitor is charged to 2/3 of the supply voltage.

In addition, our new LCD Capacitance Meter has big 15mm-high digits for easy display legibility, provides low battery warning (LOW BAT) at about 7V, and features over-range indication. The latter, by the way, is indicated by a leading "1", with the three least significant digits supressed.

With features like these, the LCD Capacitance Meter will be invaluable to hobbyists and professionals alike. It is a simple matter to sort capacitors even if they have no markings or the markings are difficult to decipher. This can be the case with capacitors which use numeric or colour codes, or tuning and trimmer capacitors which usually have no marking at all.

Now, with the flick of a switch, those previously unfathomable values become instantly apparent.

Unlike conventional meters, a digital meter offers high resolution; in this case 3½ digits. Resolution is 1pF on the 2000pF range, 0.1nF on the 200nF range, and 0.01μF on the 20μF range.

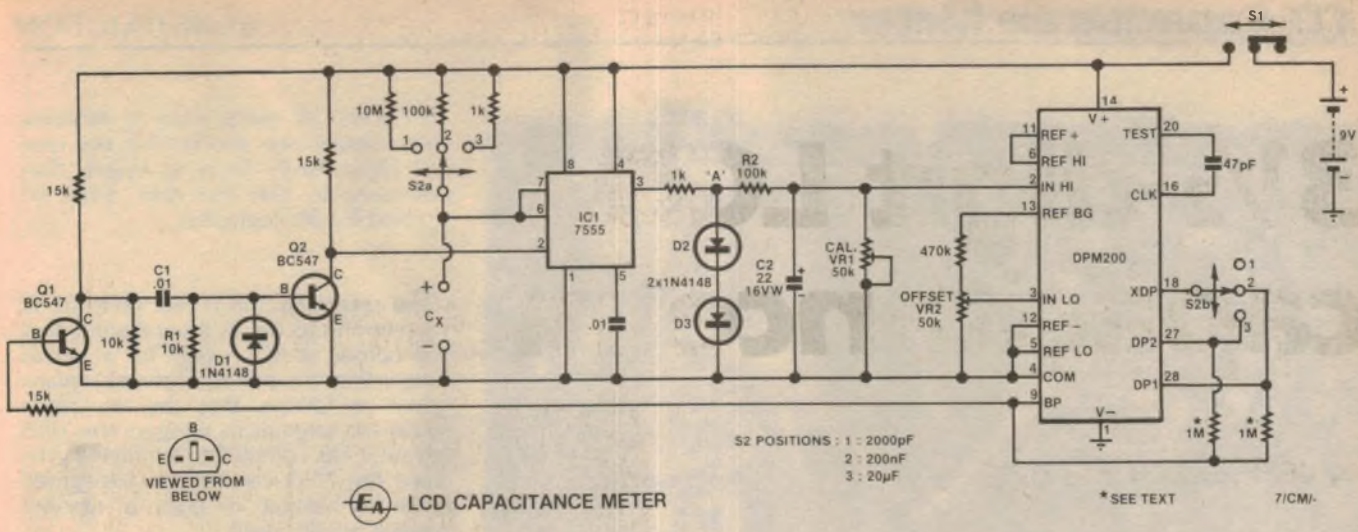
Finally, our new LCD Capacitance Meter will prove a handy test instrument for servicemen. Its compact size and battery power supply mean that suspect capacitors can be quickly checked both at the work bench and in the field.

How it works

In this circuit, a capacitor is measured by connecting it in the charging circuit of a 7555 monostable which is triggered continuously at around 35Hz. The monostable thus produces a train of pulses with a repetition rate of 35Hz and with pulse length proportional to the capacitance.

This pulse train is clipped to a constant amplitude which means that the average DC value of the pulse train waveform is directly proportional to the capacitance. By feeding this averaged value to the LCD module, a direct readout of the capacitance can be obtained in either pF, nF or, μF, depending upon the range selected.

By basing the design of the capacitance meter around the DPM-200 LCD module, the external parts count has been kept to a minimum. The operation of the DPM-200 module has been described before (see EA February, 1982)



The circuit consists of a trigger circuit (Q1 and Q2), a monostable pulse generator, an integrator and the LCD module.

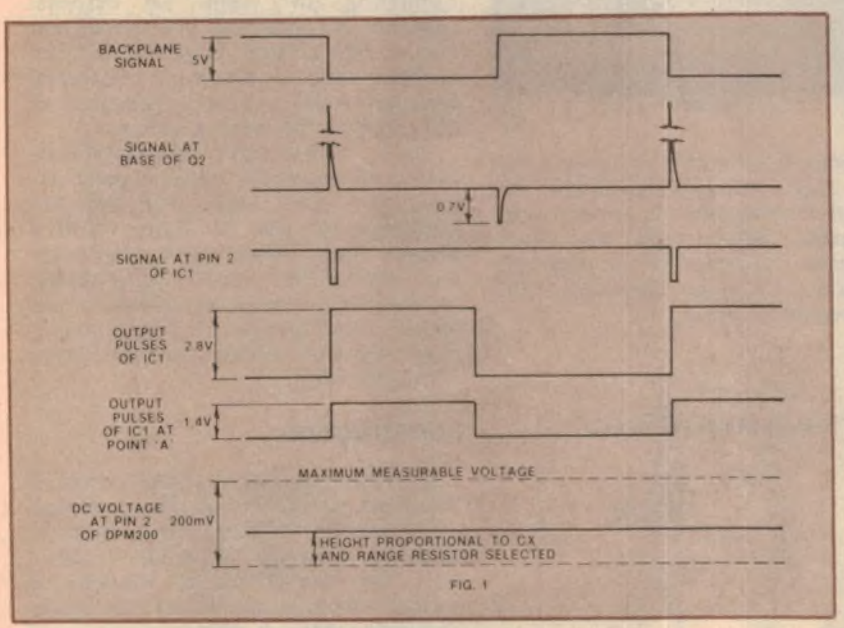


Fig. 1: Timing waveform diagram. Output pulses from the 7555 are clipped and averaged to produce a constant DC voltage at the input to the DPM-200.

but for the sake of clarity we will briefly review some of the functions once more.

The DPM-200 is essentially a high input impedance voltmeter with a full-scale reading of 199.9mV. Heart of the circuit is an analog to digital converter chip which drives the liquid crystal display, while additional circuitry drives various display annunciators.

Stable reference voltages of 1.2V and 100mV are provided on the module, with the latter voltage used as the reference against which the input voltage is compared. The reading displayed by the liquid crystal display when 100mV is used as the reference voltage is 1000 Vin/Vref.

Annunciators are supplied on the LCD and include all the commonly used electrical abbreviations such as mV,mA,Ω,+,–, etc. Decimal points are also included and may be switched on and off as required. To enable an annunciator, a connection is made from the annunciator pin on the module to the XDP pin.

The common (COM, pin 4) is maintained by the module at Vcc – 2.8V and may be used as the "earth" return for an external circuit. If a zero display reading is required when the actual input is not 0V, then an offset voltage may be applied between the COM and IN LO pins.

Clock signals are provided by an internal 48kHz oscillator which is also divided down to give the 60Hz backplane signal necessary to drive the display. This backplane signal is made available at the BP pin (pin 9), and is a square wave with an amplitude of ±2.5V with respect to the common rail. The oscillator frequency can be reduced by connecting a low-value capacitor between the TEST and CLK pins.

The supply voltage for the external circuitry is derived from the difference in voltage that is maintained between the positive supply and the COM pin by the module. This means that the external circuitry has a supply voltage of about 2.8V.

Circuit description

Refer now to the circuit diagram and to the timing waveform diagram Fig. 1. The circuit is based on one that appeared in "Practical Electronics" for July, 1981 and can be broken into three parts: the LCD module itself, a 7555 CMOS timer, and a transistor trigger circuit (Q1 and Q2).

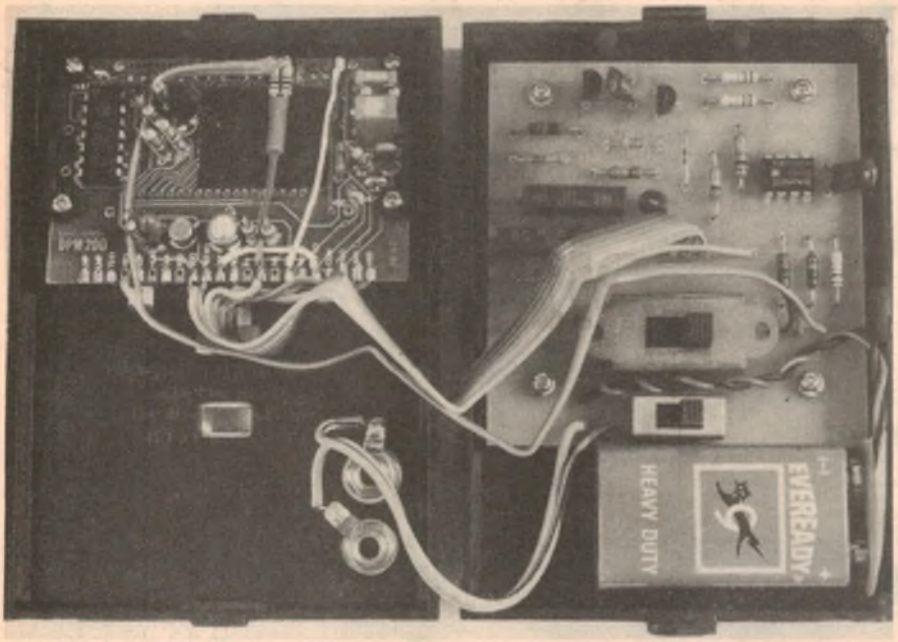
The backplane signal from the display module is fed via a 15kΩ resistor to the base of transistor Q1 which turns hard on when the backplane signal is high, and hard off when the backplane signal is low.

Thus, Q1 buffers the backplane signal and applies it to a voltage divider consisting of 15kΩ and 10kΩ resistors. From there, the signal is applied to a differentiating network (C1 and R1) which produces large positive and negative output spikes coinciding with the rising and falling edges of the input waveform. In this circuit, however, the large negative spikes are clipped by diode D1 to prevent damage to the emitter base junction of transistor Q2 (see Fig. 1).

Normally, transistor Q2 is held off by R1 and is briefly turned on each time a positive pulse is applied to its base. Q2 thus serves to invert the positive spikes, turning them into negative-going pulses with an amplitude approaching the 2.8V supply.

These negative-going pulses coincide with each negative-going edge of the backplane signal, and are used to trigger the 7555 timer IC.

The 7555 IC may seem unfamiliar to



LEFT: Keep all wiring short to minimise stray capacitance and so that the case will close easily (ours is longer than necessary so that the case could be opened for photography).

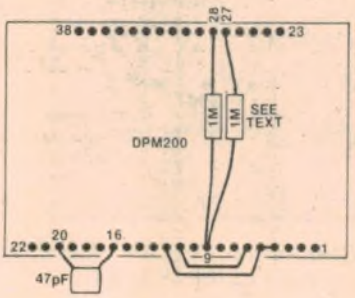
many readers at first glance, but it's really just a CMOS version of the 555. In this circuit, the 7555 has been wired as a one-shot monostable and produces a positive pulse with length proportional to the test capacitor and the range resistor selected whenever a negative pulse appears on the trigger input (pin 2).

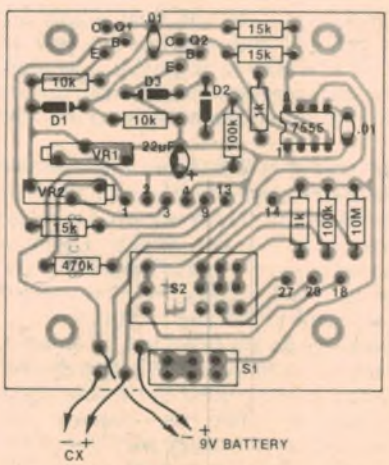
The 7555 works as follows: When pin 2 goes low, the test capacitor Cx, which is initially discharged, begins charging towards the positive supply rail. While ever it remains below 2/3 supply, the output of the 7555 (pin 3) is high. Cx charges via one of the range resistors and, when it reaches 2/3 supply, pin 3 goes low and the 7555 is reset ready for the next trigger pulse.

Switch S2a selects the appropriate range resistor, while S2b switches the decimal points. In order to maintain accuracy between ranges, the range resistors specified are all close tolerance types.

Output pulses from the 7555 pass through a 1kΩ resistor and are clipped by diodes D2 and D3 so that they are of a constant amplitude (approximately 1.4V). This is necessary otherwise small variations in the amplitude of the output pulses would give incorrect readings and cause display jitter. R2 and the CAL trimpot VR1 form a voltage divider with C2 acting as an integrator to average out the pulses and produce a constant DC voltage. The CAL trimpot is adjusted so that the full-scale DC voltage to the DPM-200 display module is 199.9mV.

A 47pF capacitor has been added to the DPM-200 display module between the CLK and TEST pins in order to slow the internal oscillator frequency slightly. This reduces the backplane frequency to around 35Hz and ensures that the maximum pulse length from the monostable (1kΩ × 20μF = 20ms) is shorter than the period of the triggering waveform. If the monostable pulse length was made longer than the period of the triggering waveform, the timing relationship of the circuit would be upset.





Don't forget the wire link between pins 4 and 5 on the DPM-200 display module.

The reason for this is best understood by referring to Fig. 1. If we assume that the output of IC1 is high for a period longer than the period of the backplane signal, it follows that the backplane signal will attempt to retrigger the 7555 before it has completed its timing cycle. Since the 7555 can not be retriggered while its output is high, a random reading would result.

An OFFSET trimpot, VR2, has been provided to null out the residual output which is produced by IC1 when it is not oscillating, ie, when no external capacitor is connected. We should add that on the 2000pF range IC1 will still oscillate when no capacitor is connected because of the residual capacitance of the wiring to the banana sockets.

Finally, 1MΩ resistors have been connected between the decimal point annunciators (DP1 and DP2) and the backplane pin (pin 9). These resistors prevent noise picked up by the leads connected to DP1 and DP2 from turning on the decimal point annunciators, yet allow normal operation of each annunciator when it is connected to XDP. More about this later.

Construction

The LCD Capacitance Meter is housed in a small plastic case specifically designed to suit the DPM-200 display module. This case measures 80 × 110 × 30mm and, like the DPM-200 module, is available from Jaycar Pty Ltd (380 Sussex St, Sydney 2000). A printed circuit board measuring 72 × 71mm and coded 82cm3 is used to hold all external components except for the 47pF capacitor and the two 1MΩ resistors.

Begin construction by assembling the PCB according to the wiring diagram. Fit the three close tolerance range resistors first (10MΩ 2%, 100kΩ 1%, 1kΩ 1%), followed by the remaining components and the 7555 timer IC. Remember that the 7555 is a CMOS device and can be destroyed by static electricity. When soldering it into circuit, connect the barrel of your soldering iron to the COM track on the PCB (use a clip lead) and solder the power supply pins (1 and 8) first to activate the static protection circuitry.

Depending upon the type of switches supplied, the holes for the switch pins may need to be enlarged slightly. Mount the switches on the PCB so that the top of each switch body is 10-12mm above the PCB. If the switches supplied have side supports, these should be trimmed

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DIGITAL CAPACITANCE METER

Ref: EA March 1982
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Kit includes case.

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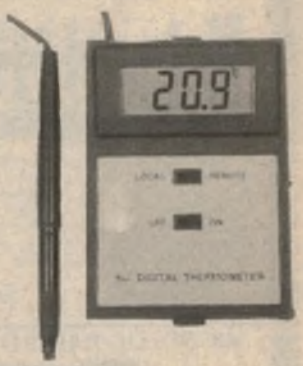

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sensational LCD Panel Meters

The illustration shows the display with all segments and annunciators actuated. The unit is housed in a neat plastic escutcheon as shown in the illustration on the left. The DPM measures 72x36mm overall. Digital height – 15mm (can be read at distances up to 10 metres).

DPM-200 ONLY

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Specs:
Input impedance: >100m
Full scale reading: 199.9mV
Accuracy 0.05% of reading +1 digit
Power supply: 5-15VDC 50uA
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Auto polarity, auto zero, over-range warning
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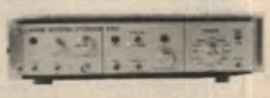

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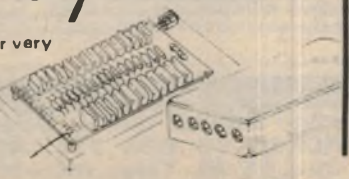

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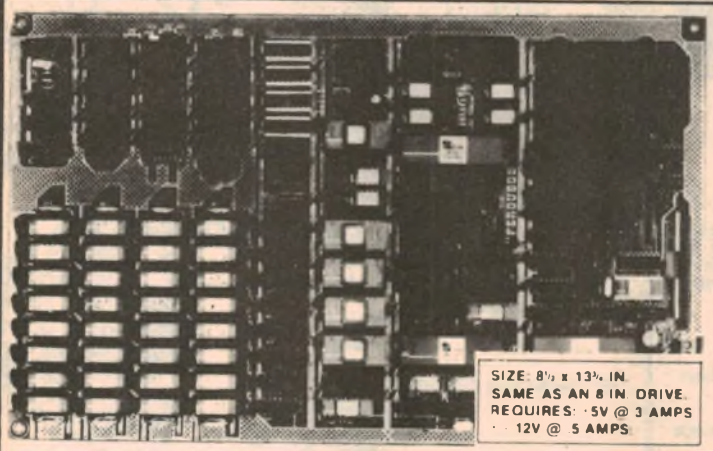

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with a pair of side cutters before the switches are soldered in.

Now take a sharp knife and carefully cut off the top 2mm of plastic from each mounting post in the lower case half. Do not cut off too much plastic or there will be nothing left to screw the mounting screws into. At the same time, you should also remove the same amount of plastic from the battery rib closest to the mounting posts. This is done to allow plenty of clearance between components on the PCB and components on the DPM-200 display module.

Next, use the front panel artwork to mark out hole positions for the switch actuators and banana sockets on the top of the case. Drill the banana socket holes to size, and use a small drill to remove most of the plastic from the switch actuator holes. A small, flat file can then be used to square up the actuator holes to their correct size.

The "Scotchcal" front panel can now be glued in position and holes made for the switch actuators and banana sockets by drilling and cutting with a sharp knife. This done, mount the two banana sockets in position with the red socket at the top adjacent to "+" sign. Do not mount the DPM-200 display module at this stage.

The 47pF capacitor can now be soldered in between TEST and CLK, and the wiring on the display module and between the module and the PCB completed using ribbon cable. Keep this wiring as short as practicable so that it will fit easily into the case when the case is finally assembled. Although we used a fairly long length of ribbon cable, this was done simply to allow the two case halves to be placed side-by-side for photography.

Finally, solder in the battery clip, taking care that the polarity is correct, and use a short length of figure eight wire to connect the two banana sockets to their respective inputs on the PCB. The PCB can then be screwed into place in the lower case half and a final check made to ensure that all wiring is correct.

Note: keep the wiring to the banana sockets as short as possible to minimise stray capacitance.

Calibration

It is not necessary to mount the display module prior to calibration, as this can be done later. For the time being, sit the module display side up on an insulated work bench, clip a 9V battery into place and switch on. You should get a low reading determined by the settings of the CAL and OFFSET trimpots.

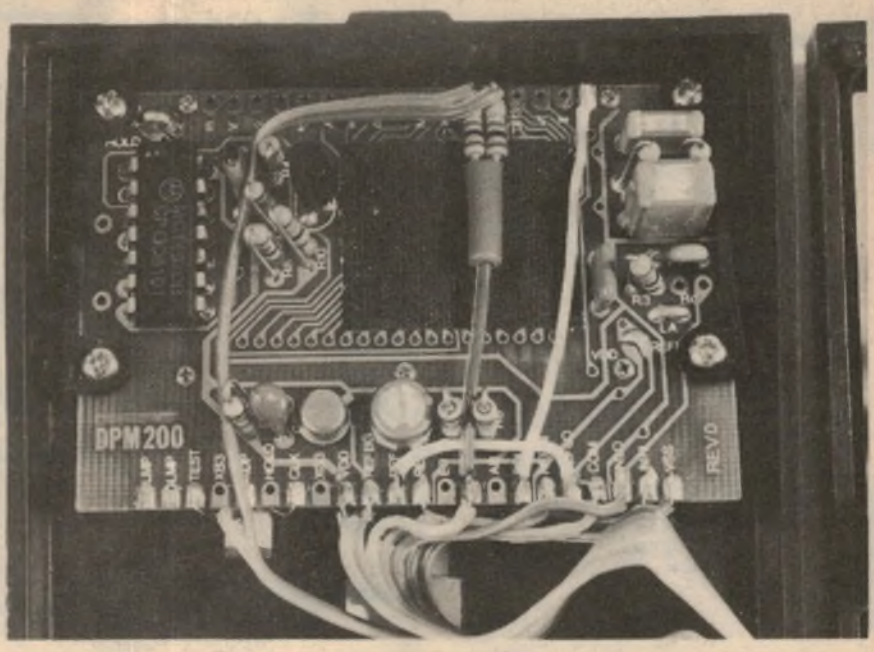
To carry out calibration, you will need a close tolerance capacitor or one with accurately known value. Calibration should be performed on the 200nF or 20μF ranges rather than on the 2000pF range where stray capacitance will be significant.

The calibration procedure is as follows:

- Turn the CAL trimpot VR1 clockwise as far as it will go (until you hear "clicks") and the OFFSET trimpot anticlockwise as far as it will go. The display should show "0.00";
- Connect the calibration capacitor to the test terminals, set the range switch to 20nF or 20μF as appropriate, and adjust the CAL trimpot until the display shows the value of the capacitor;
- Remove the calibration capacitor and adjust the OFFSET trimpot until the display reads "0.00";
- Re-connect the calibration capacitor and re-adjust the CAL trimpot for the correct value. The display should now read "0.00" with the capacitor removed.

Readers should note that both positive and negative readings may be obtained over the range of the OFFSET trimpot, but the plus and minus display annunciators are not normally shown. If you have difficulty locating the null, connect a wire from the POL output (pin 7) to the minus annunciator (pin 23) on the display module. Now, when the reading is less than zero, the minus annunciator will appear and it will be quite easy to locate the null.

You can even leave pins 7 and 23 connected if you like (we did), since this does not affect the normal operation of the meter.



Close-up view of the display module mounted in the plastic case. Note the link from the POL output (pin 7) to the minus annunciator (pin 23) (optional; not shown on circuit).

PARTS LIST

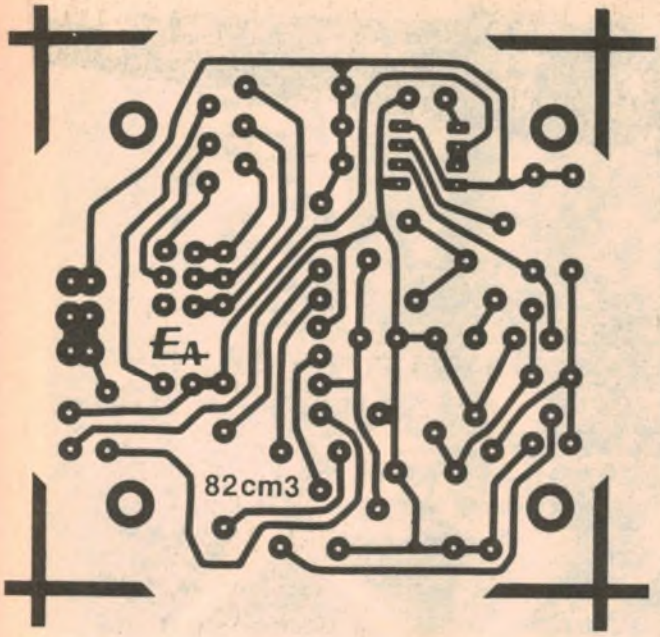
1 printed circuit board, 72 x 71mm, code 82cm3
1 plastic case, 80 × 110 × 35mm
1 Scotchcal label, 72 x 60mm
1 DPM-200 liquid crystal display module
1 DPDT slide switch
1 3P3W slide switch
1 9V 216 battery
1 battery clip to suit
4 small self-tapping screws
1 20cm length of ribbon cable
1 9cm length of figure eight cable
2 4mm banana sockets, 1 red, 1 black

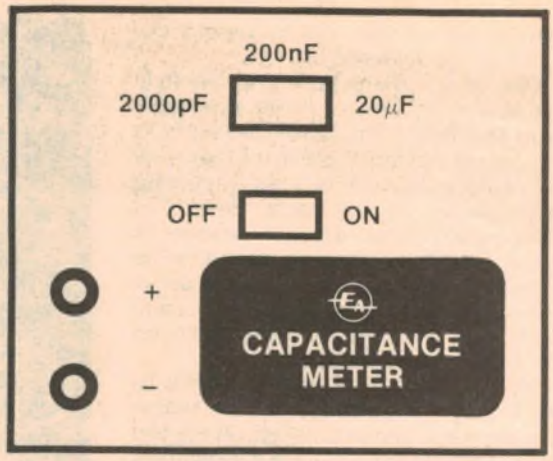
SEMICONDUCTORS
3 1N4148 silicon diodes
2 BC547 NPN transistors
1 7555 CMOS timer IC

CAPACITORS
1 22μF/16VW tantalum
1 0.01μF metallised polyester
1 47pF ceramic

RESISTORS (¼W, 5% unless specified)
1 x 10MΩ 2%, 2 x 1MΩ (see text), 1 x 470kΩ, 1 x 100kΩ, 1 x 100kΩ 1%, 3 x 15kΩ, 2 x 10kΩ, 1 x 1kΩ 1 x 1kΩ 1%, 2 x 50kΩ multi-turn trimpots.

Note: Components specified are those used in the prototype. Components with higher ratings may generally be used provided they are physically compatible.





Here are actual size artworks for the printed circuit board and the front panel.

That completes the calibration procedure. No adjustments are required on the other two ranges due to the close tolerance 2% range resistors used. Note, however, that if the meter is switched to the 2000pF range with no test capacitor, a reading of around 20 or 30pF will be displayed. This is quite normal and is due to stray capacitance between the PCB tracks, the hook-up wire and the banana sockets.

While this stray capacitance could be nulled out using the OFFSET trimpot, readings on the other two ranges would no longer be accurate (the meter would read low). The best procedure for measuring low-value capacitors is to measure the stray capacitance first and then subtract this from the final reading.

Provided you have kept the leads to the DP1 and DP2 pins (pins 28 and 27) reasonably short, the two 1Mμ resistors will not usually be required. While some readers may wish to fit them as a precautionary measure, they are really only necessary if the decimal points do not extinguish completely when not wanted. Check your wiring between S2b and the module if the decimal points fail to come on as required (200nF and 20μF ranges only).

The display module can now be inserted sideways through its mounting hole, slipped into position and secured by screwing down the two small plastic retaining brackets. Now screw the two halves of the plastic case together, making sure that components on the display module and the PCB do not foul each other, and the job is complete.

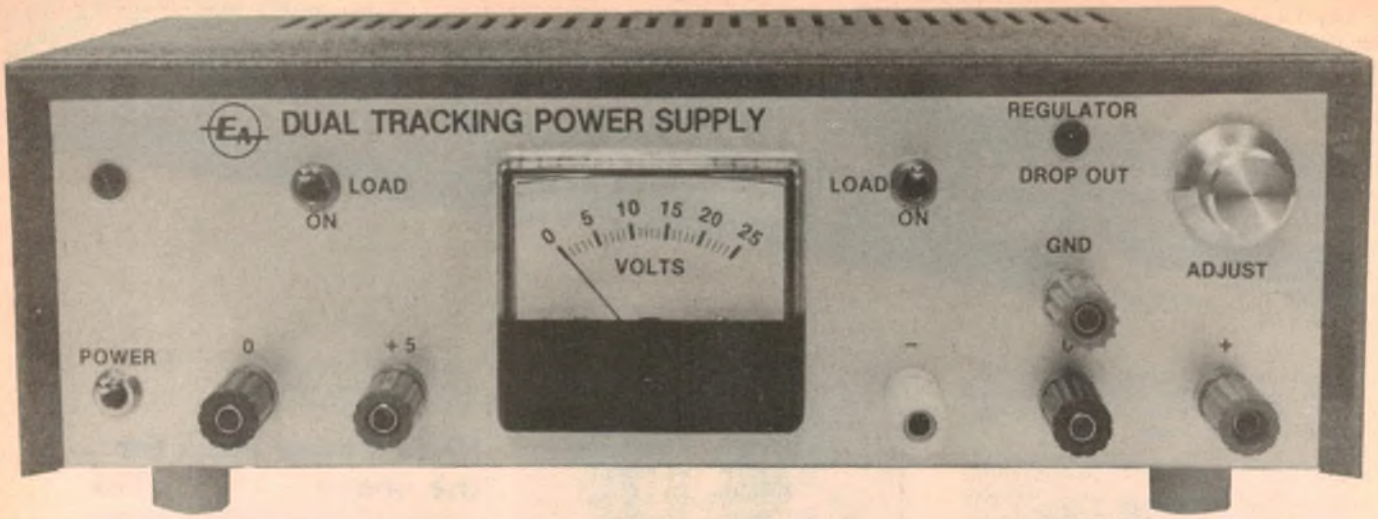
We estimate that the current cost of components for this project is

$60

This includes sales tax.

A final word of warning before you rush out and measure every capacitor in sight. Always make sure that any capacitor you measure is completely discharged before connecting it to the meter, otherwise the 7555 IC could be damaged.

That's it! We're sure that you will find our new LCD Capacitance Meter an invaluable test instrument.



Dual tracking ±22V power supply

Built around positive and negative 3-terminal regulators, this versatile dual-tracking power supply can provide voltages from ±1.3V to ±22V at currents up to 2A. In addition, the supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway.

by JOHN CLARKE

Power supplies are always a very useful addition to any workshop or experimenter's bench. They are invariably in constant use for powering battery-operated equipment during servicing and as a power source for circuits under development. By far the most useful power supply is one which can be adjusted to provide a wide range of output voltages and which can supply the necessary current. Add to this the benefits of full protection and regulation and you have an invaluable piece of test gear.

The voltages available from our power supply should be adequate for virtually any modern circuit configuration apart, from high powered amplifiers. Many circuits use operational amplifiers which often require plus and minus supply rails. Some op amps, such as the RCA CA3140, will function from a supply as low as ±2V and most consumer op amps can be operated from voltages up to ±18V. As well as providing these supplies, a fixed +5V supply is also useful for circuits combining logic ICs and op amps.

Extremely low voltages are also a useful feature of a power supply, since many circuits are designed to run from a single 1.5V dry cell or from a 1.35V mercury cell.

Since ±22V can be obtained from the power supply, a total of 44V is available across the positive and negative rails. Of course, the ±5V rail is still referred to the 0V rail. Any of the terminals (either the −, 0, + or +5V) can be tied to the Ground, which is a separate terminal. Alternatively, the power supply can be left floating.

Two separate switches are provided to disconnect the voltage from the output terminals, one for the +5V rail and the other for the variable supply rails. A meter continuously monitors the voltage across the positive supply rail. Loss of regulation at high currents is indicated by a "Regulator Drop Out" LED indicator.

PERFORMANCE

The performance of the prototype with respect to the adjustable plus and minus supplies is shown by the two accompanying graphs. Regulation is such that both outputs vary by less than 100mV for a load change from 0 to 2A. Maximum current is limited to 0.9A at 1.25V, but about 2A can be supplied from between 9 and 18 volts.

The limits of the curve are determined by the internal limits of the regulator IC and also by the regulation of the transformer. When the +5V regulator is supplying its maximum load current of 0.9A, the transformer is loaded to such an extent that the adjustable regulators will drop out of regulation at around 17V. This drop out condition is indicated by the "Drop Out" LED on the front panel of the power supply.

The unloaded tracking ability – ie the accuracy with which the negative supply follows the positive rail – is within 1mV. However, the actual difference between the absolute values of the positive and negative supplies could be up to 100mV, depending upon the reference voltage from each particular regulator. Although we used a low resolution (±0.5V) meter for monitoring the output voltage across the positive supply rail. the actual voltage can be set to within 10mV with a 10-turn voltage adjust potentiometer (provided you have a digital multimeter).

Heart of the design are the National Semiconductor 3-terminal adjustable regulators. The positive supply regulator

is designated the LM317, while the negative regulator is the LM337. As well as having a minimum output voltage of 1.2 volts, these regulators have better line and load regulation than standard 3-terminal regulators. Included in the regulator ICs are current limit, thermal overload and safe area protection circuitry.

Turning to Fig. 1, we can see how the three terminal regulators are used as an adjustable supply and how the negative regulator is connected to track the positive regulator. Let's look first at the positive LM317 regulator. This regulator is designed so that a nominal 1.25 volts is developed between the OUT and ADJ terminals, regardless of supply current.

In practice, though, this fixed reference voltage could be between 1.2V and 1.3V, and a minimum load current must be provided.

The reference voltage (VREF1) is impressed across R1 to produce a constant current IQ1, which is equal to VREF1/R1. The ADJ terminal also produces a bias current, IADJ1, and both these currents flow through R2 to produce the voltage (IQ1 + IADJ1) x R2. The voltage at the output of the regulator is therefore the sum of VREF1 and the voltage across R2. This simplifies to: VOUT = VREF1(1 + R2/R1) + IADJ1 x R2.

The maximum IADJ1 current is 100μA, which can be ignored since this value is only 1% of IQ1. The VOUT equation simplifies approximately to: VOUT = VREF1 x (1 + R2/R1).

It follows from this that the minimum voltage is VREF1 when R2 is zero, and the maximum voltage is 22.08V when R2 is 2kΩ (assuming VREF1 is 1.25V).

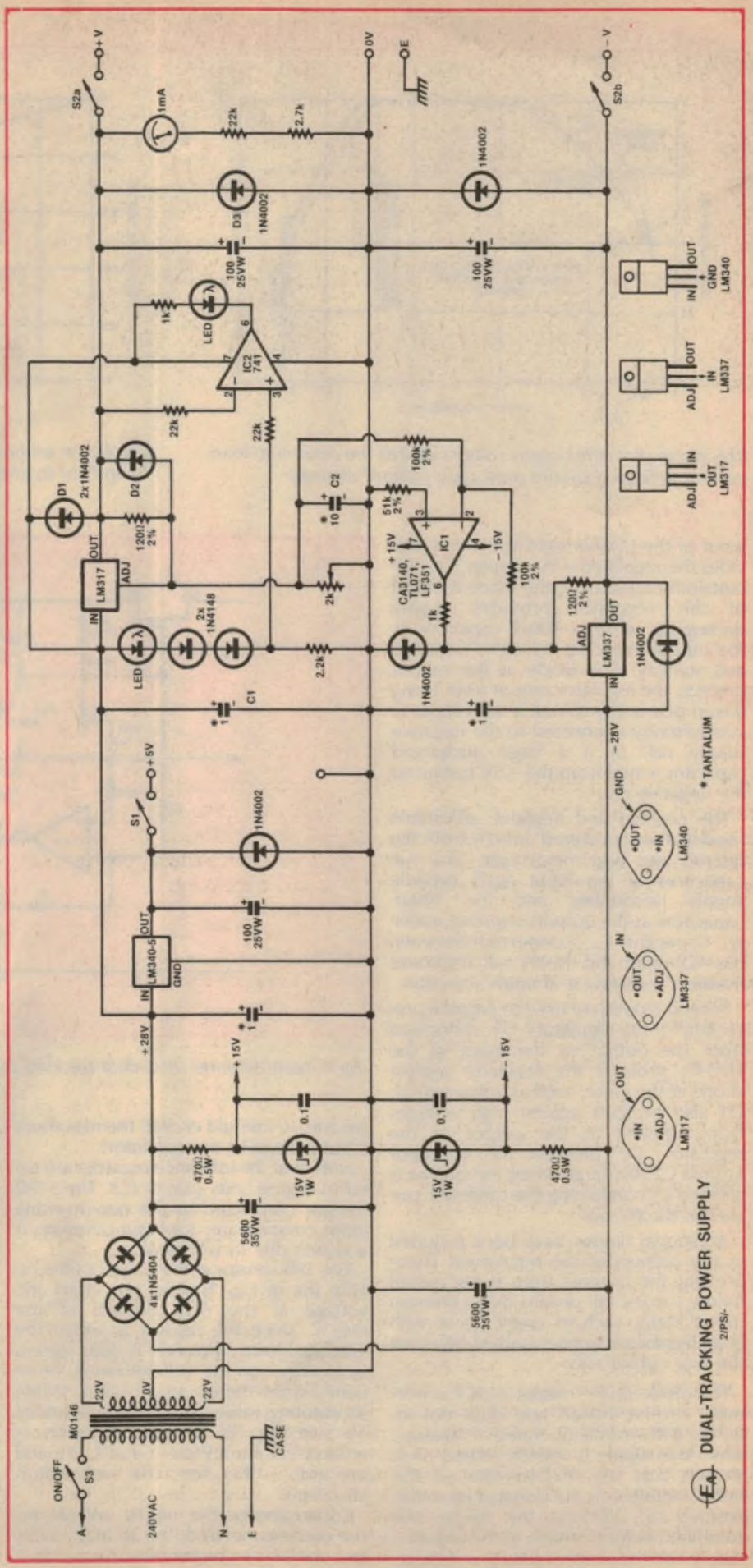
The voltage at the ADJ terminal of the LM317 is inverted with the unity gain inverting operational amplifier and applied to the ADJ terminal of the LM337 negative regulator. The voltage output from the negative LM337 regulator is therefore minus the voltage at the ADJ terminal of the LM317 minus VREF2. This reduces to the equation for VOUT (-) of Fig. 1.

By comparing the VOUT and VOUT (-) equations, it can be seen that the negative rail will track the positive rail and their absolute values will differ only by VREF1 – VREF2. This difference will only be a maximum of 100mV and will generally be much less than this.

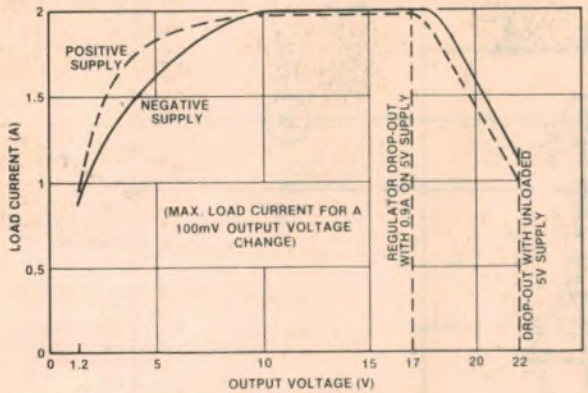
THE CIRCUIT

Looking now to the circuit diagram, a centre tapped transformer is used to provide 22V RMS per winding. The centre tap is used as the zero reference and the positive and negative sides of the power supply are obtained from a full wave bridge rectifier consisting of four 3A silicon rectifier diodes. The resulting DC voltage is filtered by two 5600μF capacitors, one from the positive rail to the centre tap and the other to the negative rail from the centre tap.

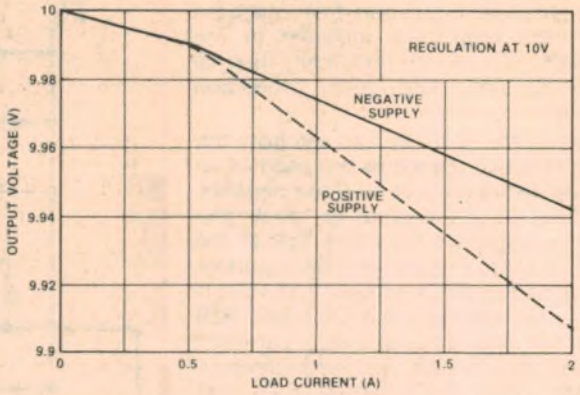
The positive voltage is applied to the



Dual tracking power supply



This graph plots the output voltage against the maximum load current delivered by the prototype (100mV change).



Regulation on both positive and negative rails is better than 100mV for load currents from 0 to 2A.

input of the LM340 regulator which provides the regulated +5V supply. The 1μF tantalum capacitor at the input terminal of this regulator provides supply decoupling while a 100μF capacitor at the output improves transient response and stability. The diode at the output protects the regulator output from being driven below the 0V rail if the output is inadvertently connected to the negative supply rail, or if a large uncharged capacitor is tied from the +5V output to the negative rail.

The positive and negative adjustable regulators are powered directly from the filtered plus and minus rails. The 1μF capacitors at the input again provide supply decoupling and the 100μF capacitors at the outputs improve stability. Capacitor C2, connected between the ADJ input and the 0V rail, improves transient response and ripple rejection.

Several diodes are used to provide protection for the regulators. D1, connected from the output to the input of the LM317, protects the regulator against shorts at the input, such as a shorted C1. D1 also protects against high voltages being applied at the output of the regulator. D2 protects the regulator against C2 discharge when the output is shorted by conducting the capacitor current to the 0V rail.

Additional diodes have been included at the outputs of the regulators. These prevent the outputs from being pulled below the 0V rail due to high common mode loads, such as might occur with large bypass capacitors applied between the two output rails.

The diode at the output of IC1 is normally reverse biased and does not interfere with normal operation. However, when the supply is initially turned on it ensures that the ADJ terminal of the LM337 regulator is not dragged up to the positive rail. Without this diode, the combined output voltage of the negative supply and the positive supply voltage to

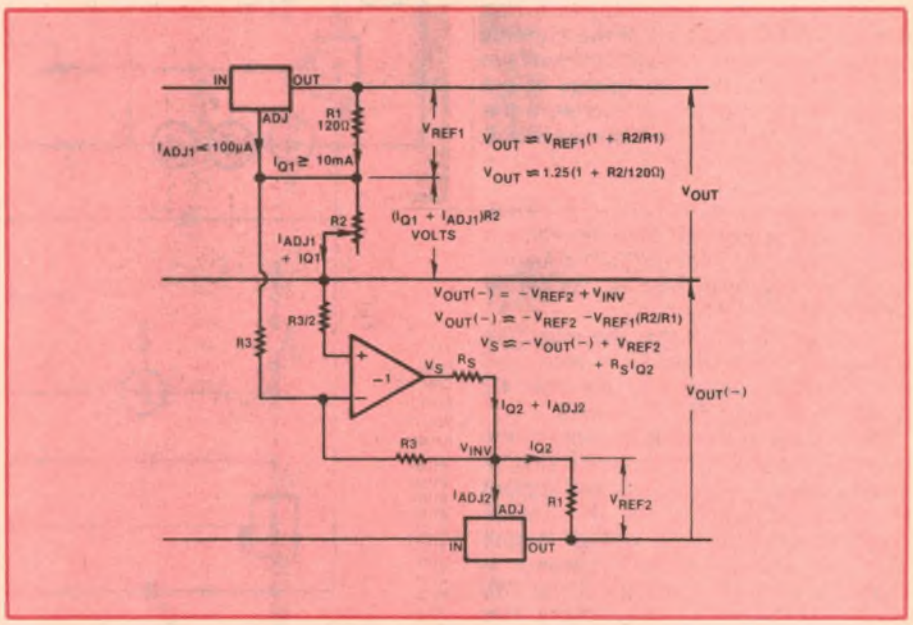


Fig.1: basic scheme for a dual tracking supply using 3-terminal regulators.

op amp IC1 would exceed the maximum input voltage to the regulator.

Note that 2% tolerance resistors are used to ensure unity gain of IC1. The 51kΩ resistor connected to the non-inverting input compensates for input offset error and drift due to temperature.

The 1kΩ resistor at the output of the op amp (Rs of Fig. 1) does not effect the voltage at the ADJ terminal of the LM337, since the resistor is within the feedback loop. However it does have a large effect on the voltage swing Vs required from the op amp output. When substituting values into the equation for Vs (see Fig. 1), we obtain values of around 11V for a VOUT (–) of 1.25V and around –12V for the maximum VOUT (–).

Consequently, the supply voltage for the op amp needs to be at least ±12V and preferably greater than this to offset the fact that the op amp will not swing to the full supply rails.

The maximum allowable supply voltage for the op amp is ±18V and so the supplies cannot be derived from the rectified transformer voltage. Instead, zener diodes are used to drop the rectified voltage to ±15V. The 0.1μF bypass capacitors across the zeners reduce the possibility of instability in the op amp.

IC2 is used to monitor the drop out voltage across the positive adjustable regulator. Two diodes and a LED in series are connected to the input of the regulator and are biased on with a 2.2kΩ resistor. This LED is used as the power on indicator and, in conjunction with the other two diodes, gives a voltage drop from the positive supply of about 3V.

IC2 monitors this voltage, as well as the voltage at the output of the regulator. Normally the input voltage to the

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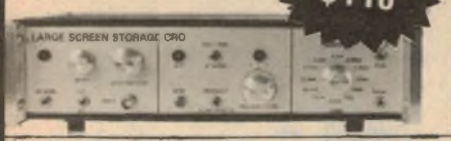

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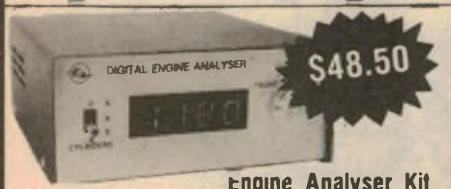

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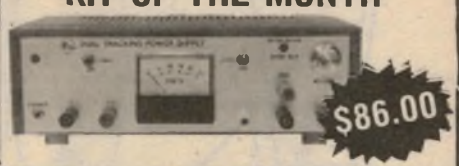

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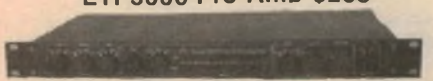

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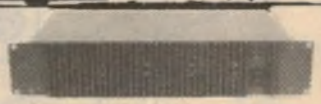

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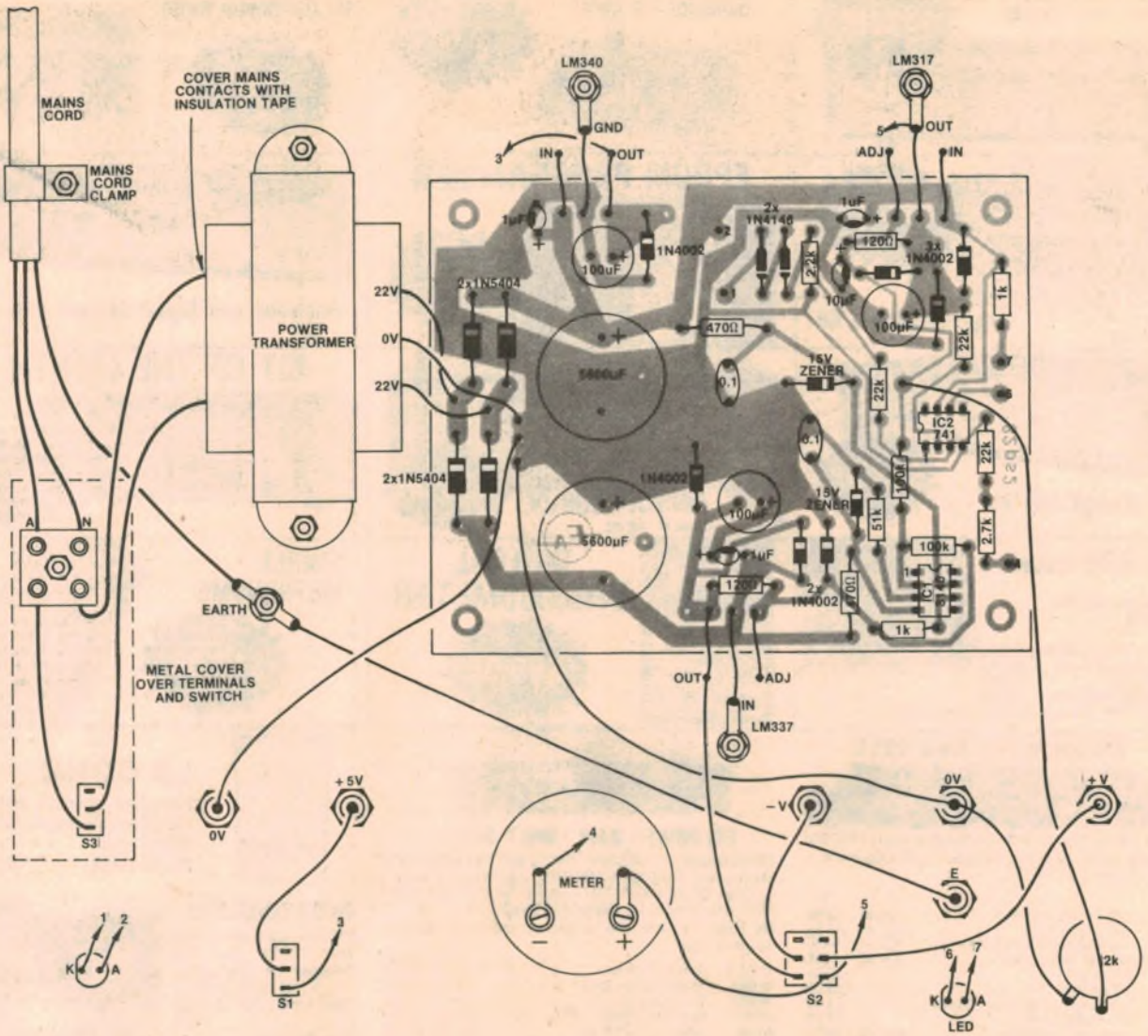
Dual tracking power supply



Note that the three regulator ICs must be insulated from chassis (see text and diagram). Keep mains wiring neat and tidy.

PARTS LIST

1 K and W instrument case, 256 x 90 x 159mm
1 Scotchcal front panel, 251 x 76mm
1 meter scale, 51 x 43mm
1 PCB, code 82ps2, 95 x 120mm
2 SPDT switches
1 DPDT switch
6 binding post terminals (2 red, 2 black, 1 white, 1 green)
1 transformer, 22-0-22V at 1.25A, M-0146 or equivalent
1 Bourns ten turn potentiometer, 2kΩ, 3540S
1 1mA FSD meter, 58 x 52mm
1 knob
2 red LEDs and bezels
1 mains cable and plug
1 two-way terminal block
1 cord clamp
1 grommet
4 earth lugs
3 TO-3 mica washers and 6 bushes
3 TO-3 plastic covers
1 piece of aluminium, 60 x 60mm

SEMICONDUCTORS
1 LM340-5, 7805 TO-3 3-terminal regulator
1 LM317 TO-3 3-terminal adjustable regulator
1 LM337 TO-3 3-terminal adjustable regulator
4 1N5404 3A silicon diodes
7 1N4002 1A silicon diodes
2 1N4148, 1N914 small signal silicon diodes
1 CA3140, TL071, LF351 Bi-FET input op amp
1 741 op amp
2 15V 1W zener diodes

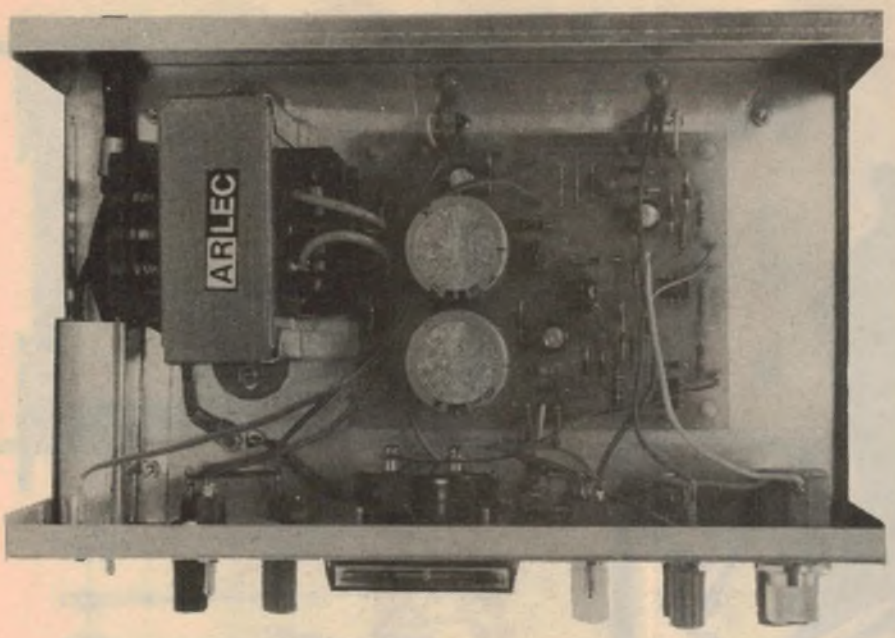
CAPACITORS
2 5600uF 40VW PC electrolytic
3 100uF 25VW PC electrolytic
1 10uF 35VW tantalum
3 1uF 35VW tantalum
2 0.1uF metallised polyester

RESISTORS (5%, ¼ unless noted
3 x 22kΩ, 1 x 2.7kΩ, 1 x 2.2kΩ, 2 x 1kΩ, 2 x 470Ω ½W.

RESISTORS (2%, 1/4W)
2 x100kΩ, 1 x 51kΩ, 2 x 120Ω

MISCELLANEOUS
Screws, nuts, washers, hook-up wire, solder, PC stakes etc

NOTE: Components specified are those used in the prototype. Components with higher ratings may generally be used provided they are physically compatible.



View inside the prototype. We covered the mains terminal strip and the power switch with a small metal cover made from scrap aluminium.

regulator is more than 3V above the output and so the op amp output is high. When the input voltage is less than 3V above the output of the regulator, the op amp goes low and the LED connected to the pin 6 output lights to indicate a drop out.

The drop out LED provides early warning of regulator drop out, which occurs at around a 2V voltage differential between the input and output. Although the drop out is only monitored for the positive supply, the LED will also light for a drop out condition on the negative regulator due to loading on the transformer affecting the positive rail.

A 1mA meter is used to monitor the voltage across the adjustable supply. The 22kΩ and 2.7kΩ resistors in series with the meter allow 1mA (full scale deflection) to flow through the meter when 25V is across the supply rails.

CONSTRUCTION

We constructed our power supply in a K and W instrument case, which has a folded heavy gauge aluminium base and a steel lid with a blue hammer tone finish. The case measures 256 x 90 x 159mm (W x H X D), and is available from most parts suppliers. A printed circuit board, coded 82ps2 and measuring 95 x 120mm, is used for the majority of the circuit components. In addition, a Scotchcal front panel artwork has been produced and measures 251 x 76mm. A 0 to 25V meter scale artwork measuring 51 x 43mm is also available and is suitable for meters measuring overall 58 x 52mm.

Start construction by drilling mounting holes for the mains cable grommet, cable clamp, terminal strip, earth lug, transformer, and the PCB. Use the photographs and wiring diagram to help you position these components within the case. The mounting holes for the regulators should be positioned such that their leads are close to the edge of the PCB and in line with the pads on the PCB to which they are to be wired.

The Scotchcal label can now be sprayed with a hard setting lacquer to prevent scratches and attached to the front panel of the case. Drill the holes for the meter, terminals, pot, switches and LEDs. Clean the burrs from around the holes and mount the components. The transformer, terminal block, grommet and cable clamp can now be mounted.

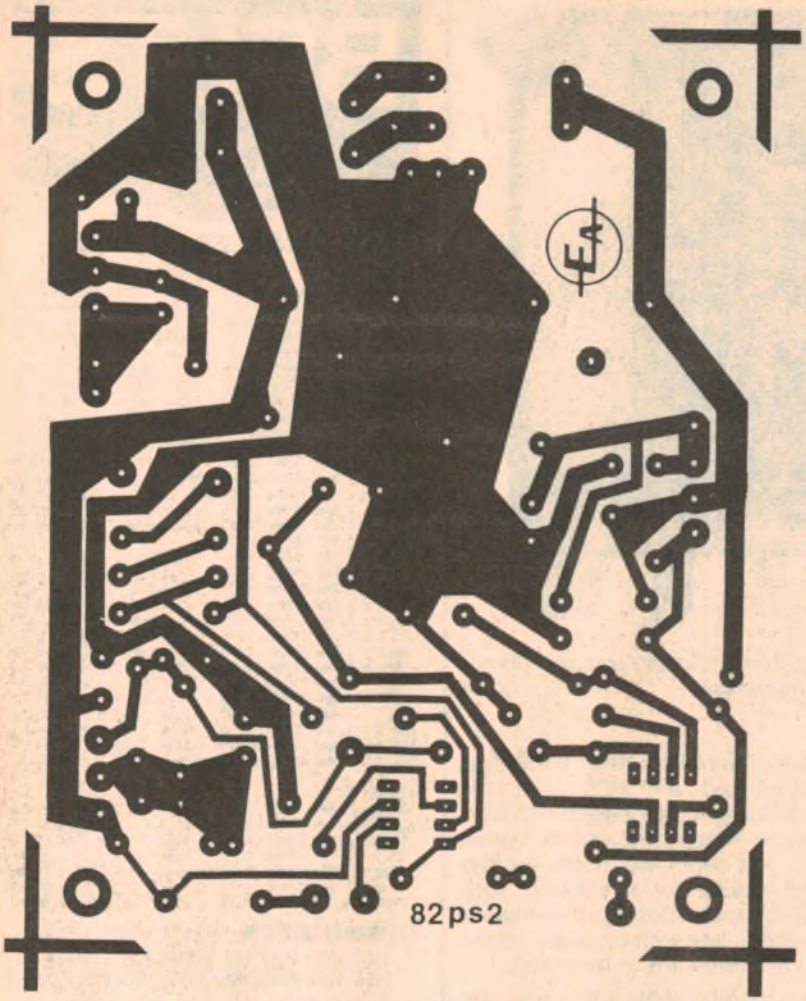
The 0 to 25V scale for the meter is positioned in the meter by removing the plastic front cover, unscrewing the two screws and securing the new label in place.

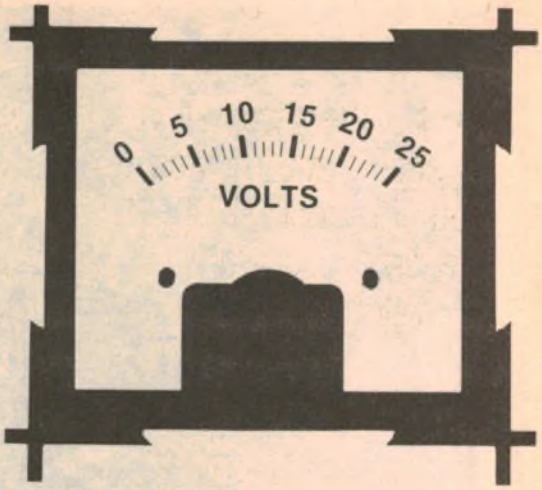
The TO-3 regulators are mounted beneath the base of the case and the leads connected with short wires. Mica washers and insulating bushes are used to electrically isolate each regulator from the case. We used TO-3 plastic covers on the regulators to prevent the otherwise exposed regulator from accidently shorting to the case.

We estimate that the current cost of components for this project is

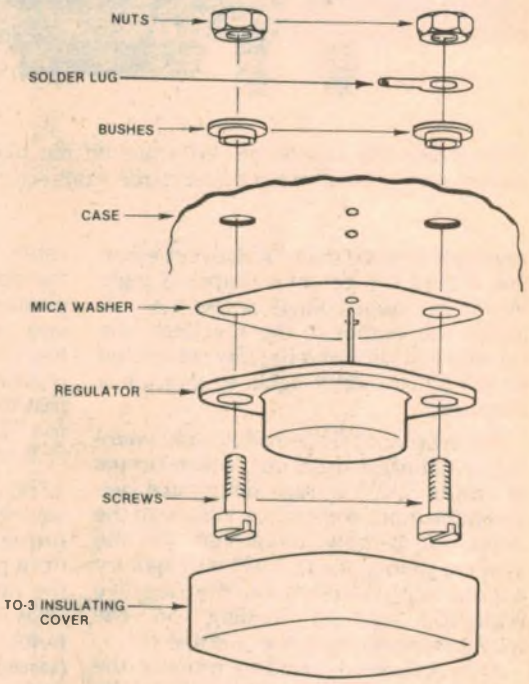
$86

This includes sales tax.





Above are actual size artworks for the PCB and the meter scale. The front panel has not been included because it is too big to fit the page.



RIGHT: This diagram shows how the TO-3 regulators are mounted.

The correct method of mounting the regulators is shown in the accompanying diagram. Make sure that all metal swarf is removed from around the holes and that the mounting surface is clean. Use heatsinking compound between the mica washer-to-case and mica washer-to-regulator surfaces. Note that the mounting screws should not be too long, otherwise they may short to the tracks on the PCB.

After the regulators have been mounted, check that they are in fact isolated from the case by checking with a multimeter set to the ohms range.

Although we recommend the TO-3 case style for all regulators, it is possible to use TO-220 regulators with some sacrifice in available output power but with a reduction in cost. These regulators will directly mount in the pads allocated for the regulators on the PCB, and should also be heatsinked to the base of the case. Electrical isolation of the regulator from the case is necessary.

Work can now begin on the PCB. We used PC stakes for all the external connections, since the wiring is made considerably easier. Mount all the components according to the overlay diagram and make sure that they are oriented correctly. The zener diodes are mounted about 2mm above the PCB and a loop made in one of the leads. This loop allows heat expansion without breaking the delicate glass seal of the zener body.

When complete, the PCB can be mounted within the case with PCB standoffs and the wiring can now begin. Rainbow cable can be used for the LED and meter wirings, but heavy-duty hookup wire (eg 24 x 0.2mm) is recommended for all other wiring. Note that the regulator outputs should be wired directly to the output terminals and not run via the pads on the PCB, except when TO-220 regulators are used.

It is important that the mains wiring be safely covered. If a wire from the power supply circuitry were to come adrift and find its way to the mains active, the whole supply could be at mains potential. Consequently, we covered the mains terminals on the transformer with several layers of insulating tape and made a small metal cover from scrap aluminium to cover the power switch and terminal strip.

When wiring is complete, make a final check that all is correct and apply power. Check that ±5V is supplied by the LM340-5 and that the meter is working correctly (use your multimeter). Measure the voltage from the variable supply and check that the negative rail tracks the positive rail when the adjust knob is rotated. It should be possible to vary the voltage from 1.3 to 22 volts.

Finally, check the operation of the load switches and confirm that the Drop Out LED works when a 0.9A load is applied to the +5V supply with the adjustable supply set to ±22V.

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The Serviceman

How many faults can there be in one set?

The above question is one that I have asked before, when I felt I had encountered some kind of record, but I reckon the following story will take some beating. Many of the faults occurred while the set was being serviced!

The story is not from my own bench but comes from a colleague who is now almost a regular contributor to these notes: Mr J. L. of Tasmania. Any reader who has ever been caught with a seemingly endless succession of faults will understand how he felt. Here's how he tells the story.

The set was a Pye model T30 colour receiver, and it had been into the workshop a couple of times in the past three years. The first time it was for a leaky pincushion diode, D606 (MR9773), which had caused failure of the line output transistor, Q65 (2SD350A).

The second time was for a loosened pin on the yoke plug, which had also caused a failure of the line output transistor. The looseness had caused overheating of the socket and the contacts had lost tension. A thorough clean-up and retensioning had put the set back into operation, although I had some reservations about the long-term reliability of the type of plug and socket used.

Back for another round

Well, my doubts were confirmed recently when the set turned up again with no picture and no sound. One look at the plug and socket was sufficient and, even without switching it on, I whipped out the old plug and socket and replaced it with an octal plug and socket assembly from an old AWA monochrome set. "That's fixed you!" I thought. There is no way that these plugs will work loose and they can carry plenty of current.

I switched on, hoping for sound to come up immediately, and the picture shortly after, but the set was quite dead. The mains fuse was open circuit and the line output transistor shorted. OK, I thought, that's par for the course, and was what had happened before when the voke socket worked loose.

I replaced the transistor and fuse, but this time I elected to start the set up slowly with a Variac. As the Variac reached about 100V input, both current sensing resistors (R410,411) went "ffft", and disintegrated in flames. Then the fuse blew. And, guess what? The new line output transistor was shorted.

I replaced the fuse and the two resistors, but the failure of the latter suggested that there was something badly amiss in the HT regulator circuit. I carefully checked the regulator on a dummy load and, as far as I could tell it was working perfectly.

Then it was back to the shorted line output transistor. Apart from the cost of 2SD350As, they are firmly soldered to a massive heatsink and it is almost a blowtorch job to shift them! I find I need a 150W plumber's type soldering iron to move them, so I fired up the old Birko again and soon had a new transistor in place.

This time I didn't risk an uncontrolled switch-on, but protected the new transistor with a 100W lamp in series with the HT supply to the transistor. At 80V input the lamp started to glow and the HT rail was up to 100V. As the input reached 240V the 122V rail was reading 150V and the lamp was glowing brightly. There was no indication of regulation within the power supply.

"Next time you check resistance ranges around here, leave me out of it!" (Radio-Electronics).

It didn't take long to find that the regulator transistor, Q44 (2N6308) was now short circuited. This was replaced and and the system tested without the line output stage connected. The 122V rail now regulated well from about 100V input, so I hooked up the line output stage, still with the protection lamp in circuit.

As the input from the Variac passed 100V the main fuse flashed brightly and we had another dead line output transistor. That made three 2SD350As lying on the bench with their arms folded. But I felt sure that the last one must have been crook from the start, because the protection lamp should have limited the current to a reasonable figure.

In went number four, and this was a good one because it survived even though the 122V rail shot up to 150V, which meant that the regulator was U/S – again! This time it was the regulator driver, Q43 (MJE350), that had shorted. I replaced it and sat back to review all that I had done and where to go next.

Possible alternatives

Basically, the fault was excessive current in the line output, due to either (1) a shorted tripler, (2) shorted turns in the line output transformer, or (3) a fault in the pincushion modulator. I had removed the tripler early in the exercise, and the modulator had been serviced not so many months before.

That seemed to point to the line output transformer, so out it came. These transformers are impregnated with pitch rather than wax and the workshop was soon filled with the acrid fumes of hot pitch and smelled like a council road works. I might have saved myself the effort because the transformer checked out perfectly.

That seemed to throw suspicion back on the modulator diodes (D606, D607).

They showed no signs of leakage on the high ohms range of a multimeter but, when hooked across a 30V power supply, one did show a milliamp or two of leakage. I was pretty desperate by now, so both diodes were condemned and two new ones fitted.

You can imagine my nervousness as I switched on again – and my fears were fully justified; the boost voltage diode, D608 (1S2711), exploded with a loud crack and a sheet of flame. Well, the set was at least being consistent. I replaced the diode and had a bet with myself that the picture tube would be the next thing to fail.

In fact, things were looking up. When I switched on this time I was greeted with a healthy sound from the speaker. The 100W protection lamp was still in circuit, so I connected the tripler and was rewarded with indications of EHT. It was only about 5kV, but it did seem that the tripler was OK.

The 100W lamp was obviously limiting the line output current to too low a value, so I connected another 100W lamp in parallel and obtained a slight increase in EHT. But it was clear that the circuit could not function with any degree of resistance in it so, with much trepidation, I removed both lamps and connected the line output stage directly to the power supply.

Both sound and EHT came up at switch-on and a few seconds later there was a line across the screen. The line was coloured, and it was moving, and, since it was the best result from the set so far, I was sorely tempted to quit while I was ahead! Unfortunately, the customer would not have been as happy with the coloured line as I was so I pressed on.

This time we had two U/S vertical output transistors, one shorted emitter to collector and the other open base to emitter. Replacing these improved matters considerably; I now had half a picture – the bottom half! (Once again I was tempted to quit while I was ahead.) In fact, this was probably the easiest part of the whole job; the emitter resistor on the top transistor was open circuit. A new one gave a full scan and a near perfect picture.

Now that the job was completed it seemed that a post mortem was in order. The original line output transistor probably failed because of the faulty plug and socket; the second because of the leaky modulator diode, and the third because of an internal fault. But I can't explain the failure of the regulator transistor, regulator driver transistor, vertical output transistors, and the boost diode.

Anyway, the set was duly returned to the customer, but I was shocked to be called to an identical set the next day suffering from a badly burned yoke plug and socket. I replaced it with another octal assembly, but the set remained dead.

With visions of a repeat of the above story, I took the set back to the workshop. Fortunately, it was rather simple this time; an open circuit comparator transistor, Q42 (2N6517) in the regulator section.

Now I can't make up my mind whether to refuse any more Pye T30s, or to capitalise on my now profound knowledge of the chassis.

But there is a postscript to the story and one with something of a sting in it. After the owner of the rogue T30 collected his set it worked perfectly – for three weeks! Then he rang to say that it had failed again and he was going to junk it. He had bought it second hand anyway, and felt that he had had his money's worth. He asked me if I wanted it for parts.

The set eventually landed back in my workshop and I gave it a quick once over. Sure enough, the line output transistor was short circuit. As I was fairly busy at the time I put it aside, intending to investigate further when time permitted.

In the meantime, I related the story to a colleague who teaches colour TV at the Hobart Technical College. His reaction was immediate – could he have the set as a teaching aid? He can simulate faults for his students, but a real live one, with a long documented history, would be of much more value to them. So the set found itself revealed to a small crowd of interested students.

I don't know the details of their actions, but the result was that R624, a 2.2Ω 10%, ½W resistor in series with D603 across the line driver transformer (T1, feeding the base of the line output transistor) was found to be open circuit. I had checked these components and the line drive waveform on several occasions, and found nothing wrong. Presumably, the resistor had been intermittent and had finally failed completely.

And that is the story as JL tells it. It must surely set some kind of record for the number of faults occurring in the one set at the one time; many of them while it was actually being serviced. It must also set some kind of record in ultimate frustration – having expended all that effort, JL had to suffer the disappointment of seeing the owner discard it after only three weeks. But, as I said before, "You can't win 'em all".

From my own bench

Here is a short story, with a happier ending, from my own bench. On a number of occasions, I have related how TV sets intercepted on their way to the tip often turn out to be suffering from quite trivial faults. This is a similar such story, although a TV set was not involved.

In this case, a family friend turned up on the doorstep one Sunday afternoon with a large cardboard box under his arm. "Here," he said, handing me the box, "I was going to chuck these on the tip, but I thought you might be able to use them, at least for the bits. If you can get any of them going, you're welcome to them."

"These" turned out to be one small portable radio, one somewhat larger portable radio, and one electronic flash unit. "You might do something with the small set," said my friend. "I dropped it and broke the ferrite rod. I think it goes, but not very well. The big set isn't so good, its had its teeth kicked in. And the flash just doesn't work."

He was right about the big set; it had had its "teeth" (more correctly, its dial) kicked in, the result, I understand, of someone leaving it sitting on the floor. Like him, I didn't hold out much hope of repairing it economically. And the flash was an unknown quantity.

But I was intrigued by the small set, a National Panasonic Model R-225J dual-wave measuring about 15 × 10.5 × 4.5cm. It was about 12 years old, according to my friend, having been purchased in Singapore, along with the flash unit, during an overseas trip.

Since my friend has some knowledge of things electronic, I asked him why, if the only fault was a broken ferrite rod, he had not attempted to fix it, even by gluing it together. He shrugged. "I thought about it," he admitted, "but it was easier to go out and buy a new one at the time. I meant to have a go at it later, but never got round to it."

Corroded battery terminals

Later, on the bench, I took a closer look at it. It was a beautiful little set, and I was determined it wasn't going to finish up on the tip if I could help it; the more so since Mrs Serviceman had taken a liking to it as soon as she saw it.

I unclipped the plastic cover on the back to reveal the battery compartment. There were no batteries in it, but I could see where they'd been — a not uncommon situation when sets are put aside like this. Fortunately, the corrosion looked worse than it was, being mainly on the negative battery contacts, and I was able to scrape it away without too much effort.

However, it had attacked the plating in some places and I subsequently corrected this by tinning the contacts with the soldering iron. But right now I was anxious to get power into the set and see what kind of response, if any, I could get from it. I didn't have the appropriate batteries on hand (four "AA" cells, to give 6V) but planned to drive it from a power supply.

Unfortunately, it was impossible to be sure which were the positive and negative contacts. Rather than risk doing the wrong thing, I decided to play safe and lift the whole board clear of the cabinet and identify the appropriate leads. Removing the cabinet back confirmed that the ferrite rod had snapped, quite cleanly, almost exactly in the centre. The shortwave coil was on one part, the broadcast coil on the other.

Next I removed the necessary screws and lifted the board clear of the cabinet front, but still attached to it by various leads to auxilliary sockets on the side. I identified the battery contacts, clipped the power supply leads to them, and switched on.

The speaker crackled encouragingly as I advanced the volume control, and made more noises as I moved the tuning dial. Then, suddenly, I was listening to a series of time pips. It turned out that I was switched to the shortwave band and I was listening to VNG Melbourne on 7.5MHz. And this with the set in pieces and a broken ferrite rod for an aerial!

Well, I thought, there can't be much wrong with it if it performs like that. I found the wave-change switch and crossed to the broadcast band. A quick run across the dial brought in a succession of local stations, all loud and clear. As far as I could tell there was little, if anything wrong with the set at all.

My only reservation was that the sensitivity seemed to be a little down on the broadcast band, but I blamed that on the broken ferrite rod. The next question was, what to do about the rod?

While the most elegant solution would have been to fit a new rod, I wasn't too keen on the idea. Both aerial coils were firmly cemented to the existing rod, and it might be a tricky job to get them off intact. Why not just glue the two pieces together and see what happened?

Accordingly, I applied epoxy adhesive to the broken faces, and forced the two pieces together as hard as I could. The surplus adhesive oozed out and formed a ring around the break. By turning it slowly as the adhesive set, I finished with a neat, strong, patch.

I fitted the board back into the cabinet front and tried the set again. It performed much as before, except that I still felt that the broadcast performance was down for a set of this quality. Then, suddenly, tuning around the high frequency end of the band I encountered strong Morse code signals: not CW thumps as from an amateur station, but clear ICW tones.

That shook me for a few minutes. Where was it coming from, and how the heck was it getting into the broadcast band? The most likely source was the international marine band on 500kHz and the only way it could turn up where it had was if the aerial tuned circuit was not functioning.

If you have a factual and interesting story to tell about electronic servicing, write it in your own words and sent it to "The Serviceman", c/- "Electronics Australia", Box 163, Chippendale 2008. If the Serviceman uses it in his column, we will pay an appropriate fee.

Was the gluing trick a failure, or had the coil been damaged when the rod broke? I went over the coil, looking for any damage to the winding, but could find nothing. Then my eyes strayed beyond the winding towards the tuning capacitor, following the red lead from the coil.

And there was the answer. The lead went nowhere. It was being held in its normal position by several other wires around it, but was broken away from its intended tag on the tuning capacitor.

Little wonder that the set was picking up Morse code, or that the sensitivity was down. With no preselection, the set would be wide open to the second spot of 500kHz. This would be twice the IF (455kHz) away, or 910kHz above 500kHz at 1410kHz, not far from 2WN Wollongong, which I had been seeking at the time as a subjective sensitivity test.

With the connection restored the set really came to life and turned out to be a first class performer.

The aerial

That left only one thing to be fixed. The set was fitted with a telescopic aerial to supplement the ferrite rod, particularly on shortwave. At some stage of its life the small knob on the last section had been lost and, subsequently, someone had pushed all the sections hard down. As a result, it was impossible to grip anything to withdraw the aerial.

At first I thought I could grasp the next section with the pliers, but there was too little protruding, and it was too rounded. Then I hit on the idea of trying to solder a piece of tinned copper wire to the end of the last section, which was only about 16g itself.

The result was partially successful; the solder took to second section as well as the first and I was able to withdraw all the aerial except the last thin section.

I was half inclined to leave it at that, since the extra 45mm or so would have had little effect on results. On the other hand, I didn't like it beating me. So I tried the soldering trick again and, after about the third try, the solder held long enough for me to withdraw about 10mm before the joint failed.

That was enough, of course, and it only remained to find something to replace the missing knob, and prevent the same thing happening again. I finally settled for a 12mm length of surplus pot shaft, drilled longitudinally for about half its length to fit the aerial section, and secured by soldering.

And that finished the job. The end result was so good that I felt rather guilty about keeping the set since there had been so little wrong with it. In fact I rang my friend, told him the story, and asked him if he wanted it back. But he wouldn't hear of it; he was quite happy with the one he had and, as he put it, could only listen to one at a time.

So Mrs Serviceman is one portable to the good.

Bill Edge's ELECTRONIC AGENCIES

THE LATEST & GREATEST KITS FROM THE KIT SPECIALISTS!

NEW 50MHz Counter

This great new EA design uses the latest LSI technology and brings you a level of performance normally found only in instruments costing many times the price. These include:

- Bright seven digit readout.
- Expansion to 500MHz as an option.
- Period measurement with switchable gating times.
- High quality instrument case.
- High sensitivity (10mV at 30MHz).
- Quartz crystal timebase.
- Cat KE1810

$119

Conversion kit (to convert to 500MHz operation) Cat KE1815 $25.00

SANDGLASS

Update that old egg timer with this deluxe solid state unit. Designed by EA, this novel timer has a solid state display in the shape of the traditional sandglass. The electronic 'Sand' falls from top to bottom until the preset interval is reached. A real conversation piece that's practical as well. Cat KE1027 $26.50

NEW PROGRAMMABLE TIMER Cat KE1125

Features:

- Period timing in preset intervals
- 10 intervals maximum with LED countdown
- Switched 240V and audio warning outputs

$44.50

ETI 5000 SERIES

ETI5000 preamp

One of the finest preamplifiers available at any price. The 5000 has moving coil and moving magnet inputs, monitor amplifiers, muting and peak and average metering. Cat. KE5000 Complete kit $245

ETI5000 Power amp

The use of ultra fast power MOSFETs and high slew rate design means this amplifier not only has the very finest conventional specs (THD less than 0.001%) but also has incredible transient power and a complete absence of transient distortion. This amplifier can probably do more to improve your hi-fi than any other.

KE5050 kit includes special anodized folded case and precision brush front panel. $295

Bridging Adaptor

Convert your ETI5000 power amp into a 300 Watt mono amplifier. This bridging adaptor has been designed so as to maintain the superlative performance of the 5000, while allowing the amp to deliver 300W into 8 ohm loads. (Note: the bridging adaptor will also work with the ETI477 modules.

Includes PCB and components Cat KE4350 $9.95

150 Watt MOSFET PA Module

This great new ETI design (March 1982) uses the latest Power Mosfets (four of them for ruggedness). The use of these devices makes the module almost destruction proof. It will deliver 150 watts continuous into 4 ohms all night without giving up. Sensitivity is 1V in for full output. For P.A., Guitar amp and Disco applications, this is the module!!

Kit includes heatsink, power supply and transformer (no box) Cat KE3040 $99.00

NEW Simple Metronome

This EA design is very easy to get going and comes complete with Zippy box. Inbuilt speaker and flashing LED keep time. There are two controls, for speed and volume. Cat KE1065

$17.50

NEW THE CONCORD II – Apple power – near half price!

Case and power supply not included. Please phone for details of price and availability

Now you can use the vast range of software designed for the Apple computer – without buying an Apple! The Concord II, exclusive to Electronic Agencies, is fully compatible with Apple software and hardware. And by building your own power supply and case, you save a fortune over the price of an equivalent computer. Look at these features:

- 48K RAM
- Applesoft-compatible BASIC
- Inbuilt numeric keypad
- Fully built and tested motherboard and keyboard assembly

$899

EPROM PROGRAMMER

$65.00

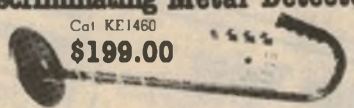
This great new EA design is completely freestanding, i.e. it requires no micro to work with it. The unit includes its own hex keypad and transformer.

Cat KE1880

Discriminating Metal Detector

Cat KE1460

$199.00



This extremely powerful ETI design incorporates features normally found only one detectors costing around $600. Important features include:

- 4 mode operation for maximum sensitivity under all conditions.
- Ground balance circuit nulls out varying ground characteristics.
- Precision pre-wound search coil gives incredible depth penetration.
- Discrimination feature allows you to sort out junk from treasure before you dig it up.

NEW ETI660 COMPUTER

With the ETI660, computers break the $100 barrier. Now you can build a truly expandable Micro (with Colour option) at an incredibly low price.

Basic kit does not include keyboard.

Cat KE6600 Kit inc. PCB, ICs, sockets	$99.00
Cat KE6602 Colour Option	$13.50
Cat KE6603 Video modulator in Diecast box	$14.50
Cat ME7712 Plugpack to suit 8VAC/1A	$11.95
Cat ZE6114 Set of 4 2114 RAMs (3K upgrade)	$17.00
Cat KE6601 18 keys plus Scotchcal labels	$32.00
Cat BE7100 'COSMAC Users Guide'	$5.00

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Electronic Agencies now has a store in the heart of the retail electronic centre of Sydney – York Street. Now city customers have a choice! Call in and meet Bill at 123 York Street between 9am and 5:30pm weekdays, or until 9pm on Thursday night, and 9am to noon Saturday. Our phone number is 29 2098

INCLUDED FREE WITH EVERY KIT!

Now every kit we sell includes a free copy of Bill Edge's Kit Constructor's Reference Manual – our exclusive guide for beginning and experienced kit builders. Everything you need to know from component identification to soldering. Also available separately for 50¢

Prices correct and goods expected in stock at time of going to press.

Bill Edge's ELECTRONIC AGENCIES

AUDIO

ETI 467 Mixer Preamp

This superb mixer combines up to 4 inputs, with individual level controls. 3 band tone controls are included. Comes without case so you can build it in. Needs transformer (ME2839 $10.95) or other source of 2x15VAC. ETI July 1980.
Cat. KE1400

Playmaster MOSFET Stereo Amplifier

The use of power Mosfets has given the new Playmaster superlative performance. And with the Electronic Agencies kit you get full 50W per channel and 75dB S/N. We use the correct Ferguson Transformer. Don't buy cheap imitations!!

Cat. KE4180
$169.00

Preamp/Control Unit

This high performance unit is the heart of the ETI 4000 stereo amplifier. All parts mount on one PC board and the finished unit fits in a standard rack o rack mounting case. Suits all power amp modules. See ETI June 1979 for details.
$47.90
Cat. KE1975

ETI480 Series amplifier modules

100W power amp module

This extremely rugged module delivers 100 watts RMS into 4 ohms. Parallel transistors ensure reliability. Works with the KE3050 power supply below and ME2004 transformer ($15.40)

$25.00
KE3070

50W Module

Same as the 100W but gives 50 watts into 8 ohms and has only half the number of output transistors.
KE3060 $19.50

Identical in appearance to the 100W module, but without the two outboard power transistors.

Power Supply

Suits the above modules either 1 100W or 2 50W modules. Transformer not included.
KE3050 $19.50
ME2004 Transformer to suit $15.40

EA FUZZBOX

This EA design (February 1981) gives a adjustable fuzz sound to your guitar. Adv CMOS switching means there are no an clicks and thumps as the unit is switched out. The rugged diecast box and foots make the unit ideal for stage use.
KE1080
$19.50

ETI445 pre

This versatile little stereo pr arranged to suit most applic as a phono preamp, a tape microphone preamp by jus component values. PC Bo Runs on 10-40V d.c. See Cat. KE2080

Sound

Add tremelo effect other fascinating music. Sound Ber microphones, ele
KE1015

LED

This ETI des you need i 60dB rang Operates PCB and
KE1900

300 Watt Module

This fantastically rugged EA designed module offers the ideal low cost solution for those building a PA system or wanting a really powerful home sound system.

KE6010 Module kit $85.00
KE6020 Power supply and transformer $56.95
KE6030 Speaker protector kit $12.95
KE9250 Thermal cutout $8.95
KE9010 75mm fan $29.95
HE1477 Rack case $39.95

ETI 488 LED level meter

This design is used in the ETI 5000 preamp and gives both a peak and an average display. Suits any preamp. Two needed for stereo. See ETI June 1981.
Cat KE4500
$27.50

HOUSEHOLD KITS

EA Infra-red remote contol

This kit consists of an infrared transmitter and a specially selective receiver. The units can be used as either beam which triggers if broken (for wildlife photgraphy or alarm use) or as a conventional transmi/receive arrangement, where the transmitter triggers the receiver when it gets within range. Uses include target games.
See E.A. March 1981
$39.50
Cat KE1550

ETI Remote Control

This ETI design (April 1981) will control mains operated equipment over distances up to 10 metres. Internal relays in the receiver will switch up to 5 Amps. The transmitter is in a small Zippy box and is operated with a pushbutton.
Cat. KE4120

$69.00

Ion Generator

This ion generator includes all hardware and power supply. This kit is complete in every way. It includes the case and test PCB.
Cat. KE1600

$39.00

'Le Gong' doorbell

The ultimate in electronic doorbells. LSI generates complex chimes. Kit does not include pushbutton (SE0300 $2.50)
Cat KE1120

$15.00

Microwave leak detector

This simple and easy to build detector gives you an instant check on the safety of your Microwave.It needs no power and uses a meter to give unambiguous indication.ETI724
Cat. KE1100

$14.95

Flash Kit

This flash trigger works on either sound or light sources to let you produce those really incredible action shots. The flash trigger lets you freeze motion on water splashes, eggs breaking, and a thousand other types of special effect shots. Controls let you vary time delay and sensitivity.
See ETI October 1980.
Cat. KE1070

$26.95

JUST FOR FUN

Lotto/Pools Selector

Simply select Lotto or Pools, press the button and the unit does the rest.
See EA July 1981.
$25.00
Cat. KE1025

PC Birdies

With this great little unit, you can create your own bird noises at the push of a button. And the only food it needs is an occasional battery. See EA May 1981.
$14.95
Cat. KE1050

Steam train and whistle

This is the ultimate sound effect device the model train enthusiast. Uses latest technology.
Cat KE1060

Cylon Voice

With this fantastic ring modulator design you can simulate the famous 'Dalek' sound. Make people really take notice!!
Cat KE1110
$18.95

Selectalott

This is the easy way to select your Lotto scores and learn about digital ICs. 4o LEDs show the score.
See EA December 1980.
$22.95
Cat. KE1000

Electronic Organ

This is no ordinary touch organ. The advanced EA (July 1971) design uses the latest CA3080 ICs to provide voltage controlled oscillators and amolifiers (justy like in expensive synthesizers). You get a huge range of effects over two octaves. Built-in amplifier, speaker, temelo and percussion.
Cat. KE3000
$69.00

Sound Ef

Learn about the latest chip from Texas Instru ETI design allows you range of sounds. Gre unfriendly neighbou
KE0200 Bomb and
KE0210 Steam trai
KE0220 Phaser an
KE0230 Phaser an
KE0240 Gun sho
SN76488 Synthe

SPEAKER KITS

Peerless PAS100 3-way 100 litre

This system is the flagship of the Peerless range. A superb 3-way system, its 100 watt power handling capacity and high sensitivity mean superb results. 30cm base driver, dome midrange and tweeter give ultra smooth and dynamic sound. $379.00
Cat. CE2422 (all drivers and crossovers for a pair) $229.00
Enclosures (pair – fully built) Cat. CE2465

Peerless PAS60 3-way 60 litre

For those who don't need the high acoustic levels of the PAS100, this sytem offers a superb alternative. The three way system uses a 25cm bass driver, 75mm midrange and 25mm soft dome tweeter to provide accurate, wide ranging sound. Power handling is 60 watts continuous program. See EA July 1981 for details. $225.00
Cat. CE2424 (all drivers and crossovers for a pair

Peerless PAS25 2-way 25 litre

The PAS25 offers fantastic performance for its size. Although only 25 litres, its special bass driver gives terrific bass response. The soft dome tweeter gives extended treble to the limits of audibility. $179
Cat. CE2426 (includes all speakers and crossovers for a pair)

ETI4000/1 4-way

The kit speaker to beat all. Based on Philips drivers, this is a no compromise design that would satisfy the most fastidious audiophile and gives commercial speakers costing up to double the price a real run for their money. Power handling 100 watts continuous. On demonstration in our stores – come in and have a listen. $499.00
Cat. CE2430 Includes all drivers and crossovers for a pair $250.00
Cabinets, fully built pair Cat. CE2470

ETI4000/2 3 way

Based on three of the same drivers of the 4000/1, and similar design principles, this system offers audiophile sound at an affordable price. $386.00
Cat. CE2440 Drivers and crossovers pair $210.00
Cabinets. Fully built pair Cat. CE2480

Mosfet Module ETI477

This is the superb module which forms the heart of the fantastic ETI5000 power amp. Power output with the transformer specified below is 150W RMS. Frequency response is a super flat 8Hz to 20kHz. S/N is 116dB and distortion is below 0.001%. This, plus the incredible transient response of the power FETs means superlative sound. See ETI February 1981 for full details.
KE4300 Module only $59.90
KE5030 Power Supply (no transformer) $49.00
ME2361 Transformer (one per module) $$35.00

ETI466 300W amp module

The use of four ultra rugged output devices and fully complementary design makes this ETI design exceptionally reliable, whilst delivering very low distortion sounds. Output is 300W RMS into 4 ohms and 200W RMS into 8 ohms. Construction is easy, thanks to the predrilled on-board heatsink bracket. All you need is an ME2063 transformer ($36.50) and heatsink (HE2433 is excellent $29.50), and the ETI466 can be built into a case (HE1477 is suitable $39.95).
KE3090 Complete module $69.50

AUTOMOTIVE KITS

With this great lineup of automotive kits, you can have the latest electronic technology in your car. Because you build it yourself, you only pay a fraction of the price of equivalent builtup equipment. And all our kits are built to the highest standards, complete to the last nut and bolt.

Deluxe car alarm

This great new ETI design (ETI330 July 1981) works on the voltage drop system, but incorporates a number of refinements to ensure absolute reliability. LED displays indicate whether the unit is armed, whether it has been triggered and best of all, you don't need to remember to turn the unit on, its automatic!! The unit is very easy to build and install and comes complete with its own tough diecast box. All the features of those $300 alarms at a fraction of the price.
Cat. KE1725
$29.50

Car Alarm

This easy to build 'voltage drop' design incorporates a dash mounted flashing light and a heavy duty relay to sound the car's horn. All you need is a concealed external switch or a key switch. Cat. KE1700 $12.50

Digital Engine Analyser

With this great EA design (October 1980), you can keep your car in better tune than any Service Station could. Digital readout of engine RPM, dwell angle and battery voltage for any 4 six or eight cylinder car is possible. The digital readings are precise and flicker free. Precise tuning means you save on fuel and maintenance costs. And have the satisfaction of doing it yourself.
Cat. KE1775 $53.50

Transistor Assisted Ignition

Are you tired of replacing worn points? Do you want a little more performance from your car? THen build this great EA design Transistor Assisted Ignition. The TAI has much higher reliability than the older CDI electronic ignitions whilst having all of their benefits. Your car will run much better, especially at high revs and will stay in tune much longer. The Electronic Agencies kit is better to , with a diecast case and parts exactly as specified by the magazine.
CVat KE1825
$35.00

LED Voltmeter

This great ETI design uses a row of LEDs and advanced IC circuitry to give unambiguous reading of battery voltage. Because the LEDs only cover a small range of battery voltage, you get a much better and more precise indication of battery condition.
Cat. KE1650 $12.99

Speed Sentry

Build this great device and stop worrying about speeding tickets. The speed sentry connects to your ignition system and functions as both a rev limiter/alarm and a speed warning. Construction is very easy, being all on one PC board.
Cat. KE1090 $12.00

Breakerless Ignition

Are you tired of replacing worn out breaker points? If you have a transistor assisted or CDI ignition, the addition of EA (June 1981) breakerless ignition will end this problem. The kit includes all parts as per the EA article, but does not include the chopper disc.
Cat. KE1850 $15.00

STOP PRESS STOP PRESS

LATE ADDITIONS

KE0193	EA11/81 Traffic Buzzer	$7.50
KE0195	EA12/81 Flashing LEDs	$15.50
KE1010	EA11/81 Photon Torpedo	$26.50
KE1085	HE121 Scratch Hiss Filter	$9.95
KE4080	EA2/82 Dual tracking P/S	$89.50
KE1630	EA10/81 Windspeed meter	$44.50
KE1631	EA1/82 Wind direction indicator	$25.00
KE1950	ETI581 Dual 15V Power supply	$9.50
KE2075	ETI455 Loudspeaker protector	$26.00
KE1450	ETI449A metal detector	$35.00

STOP PRESS

Low Fuel Indicator

This great new EA kit measures the voltage across your tank sender and gives you an audable indication of the state of your fuel tank. Just like those expensive European cars!! The kit is easy to build and includes the PCB, parts and buzzer. Build one this weekends and don't get stuck on the holidays!!
Cat. KE1095 $15.00

LIGHTING EFFECTS

Musicolor III

This great sound to light convertor is easy to build, with its one board construction. The built in compressor circuitry gives great effects at any sound level, whether you're working it from a big amp or a transistor radio. And you can connect up several hundred watts of lights to each channel. The kit has a fully punched metalwork and deluxe front panel.
Cat KE1500 $59.50

EA Light Chaser

Now you can build a unit which will give you those dazzling light shows. This EA design (August 1980) is three channel and has controls to vary rate, direction and mode.
Cat KE1525 $65.00

Musicolor IV

This is the ultimate lighting controller.
- Light chaser with four different chaser patterns.
- Auto and manual reverse chase.
- Sound triggered chase.
- Inbuilt electret microphone.
- Brand new design four channel Musicolor sound to light convertor.

Cat KE3025 $89.90

BEGINNERS KITS

The following are a selection of educational beginner's kits from ETI's 'Project Electronics' (DE5000 $4.75). All the kits include parts and PC board only. The kits are easy to build and get going and form an ideal base for the beginner.

Buzz Board

This great little kit is easy to build and provides a great skill game when you've finished it.
$4.90
Cat KE0110

Siren

Learn about the 555 timer IC and build this useful siren. Its great for a car or home burglar alarm, especially with a horn speaker like our CE2705. ETI project ETI065.
Cat KE0150 **$5.90**

Basic Amp

This great little amp is fun to build and has heaps of uses. It will amplify the signal from your crystal set and power a small loudspeaker or headphones.
Cat KE0120 $5.90

LED Dice

Learn about CMOS digital circuitry and build this mini chaser which also doubles as the electronic answer to the dice.
Cat KE0180 **$5.90**

RF & AMATEUR KITS

FM Wireless microphone

Hobby Electronics kit. Lets you transmit to any FM radio. Project HE106.
KE1150 $7.50

Wideband Receiver

This incredible little receiver covers the complete Broadcast and Shortwave bands in 4 plug in ranges. See EA November 1980.
Cat KE4110 $75.00

Masthead Amplifier

If your in a fringe area , or running several TV's off the same antenna, this masthead amp is the solution. The amplifier mounts at the masthead in its own weatherproof diecast box. The power supply sits behind your TV set. Simple to build and really high performance, thanks to the use of Philips OM350. See EA August 1979.
Cat KE1625 $35.00

TEST EQUIPMENT KITS

pH Meter

This ETI design (December 1980) allows really precise measurement of pH at very low cost compared to professional units. The display is a 3.5 digit LCD panel giving excellent readouts under ambient light conditions. The kit comes complete with a calibrated pH probe and buffer solutions. Now you can check your lab solutions, swimming pool etc. with a precision instrument you have built yourself.
Cat KE4050 $109.50

Dual Trace Switch

With this great design you can get the benefits of a dual trace CRO without having to buy one. The kit is easy to build and provides all the necessary switching and attenuators (including sync switching AC and DC coupling) to give you all the facilities of a dual beam CRO. Operates form a pluggack power supply (included). See EA February 1981.
Cat KE1420 $65.00

pH Electrode

This is the electrode as used in the ETI572 pH meter. It comes complete with two buffer solutions, high quality cables and BNC connector.
Cat QE5602 $45.00

Capacitance Meter

Build this incredible EA design (September 1980) and you can measure form 1pF to 30,000uF in three ranges with four digit accuracy. The kit uses advanced CMOS cicuitry and comes complete with metal case and front panel.
Cat KE4070 $59.90

LCD

This brand new EA design (EA March 1982) features battery operation and LCD display for low power consumption.
Cat KE4075 **$59.90**

Benchmate

This great little unit will soon make itself indispensible on your work bench. It incorporates the following features:
- 1W audio amplifier with 1mV and 70mV sensitivity inputs.
- Variable regulated power supply capable of delivering 1.25 to 16V DC at currents up to 1 amp.

Cat KE1875 $45.00

TV CRO Adaptor

With this EA design (May 1980) you can convert your TV into an oscilloscope for audio and demonstration use. Controls for gain, focus and sync are all on the unit. Our kit includes the plug pack power supply.
Cat KE1410 $39.90 **$39.90**

3.5 digit LCD Panel Meter

This Intersil package provides you with a very precise 3.5 digit LCD voltmeter with a basic full scale sensitivity of 200mV. With the addition of extra resistors you can make a wide range voltmeter.
Cat KE4010 $42.50

Low Ohms Meter

Now you can accurately measure very low resistances that muimeters can't cope with. Especially good for checking cable resistance, low value resistor etc.
Cat KE1877 ETI158 **$45.00**

Low Distortion Audio Oscillator

If you need an audio oscillator with really low distortion (0.003%) this is the one to build. Designed by EA (June 1981), this design uses fully complementary design to give really low distortion over a wide frequency range.
Cat KE4090 **$68.00**

Sound level meter

The completely self contained EA design (May 1981) gives accurate measurements of hi-fi, PA and other sound equipment. The microphone capsule will cope with up to 120dBA, yet works down to 30dBA. An 'A' weighting scale is built in to allow for standard tests of noise pollution, sound breakthrough etc.
Cat KE4100 **$39.50**

EA Graphic Analyser

This superb piece of test equipment allows you to graphically view the performance of your sound system and room acoustics. The frequency spectrum is displayed as a sequence of coloured bars on your TV screen. The kit is complete and even includes a pink noise source.
Cat KE4150 $119.00

Bill Edge's

ELECTRONIC AGENCIES

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A word about Electronic Agencies' kits

We at Electronic Agencies aim to give you the best, most complete kits available. We don't substitute parts unless it's absolutely necessary, and we always get the approval of the kit designer before making any substitution. All components in kits are guaranteed new and carry a full three months warranty from us.

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Instructions

At a minimum, all kits include a copy of the original magazine article. As we try and build our kits ourselves, these are often augmented by our own notes on construction.

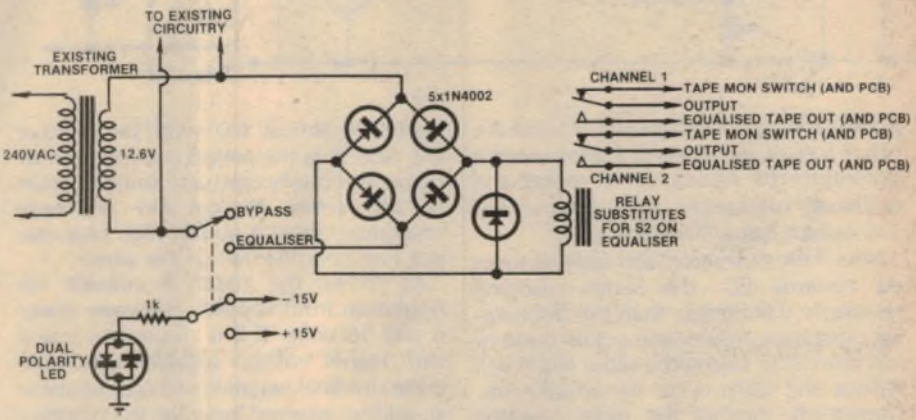
All kits include a copy of Bill Edge's Kit Constructors' Reference Manual – our exclusive – which has detailed information for the beginning kit builder and useful reference material for the more experienced.

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.

Suppressing Audio Switching Transients

Many ancillary items of hifi audio equipment produce unwanted audible transients at switch on and/or off. As most of these devices are intended for insertion into the "tape monitor" circuitry of their associated audio amplifier systems, a switched OPERATE/BYPASS function is usually featured in these units for in/out comparison of sound quality. Substitution of a DPDT relay (and interfacing components) for the hard-wired switching circuitry enables suppression of the aforementioned audible transients.



For example, the Playmaster Graphic Equaliser (EA May, 1979) produces a slight "chirp" at its output when it is switched off. This chirp can be muted by installing a supplementary bridge rectifier and 12 volt DC relay to perform the audio switching (as shown in the accompanying diagram). One pole of the BYPASS/EQUALISE switch is utilised to interrupt the supply to the rectifier and thus control the relay operation. If desired, the spare pole of this 2-pole switch could be utilised to change polarity to a bi-colour dual polarity LED, and so give visual indication of the equaliser's operational mode.

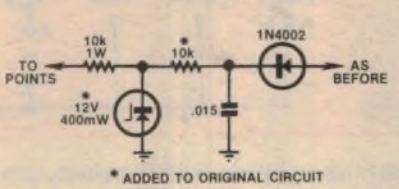
The changeover contacts are so wired that the equaliser is only in circuit when the relay is energised. Thus, at "switch off", power is removed from the relay and the contacts change the circuit to the BYPASS mode so that the chirp is not heard.

R. Raymond,
Como, WA.

Cure for Fluctuating Dwell and Tacho Readings

When used on some motor vehicles, the EA Digital Engine Analyser (October, 1980) may produce slightly varying readouts (of the order of 1 to 3%). This can be due to an above average voltage "spike" being generated across the points of that vehicle's ignition system. This problem can be simply cured by adding a "voltage clipping section" ahead of the low pass filter at the input of the instrument.

Only two additional components are required: a 10kΩ resistor, and a 12 volt zener diode. Lift the end of the original 10kΩ 1 watt series input resistor from its connection with the 0.015μF capacitor and 1N4002 diode. Insert the new 10kΩ resistor between the unattached end of the original resistor and the capacitor/diode junction. The neatest modification is to stand both resistors vertically to the printed circuit board, and "arch" their junction.



Now connect the cathode of the zener diode to the junction of the two resistors. Drill a small hole in the PCB near the "earthy" end of the 0.015μF capacitor, pass the anode lead of the zener through this hole and solder to the "earth" track.

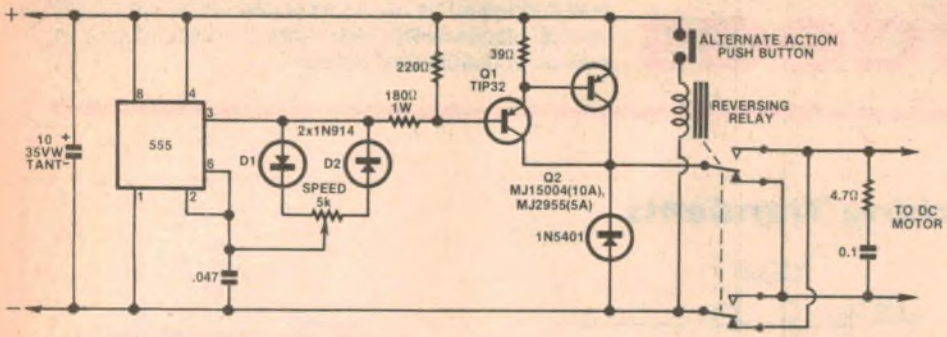
G. W. Ford,
Horsham, Vic.

Switch-Mode Control of Low Voltage DC Motors

Whilst this power control circuit was developed for use with radio-controlled model boats, it may also be used in other low-voltage DC load applications. As shown, the design is suitable for 7 amp continuous loads; and up to 10 amps intermittent. If 5 amps (or less) maximum output is required, an economical MJ2955 may be substituted for the MJ15004(Q2). In contrast with the characteristics of the usual power rheostats (used in model boats), speed control of a motor is very smooth with reliable running at very low rpm. Such performance is due to the unit's low source impedance at the "simulated" low voltage outputs.

Basis of the design is to vary the duty cycle of a 555 timer which is connected in the astable mode. The pulsed output of the 555 drives a Darlington pair of PNP transistors, which feed the load. For model boat applications, a relay with heavy duty changeover contacts is interposed between the output and the motor to permit simple remote reversing control. The reverse connected 1N5401 diode protects the output transistors from possible voltage "spikes" produced by an inductive load.

A novel method has been chosen for varying the duty cycle of the free running 555 timer circuit, with the complementary-symmetry output of the 555 being used as the source for both charging and discharging the timing capacitor. The charging circuit is via D1 and half the resistance of the potentiometer (assuming the potentiometer is set to its mid-



point); and the discharge via D2 and the other half of the potentiometer. At this potentiometer setting, series charge and discharge resistances are equal, so the 555 output has a 50% duty cycle.

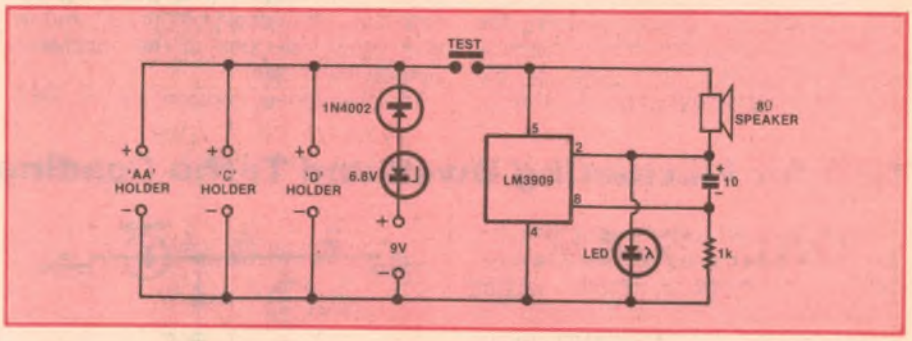
Now if the potentiometer slider is moved towards D1, the series charging resistance will be less than the discharging resistance, resulting in a duty cycle of less than 50%. Taking the slider to D1 will reduce the duty cycle to virtually 0%. Conversely moving the slider towards D2 increases the duty cycle, with it becoming almost 100% with the slider at D2. Note that the period of oscillation remains essentially constant, since the sum of the series charge and discharge resistances (hence output high plus output low periods) remain the same.

As shown the circuit is suitable for operation from supplies between about 6 and 16 volts. If it is desired to use it with higher voltage supplies a suitable three terminal negative voltage regulator should be inserted between the negative "return" of the 555 timer and the negative rail, such that the supply to the 555 is kept around 12 volts.

Note that for model boat applications it is possible to use a standard radio control servo unit (without the need for gearing) by modifying a wire-wound 10kΩ potentiometer. Obtain a small length of nichrome wire (eg from a jug element) and prise off the back cover of the pot. At the point where it is desired to limit the angular rotation of the pot (say 100°), twist one end of the nichrome wire around the pot winding and solder the other end of the wire to the far end connection of the pot winding. The result is a 4kΩ pot (100° = approx 40% full rotation) that rotates only 100° to match the servo's rotation. If an alternate action (push on/push off) pushbutton switch is used to control the reversing relay, it could be mounted to operate from the same servo in such a way that is triggered each time the servo returns to the "stop" position.

P. Allison,
Summer Hill, NSW.

Battery Tester for Blind Persons



Using an LM3909 "LED Flasher" IC, essentially connected in the manufacturer's suggested "Buzz Box Continuity Tester" configuration, this circuit provides audible indication of battery condition. It was designed for use by blind persons, most of whom have a keen sense of hearing in terms of pitch and amplitude of sound.

Any standard 1½ volt cell, or a rectangular 9V "transistor" battery may be tested. Note that the voltage from a 9V battery is reduced to a nominal 1½V by two series diodes (one a 6.8 volt zener) which also provide reverse-polarity protection. Battery terminal voltage and internal resistance determine the pitch and volume of the sound, such that an experienced operator can soon determine cell condition.

C. Groenhout,
Watson, ACT.

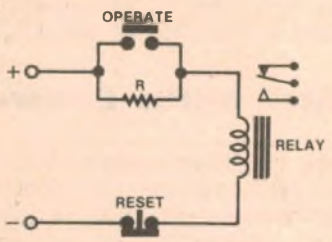
Simple Relay Latching Circuit

Unlike the standard relay latching circuit which uses a normally-open contact set to latch the relay when it is operated, this circuit makes that contact set available for other purposes since latching is obtained without the need for a contact set.

This idea is based on the fact that it usually takes at least twice the current to pull-in a relay armature from its "rest" position, than it does to hold the armature in its "operated" position.

Operation of the circuit is such that the relay armature is pulled-in by the momentary action OPERATE pushbutton in the normal way. When this button is released, a resistor (connected across the switch contacts) passes sufficient current through the relay coil to securely hold its armature in. Pressing the momentary action RESET pushbutton opens the circuit to the relay, and the armature is thus released. After the button itself is released, current once again flows through the relay coil (via the aforementioned series resistor) but is insufficient to pull-in and operate the relay.

The value of the series resistor has to be determined by trial and error (since exact value is dependent upon the electro-mechanical characteristics of the particular relay). However a good starting point is to try a resistor whose value



is about twice the DC resistance of the relay coil.

G. Sheridan,
Hunters Hill, NSW.

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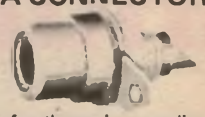

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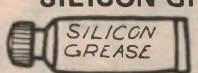

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Simple circuit tells you when to "fill 'er up"!

Low fuel warning indicator for cars

If you've ever experienced the feeling of foolishness as your car splutters to a halt, fuel gauge on empty, this project is for you. When the car's fuel reserve falls below a preset minimum level, the circuit sounds a buzzer and lights a lamp to warn the driver to "fill 'er up"!

by COLIN DAWSON

Running out of petrol is inconvenient at the very least, and dangerous at worst. The trouble is, it is all too easy to get caught, especially if one is trying to squeeze an extra few kilometres from the tank during the occasional petrol strike. This circuit is presented in an effort to banish forever the stranded, jerrycan-toting motorist – at least amongst "Electronics Australia" readers.

The circuit is all contained on a small PC board, can be easily fitted to most cars, and can be set to trigger at any fuel level. When triggered, it sounds a buzzer for five seconds and a lamp remains on to remind the driver that the tank needs filling. If the tank is not filled immediately, the buzzer and lamp will come on each time the car is started (ie each time the ignition switch is turned on).

The driver would have to be both blind and deaf, or preoccupied with the blonde in the car in front to overlook these warnings!

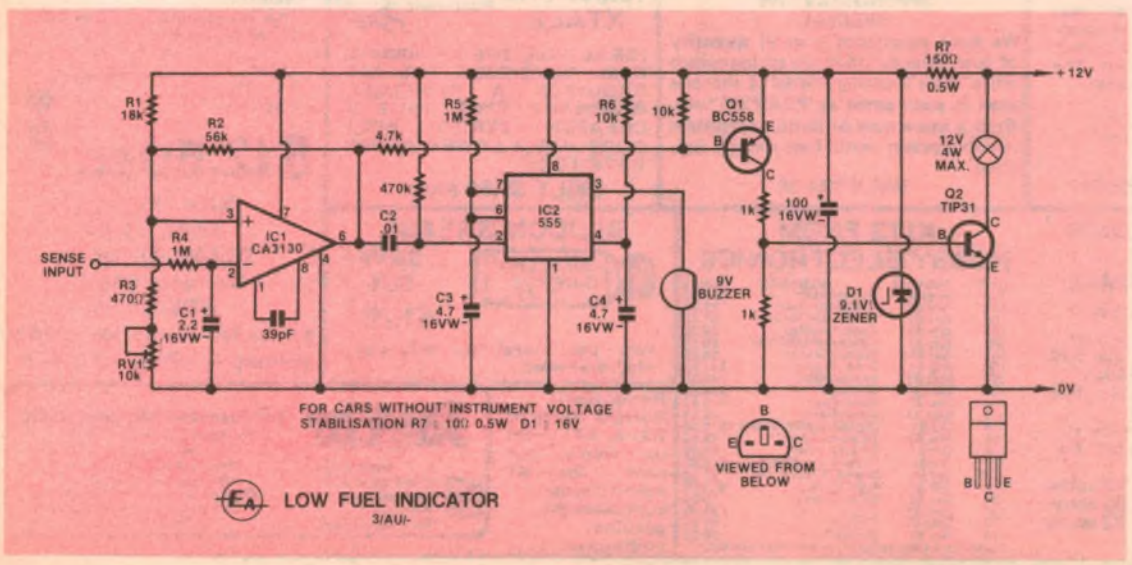
The warning circuit can be adapted for use in most cars, provided they have conventional fuel tank sensors. It should prove simple to install, requiring only connections to chassis, +12V from the ignition switch, and the fuel gauge sender unit.

Before describing the circuit, readers may find the project's background of some interest. The circuit originally suggested came from the Dick Smith Electronics technical department, who designed it for use in Dick's Bell Jet-Ranger helicopter. With the recent spate of helicopter and light aircraft accidents, perhaps such a device should be more widely used. Whilst we do not regard fuel exhaustion in a Kingswood to be as traumatic as in a Jet-Ranger, it can nevertheless prove awkward to find yourself making a "forced landing" on the Harbour Bridge during peak hour!

The helicopter low fuel warning indicator was designed to switch on a warning lamp – much the same as some late model cars do. We felt that a five-second buzzer would be a useful addition, and several other circuit modifications were incorporated to adapt the circuit to the rigours of the automotive electrical system.

While testing this project, we found that there are several different types of fuel level indicating systems used. The PC board has been designed to accommodate most systems that we know of, although a few component values will depend on the particular car. Details on finding out exactly what type of sensor is fitted to your car are given later on in the article.

Readers should note, however, that the circuit is not suitable for use with XD Ford Falcons. The XD Falcon uses a capacitance-type sensor (as used in many aircraft) in which the different dielectric values of air and fuel determine the reading. While we are not aware of any other vehicles using this system, owners of late model cars should check carefully before embarking



The circuit consists of a CA3130 comparator driving a 555 monostable timer and transistors Q1 and Q2.

on this project, otherwise you could waste your money.

Note: many late model cars are already fitted with low-fuel warning lights, although we do not know of any that also have a buzzer!

HOW IT WORKS

In most vehicles, the fuel-level sensor is a float-controlled rheostat wired in series with the dashboard-mounted fuel gauge and connected between chassis and +12V as shown in Fig. 1. When the tank is full, the float arm rises and the rheostat normally has minimum resistance, although a few circuits work in the opposite sense. The fuel gauge, which is actually a milliammeter, will respond with full-scale deflection.

As the fuel level in the tank drops, the resistance of the rheostat increases (or decreases) and the current through the circuit varies accordingly. The voltage across the rheostat thus depends on the fuel level and, by monitoring this voltage, we can detect when a certain fuel level is reached.

The voltage generated across the fuel-level sensor is first applied to low-pass filter R4-C1 so that the voltage across C1 is the average across the sensor. This low pass filter eliminates voltage transients generated by the switching voltage regulator used in some vehicles, as well as voltage fluctuations due to fuel sloshing and a bouncing sensor float.

Heart of the circuit is IC1, a CA3130 FET input op amp capable of swinging its output to either supply rail. It is used here as a comparator with either its inverting or non-inverting input used as the sense input. When the comparator detects a low fuel condition its output goes low, switching on IC2 – a 555 timer – to drive the buzzer, and transistors Q1 and Q2 to drive the lamp.

Since the circuit may have to trigger on either a rising voltage or, in some cars, a falling voltage, the sense input may be either the inverting or non-inverting inputs. As shown in the main circuit diagram, the inverting input (pin 2) is used where the voltage across the rheostat increases as the fuel level drops. This voltage is compared to a pre-set voltage on the non-inverting input (pin 3). When it exceeds this pre-set voltage, the comparator triggers and its output goes low.

Fig. 2 shows the alternative input stage used when the voltage across the rheostat decreases as the fuel level drops. As can be seen, the non-inverting input is now used as the sense input and the pre-set voltage is on the inverting input.

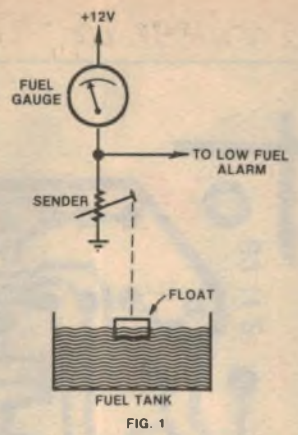


FIG. 1

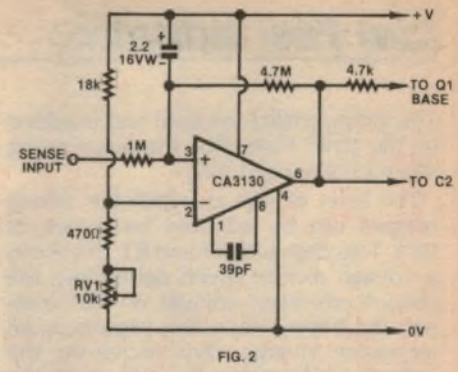
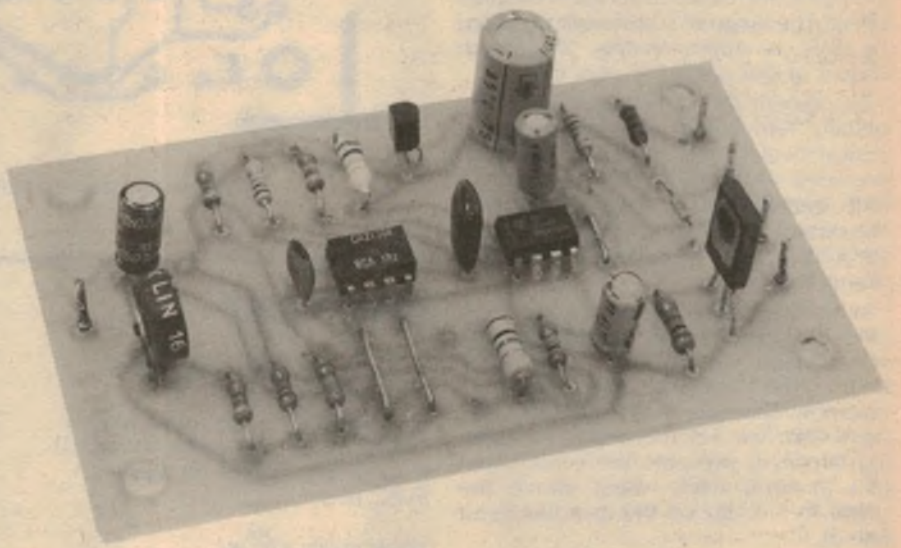


FIG. 2

Fig. 2: alternative negative triggering input stage (see text).

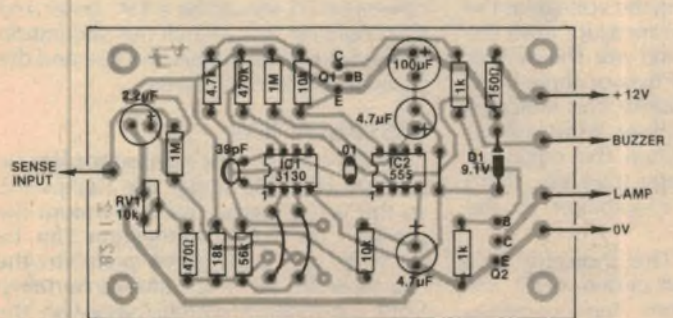


The prototype low fuel warning indicator. Note that the PC pattern for the final version differs slightly from the prototype (see below).

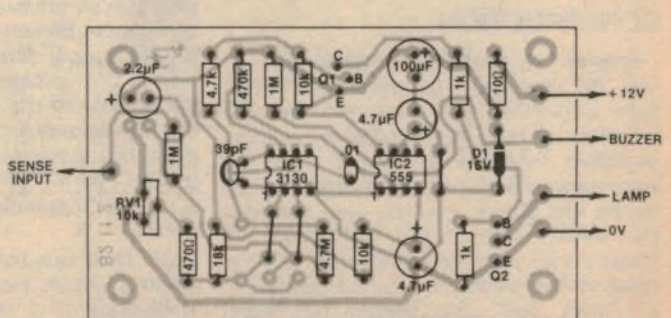
When the output of IC1 goes low, C2 provides a brief negative pulse to the trigger (pin 2) of the 555 timer. The 555 is used here as a monostable, the duration of its timing cycle determined by R5 and C3. When triggered, C3, initially discharged, begins charging towards the positive supply rail. The output of the 555 remains high for as long as pin 6 a voltage lower than 2/3 supply C3 charges via R5 and when it reaches 2/3 supply, the 555's output goes low and the timing cycle ends.

Normally the reset (pin 4) is tied high for monostable operation, but we have included a capacitor (C4) which grounds pin 4 at switch on. This prevents the possibility of false buzzer triggering when the ignition is turned on.

When the output of the comparator is low, transistor Q1 – a BC558 – is turned on. This, in turn, switches on power transistor Q2 – a TIP31 – to drive the lamp.



Component overlay – positive triggering version.



Component overlay – negative triggering version.

The lamp remains on until fuel is added to the tank. Note that the lamp rating should not exceed 4W.

The level of fuel at which the device triggers can be adjusted by means of RV1. Together with R1 and R3, this forms a voltage divider which determines the pre-set reference voltage on the comparator. If the comparator triggers on an increasing voltage, then increasing the voltage of the reference will cause the warning to trip at a higher fuel gauge reading. For a comparator which triggers on a decreasing voltage, the reference voltage is decreased to achieve the same effect. The range of adjustment provided by RV1 is approximately 2V, which should be adequate for most cars.

To prevent the comparator from continually retriggering when fuel is at a critical level, positive feedback has been provided via R2 to give the comparator a little hysteresis. This means that when the output of the comparator goes low, the voltage on pin 3 is also pulled low by about 1.5V.

In the case of the positive triggering circuit, this prevents the voltage on the sense input (pin 2) from easily falling below the reference on the non-inverting input (pin 3) and hence rearming the device. For the negative triggering circuit, it prevents the sense input (pin 3) from easily rising above the reference voltage on the inverting input (pin 2).

The circuit also includes a zener diode voiltage regulator which may be either 9.1V or 16V, depending on the particular car. Some cars have a voltage stabiliser for the instruments. If this is the case, the low fuel warning circuit would lose some accuracy if it were not also stabilised, so the 9.1V zener diode should be used. If the car does not have an instrument voltalge stabiliser, the 16V zener should be used instead.

It is important that the circuit have a zener diode to provide protection against voltage spikes which can be present on automotive electrical systems. Without protection from these spikes, the circuit may be subject to false triggering, or worse, damage to the semiconductors.

CONSTRUCTION

Before commencing construction, it will be necessary to determine what type of sender unit your car has and whether it has an instrument voltage stabiliser. To check the sender, it will be necessary to disconnect the wire running to the fuel gauge. Use this wire to short the sender side of the fuel gauge to chassis and, with the ignition turned on, observe the reading on the fuel gauge. If it shows "full", the sender has least resistance when the tank is full and the positive triggering circuit must be used. If the gauge shows "empty", the sender has least resistance when the tank is empty and will require the negative triggering circuit.

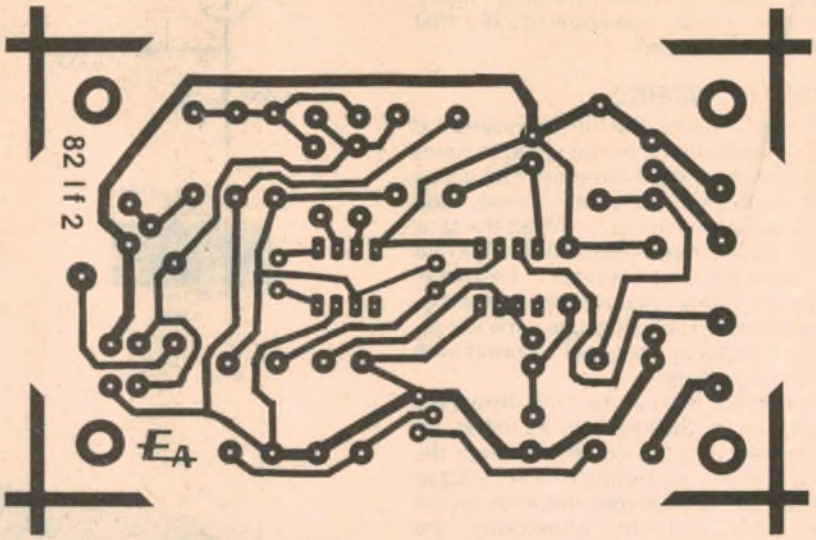
The simplest way of determining whether the car has an instrument voltage stabiliser is to consult the wiring diagram in the manual. If you don't have access to a manual, it is possible to determine whether the car has the stabiliser by measuring the voltage at the fuel gauge. Be sure to measure from the power supply side and not the sender side. If the voltage is two or three volts below that of the battery, this indicates the presence of a stabiliser. If this voltage does not increase when the engine is started and run at faster than idle, there is almost certainly a stabiliser in the circuit.

We built our Low Fuel Indicator on a printed circuit board coded 82lf2 and measuring 59 × 96mm. Begin construction by fitting the three wire links. The first link – adjacent to the 555 timer – is the same on all circuits. The other two links, however, determine whether the circuit is negative triggering or positive triggering, so make sure that you follow the relevant wiring diagram carefully.

Once the links have been installed, the remaining components may be soldered into position. If your car has an instrument voltage stabiliser, be sure to use a 9.1V zener for D1 and make R7 150Ω; otherwise D1 should be a 16V zener and R7 should be 10Ω. Watch the orientation of the zeners, transistors and ICs, and the polarity of the electrolytics.

INSTALLATION

All the connections needed for the circuit are available under the dashboard, so this is the logical place to mount the project. The earth connection can be made to any convenient point on the chassis while the +12V should be taken from the ignition switch, otherwise the warning may be tripped whenever the ignition is turned off. To determine



Above is an actual size artwork for the PC board.

PARTS LIST

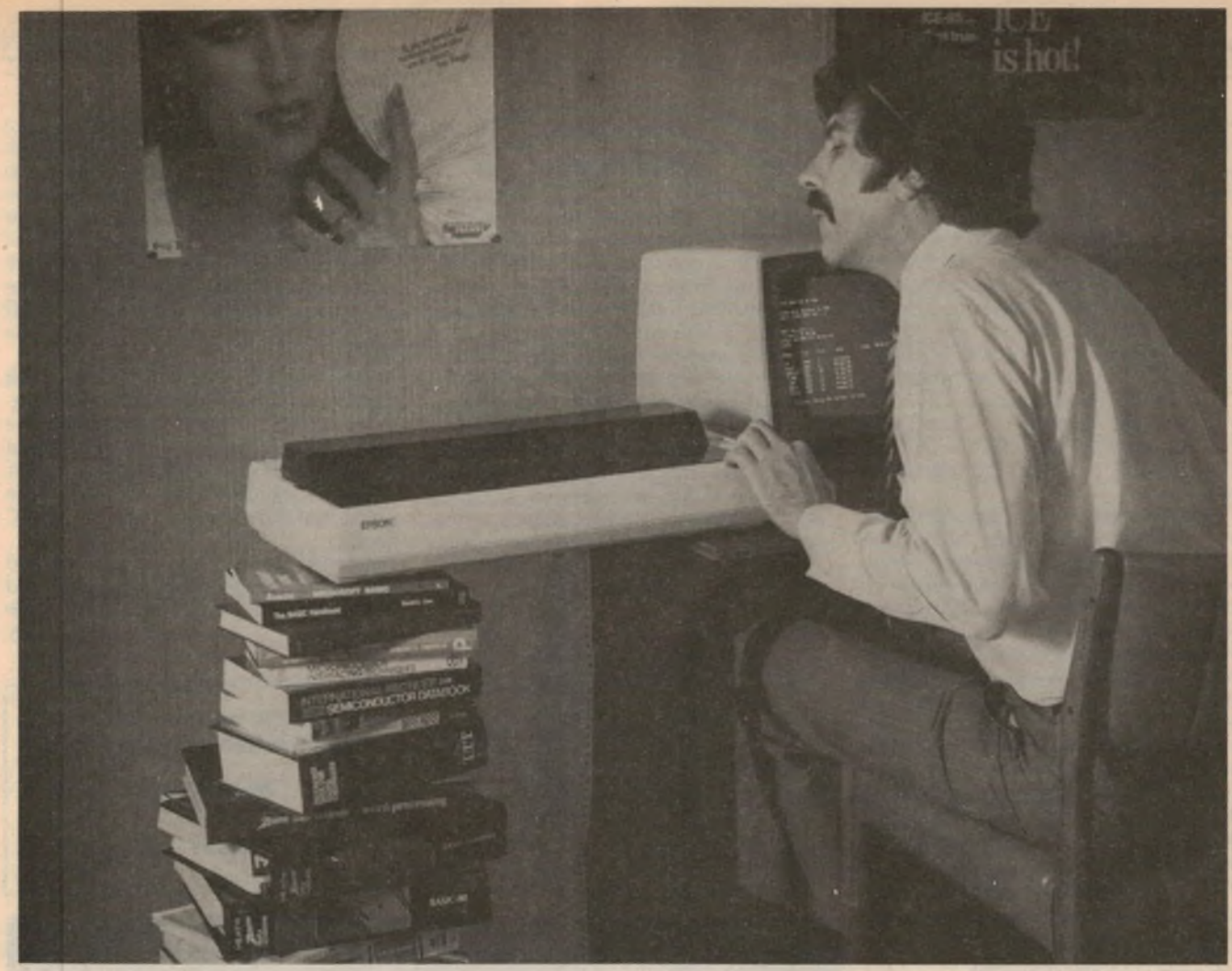
1 PC board, code 82lf2, 59 × 96mm
1 9V miniature electronic buzzer
1 12V instrument lamp (4W max)
2 mounting screws for buzzer
5 PC pins

SEMICONDUCTORS
1 CA3130 op amp
1 555 timer
1 BC558 PNP transistor
1 TIP31 NPN power transistor
1 9.1V zener diode (16V zener diode)

CAPACITORS
1 100µF 16VW electrolytic
2 4.7µF 16VW electrolytic
1 2.2µF 16VW electrolytic
1 0.01µF greencap
1 39pF ceramic

RESISTORS (¼W, 5%)
2 x 1MΩ, 1 x 470kΩ, 1 x 56kΩ(4.7MΩ), 1 x 18kΩ, 2 x 10kΩ, 1 x 4.7kΩ, 2 x 1kΩ, 1 x 470Ω, 1 x 150Ω ½W (10Ω ½W), 1 x 10kΩ 5mm vertical trimpot.

MISCELLANEOUS
2.5mm auto cable, hook-up wire, machine screws and nuts etc.



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WF820/81

which wire goes to the fuel gauge sender, you can once again refer to the manual, or failing this, trace the wire from the sender.

It would be advisable to put the project in a zippy box to protect it from prying screwdrivers and other implements which can find their way behind the dashboard. If you choose to do this, remember that the buzzer and warning lamp will have to be mounted outside of the box. The buzzer can be mounted at any convenient point under the dash, provided, of course, that it is easily audible. The warning lamp will need to be mounted on or near the instrument panel.

The connecting wires can be soldered to the PC board terminals, but to conform to automotive standards, connectors should be used to interface the circuit to the car. There are several types of connectors which are suitable. The simplest are "Scotch-lock" squeeze-on connectors which require no stripping, soldering or terminating of the wires. All that is necessary is to lay the two wires to be joined side by side in the connector and squeeze it closed!

These connectors have the added advantage that if you should accidentally connect to the wrong wire, they can be easily removed.

A more conventional approach to installing the project would be to use "bullet" connectors. Four-way female "bullet" adapters (Utilux H862 or equivalent) and male "bullet" connectors (Utilux H863 or equivalent) are needed. To fit these it is necessary to cut the wire you wish to tap into. Fit a male "bullet" connector to each end of the severed wire and insert them into the four-way adapter. If you don't have access to a crimping tool, the male "bullet" connectors can be soldered on to the wire.

To calibrate the circuit, one of two methods can be used. The most obvious is to syphon petrol from the tank until the desired "critical" quantity is reached. It is then simply a matter of adjusting RV1 until the device just triggers. Alternatively, the wire to the fuel gauge sender can be disconnected and a rheostat of about 100Ω substituted. With one side of the rheostat connected to ground, the fuel gauge can now be made to indicate any quantity. First set the fuel gauge to indicate the level of fuel at which you want the warning to be activated and then adjust RV1 until the device just triggers. Remove the 100Ω rheostat and reconnect the wire to the sender.

Some readers may find that it is not possible to get enough range of adjustment on RV1. In that case, it may be necessary to attenuate the sense input by connecting a high-value resistor across C1, eg 3.3MΩ. This resistor can be wired on the copper side of the PC board.

That's it for calibration. Provided you have done the job properly, you should never run out of petrol again. Safe motoring!

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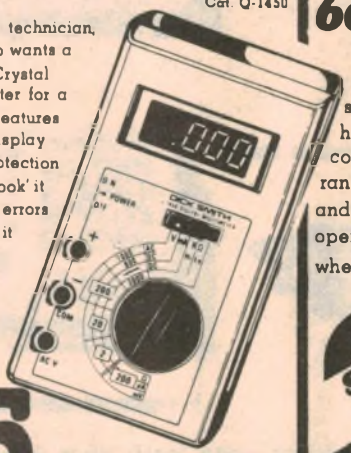

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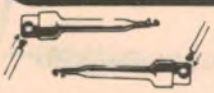

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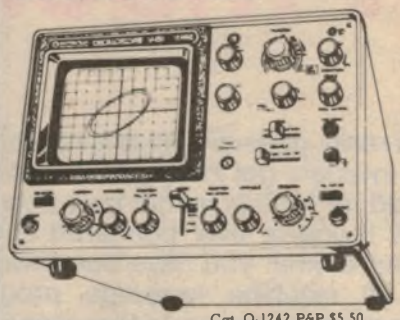

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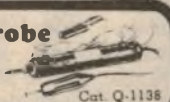

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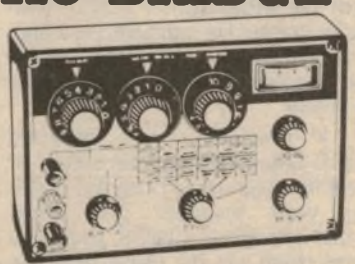

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Part 1 of a new series

How to program in machine language

What really goes on inside a microprocessor? How do all those little alien invaders get inside there? How do you make a computer do as it's told, or for that matter how do you make a computer do anything at all? If you've ever pondered these questions this new series of articles is what you have been waiting for. In these articles we will look at machine language programming, computer arithmetic, addressing modes and subroutines — all the jargon that goes so well at parties. We will also look at what's behind the jargon — the microprocessor and its operations — the leading edge of modern electronics.

by TONY HAIG

Within every computer is a machine language; from the multimillion dollar time-sharing installation to the hundred dollar microcomputer. It is the actual instruction set "understood" by the computer's processor and is the building block of all higher level languages. Before the processor can handle any other language – be it Basic or Pascal or even CHIP-8 – the computer must first break it down into machine code through a compiler or interpreter. Why then must the programmer bother with machine language? He can just use a high level language and let the interpreter/compiler worry about the machine code.

Firstly, a machine code program usually runs faster than an interpreted or even compiled high level program. If (for instance) your invaders just aren't moving fast enough in CHIP-8, then you can speed them up by using machine language instead. Also you can predict exactly how fast the machine code program will run, which is very important in many applications.

Secondly there are some things which the high level language simply cannot do which are easy in machine code, particularly peripheral control (eg, try to get 1200Hz bleeps out of the DREAM's speaker using CHIP-8).

Thirdly data may be more effectively packed into memory using machine language. This is important when the data array size gets large while the available memory remains small.

Fourthly, since nigh level language instructions are built out of many machine code instructions then if we know machine language and how each high level instruction is performed, we can improve our high level programming by using one faster or more memory efficient instruction sequence instead of another.

Finally, machine language is important since many applications of microprocessors (intelligent appliances, machine tools, microprocessor controlled measuring instruments etc) will not have, or need, the capability of high level language programming.

Programming microprocessors

For the purpose of teaching how to write machine code programs this series will centre around one specific microprocessor and its machine language – Motorola's 6800, used in the DREAM 6800 and many thousands of computer systems and industrial controllers. No machine language experience and little programming experience will be assumed, making the series ideal for beginners.

Although we concentrate on a particular microprocessor the principles of machine language programming are the same for other processors (Z80, 6502 etc). Binary and hexadecimal arithmetic, the concept of addressing modes and the distinction between programs and data must be understood by any machine language programmer, regardless of which particular microprocessor he or she is using.

Note also that the successor to the 6800, Motorola's 6809 can run assembly language programs written for the 6800. The actual machine code, or object code of the 6809 is very similar to that of the 6800. Many 6800 and 6809 instructions are identical and some additional 6809 instructions are consistent additions to the 6800 set required to handle the new 6809 registers. Other instructions of the 6809 are entirely new, although in most cases they are patterned after the 6800 instruction set. For a full explanation of the difference between the two processors see "6809 Assembly Language Programming" by Lance A. Leventhal, McGraw-Hill Inc, USA 1981.

(Users of the DREAM 6800 who follow the series should remember that programs written entirely in machine language do not need to have their first instruction located at address 0200 as in CHIP-8. Machine language programs can begin from any available free memory space. Also remember that to RUN a machine language program, don't type C000 Fn 3. Type the address of the first instruction of the program, then press the Function button and the 3 key.)

Within the 6800 MPU there is a set of six storage registers (see Fig. 1). They are: an eight-bit condition code register (CCR), two eight-bit memories called accumulator A and accumulator B (ACCA, ACCB), a 16-bit Index Register (IX), the 16-bit Program Counter (PC), and the 16-bit Stack Pointer (SP). There are also three buffer registers used internally by the microprocessor which are of little concern to the programmer.

Computer programs are simply sets of detailed instructions telling the computer how to manipulate these registers and the computer's memory (RAM, PIA, etc). Each of these instructions has two parts, an operation code (op code) and zero, one, or two operands. There are a total of 197 different op codes for the 6800 and each code must be followed by its specific number of operands. Each instruction is stored in memory (RAM, ROM etc) op code first, followed by any operand/s. Although there are 197 different instructions many perform similar operations, differing only in what they use as data.

An operation may be performed using

the operand as the actual data, as the address of the data, part of an address, or with various other interpretations. Thus an operation can be performed in perhaps four different "addressing modes", with four different op codes, yet perform similar functions. The 6800 has six addressing modes: Immediate, Direct, Extended, Indexed, Implied and Relative.

Addressing modes

All instructions which can be performed are given in the table overleaf. These operations are discussed in further detail in the Motorola 6800 Microprocessor Applications Manual, which is recommended reading for anyone using the 6800 processor. Note that what Motorola called the "Inherent" addressing mode is referred to here as "Implied" addressing, in keeping with the practice of other microprocessor manufacturers. Throughout this series we will refer frequently to this table, referring to each instruction by its mnemonic (shown in the second column of the table).

A "mnemonic" by the way is merely a memory aid, a handy abbreviation for a microprocessor instruction.

The first addressing mode we will look at is the "immediate" mode. Most of the instructions in this group relate to calculations on the two accumulator registers A and B. In immediate mode instructions the operand following the op code is used as data in the accumulator in various ways. For instance the instruction LDAA No.3A (86 3A in machine code) will load 3A (hex) into accumulator A. If it was followed by ADDA No.95 (8B 95) then 95 (hex) would be added to accumulator A and the result (CF in hex) left in the accumulator. A look at the instruction set, specifically those instructions in the column marked IMMED, shows us that 23 operations are valid in this addressing mode, of which 20 operate on either Acc A or Acc B.

Hold on there! 3A + 95 = CF? What sort of strange arithmetic is this? How big is an "A"? If you're floundering at this point, refer to the text box on "Hexadecimal numbers".

Each instruction in the Immediate mode is two bytes long (a one-byte op code specifying the operation to be carried out and a one-byte operand which is the data to be operated on). Each instruction takes two microprocessor clock cycles to be performed. In the DREAM 6800 for example, each clock cycle lasts for 1μs, so these instructions take 2μs to be completed.

Notice the hash sign (#) used in conjunction with the mnemonics. This symbol is used to indicate which addressing mode a particular operation is to be performed in. As mentioned, some operations can be performed in more than one addressing mode and would share the same mnemonic except for the use of these special symbols. The hash sign is used as an abbreviation for "number" or "number of". Another symbol, the dollar sign, will be used to indicate "address" or "address of".

As an example consider the instruction to load some value into accumulator A. In the immediate mode the instruction LDAA#3F means load A with the number 3F. In the Direct addressing mode (considered in more detail later) the instruction LDAA$3F means load A with the contents of address location 3F. In the Direct mode the 6800 microprocessor supplies 00 as the high order byte of the address, allowing the

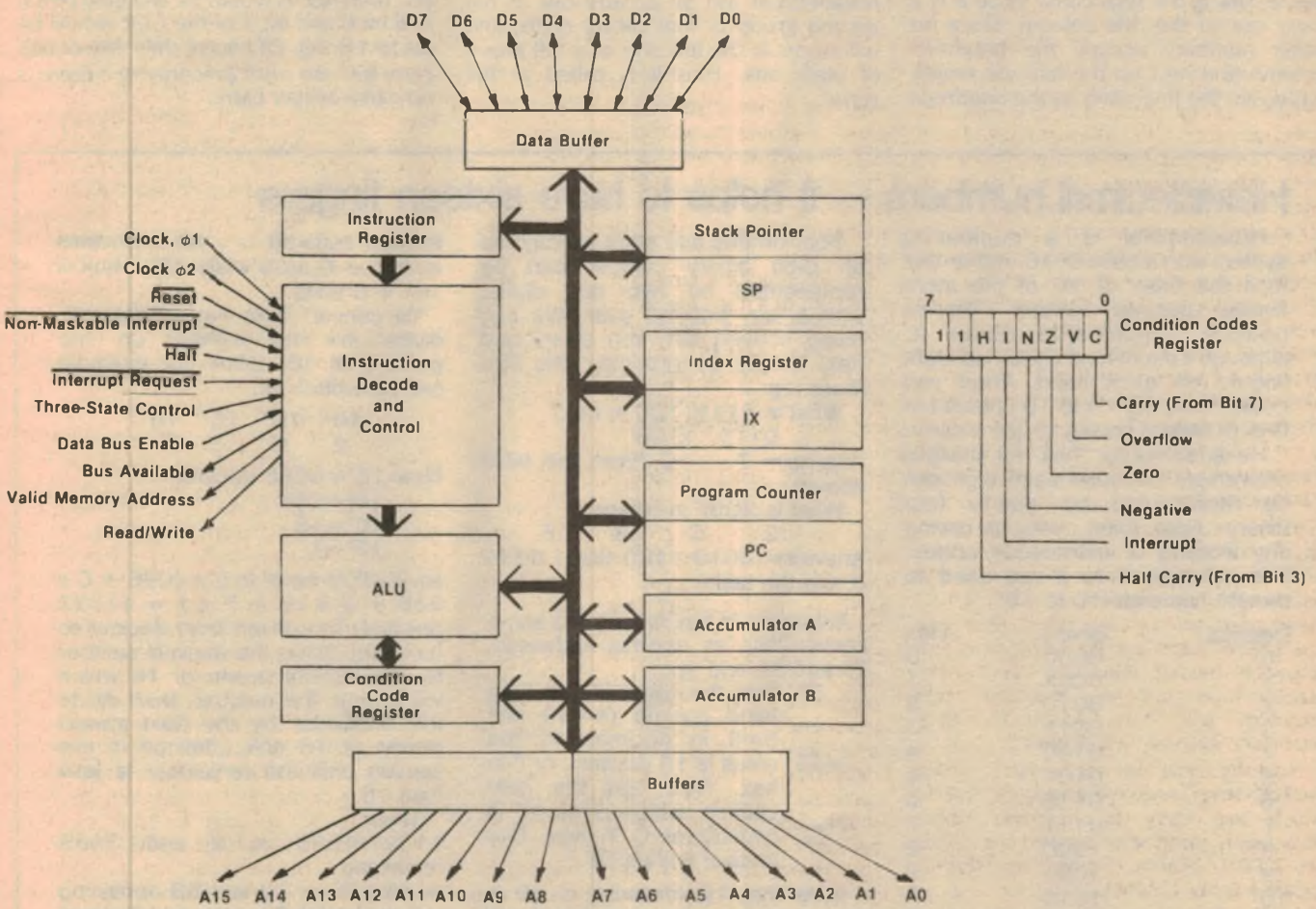

Fig. 1: Functional representation of the MC6800. The Instruction Register is a temporary store for the operation code currently being performed. The Instruction Decode and Control logic uses this and the various control signals it receives to determine how the instruction is to be executed. The ALU (Arithmetic Logic Unit) is the circuitry required to add, substract, shift or complement data. The Instruction Register, the data buffer and the address buffer are temporary storage which are automatically changed by each instruction. Others are programmable storage registers, used for various purposes.

shorter direct mode instructions to reference the first 256 locations in memory. (In the 6809 there is a Direct Page register which can be loaded by the programmer with any high order byte, allowing the direct mode instructions to access any location in the address space as long as the "page" is correctly specified.)

Computer arithmetic

To make a microprocessor do useful things it is important to understand binary and hexadecimal (base 16) arithmetic and particularly the way the processor uses "carry bits" in binary addition. Remember that in the decimal addition of 59 and 73:

```
Tens carry – ¹ ¹ – Units carry
      59
     +73
     132
```

9 and 3 is 12, so put down the 2 and carry 1 (this is the carry out of the units column). Now, 5 and 7 are 12, plus the carry from the units column, which gives us 13. Again put down the 3 and carry the 1. This is the tens carry, since it is a carry out of the 10s column. Since no other numbers occupy the hundreds column (the next on the left) we simply put down this final carry as the hundreds part of our result, and the addition is complete.

Similarly in hexadecimal if we add BD and A6 to get 163 then:

```
"full carry" – ¹  ¹ –"half carry"
      BD
     +A6
     163
```

D and 6 is 13, so put down the 3 and carry 1 out of the units column. B and A is 15, plus the previous carry is 16, so put down the 6 and carry 1. Again, since there is no entry in the third column of our example, the 1 carried from the sixteens column is put down as the next part of the result. Our answer is thus 163 (hex, remember).

But what is this "half carry" and "full carry" business? Remember that each two hex digits represents an 8-bit binary number. A carry out of the first (units) column in hexadecimal addition will actually be a carry from the first group of four binary digits to the second group of four. It will occur in the middle of the eight bit number, so it is a "half carry". A carry out of the second column in hexadecimal will be a carry out of the second group of four binary digits, and will occur at the left side of a full group of eight bits. Thus it is called a "full carry".

This can be seen more clearly in binary addition:

```
"full carry" – ¹      ¹ – "half carry"
          1100  1001
         +1000  1100
          0101  0101

            C9
           +8C
           155
```

Note that the full carry is actually a ninth bit, and this is the next problem to be dealt with, using our first example.

Obviously 163 (hex) won't fit into 8 bits – what do we do with that extra one? In most cases it can be discarded and only the 63 will be significant, but sometimes we will need it, and there are times when we want to know the half carry as well. We must keep these bits somewhere. This is one purpose of the Condition Code Register mentioned earlier. Bit 0 of this register is used to store the extra bit called the "carry bit", while the "half carry bit" is stored in bit 5 of the CCR. Thus if we add A6 to Accumulator A, which already contains BD, then Acc A would be changed to 63, and bit 0 and bit 5 of the CCR would be set to 1 (true). Of course the carry or half carry bits are reset (become 0) if there is no carry or halt carry.

Hexadecimal numbers — it helps to have sixteen fingers

Hexadecimal is a numbering system with a base of 16, rather that than the base of 10 of the more familiar decimal system. There's nothing complicated about it, although it might help if you had eight fingers on each hand. Then you could count from 0 to 15 (instead of 0 to 9) before having to use a carry.

Hexadecimal (or "hex" for short) is convenient because each digit can be represented by exactly four binary digits (bits), without having any missing or extraneous codes. The symbols A to F are used to denote numerals 10 to 15:

Decimal	Binary	Hex
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

Four divides into eight exactly; so an 8-bit binary number can be represented by two hex digits, without any bits left over. We can easily convert between binary and hex, simply by grouping bits into fours, eg:

```
What is 01111100 in hex?
        0111  1100
Answer=  7     C  (from the table above)
```

```
What is 2C3F in binary?
        2     C     3     F
Answer= 0010 1100 0011 1111
(From the table)
```

Arithmetic in hex follows the same conventions as decimal arithmetic. To add 3A and 95:

```
  3A  Add the digits in the right
      hand column (A=10 and
      5=5 in decimal, so the
+95   result is 15 decimal, or F in
      hex. Now add the next
      column, which gives 12 in
 CF   decimal or C in hex. Our
      answer is thus CF.
```

Note that 16 (decimal) is 10 in hex. Just as a decimal (base 10) number can be represented as units, tens, hundreds etc, so a hexadecimal number can be represented as units, sixteens, sixteen squared . . . 10 in decimal is 10^1 + 0 units while 10 in hex is 16^1 + 0 units.

To convert from hex to decimal, divide the hex number up into powers of 16. 2C3F for example can be written as:

```
  16³  16²  16¹  16⁰
   2    C    3    F
```

Now 16^3=4096 decimal
16^2=256
16^1=16
16^0=1

so 2C3F is equal to 2 x 4096 + C x 256 + 3 x 16 + F x 1 = 11327 decimal. To convert from decimal to hex, first divide the decimal number by the highest power of 16 which will go into the number, then divide the remainder by the next lowest power of 16 and continue in this fashion until the remainder is less than 16.

Thus:
11327/4096 = 2 and 3135 remaining
3135/256 = 12 and 63 remaining (12 decimal is C in hex, so put down C)
63/16 = 3 and 15 remaining (which is F in hexadecimal)

Our answer is therefore 2C3F.

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6800 microprocessor instruction set

ACCUMULATOR AND MEMORY INSTRUCTIONS

OPERATIONS	MNEMONIC	IMMED OP ~ #	DIRECT OP ~ #	INDEX OP ~ #	EXTND OP ~ #	IMPLIED OP ~ #	BOOLEAN/ARITHMETIC OPERATION (All Register Labels refer to contents)	5 H	4 I	3 N	2 Z	1 V	0 C
Add Acmltrs	ABA					1B 2 1	A + B → A	T	*	T	T	T	T
Add with Carry	ADCA	89 2 2	99 3 2	A9 5 2	B9 4 3		A + M + C → A	T	*	T	T	T	T
	ADCB	C9 2 2	D9 3 2	E9 5 2	F9 4 3		B + M + C → B	T	*	T	T	T	T
Add	ADDA	8B 2 2	9B 3 2	AB 5 2	BB 4 3		A + M → A	T	*	T	T	T	T
	ADDB	CB 2 2	DB 3 2	EB 5 2	FB 4 3		B + M → B	T	*	T	T	T	T
And	ANDA	84 2 2	94 3 2	A4 5 2	B4 4 3		A · M → A	*	*	T	T	R	*
	ANDB	C4 2 2	D4 3 2	E4 5 2	F4 4 3		B · M → B	*	*	T	T	R	*
Shift Left, Arithmetic	ASL			68 7 2	78 6 3		M ←	*	*	T	T	6	T
	ASLA					48 2 1	A ← □ ← ▭▭▭▭▭▭▭▭ ← 0	*	*	T	T	6	T
	ASLB					58 2 1	B ← C b7 b0	*	*	T	T	6	T
Shift Right, Arithmetic	ASR			67 7 2	77 6 3		M →	*	*	T	T	6	T
	ASRA					47 2 1	A → ▭▭▭▭▭▭▭▭ → □	*	*	T	T	6	T
	ASRB					57 2 1	B → b7 b0 C	*	*	T	T	6	T
Bit Test	BITA	85 2 2	95 3 2	A5 5 2	B5 4 3		A · M	*	*	T	T	R	*
	BITB	C5 2 2	D5 3 2	E5 5 2	F5 4 3		B · M	*	*	T	T	R	*
Compare Acmltrs.	CBA					11 2 1	A - B	*	*	T	T	T	T
Clear	CLR			6F 7 2	7F 6 3		00 → M	*	*	R	S	R	R
	CLRA					4F 2 1	00 → A	*	*	R	S	R	R
	CLRB					5F 2 1	00 → B	*	*	R	S	R	R
Compare	CMPA	81 2 2	91 3 2	A1 5 2	B1 4 3		A - M	*	*	T	T	T	T
	CMPB	C1 2 2	D1 3 2	E1 5 2	F1 4 3		B - M	*	*	T	T	T	T
Complement, 1's	COM			63 7 2	73 6 3		$\bar{M}$ → M	*	*	T	T	R	S
	COMA					43 2 1	$\bar{A}$ → A	*	*	T	T	R	S
	COMB					53 2 1	$\bar{B}$ → B	*	*	T	T	R	S
Decimal Adjust, A	DAA					19 2 1	Converts Binary Add of BCD Charact's	*	*	T	T	T	3
Decrement	DEC			6A 7 2	7A 6 3		M - 1 → M	*	*	T	T	4	*
	DECA					4A 2 1	A - 1 → A	*	*	T	T	4	*
	DECB					5A 2 1	B - 1 → B	*	*	T	T	4	*
Exclusive OR	EORA	88 2 2	98 3 2	A8 5 2	B8 4 3		A⊻M → A	*	*	T	T	R	*
	EORB	C8 2 2	D8 3 2	E8 5 2	F8 4 3		B⊻M → B	*	*	T	T	R	*
Increment	INC			6C 7 2	7C 6 3		M + 1 → M	*	*	T	T	5	*
	INCA					4C 2 1	A + 1 → A	*	*	T	T	5	*
	INCB					5C 2 1	B + 1 → B	*	*	T	T	5	*
Load Acmltr.	LDAA	86 2 2	96 3 2	A6 5 2	B6 4 3		M → A	*	*	T	T	R	*
	LDAB	C6 2 2	D6 3 2	E6 5 2	F6 4 3		M → B	*	*	T	T	R	*
Shift Right, Logic	LSR			64 7 2	74 6 3		M →	*	*	R	T	6	T
	LSRA					44 2 1	A → 0 → ▭▭▭▭▭▭▭▭ → □	*	*	R	T	6	T
	LSRB					54 2 1	B → b7 b0 C	*	*	R	T	6	T
Complement, 2's (Negate)	NEG			60 7 2	70 6 3		00 - M → M	*	*	T	T	1	2
	NEGA					40 2 1	00 - A → A	*	*	T	T	1	2
	NEGB					50 2 1	00 - B → B	*	*	T	T	1	2
Or, Inclusive	ORAA	8A 2 2	9A 3 2	AA 5 2	BA 4 3		A + M → A	*	*	T	T	R	*
	ORAB	CA 2 2	DA 3 2	EA 5 2	FA 4 3		B + M → B	*	*	T	T	R	*
Push Data	PSHA					36 4 1	A → M_{sp}, SP - 1 → SP	*	*	*	*	*	*
	PSHB					37 4 1	B → M_{sp}, SP - 1 → SP	*	*	*	*	*	*
Pull Data	PULA					32 4 1	SP + 1 → SP, M_{sp} → A	*	*	*	*	*	*
	PULB					33 4 1	SP + 1 → SP, M_{sp} → B	*	*	*	*	*	*
Rotate Left	ROL			69 7 2	79 6 3		M →	*	*	T	T	6	T
	ROLA					49 2 1	A → □ → ▭▭▭▭▭▭▭▭	*	*	T	T	6	T
	ROLB					59 2 1	B → C b7 b0	*	*	T	T	6	T
Rotate Right	ROR			66 7 2	76 6 3		M →	*	*	T	T	6	T
	RORA					46 2 1	A → □ → ▭▭▭▭▭▭▭▭	*	*	T	T	6	T
	RORB					56 2 1	B → C b7 b0	*	*	T	T	6	T
Store Acmltr.	STAA		97 4 2	A7 6 2	B7 5 3		A → M	*	*	T	T	R	*
	STAB		D7 4 2	E7 6 2	F7 5 3		B → M	*	*	T	T	R	*
Subtract Acmltrs.	SBA					10 2 1	A - B → A	*	*	T	T	T	T
Subtr. with Carry	SBCA	82 2 2	92 3 2	A2 5 2	B2 4 3		A - M - C → A	*	*	T	T	T	T
	SBCB	C2 2 2	D2 3 2	E2 5 2	F2 4 3		B - M - C → B	*	*	T	T	T	T
Subtract	SUBA	80 2 2	90 3 2	A0 5 2	B0 4 3		A - M → A	*	*	T	T	T	T
	SUBB	C0 2 2	D0 3 2	E0 5 2	F0 4 3		B - M → B	*	*	T	T	T	T
Transfer Acmltrs.	TAB					16 2 1	A → B	*	*	T	T	R	*
	TBA					17 2 1	B → A	*	*	T	T	R	*
Test, Zero or Minus	TST			6D 7 2	7D 6 3		M - 00	*	*	T	T	R	R
	TSTA					4D 2 1	A - 00	*	*	T	T	R	R
	TSTB					5D 2 1	B - 00	*	*	T	T	R	R
								H	I	N	Z	V	C

COND. CODE. REG

Instruction set of the 6800. Above, accumulator and memory operations. Jump, Branch, Stack and CCR instructions at right.

JUMP AND BRANCH INSTRUCTIONS (PROGRAM COUNTER MANIPULATION)

OPERATIONS	MNEMONIC	RELATIVE OP ~ #	INDEX OP ~ #	EXTND OP ~ #	IMPLIED OP ~ #	BRANCH TEST	COND.CODE.REG. 5 H	4 I	3 N	2 Z	1 V	0 C
Branch if Carry Clear	BCC	24 4 2				C = 0	*	*	*	*	*	*
Branch if Carry Set	BCS	25 4 2				C = 1	*	*	*	*	*	*
Branch if = Zero	BEQ	27 4 2				Z = 1	*	*	*	*	*	*
Branch if ≥ Zero	BGE	2C 4 2				N ∀ V = 0	*	*	*	*	*	*
Branch if > Zero	BGT	2E 4 2				Z + (N ∀ V) = 0	*	*	*	*	*	*
Branch if Higher	BHI	22 4 2				C + Z = 0	*	*	*	*	*	*
Branch if ≤ Zero	BLE	2F 4 2				Z + (N ∀ V) = 1	*	*	*	*	*	*
Branch if Lower or Same	BLS	23 4 2				C + Z = 1	*	*	*	*	*	*
Branch if < Zero	BLT	2D 4 2				N ∀ V = 1	*	*	*	*	*	*
Branch if Minus	BMI	2B 4 2				N = 1	*	*	*	*	*	*
Branch if Not Equal Zero	BNE	26 4 2				Z = 0	*	*	*	*	*	*
Branch Always	BRA	20 4 2				None	*	*	*	*	*	*
Branch if Plus	BPL	2A 4 2				N = 0	*	*	*	*	*	*
Branch if Overflow Clear	BVC	28 4 2				V = 0	*	*	*	*	*	*
Branch if Overflow Set	BVS	29 4 2				V = 1	*	*	*	*	*	*
Branch to Subroutine	BSR	8D 8 2					*	*	*	*	*	*
Jump	JMP		6E 4 2	7E 3 3		See Text	*	*	*	*	*	*
Jump to Subroutine	JSR		AD 8 2	BD 9 3		See Text	*	*	*	*	*	*
No Operation	NOP				01 2 1	Advances Prog. Cntr. Only	*	*	*	*	*	*
Return from Interrupt	RTI				3B 10 1	See Text	—— 10 ——					
Return from Subroutine	RTS				39 5 1	See Text	*	*	*	*	*	*
Software Interrupt	SWI				3F 12 1	See Text	*	*	*	*	*	*
Wait for Interrupt	WAI				3E 9 1	See Text	*	11*	*	*	*	*

INDEX AND STACK POINTER MANIPULATION

POINTER OPERATIONS	MNEMONIC	IMMED OP ~ #	DIRECT OP ~ #	INDEX OP ~ #	EXTND OP ~ #	IMPLIED OP ~ #	BOOLEAN/ARITHMETIC OPERATION	COND.CODE.REG. 5 H	4 I	3 N	2 Z	1 V	0 C
Compare Index Reg	CPX	8C 3 3	9C 4 2	AC 6 2	BC 5 3		X_H - M, X_L - (M+1)	*	*	7	T	8	*
Decrement Index Reg	DEX					09 4 1	X 1 → X	*	*	*	T	*	*
Decrement Stack Pntr	DES					34 4 1	SP - 1 → SP	*	*	*	*	*	*
Increment Index Reg	INX					08 4 1	X + 1 → X	*	*	*	T	*	*
Increment Stack Pntr	INS					31 4 1	SP + 1 → SP	*	*	*	*	*	*
Load Index Reg	LDX	CE 3 3	DE 4 2	EE 6 2	FE 5 3		M → X_H, (M + 1) → X_L	*	*	9	T	R	*
Load Stack Pntr	LDS	8E 3 3	9E 4 2	AE 6 2	BE 5 3		M → SP_H, (M + 1) → SP_L	*	*	9	T	R	*
Store Index Reg	STX		DF 5 2	EF 7 2	FF 6 3		X_H → M, X_L → (M + 1)	*	*	9	T	R	*
Store Stack Pntr	STS		9F 5 2	AF 7 2	BF 6 3		SP_H → M, SP_L → (M + 1)	*	*	9	T	R	*
Indx Reg-Stack Pntr	TXS					35 4 1	X - 1 → SP	*	*	*	*	*	*
Stack Pntr-Indx Reg	TSX					30 4 1	SP + 1 → X	*	*	*	*	*	*

CONDITION CODE REGISTER MANIPULATION INSTRUCTIONS

OPERATIONS	MNEMONIC	IMPLIED OP ~ #	BOOLEAN OPERATION	COND.CODE.REG. 5 H	4 I	3 N	2 Z	1 V	0 C
Clear Carry	CLC	0C 2 1	0 → C	*	*	*	*	*	R
Clear Interrupt Mask	CLI	0E 2 1	0 → I	*	R	*	*	*	*
Clear Overflow	CLV	0A 2 1	0 → V	*	*	*	*	R	*
Set Carry	SEC	0D 2 1	1 → C	*	*	*	*	*	S
Set Interrupt Mask	SEI	0F 2 1	1 → I	*	S	*	*	*	*
Set Overflow	SEV	0B 2 1	1 → V	*	*	*	*	S	*
Acmltr A - CCR	TAP	06 2 1	A → CCR	—— 12 ——					
CCR - Acmltr A	TPA	07 2 1	CCR → A	*	*	*	*	*	*

CONDITION CODE SYMBOLS

H	Half carry from bit 3
I	Interrupt mask
N	Negative (sign bit)
Z	Zero (byte)
V	Overflow, 2's complement
C	Carry from bit 7
R	Reset Always
S	Set Always
T	Test and set if true, cleared otherwise
*	Not Affected

LEGEND:

OP	Operation Code (Hexadecimal)
~	Number of MPU Cycles
#	Number of Program Bytes
+	Arithmetic Plus
-	Arithmetic Minus
·	Boolean AND
+	Boolean Inclusive OR
∀	Boolean Exclusive OR
$\bar{M}$	Complement of M
→	Transfer Into
0	Bit = Zero
00	Byte = Zero

CONDITION CODE REGISTER NOTES:

		(Bit set if test is true and cleared otherwise)
1	(Bit V)	Test Result = 10000000?
2	(Bit C)	Test Result = 00000000?
3	(Bit C)	Test: Decimal value of most significant BCD Character greater than nine? (Not cleared if previously set)
4	(Bit V)	Test Operand = 10000000 prior to execution?
5	(Bit V)	Test Operand = 01111111 prior to execution?
6	(Bit V)	Test: Set equal to result of N∀C after shift has occurred.
7	(Bit N)	Test: Sign bit of most significant (MS) byte = 1?
8	(Bit V)	Test: 2's complement overflow from subtraction of MS bytes?
9	(Bit N)	Test: Result less than Zero? (Bit 15 = 1)
10	(All)	Load Condition Code Register from Stack. (See special operations)
11	(Bit I)	Set when interrupt occurs. If previously set, a Non-Maskable Interrupt is required to exit the wait state.
12	(All)	Set according to the contents of Accumulator A.

The uses of the carry bits aren't immediately obvious but their importance will become clear as we go along. One reason worth mentioning now is the use of the full carry bit in 16-bit addition. Consider the addition of 7B57 to 54B6:

```
   3rd half carry—/   /—2nd half carry
final carry —  0 1 1 0  —1st half carry
      5 4   B 6
    +7 B    5 7
      D 0   0 D
```

This sort of situation frequently occurs in computers because values are often going to rise above 255 decimal — the limit set by 8-bit arithmetic — so it becomes helpful to be able to add and subtract 16-bit, 24-bit, 32-bit or larger numbers. The addition shown above has to be performed in two steps — first adding B6 to 57, then adding 54 to 7B plus the carry from the first addition. If Accumulator B has the low byte and Acc A contains the high byte of the operation, then the addition can be performed by loading 54 into Acc A and B6 into Acc B, then adding 57 to Acc B and adding the carry bit from that addition to Acc A along with 7B.

Referring to the table of operation codes, we can write the program to do this addition (almost):

LDAA#54 — load Acc A with 54 (hex)
LDAB#B6 — load Acc B with B6
ADDB#57 — add 57 to Acc B
ADDA#7B — add 7B to Acc A

Actually, this program won't give us the correct answer — we haven't made any provision for adding that carry bit to Accumulator A. We need some instruction to do this, and such an instruction is found in the 6800 set — ADCA (add with carry) which adds the operand and the carry bit to Accumulator A at the same time. Our program should be:

LDAA#54 — load Accumulator A
LDAB#B6 — load Accumulator B
ADDB#57 — add 57 (hex) to Accumulator B
ADCA#7B — add the contents of the carry bit of the CCR and 7B to Acc A.

This program will give us 0D in Accumulator B and D0 in Accumulator A, which is as it should be.

A further point worth noting about addition can be illustrated by adding FF to 07 to give 106 (hex). In 8-bit arithmetic this will be equivalent to 06 with the carry bit set (to 1). If we disregard the carry bit, we can say that adding FF is the same as subtracting 01, or adding −1. Similarly adding FE equals subtracting 02, adding FD equals subtracting 03 and so on. Try it for yourself on paper.

Binary addition can be easily performed by microprocessors as the process can be performed by simple transistor circuitry, but binary subtraction cannot be done quite so easily. Instead of subtracting 03 it is easier for the processor to add FD. The processor must convert the 03 which is required to subtract into the FD which it will add. In 8-bit binary 03 is 0000 0011. The microprocessor can "ones complement" this by turning ones into zeros and zeros into ones, so that 0000 0011 becomes 1111 1100. If we add 1 to this figure the result is 1111 1101 in binary or FD in hex — called the "twos complement" of 03. Subtraction therefore is the same as the addition of the twos complement of the subtrahend.

Just as addition uses the carry bit when adding values with more than 8 bits, so subtraction uses the carry bit to indicate a "borrow". In decimal subtraction:

```
  ¹ — "borrow"
  4 2 6 7  minuend
− 2 1 9 1  subtrahend
  2 0 7 6  difference
```

we borrow "one" from the hundreds column when the tens of the minuend is smaller than the tens of the subtrahend. The same occurs in hexadecimal, and the processor sets the carry bit to indicate a borrow or resets it to show that no borrow was required. The instruction SBC (Subtract with carry) uses this fact so that subtractions with more than 8 bits can be performed.

	8 bit binary		decimal	hexa-decimal
	1111	1111	-1	FF
	1111	1110	-2	FE
	1111	1101	-3	FD
	....	....	...	..
NEGATIVE	....	....	...	..
	....	....	...	..
	1000	0010	-126	82
	1000	0001	-127	81
	1000	0000	-128	80
	0111	1111	127	7F
	0111	1110	127	7E
	0111	1101	125	7D
	....	....	...	..
POSITIVE	....	....	...	..
	....	....	...	..
	0000	0011	3	03
	0000	0010	2	02
	0000	0001	1	01
ZERO	0000	0000	0	00

Fig. 2: The 8-bit signed number system.

Signed Numbers

The MC6800 is, of course, an 8-bit microprocessor, which means it deals with binary data between 0000 0000 and 1111 1111 inclusive. We can interpret this in a number of ways, such as: the decimal numbers between 0 and 255, or the hexadecimal numbers between 0 and FF, or the decimal numbers between −255 and 0, or anything else which happens to be useful. It often is useful to have both positive and negative numbers, so we interpret the data as being the decimal numbers between −128 and +127 inclusive (see Fig. 2).

This system is not randomly chosen as it may at first seem; there are several reasons why it is useful. Firstly the sign (positive or negative) can be simply determined by the value of bit 7: if it is one then the number must be negative, if it is zero then the number must be positive or zero. Secondly, zero is still at 0000 0000 which is usually more convenient. Thirdly, the signed positive numbers are the same as the "unsigned" positive numbers, while the negative numbers are the appropriate two's complement of the positive numbers (Note: signed number systems can be multibyte. In each case the highest bit is the sign bit, and determines whether the

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number is positive or negative; again, all the signed positive numbers are as for unsigned, and the negative numbers are their two's complement, zero is at 0000 0000). And fourthly, most of the arithmetic operations work whether operating on signed or unsigned numbers.

When operations on 8-bit numbers generate a result which is larger than 8-bits an "overflow" occurs. The situations which result in an overflow will be different for signed and unsigned values. Consider the following additions:

HEX	SIGNED	UNSIGNED
04	4	4
+05	+5	+5
09	9	9
52	82	82
+6A	+106	+106
BC	−60	188
	Wrong	
A5	−91	165
+76	+118	+118
1B	27	27
		Wrong

Take a look at the centre of the middle row above. To understand what is wrong, do the same addition in binary:

0101 0010
+0110 1010

1011 1100

The result is 188 in decimal, which is correct for unsigned binary. However, in signed binary bit 7 (on the left) is the sign bit, and a 1 means that this is a minus number (−60 in decimal), which is definitely wrong. The error occurs because the carry out of bit 6 of the addition is added, as usual, to bit 7, resulting in an incorrect sign bit.

Signed binary numbers are in the range −128 to +127, so a carry out of bit 6 indicates that the result is outside this range. An overflow has occurred, but the effect of the overflow is to change the sign bit in bit 7.

For unsigned numbers the range is 0 to 255 decimal, and a carry out from bit 7 indicates an overflow. Thus the carry bit of the CCR can be used to indicate an overflow condition. However this will not work for the overflow from the addition of signed numbers, which must be indicated differently. The microprocessor generates an overflow status bit (designated "V") which indicates that if the data is being interpreted as signed numbers then an overflow has just occurred. Bit 1 of the CCR is the overflow bit which is set or reset following each addition in a similar fashion to the carry and half carry status bits. The microprocessor forms the overflow bit by Exclusive ORing the full carry bit with the carry out from bit 6 to bit 7. With each addition the microprocessor performs it sets or resets as necessary bits 0 (carry), 1 (overflow) and 5 (half carry) of the CCR.

There are two other statuses which the microprocessor also stores in the CCR; they are negative status bit (N) (bit 3 of the CCR) which is set if the sign of the result of the addition is negative (in other words it is the same as bit 7 of the result), and there is the zero status bit (Z) (bit 2 of the CCR), which is set if the result is zero. Thus when an addition is performed five bits of the CCR are set or reset as required. These bits may also be relevant when other operations are performed. In subtraction operations, for example, the half carry is not useful and is unchanged by the operation, but the other four statuses may all be significant and are tested for and then set or reset.

In the next article we will look at how these "status bits" can be used by the programmer to control the execution of a program.

If the reference to Exclusive OR left a question mark in anyone's mind, we need to brush up on Boolean algebra (a symbol system used to describe logic functions). Three logic functions of interest are the AND, OR and Exclusive OR (EOR) operations, which can be defined by their respective truth tables as follows:

AND

A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

OR

A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

EOR

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

That's fine, but what does it all mean? Taking AND as an example, consider A and B as inputs and C as an output. If A **and** B are both 1, the output will be a 1 otherwise the output will be 0. For the OR operation, if A **or** B is 1, the output will be 1. Note that, logically, when both A and B are 1 the OR condition is also satisfied. This is different from Exclusive OR; which means that A **or** B **but not both** must be 1 to produce a 1 output. If both inputs are 1, the output is 0, just as in the case of two 0 inputs.

Eight bit Boolean algebra is no different. When ANDing two 8-bit values for instance, each bit of one number is ANDed with the corresponding bit of the other number, and the result becomes the appropriate bit of the result:

ANDing

1011	0110	B6
0011	1100	3C
0011	0100	34

ORing

1011	0110	B6
0011	1100	3C
1011	1110	BE

EORing

1011	0110	B6
0011	1100	3C
1000	1010	8A

So now we've looked at all the operations in the immediate addressing mode except for the Bit Test, Compare, Compare Index Register (which we will look at next month when we look at branching), Load Index and Load Stack Pointer. LDX is similar to LDAA except that it stores a two byte number (not one) in the Index Register (not Acc A). LDS is the same as LDX except the value is stored in the Stack Pointer.

Next Month: Extended, Direct and Relative Addressing modes, and a sample program.

Letters to the editor

RF projects — a neglected field

Firstly, many thanks for introducing me to a very rewarding hobby. Your articles on getting started were a great help and your presentation of projects with detailed circuit descriptions really are first class and enable one to "catch on" very quickly.

Unfortunately, I have a few gripes. For the life of me I can't understand why you neglect the field of radio. It is a whole area of electronic design which could give rise to dozens of projects and articles, eg, aerials, converters, receivers, etc. True, CMOS circuits are cheap and easier to design but 10 years after the digital invasion I think you should reconsider this forgotten field, especially since you acknowledge that there is an interest by having columns like SW Scene, CB Scene and Amateur Radio.

I've nothing against hifi or computer projects; these, like radio projects, give the hobbyist something to design and build around, ie, a centre for his efforts.

At present the "hotch-potch" of novelty and household projects which you present are okay but please don't make them all that you have. How about getting back into radio in the same sort of way as you are into computers and hifi at present. The worst you could do by presenting a few projects is force the component stockists to bring in some of the specialised parts needed.

For starters, how about a full blooded communications receiver with options like noise blanking, frequency meter, S meter etc, to keep costs down if necessary. I'm sure it would be very popular.

The rest of your magazine is really excellent. It's well set out, very readable, informative and with interesting features and columns. Keep it up and consider going international.

D. Brown,
Nedlands, WA.

Metric confusion

Your Wind Direction Indicator project (Jan '82) commits a serious error. "Kph" is not an acceptable abbreviation for kilometres per hour. The daily press offers a wide variety of equally faulty abbreviations, but a serious scientific publication such as yours, should be accurate on matters like this.

G. R. Holland,
Brisbane, Qld.

COMMENT: You are quite correct — km/h is the accepted abbreviation. The offending staff member has been shot, hung and quartered!

More on exploding batteries

Re the letter from ophthalmologist Dr S. Siebert (EA October, 1981). It was my misfortune to have had a most unnerving experience similar to those described by the eye doctor.

Radio amateurs who may be using the low-maintenance type of storage battery to power their transceivers should have second thoughts about continuing to do so. The usual arrangement is to float the battery across a charger while operating to keep the battery output at 13.8 volts, the charging rate being about 2 amps.

While in contact with another amateur when testing a new transceiver I asked the operator to listen for possible hum induced by the battery charger across the supply. The battery was on the floor alongside me and I bent down to remove one of the clips from the battery. The instant I touched the clip there was a violent explosion. My hand was numbed and it was several seconds before I could collect my wits. I then dashed outside to a tap and put my head under it because I had collected the full force of the acid in the face. Fortunately I was wearing glasses and that no doubt helped to save the eyes from damage.

The acid was sprayed over everything in the room, reaching walls and the ceiling. All clothing being worn later fell to pieces.

There is no doubt in my mind that it was an explosion of hydrogen which was being forced out of the cells at the point where the post emerged from the cells. The entire battery case disintegrated into small fragments. The leaking gas, from what was thought to be a sealed battery, was touched off by a spark as the clip was removed. This of course is something that anyone with experience with vented batteries would not think of doing with a battery on charge.

I have heard of a number of cases where the low-maintenance batteries have exploded inexplicably in cars.

My advice to any fellow hams who may be using such a battery in the shack is to get rid of it quickly and go back to the conventional type of vented storage battery.

G. Thompson, VK3AC
Hawthorn, Vic.

COMMENT: Readers are advised that low-maintenance batteries are not "maintenance free", and may require topping up from time to time. Explosions have occurred in these batteries due to the electrolyte level dropping below intercell connectors, one of which may have become faulty. Further details are in "Electronics Australia", August 1981.

Vital information

In the October, 1981, issue of EA, Jamieson Rowe states (p118, para 2): "... the word 'data' is basically just a synonym for 'information'."

However, this isn't always the case. Take for example 352334 – that is quite clearly data. But 35-23-34 – ah, now there's information.

COMMENT: To dedicated computer freaks, numbers are just numbers!

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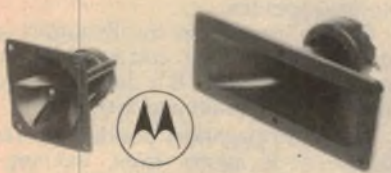

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Amateur Radio

by Pierce Healy, VK2APQ

Antarctic expedition — amateurs maintain radio contact

During the recent festive season, amateurs on both sides of the Tasman; at Macquarie Island and at Casey base on the Antartic continent had the pleasant task of passing Christmas and New Year greetings between members of the Antarctic research expedition and their families.

Nightly communication with the Antarctic Research Foundation expedition, on the schooner "Dick Smith Explorer", has provided interesting and unusual contacts during the past month.

As these notes were being completed the expedition was endeavouring to find a way through the ice floes to make a landing at Commonwealth Bay – often referred to as the "weather kitchen" of this part of the world.

Since leaving Sydney on 12th December, 1981, the position of the schooner with its crew of 12 led by Dr David Lewis, has been plotted nightly by a very keen group of amateur radio operators.

Operating from the schooner under the call sign VK0DL the expedition's radio operator Don Richards, VK2BXM, a Sydney amateur, has kept skeds on 14105kHz at 0915UTC with amateurs in Sydney, Hobart, several places in New Zealand, Macquarie Island and Casey on the Antarctic continent. In fact it's almost as if they have become part of the expedition themselves – even if only as armchair mariners.

As well as keeping a day-to-day position record, the main purpose of the group – which has moulded itself into an efficient communication net – is to pass messages between expedition members and relatives, friends, and those interested in the well-being and success of the expedition. In addition there have been occasions when information or advice on equipment has been requested.

For instance during the trip from Sydney to Hobart the audio quality of the amateur transceiver was well below standard; by the time Hobart was reached the problem had been discussed. With the co-operation and assistance of several amateurs in Hobart the problem was tracked down to low DC voltage at the input to the FT-ONE transceiver. Supply wiring changes were made and the problem overcome. Resealing antenna connections was another task carried out.

Initial public interest in the arrival of the "Dick Smith Explorer" in Hobart was generated by amateurs in that city.

Since leaving Hobart around noon on Wednesday, 23rd December, 1981, regular 24-hourly scheduled contacts have been maintained. Personal messages between expedition members and their families in Sydney and New Zelanad have been passed, particularly during the festive season when we learned that Christmas dinner aboard consisted of – sliced leg of ham, roast chicken, baked potatoes, several combinations of salads, Christmas pudding and cream, plus the traditional bottles of bubbly.

Weather conditions have varied from bright clear sunny skies and comfortable sailing, at times under power, at other times under canvas, to heavily overcast skies, storms, and rough seas with force 7 to 8 winds, which has had effect on some appetites.

(Force 7 winds on the Beauford scale are defined as "high" and are between 56 and 68km/h, Force 8 is defined as "gale" and is between 68 and 80km/h.)

Radio propagation conditions varied between locations from evening to evening. A severe magnetic storm, attributed to unpredicted solar activity, commenced on 29th December, 1981 and caused unusual communication conditions for several days.

Although signals and messages could be copied on board the schooner, messages from the schooner had to be relayed by amateur stations in New Zealand, Tasmania, or Macquarie Island. At times Sydney stations handled messages to Macquarie Island, and from other areas to the expedition station VK0DL.

Author Pierce Healy's home station VK2APQ, which kept in contact with the Antarctic expedition.

AMATEUR RADIO

The same propagation conditions affected communication on commercial marine frequencies between the schooner and shore stations.

On Christmas eve, propagation favoured Sydney. During the evening contact, the leader of the expedition expressed his feelings in these words (transcribed from a recording made of that contact);

"Hello to the group, this is David Lewis speaking.

You have no idea what a pleasure it is to have you all listening in and keeping in communication with us. We really feel your support."

"I would like to say that things are going very well indeed. We have a good breeze and travelling along under full sail. The boat is lifting to the waves wonderfully – sometimes a little too much for our stomachs, but that will all settle down. I would like to wish you all a very merry Christmas and thanks for staying with us."

On Boxing Day, Saturday afternoon 26th December, 1981 a large number of visitors at the Museum of Applied Arts and Sciences heard the Museum station VK2BQK in a very good contact with VK0DL. Answering questions, Don reported that they were under sail in a good wind. He also commented on how they had spent Christmas Day.

Except for the 29th December, 1981 when the magnetic disturbance prevented the scheduled contact, daily contacts were made by stations in the net and VK0DL.

During the evening contact 8th January, 1982, as these notes were being prepared, Don reported their position and situation as – 65 degrees 24 minutes south latitude, 141 degrees 18 minutes east longitude, approximately 180 kilometres from Commonwealth Bay. The temperature inside the wheelhouse was 0°C with a strong headwind and little progress in choppy seas.

They had sighted their first iceberg, 100 metres high, and a continuous watch would be kept all night for ice.

Maintaining contact was not without incident. A pre-arranged sked for Saturday afternoon, January 9, 1982 from the Museum of Applied Arts and Sciences station VK2BQK was missed, as was the usual 0900UTC sked the same evening.

However, on the 0900UTC sked Sunday, January 10 it was learned that a power supply problem had prevented the Saturday skeds being kept, but all was well and they were entering Commonwealth Bay under sail through floating ice.

On the 0900UTC sked Monday, January 11 the news was that the "Dick Smith Explorer" was safely anchored at 67deg 00min south latitude, 142deg 41min east longitude in a natural harbour discovered by Mawson 71 years ago in Commonwealth Bay.

Members of the expedition had been ashore and visited Mawson's hut and had started carrying out scientific work around the base.

On Tuesday, January 12 we learned that they were still enjoying beautiful sunshine at zero degrees celsius. There were thousands of penguins around the immediate area. Don also indicated that he would put up a dipole antenna to try and improve his signal to us.

Signals from VK0DL on the Wednesday and Thursday sked were much improved by the use of a dipole antenna, one end fixed to the top of a mast, and we listened intently as Don and Dr David Lewis told of the scientific work being done. A party of four had been taken in a dinghy and left on Great MacKellar Island and then taken to another island and had counted over 10,000 penguin chicks.

David had taken a bath in a "melt pool" with the water temperature at 0°C. Dick Hefferman had ventured into the waters of the bay. Cameraman Malcolm Hamilton had been taking reels of film, including some underwater shots with a camera on the end of a pole. The films are for a Channel 7 TV documentary.

On Friday evening signals were very good from VK0DL.

The dipole antenna from the masthead, which is not practicable while sailing, was proving its worth.

It was with much pleasure that I (VK2APQ) passed this message to Dr David Lewis.

"Hearty congratulations on your safe arrival. I wish you every success for the remainder of your expedition. It is good to see the spirit of adventure is still so much alive."

From Hon D. S. Thomson MC, MP, Minister for Science and Technology, Parliament House Canberra.

Dr Lewis asked that a message of thanks be sent to the Minister on behalf of himself and the whole group saying how proud they were to make contribution to Antarctic research so vital to everyone in Australia and New Zealand.

As in previous contacts Dr Lewis expressed his appreciation of the part amateur radio is playing in maintaining contact with the expedition and the service being provided.

QSO Parties

The "get together" QSO parties arranged last year in conjunction with the Old Timers Club of New Zealand got away to a rather slow start. However, by the time of the third meet, on 14MHz, support had built up to a solid level. The QSO parties will continue this year, with two more get togethers planned, with some slight changes in the rules and a time limit of three hours.

the meetings are open to members of RAOTC (Australia) and OTC, New Zealand. Some members of the Australian club overseas, mainly in the USA, took part in last year's QSO parties.

Contest Exchange. Members will exchange: Their club membership numbers, UKS prefixed by "A" and ZLS prefixed by "Z"; the year of their first licence; name; and age.

Dates and times: Contest one, on 20 metres will be held on Monday, March 8. 0200 Z to 0500 Z. Centre frequencies are 14050kHz for CW and 14150kHz for SSB. Entrants are asked to spread out around these centre frequencies.

Contest two on 40 metres will be on Monday, August 9, 0800 Z to 1100 Z. Centre frequencies will be 7015 for CW and 7075kHz for SSB.

Scoring: One completed contact with a member on CW or SSB, but not both, will score five points.

The final score will be the number of contact points multiplied by the total of VK, ZL and overseas call areas which are contacted.

Entries: Entries for the contest, showing the score claimed, the mode (CW, SSB or CW/SSB), the number of QSOs and multiplier, should be sent to John Tutton, VK3ZC, 31 Denham St, Hawthorn, Vic 3122. Lists will be exchanged between the VK and ZL clubs for publication of results.

All amateurs who have been licenced for 25 years or more are eligible to join the Radio Amateur Old Times Club. A stamped, self-addressed envelope, measuring at least 23cm × 10cm should be sent to the Secretary, Harry Cliff, VK3HC, PO Box 50, Point Lonsdale, Vic 3225 for a membership application form.

Radio clubs and other organisations, as well as individual amateur operators, are invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent to Pierce Healy at 69 Taylor Street, Bankstown, NSW 2200.

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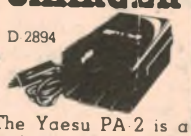

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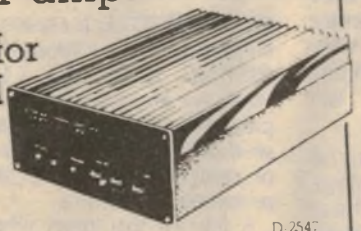

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Mobile or base

D-2869

FT707 Yaesu has used the 'state of the art' technology & put it into such a tiny package. Yes, it's the brilliant FT-707. This little wonder contains all the outstanding features that most big rigs lack. It's a full power, all HF band (inc. WARC) multi mode transceiver. You get digital readout, LED S/power meter, push button operation & all the things the amateur needs for safe reliable operation. You've waited a long time for a rig like this, so take the splurge now, it's well worth the money.

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Antenna Coupler

Get the most from your FT-707, use the Yaesu FC-707 antenna coupler & ensure your transceiver always delivers the power it should. Has all the features you need: pwr/SWR meter, in-built dummy load, all band coverage (including WARC), less than 0.5dB insertion loss. D-2875

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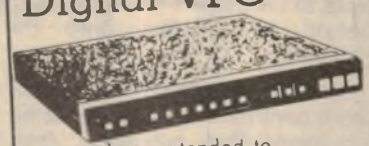
Just add the FP-707 mains supply & you're away. You get fully regulated 13.5V at 20A. Has plug-in connections so you can't cause problems, plus you get an extra speaker - for greater clarity. D-2895

ONLY $175

Digital VFO



Long n slim - intended to sit under the 707. 12 memories, up/down scanning in 10Hz steps & receiver offset tuning. Power by FT-707. D-2896

ONLY $299.50

Mobile bracket

Don't let your valuable 707 jump all around the car. Fit it in this superb mounting bracket for safety & security. Also holds the digital VFO. A must for the serious mobile operator. D-2897

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Yaesu's top 2 metre FT 480R has FM/CW & SSB

10% OFF

Yaesu call this their 'total performance VHF computerised transceiver.' And total performance it is! As the top-of-the-line Yaesu 2M family you'd expect a lot. You get FM, SSB, CW over the full 2M band, with two VFO's, four memory channels, scanning, digital readout, hi/lo power switch & much, much, more. To sum it up in one word, superb!

D-2887

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Want to go mobile? Add this superb DC/DC inverter to your car battery (13.5V nominal). Don't tie yourself to your shack - get out to where the DX is great! D-2864

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SEE OUR OTHER ADS FOR FULL ADDRESSES

The Australian CB SCENE

A National CB Organisation — at long last?

At the time of writing, it seems distinctly possible that a fully representative national CB organisation will be formed, able to speak to the Government with a united voice. It will not be before its time!

Now please don't get me wrong. The NCRA has been around for a very long time, battling for the cause but there are many people who, for various reasons, have not wished to affiliate with that body.

In the January issue, I told you that the Citizens Radio Repeater Association and the National Citizens Radio Association had agreed to terms of association.

I can now add that the Association of Citizens and Band Radio Operators (ACBRO) and the NCRA are also negotiating terms of association. I feel sure that the details will have been hammered out successfully by the time you read this.

What it should mean is that there should henceforth be an automatic exchange of information and ideas between the three bodies and a united voice in dialogue with the authorities.

There are to be no constitutional ties between the groups, and each will remain autonomous. Nor is there any rule stating that each has to conform to the policies of the other; indeed, the agreements provide for the occasions when views differ.

At this juncture, there is no direct link, either, between the CRRA and the ACBRO; the NCRA is the common denominator and that is a step in the right direction. Hopefully, it will be a step towards an Australian Council of CB Groups.

One thing to bear in mind, though, is that each of the Associations relies on membership for the funds to operate so, if you are not a member of one of them, how about inquiring about them and joining the one which best suits your particular needs. In the next issue, I will give you a brief resume of each of them, along with their addresses.

A CHANGE IN MOOD? I thought I must have been listening at the wrong times in the past few weeks, because things certainly seem to be quieter now than they used to. Operators seem to be more content to listen for the calls which they want to take rather than jumping on any person who comes onto the call channels.

Conversations, in the main, seem to be more controlled and, at the same time, less formal than previously. And those whose behaviour left much to be desired seem to have quietened down. This, of course, does not apply to all operators but one can see the differences, nevertheless. I wonder what the cause of it is? Perhaps CB in Australia is finally coming of age!

CB NEWCOMERS: With Christmas over and the deluge of new, inexperienced operators about to begin, I would like to ask you all, as I have done in the past, to be considerate to the new ones, and try to help them out as much as possible. It is easy to forget that we were all new on the air once. We all have to learn sometime, and I can remember how grateful I used to feel when a more experienced operator would break in and, in a nice way, point out to me where I was going wrong. I am sure that many of my readers were around in the "old days" and therefore have a wealth of experience which they can pass on. It can even be fun to take a new operator under one's wing and watch how he or she progresses. Think about it.

FEE STRUCTURE: It seems as though the Department is looking for alternative methods of licensing CB operators. If you have any suggestions on this matter, please send them to me, or to the NCRA so that we can present as wide a range of options as possible, along with appropriate comments.

A few of the ideas which have been put to us so far are:

1. Return to the one set per licence system, with the appropriate reduction in the cost of the licence.
2. A label issued with each new piece of equipment to be licensed, which is stuck onto the set in question.
3. The complete abolition of licence

TRIBUTE TO TRUCKIES: The tragic accident involving a bus and a semi-trailer near Gundagai, NSW, brought CB into the news again. Truckies who came across the accident used their gear to summon help and to advise other motorists of the danger. The truckies also made the injured as comfortable as possible until help arrived, supplying them with hot tea and coffee in the small hours of the morning. Please note that I would like to hear from anyone who has a story to tell as to how CB has been of assistance to people in trouble.

fees. (That'll be the day!)
4. The operator is licensed and is issued with a "registration certificate" for each set registered to him.
5. A duplicate of the licence is issued by the Department for each set which is licensed.
6. The system stays as is, with the licensee responsible for providing a sufficient number of photocopies of the licence to cover all sets.

As you can see, there are a number of options already. Perhaps you can think of some more.

NEWS FROM SYDNEY: Our roving reporter in Sydney, Ken Upton, has written to let me know what has been going on in his neck of the woods. He has raised a couple of matters which I would like to pass on.

The first is the sad demise of the Omega Club of Sydney. I am personally saddened, as the Omega Club provided the NCRA with some fine State office bearers during the years when the organisation had separate State Divisions as well as the National Executive and Council. During the six or so years of its life, the club did much for the CB operators and also, through its many fund raising ventures, assisted a great many of the less fortunate folk in our society. I am sure that all my readers join with me and the National Executive of the NCRA in wishing health and prosperity to all the former members of the Omega Club in any future activities.

Ken also mentions a "gentleman" who is operating a jamming device from somewhere in the Blue Mountains. Apparently the device has been relocated from its original suburban home and is so far managing to elude discovery. I am aware that some officers in the Department read this column regularly, so I hope that they may be able to do something about this problem in the near future.

There were a number of other things which Ken informed me of, but, as you may have noticed, there was no CB SCENE last issue, due to the mail strike so I am having to try to include as much other material as possible this month. I will have to leave them for the moment; sorry, Ken!

THE RIGHT IDEA! To round off this month, I must acknowledge the letter I received from Phil Dimond of North Lidcombe, NSW, who asked if I could supply details of how he could join the NCRA. The information you require will be in your hands by now, Phil, so we are hoping to hear from you soon. Thanks for writing.

That seems to be it for this month. Look after yourselves and I look forward to our meeting through these pages in the next issue. Send any bits of info you might have, to Australian CB Scene, PO Box 406, Fortitude Valley, 4006.

Jan Christensen

50 & 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.

Wireless Weekly 3p

March 1932

1932 Radio Show: At the Sydney Town Hall between March 2 and 12, will be held the Radio and Electrical Exhibition of 1932. It is two years since there has been any co-operative display of radio receivers and, in that time, many changes have occurred. Because of this, the 1932 Show will surpass all previous shows in interest, and a record breaking attendance is expected.

Similarly, Australian receivers have improved out of all recognition. A couple of years ago Australian sets were far behind the rest of the world but to-day the modern Australian set could hold its own in any country. During the past three or four months we have been particularly interested in superheterodynes and have made a point of testing 14 different typical American jobs. Not one of these receivers could compare in performance or construction with an Australian-made (Darelle) superhet submitted for test last weekend.

☆ ☆ ☆

Parabolic Microphone: 2CH, the new B station which is to make a feature of special theatre transmissions very soon, has set its engineer-in-charge, Mr T. McNeil, to work on a special parabolic microphone.

The "human ear" of radio as it is called, enables the engineers to focus the microphone on any desired spot.

☆ ☆ ☆

New Superheterodyne: Never content, "Wireless Weekly" technical staff are now working on an improved eight-valve superheterodyne. Using the standard Stromberg-Carlson coils, with minor alteration which any reader can perform at home, this job has remarkable performance. An attempt to record the sensitivity on a signal generator failed, as there was too much leakage from the generator. However, a competent engineer who operated the generator estimates the sensitivity at one-tenth of a microvolt at certain settings of the dial.

RADIO TELEVISION AND HOBBIES 1/6

March 1957

More atom plants: Small atomic power plants for the production of heat or electricity can now be obtained in Britain. The equipment is of American design.

Power plants are available in three sizes, giving net electrical outputs of two, five and 10-megawatts.

A 10-megawatt station which could supply a community of 20,000 can be built on a site no larger than a tennis court. Cost of installation is about £2 million, including hire of fuel. Electric power units would be produced at around 1½d to 2d a unit.

Stations are based on a small pressurised water reactor, using light (natural) water as a moderator and coolant. The reactor would run from 18 months to two years without change of the fuel elements.

Supply of fuel, on loan, has been guaranteed by the United States for the life of the reactor.

☆ ☆ ☆

Solar-powered radio: After 18 months of development work, Admiral Corporation introduced the world's first sun-powered tubeless radio designed for the consumer market.

The solar battery ("Sun Power Pak") developed to power the radio consists of 32 individual quarter sections of silicon solar cells connected in series. This arrangement delivers a total of nine volts at 15 milliamperes.

The solar cells of the battery are encased in a block of clear plastic with a silicon oil centre. The plastic covering and oil centre not only allow the best focusing of sun on the surface of the silicon cells, they also protect the cells from shock damage.

☆ ☆ ☆

Classroom TV: England will soon repeat a system of teaching by TV now operating in Maryland (US). There, two high schools and six elementary schools, with a total of 6000 pupils are getting "piped" TV teaching at Hagerstown. The scheme will be extended to another 15 schools this year. By 1958-59 all the county school system, with 19,000 pupils, will be connected to the system.

Shortwave Scene

by Arthur Cushen, MBE

Higher power and new antenna for Austrian radio

The Austrian Radio is installing several new antenna systems and is shortly to replace one of its old 100kW transmitters with a new 250kW system coupled to a log periodic antenna to give improved worldwide reception.

The major change at the Austrian Radio's transmitting site at Moosbrunn is the installation of new antenna systems. A new non-directional antenna for service to Europe is now in operation, consisting of six towers which use horizontal dipoles to give better penetration of the signal over short distances. A fifth 250kW transmitter is to be installed to replace one of the old 100kW units, so the transmitting building will have to be enlarged. A curtain array has been put into operation, and this high gain antenna covers North and South America and can be slewed to cover Asia. The final antenna system to be installed is a log periodic type like those already in use by the Vatican Radio and Swiss Radio International. This antenna rotates on an 80 metre diameter track which supports two 80 metre towers with the antenna hung between them. The whole structure can be rotated in a matter of a few moments so that it is possible to beam signals to any part of the world.

A break-down of the mail received by Austrian Radio from Australian listeners showed that in 1978 2078 reports were received, 1979 3869 and in 1980 3408. New Zealanders wrote to the Austrian Radio in 1978 with 1441 reports, in 1979 2038 and in 1980 with 2396. From the number of reports submitted in each of the four seasonal periods of reception it is obvious that listeners prefer listening to Vienna during our winter afternoons or summer evenings.

The Austrian Radio has two transmissions in English to the Pacific area at 0430-0500UTC when broadcasts are on 17745kHz to this area, though 12015kHz generally gives the best reception. The second broadcast at 0830-0900UTC is on 17770 and 21640kHz.

ENGLISH FROM LIBYA

Tripoli has been heard with a new broadcast in English on 11815kHz between 0000-0100UTC. The transmission opens with the National Anthem, a program preview and reading from the Koran. A press review follows at 0015, news at 0030 and commentary and at 0050 popular English recordings. Closing is at 0057 with a request for reception reports to Hamahirayah Broadcasting Corporation, PO Box 333, Tripoli, Libya.

WYFR RELAYS VOFC

Family Radio Station WYFR with studios at Oakland, California, and transmitters at Okeechobee, Florida, is carrying programs for the Voice of Free China. This program exchange allows WYFR Gospel programs to be broadcast from Taipeh, Taiwan for reception in Asia.

The signals of WYFR have been noted on 11740kHz at 0200 in English up to 0300, then follows a broadcast in Chinese to 0400 and in Spanish to 0500 when the transmitter leaves the air without any identification. The English identification is heard at 0300 with the short announcement "This is WYFR Okeechobee, Florida".

FRENCH GUYANA HEARD

Broadcasts from Cayenne have been received on the new frequency of 5055kHz opening at 0900UTC. The transmission was observed with a time signal and then the French National Anthem before full identification of the frequencies in use. After popular music, a time signal announcement in French was heard over the program from 0927UTC onwards, broadcast each minute. At 0930UTC a news bulletin was broadcast following a station announcement in French.

The 5055kHz frequency seems to be a replacement of the old 4972kHz channel which over the past few months has always suffered from teleprinter interference. The power on 5055kHz is 1kW and the schedule is 0900-0100UTC.

OUT OF BAND STATIONS

Many shortwave stations are moving to frequencies outside the authorised band and Trans World Radio at Monte Carlo has been noted on two of these. The broadcasts on 7325kHz have been received with gospel programs to Eastern Europe, with an English announcement at 1805UTC indicating the preceding program was in Estonian. Another frequency, 9815kHz, is used 1800-1815UTC with broadcasts in Slovak.

All India Radio, Delhi, uses 7412kHz for a five minute news bulletin in English 1800-1805UTC. At 1805UTC the program continues in Hindi, and is a relay of the domestic service.

FREQUENCY CHANGES

Afghanistan: Radio Afghanistan has an External Service 1730-1930UTC which includes 30 minutes of English at 1900UTC. Three frequencies carry the program 7290, 9665 and 15077kHz. The first two transmitters are Soviet based, while the third frequency originates from Kabul. The transmission includes Pashto/Dari and German as well as the English broadcast.

Kuwait: Radio Kuwait has altered its frequency for the broadcast at 1800-2100UTC and this is now on 11675kHz. The transmission 0500-0800 is still received on 15345kHz.

Indonesia: Radio RPD tingkat 2 Tanah laut has been heard on the new frequency of 3491kHz relaying news from Jakarta at 1500UTC. Geoff Cosier of Melbourne reports that this is a frequency change from 3581kHz and his best reception has been at 1400UTC.

New Zealand: Radio New Zealand External Service tentative schedule for the period commencing May 2 shows the use of a new frequency, 11865kHz, for the period 0640-1215 which will carry the program to the Pacific and Australia. The use of 9540kHz is also indicated for the period 1800-2105, while 11960kHz also opens at 1800 and closes at 2130UTC.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill NZ. All times are UTC (GMT). Add eight hours for WAST, 10 hours for EAST and 12 hours for NZT. In areas observing daylight time, add a further hour.

Books & Literature

Digital Electronics for Beginners

BEGINNER'S GUIDE TO DIGITAL ELECTRONICS by Ian R. Sinclair. Published by (Newnes) Butterworths Pty Ltd, 271-273 Lane Cove Road, North Ryde 2113. Soft covers 183 × 123mm. 146 pages. Numerous tables and diagrams. Price $9.00.

For anyone who grew up in the analog age, this book could give a useful grounding in digital electronics. The seven chapters cover the essential items such as: Signals, switching and devices – Logic gates – Clocks and other inputs – Flip-flops and counters – Shift registers – Displays and drivers – Microprocessor systems.

The Author assumes that the reader has a basic knowledge of transistors, Fets and normal passive components and leads on with an explanation of the various coding systems used in digital electronics, Boolean algebra, truth tables and the basic circuit elements, using both bipolar and Mos, and the way in which these are incorporated in discrete and integrated form. One useful feature found throughout the book is the noting of advantages and disadvantages of each type of building block and component normally encountered. The chapter on displays give information on most types encountered, including LED's liquid crystal, seven segment filament, plasma display as well as the older "Nixie" neon display, dating back to vacuum tube equipment, together with the reasons for and methods of multiplexing and driving displays from various data sources.

In the preface, the author mentions the fact that the symbols used in the text comply with the international MIL-806B standards rather than the recently changed British standards, so it would be advisable to check on this point if you contemplate using the book in conjunction with a formal study course to avoid any confusion. Practical hints are given for experiments, if the reader wishes to try things for himself.

In summary, I feel that this is a book that will fill an important place between the very basic text and the "heavier" professional books that tend to deter someone seeking an understanding of an increasingly important facet of electronics. (N.J.M.)

Understanding DC Power Supplies

UNDERSTANDING DC POWER SUPPLIERS, by Barry Davis. Published 1981 by Prentice-Hall of Australia Pty Ltd, 209 Glenhuntly Rd, Elsternwick 3185. Soft covers, 235 × 170mm, 232 pages. Copiously illustrated with diagrams.

The author of this useful introduction to DC power supplies has obviously aimed for the post trade or certificate student or those in industry that need a guide to what is going on inside those black boxes.

There are eight chapters, plus four appendices, covering; Rectifiers – Filters – Voltage regulators – Integrated regulators – Voltage multipliers – DC to DC converters – Switched-mode power supplies – Fault finding and test circuits. Each chapter has a section of self-evaluation questions to check one's grasp of the subject matter and the answers to these make up one of the appendices, the others being a glossary of terms and symbols – calculation of ripple and form factor for unfiltered half and full-wave rectifiers – calculation of average and RMS values.

It is an easy matter with a text such as this to quickly establish the voltage and current relationships that can be expected when designing, building or trouble shooting modern solid state power supplies. Each circuit has a full mathematical analysis, so efficiencies of different configurations can be easily established, together with the ratings of various components.

A useful range of practical circuits is given, to illustrate the various types of regulating circuits, converters and switched-mode supplies, with the latter circuitry becoming more popular as a high efficiency power supply in colour television receivers.

The author has wide experience in industry and in teaching and curriculum development and this shows in the very strong practical emphasis in the text. In short, a book to be recommended. (N.J.M.)

Guidebook to Small Computers

GUIDEBOOK TO SMALL COMPUTERS: by William Barden Jr. Soft covers, 125 pages 138mm x 215mm, illustrated with photographs and charts. Published 1981 by Howard W. Sams & Co. Inc Price $6.75.

This little book is a guide to many of the small computer systems available today. Information on each microcomputer is summarised in a capsule description in each chapter, and reports on the capabilities of each computer are provided. Altogether, nine systems are described in separate chapters, while a final chapter describes five other computers in less detail.

The first chapter of the book is titled "Small Computer Basics" – not about programming languages, but a description of the features common to microcomputer systems. Hardware, including both "single board" and bus oriented systems are defined, and a short description of software principles is given, limited to the Basic language and assembly language.

Separate chapters on the Apple II, Atari, Commodore, Cromenco, Heath, Ohio Scientific, TRS-80, Synertek (the SYM-1) and Vector Graphic systems make up the bulk of the book.

Each chapter describes the physical appearance of the computer, accessories required, format of video display and processor type. Available peripherals, software and warranty and service policy are also described briefly. Each chapter concludes with a single page tabulation of the main features of the system described.

The final chapter gives brief descriptions of the Compucolor II, Exidy Sorcerer, North Star Horizion, SWTP systems and the TI-99/4 from Texas Instruments. Again relevant information is summarised in charts.

Some deficiencies in the description of each manufacturer's range lead one to believe that the manuscript for this book was prepared quite some time before the actual publication date. For example, there is no mention of the Apple III, or of the TRS-80 Model III or Color Computer. Nor for that matter is the Cromemco System Zero mentioned, although it was available in the United States in 1980.

"Guidebook to Small Computers" is on the whole a useful book. In the limited space available it gives the information required to make at least a preliminary decision on the virtues of a particular

microprocessor system. One possible objection is that the various systems described are not distinguished by application. Powerful business systems are mixed at random with "home" computers and single board development systems, with little indication given of the suitability of a particular system for any one application.

If you are contemplating buying a small computer, this book can save time by providing a comparative study of some of the most popular computers available. It should not be used as the sole arbitrator however, particularly since from the time of writing the fast moving microcomputer industry has produced a number of other machines which make this text slightly dated.

Our review copy came from McGill's Authorised Newsagency, 187-193 Elizabeth St, Melbourne, 3000. (PV)

Books recently received

PROTECTIVE RELAYS, Their theory and practice, by A. R. van C. Warrington. Volume 2, Third Edition. First published 1969 by Chapman and Hall Ltd, London. Hard covers 434 pages, 161 x 241mm, illustrated with many circuits and diagrams. Distributed by Associated Book Publishers (Aust) Ltd. $39.60.

While this book was first published in 1969, it apparently has been extensively updated in each edition and includes a considerable amount of material directly applicable to solid-state circuits.

INTO ELECTRONICS, an introductory text. Soft covers, 90 pages, 182 x 240mm, illustrated with photos and diagrams. Published July 1981 by Wireless Institute of Australia (NSW Division). Price $3.00.

This text is intended to provide basic theory for beginners in very simplified form. It is available for $3 including postage from the WIA Education Service, PO Box 262, Rydalmere, NSW 2116.

THE TAKE AIM MANUAL, Volume 1, by James H. Clark. Soft covers, 388 pages, 217 x 280mm. Published 1981 by Matrix Publishers, Inc, Beaverton, Oregon, USA.

This manual is designed to introduce the Rockwell Advanced Interactive Module (AIM) 65 which is a microprocessor development and teaching system. The AIM uses the 6502 microprocessor and can be used for the development of hardware and software. This book touches on virtually every feature of the AIM 65 and devotes considerable space to program development.

Our copy came direct from the publishers.

New Products...

Product reviews, releases & services

We test the Fluke 8050A portable multimeter

The Fluke 8050A portable bench multimeter is not only a highly accurate unit, particularly with the true RMS AC waveform measurement, but is provided with useful functions not normally found with multimeters. The meter is mains powered and has a 4½-digit LCD which offers high contrast and visibility.

Many modern laboratory instruments use microprocessors to perform the mathematical and control functions as well as high level features. The Fluke 8050A multimeter follows this trend and utilises the inbuilt microprocessor to the fullest. The microprocessor performs four functions, that of control, measurement, calculation, and driving the display.

Apart from the standard AC, DC volts, mA and resistance, the multimeter can also display dB, conductance and relative measurements. High accuracy is available with all measurements and in the AC ranges will provide this accuracy for waveforms other than sine waves due to the true RMS measurement technique.

The 8050A bench multimeter is housed in an impact-resistant grey plastic case which incorporates a darker grey tilting bail. The bail can be set to various angles and is also usable as a carrying handle. Overall dimensions of the unit are 220 × 60 × 250mm (W × H × D) and the mass is 1.08kg.

Three banana type input terminals are provided and are recessed to prevent accidental contact of potentially high measured voltages. The common and V/kΩ/S inputs are used for all but current measurements which require the use of the third mA socket.

A row of four pushbutton switches select functions of AC, DC, V, mA, resistance, dB and conductance, while six more buttons select the range required. Colour coding of the function switches is used to associate these with the range switch selection. Below these switches are the Relative and Power pushbuttons.

This arrangement of the front panel control switches is simplified, with more than one function available from the one switch. For example, pressing the V and mA function switches together will provide measurement in dB.

The LCD has high resolution and 4½ digits can be displayed. This means that the display can register from 0000 to 19999. Additional to this is an auto polarity (±) symbol at the left-hand side of the display and a dB, HV and REL function symbol at the right-hand side of the display. Three indications other than these, are a "1" in the left-hand side for overrange, all decimal points displayed for illegal switch positions and a blanked right-hand digit to indicate reduced resolution in the REL mode.

DC voltage ranges are ±200mV with 10μV resolution, ±2V, 100μV resolution, ±20V, 1mV resolution, ±200V, 10mV resolution and ±1000V with 100mV resolution. Accuracy for all ranges is ±.03% of reading plus two digits.

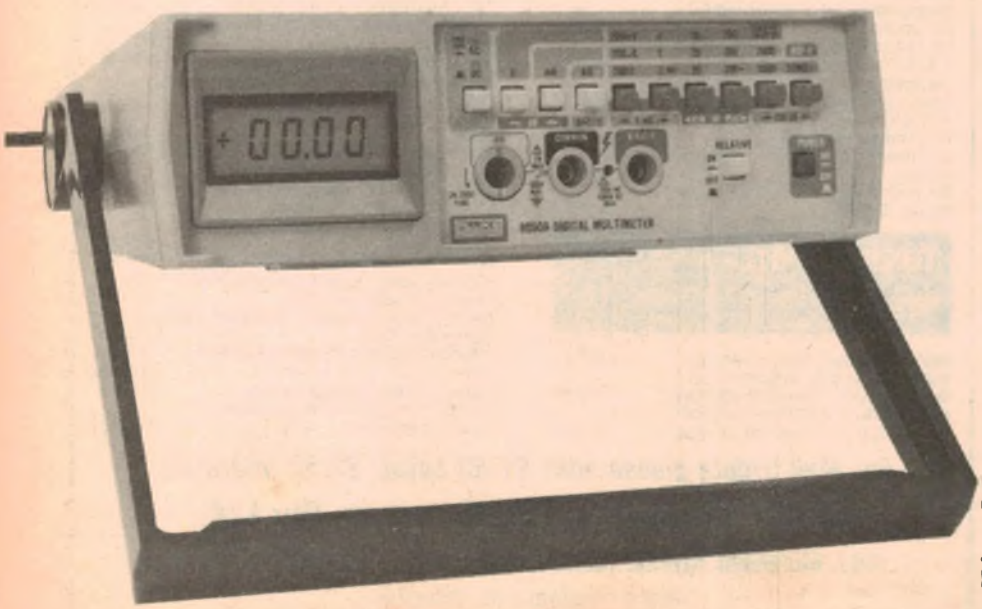
AC voltages and resolution are similar to the DC ranges with the exception that the maximum voltage is up to 750V RMS. Accuracy for frequencies above 20Hz and below 20kHz is better than 1% plus 10 digits and rising to 5% plus 30 digits between 20kHz and 50kHz.

This high upper limit of AC frequency response makes the instrument especially useful for audio work measurements, particularly since direct measurements in dB can also be made. All AC waveform measurements are calculated as true RMS rather than the usual "scaled to read RMS for a sine wave". The permissible crest factor (ratio of peak to RMS of the waveform) range is from 1:1 at full scale, which increases to 3:1 as the input signal reduces within the range.

The range of dB readings are from approximately −60dBm (600Ω) to +8dB when the 200mV button is pressed and in this position, the instrument actually auto ranges to the 2V range for best accuracy. At the 750V range, up to +60dB can be measured. Accuracy for the readings is better than ±0.25dB from 20Hz to 20kHz and rising to ±0.75dB from between 20kHz and 50khz.

When measuring in dB, any of the 15 user-selectable impedance reference levels, provided to reference a 0dBm 1mW level, can be selected. By pressing the REF Z switch, all of the impedances are sequentially displayed on the LCD at a slow rate. Values from 50Ω to 1200Ω are available and an 8Ω impedance reference level is also provided to reference a 0dBW level. When the required impedance is shown, the range switch should be selected and the instrument is referred to this selected impedance.

DC and AC current ranges are 200μA at .01μA resolution, 20mA at 1μA resolution, 200mA at 10μA and 2A at 100μA resolution. Accuracy of the DC current is ±0.3% of reading +2 digits. The burden voltage (the voltage across the meter) is 0.3V maximum for all ranges up to 200mA and less than 0.9V up to 2A. The accuracy for the AC measurements is better than 2% +10 digits from 20Hz to 20kHz.



Resistances can be measured in ranges from 200Ω to 20MΩ, with accuracies of better than 0.1% +2 digits for the lower ohms ranges and 0.25% of reading +3 digits for the upper two ranges. Three ranges provide enough voltage to turn on a silicon junction for diode testing while the remainder of the ranges will not turn on a diode junction and are suitable for in-circuit resistance measurement.

Conductance measurement (resistance inverted) having the units of siemen (S) is also available. Two ranges, above 2mS and above 200nS are provided to measure resistances from 500Ω to 10MΩ and 5MΩ to 100,000MΩ respectively. The lower scale is useful for directly measuring DC current gain of transistors.

Normal mode rejection ratio for the DC voltage measurement is better than 60dB when a 50 to 60Hz signal is superimposed on the DC voltage. The input impedance of the meter is 10MΩ in parallel with less than 100pF.

One feature which is very useful is the Relative control. Here the actual difference between the value set as a reference and the measured value is displayed. This is achieved by first measuring the offset value and pressing the Relative switch. The REL symbol will be displayed on the LCD and all values measured will be the difference between this offset value and the value measured. It should be noted that overload can occur if the sum of the offset and measured value is greater than the set range.

The meter is fully protected against excess current with a 2A fuse and voltages up to 1000V DC or peak AC. In the resistance or conductance mode up to 300V DC or AC RMS can safely be applied. Common mode voltage maximum input is 500V DC or peak AC.

The 8050A performed well under test and we found it easy to use. In fact the performance of the unit was well within specification and this is what we would expect from an instrument of this calibre. The unit would be ideal for laboratory usage particularly when audio measurements are needed as well as high accuracy and resolution.

The meter is supplied with a red and black probe lead set, a three-pin mains plug and cord which connects to the rear of the instrument and an extremely well-organised instruction manual. The manual covers specifications, operating instructions, theory of operation, maintenance (including calibration) and a schematic diagram. Many accessories are available for the 8050A, such as carrying cases; probe accessories; current probe, temperature probe, and current shunts.

Recommended retail price of the Fluke 8050A is $415 plus 17.5% sales tax. We understand that a rechargeable battery option is also available for $55 extra. For further details contact Elmeasco Instruments Pty Ltd, 15 McDonald Street, Mortlake 2137. Telephone 736 2888. (JC)

New Weller soldering station

The Weller miniature soldering station is well suited to modern electronic work. It provides continuous control of temperature from 50°C to 450°C.

Radio Despatch Service now has available the latest Weller soldering irons, including the 15W Marksman SP15D and the Weller WMCP-EC temperature controlled miniature soldering station.

The Marksman iron works directly from the 240V mains and is provided with a 2mm wedge tip. Replacement tips in various styles are available. It makes a convenient, lightweight iron for servicing or general electronic work.

The Weller 15W miniature soldering station is very well designed for contemporary electronic work. Features include a 240/12V isolation transformer, mains switch with pilot light, a fuse accessible from the front panel, soldering iron rest, cleaning sponge and a bracket to hold spare tips. The base of the unit measures 125 x 100 x 62mm (W x D x H) and is moulded in impact resistant flame-retardant plastic, heavy enough to stay put on the work bench.

High quality electronic design provides a continuously variable temperature control between 40°C and 450°C. The selected temperature is automatically maintained to within ±2°. A sensor in the tip transmits the actual temperature to the control circuitry which then adjusts the element to maintain the temperature, taking into account heat lost by radiation and conduction to the solder and work piece.

In order to provide protection for sensitive components, the soldering station incorporates a number of safety features, including low voltage operation and mains isolation. Actual temperature control is by means of a zero-voltage switching circuit, eliminating any possibility of generating high-voltage interference with other equipment.

Another nice feature is the provision on the front panel of a socket connected to the tip of the iron. An earthing lead connected between this socket and the board being worked on will prevent potential differences which may cause harmful static discharges.

All in all the unit is very well made, compact and versatile enough to handle any electronics job. In the event of a fault developing however, Weller back their products with a one year guarantee.

Weller irons are distributed in Australia by the Cooper Tool Group Ltd, PO Box 366, Albury, NSW, 2640. Radio Despatch Service is at 869 George St, Sydney, 2000. (P.V.)

Advertising display system from Dick Smith

Dick Smith Electronics recently released a large size moving character display for use in advertising and promotional campaigns. The "Point of Information Computer", as it is called, is a small, programmable version of a "Times Square" message indicator – a real attention getter!

In use, the display is programmed from a hand-held alphanumeric keypad. An internal memory holds 235 characters, continuously cycled to display the message. The display operates from 240V, but two AAA size batteries provide stand-by power for the memory which will maintain the message when the display itself is turned off.

When power is restored the previously programmed message will be displayed. It's said to be ideal for shop windows, counters and show cases.

An automatic keyboard lock is included which will prevent inadvertent or unauthorised programming.

The Point of Information Computer is supplied with power supply, mounting bracket, keyboard and full instructions. It is priced at $250 and is available from all Dick Smith Electronics stores.

New Products

Decoupling radials boost antenna performance

Decoupling radials to suit most types of two metre extended Ringo antennas are now available from GFS Electronic Imports of Melbourne.

Many reports, particularly in US magazines, testify to the improved performance gained by fitting a set of decoupling radials below the ring matching section of Gamma Ring type vertical antennas. In response to these reports GFS Electronics has made available a kit, the Model RK-2, consisting of four solid aluminium radials and a mounting ring which can be easily installed on existing two metre Ringo systems.

The RK-2 is suitable for use on masts of up to 27mm diameter. It costs $16 plus $3 post and packing, and is directly available from GFS Electronic Imports, 15 McKeon Road, Mitcham, Vic 3132.

Motorola introduce high-speed CMOS logic

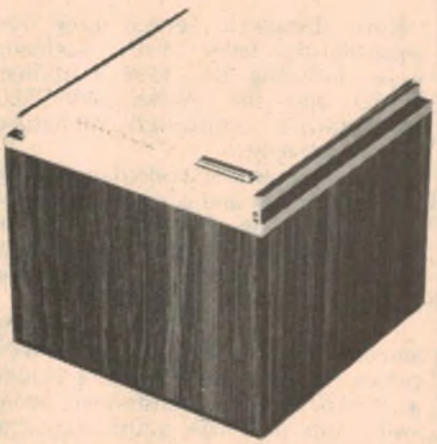
Motorola Inc is now making samples available of its new high speed CMOS digital integrated circuits. Reports from the United States indicate that the new MC54/74HC series offer the low power consumption of CMOS combined with the high speed of low-power Schottky TTL.

Motorola and National Semiconductor Corporation are both offering the circuits, and will second source each others' devices.

Features of the high-speed CMOS family include pin-for-pin compatibility with lower-power Schottky TTL devices, drive capability of up to 10 LS TTL loads, a guaranteed 25MHz clock frequency for counters and 30MHz for other devices. Propagation delay of simple gates is 15ns.

Eight of the new chips are currently being offered in sample quantities to manufacturers. Motorola say that over a hundred additional logic devices are scheduled for introduction with volume production set to begin in early 1982.

A talking clock from Tandy Electronics



Tandy Electronics are currently marketing a talking clock called the VoxClock. Quite literally, the new clock "tells the time", using electronic speech synthesis.

At the touch of a button the clock speaks the hour and minute with the notation "am" or "pm" with quartz crystal accuracy. Alternatively it can be set to announce the time on the hour. Power for the clock is provided by three AA batteries, so that it is independent of mains power supplies and unaffected by power failures.

The VoxClock is housed in a simulated 60mm x 73mm x 73mm walnut cabinet, with a loudspeaker grille and time pushbutton set in brushed aluminium on top. Other controls such as the High/Low volume switch, hourly announcement selector and time-setting buttons are housed out of sight on the base of the cube. There is no visual indicator at all.

The VoxClock is available from all Tandy Electronics stores.

Dremel "Moto-Tool" is a portable power workshop

The Dremel "Moto-Tool" is advertised as the "portable power workshop with 1001 uses", and it certainly seems to fulfil that claim.

The basic tool is a high power 30,000 rpm motor in a tough plastic hand-held unit. Power is supplied from the mains, and power consumption is 110W.

A variety of attachments is available for the Moto-Tool. Four different sizes of collet are available to accommodate drill shanks, cutting and engraving tools or grinding, polishing and sanding wheels. There is even an attachment for sharpening chain saws.

A brochure accompanying the unit lists some of its uses. Model makers can use a grinding tool to remove flash from moulded work, grinding and finishing. The electronics hobbyist can use the unit as a high-speed circuit board drill or for cutting and shaping PCBs. Handymen can do small sanding and polishing jobs or use the Moto-Tool to sharpen other tools. The unit will work on wood, metal or plastic.

Best results are achieved when the tool is used with a full wave output motor speed controller. The Dremel models 215 and 218 controllers provide variable speed control, allowing the right speed to be selected for any job.

Also available from Dremel is a Moto-Tool bench mount and a miniature drill press for precision work.

The Dremel Moto-Tool is distributed by Bill Edge's Electronic Agencies, 115-117 Parramatta Rd, Concord, NSW. Mail orders and enquiries should be sent to PO Box 185, Concord, NSW, 2137.

New products cont'd ►

20% OF ALL PRICES THIS MONTH (Exp. End March '82)

(Applies Only To This Add And Does Not Include Super Specials)

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ELECTRONIC COMPONENT SUPPLIERS, DESIGNERS & MANUFACTURERS.
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TELEX: AA38897

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SUPER SPECIALS

2708	$ 4.50	BU326	$ 1.90
2716	$ 4.90	Z80S10	$21.00
2732	$ 8.00	1771	$19.00
6800	$ 7.90	1791	$59.00
6802	$11.00	1795	$59.00
6809	$22.00	4116	$ 1.95
8085	$12.50	2114	$ 1.95
8080	$ 7.00	TA7205	$ 3.30
6821	$ 3.50	100 Red Leds	$ 9.00
Z80P10	$ 5.00	BUX80	$ 3.90
		BU126	$ 1.90

DIP SWITCHES SPST

P/N	No. Switches	Price
SD3	3	1.60
SD4	4	1.70
SD5	5	1.90
SD6	6	2.30
SD7	7	2.40
SD8	8	2.50
SD9	9	2.70
SD10	10	3.00

WIRE WRAP 3-LEVEL

	1-9	10-25
8 Pin	1.00	.90
14 Pin	1.10	1.00
16 Pin	1.20	1.70

18 Pin	1.50	1.40
20 Pin	1.80	1.60
22 Pin	1.90	1.70
24 Pin	2.00	1.80
28 Pin	2.20	2.10
36 Pin	2.60	2.40
40 Pin	2.90	2.70

COMPUTER GRADE ELECTRO

2900uf	40V	6.50
6800uf	16V	6.40
10,000uf	16V	9.00
10,000uf	25V	9.50
10,000uf	40V	11.90
15,000uf	40V	12.00

22,000uf	25V	12.90
22,000uf	40V	23.00
27,000uf	35V	23.50
33,000uf	16V	23.50
68,000uf	16V	21.50
100,000uf	10V	20.50

MULTISTRAND RIBBON CABLE
Price per m tre

	1-9	10+
10 Way	.90	.80
12 Way	1.00	.90
16 Way	1.20	1.10
20 Way	1.70	1.60
40 Way	3.20	3.00

CMOS

4000	.40
4001A	.40
4001B	.40
4002	.50
4006	1.10
4007	.50
4008	1.00
4009	.80
4010	.50
4011	.40
4012	.50
4013	.80
4014	1.70
4015	.90
4016	.70
4017	1.50
4018	1.50
4019	.60
4020	1.20
4021	1.10
4022	1.05
4023	.70
4024	1.00
4025	.50
4026	2.20
4027	.60
4028	.90
4029	1.20
4030	.60
4031	2.20
4034	3.00
4035	1.30
4039	.70
4040	1.70
4041	1.05
4042	.70
4043	.70
4044	.70
4046	1.20
4047	1.20
4048	.60
4049	.60
4050	.60
4051	1.00
4052	.80
4053	.80
4060	2.00
4066	.80
4068	.60
4069	.70
4070	.50
4071	.60
4072	.50
4073	.60
4075	.60
4076	1.20
4077	.50
4078	.60
4081	.60
4082	.60
4089	1.00
4093	.80
4503	.60
4510	1.50
4511	1.50
4512	1.10
4514	2.50
4516	1.40
4518	1.50
4519	.55
4520	1.60
4522	1.25
4527	1.20
4528	1.25
4529	1.60
4539	1.60
4541	1.60
4543	2.00
4553	5.50
4555	1.00
40097	.95
40098	.95
40175	1.00

74C SERIES

74C100	.40
74C02	.40
74C04	.40
74C08	.40
74C10	.40
74C14	.90
74C20	.40
74C30	.40
74C32	.40
74C42	1.10
74C48	1.55
74C73	.75
74C74	.70
74C76	.75
74C83	1.40
74C85	1.20
74C86	.80
74C90	.80
74C93	1.40
74C95	.95
74C107	.70
74C150	3.40
74C151	1.00
74C160	.90
74C192	.90
74C164	1.10
74C173	1.00
74C174	.80
74C175	1.00
74C192	1.20
74C195	1.00
74C221	1.90
74C373	1.80
74C374	2.00
74C901	.90
74C902	.90
74C905	11.20
74C906	.90
74C907	.80
74C915	1.50
74C922	3.80
74C923	5.00
74C925	7.80
74C926	7.80
74C927	5.90
74C932	5.50

80C SERIES

MM80C95	.90
80C96	.90
MM80297	.90
80C98	.90

LINEAR

LH0002	9.50
LH0022CD	16.60
LH0042CH	8.60
LH0070	12.70
LH0071	12.70
TL071	1.00
TL072	1.50
TL082	1.50
SAK140	2.20
UAA170	3.50
UAA180	3.50
TCA220	2.20
LM301	.50
LM301-H	.50
LM304-H	1.70
LM305-H	.80
LM307-CN	.40
LM307-H	.90
LM308	.70
LM308-H	1.20
LM310-N	2.20
LM310-H	2.60
311	.60
LM311	.60
LM311-H	1.20
LM318	2.80
LM322	3.90
LM324	1.20
LM325	3.10
LM329-DZ	1.40
LM334 Z	1.30
LM335	12.40
LM336 Z	3.20
LM339	.90
LM348	1.10
LM349	1.80
LF351-N	.70
LF356-AN	1.10
LF357	1.10
LM358	.70
LM373	4.10
LM374	5.40
LM376	.70
LM377	2.90
LM379	5.70
LM308 8PIN	1.30
LM380	
14PIN	1.50
LM318A-N	2.40
LM318N	1.80
LM382N	2.00
LM383	2.70
LM384	2.40
LM386	1.00
LM387	1.30
LM391	1.80
LM393	.80
LF398	5.00
8038	6.00
NE530	1.10
OM350	9.90
555	.40
556	1.10
LM565	1.30
LM565CH	2.00
NE566	2.50
LM567	1.50
NE571	6.50
LM709 14PIN	.70
UA710CA	.60
LM710-CH	.90
711	.80
UA711-H	.85
UA716HC	6.25
723	.50
LM723CH	1.10
LM725	3.90
LM733	1.20
UA739	2.00
741	.25
LM741-H	1.20
UA747	1.00
UA747HC	2.20
UA748	.50
UA748HC	1.25
UA753	1.80
UA760HC	4.10
UA777	2.40
UA777HC	2.65
9334	1.70
UA743	1.80
UA760HC	4.10
UA796HC	1.70
LM802	1.10
LM1310N	2.40
1408	4.90
LM1458	.60
UA1488	1.50
UA1489	1.50
MC1495	7.30
MC1496L	11.40
LM1558	1.50
LM1596	1.40
LM1380	3.10
LM2902	1.40
LM2917	
8PIN	2.80
LM2917	3.10
CA3028	1.80
LM3039	.90
CA3046	1.70
3065	.45
LM3080	1.20
LM3089	3.90
CA3130T	1.40
CA3130E	1.80
CA3140	1.40
3401	.70
3611	1.10
LM3900	.90
LM3909	1.00
LM3914N	3.90
4136	1.40
LM4250	1.75
UA4558TC	1.40
MM5837	2.50
LM7555	1.80
Mc10116L	.95
LF13741	.60
LF1374-1H	.70
DS75452	.60
76477	4.90
75451	.60
75491	1.40
75492	1.40

TTL (s)

74S00	.80
74S02	.80
74S04	.80
74S10	.75
74S11	.75
74S32	.75
75S51	.75
74S74	1.20
74S86	1.40
74S112	1.20
74S135	2.20
74S138	3.20
74S157	2.95
74S158	2.95
74S182	3.30

7400 SERIES

7400	.40
7401	.40
7402	.40
7403	.40
7404	.40
7405	.50
7406	.50
7407	.50
7408	.40
7409	.40
7410	.40
7411	.40
7412	.50
7413	.70
7414	.70
7416	.50
7417	.60
7420	.40
7421	.40
7423	.50
7425	.45
7426	.40
7427	.40
7430	.40
7432	.40
7437	.40
7438	.50
7440	.50
7441	1.00
7442	.50
7443	1.40
7444	1.20
7445	1.10
7446	1.00
7447	1.00
7448	1.00
7450	.50
7451	.50
7453	.40
8126	2.20
9300	.60
9307	1.80
9308	1.20
7454	.60
7472	.60
7473	.60
7474	.60
7475	.60
7476	.60
7480	.65
7482	1.80
7483	.80
7485	.80
7486	.60
7489	2.60
7490	.70
7491	.55
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7493	.60
7494	.90
7495	.45
7496	.80
7497	2.50
74107	.80
74109	.60
74116	2.20
74121	.45
74122	.65
74123	.60
74125	.55
74126	.60
74132	.80
74141	1.10
74145	.85
74147	2.00
74148	1.40
74150	1.20
74151	.60
74152	4.90
74153	.70
74154	1.20
74155	.90
8T28	3.00
9310	.65
9311	1.00
9312	1.35
74156	1.50
74157	.60
74161	1.00
74162	1.00
74163	.85
74164	.60
74165	.60
74174	.50
74175	.90
74176	1.10
74177	1.10
74180	.90
74181	2.30
74182	.90
74184	1.20
74185	1.20
74190	1.00
74191	1.50
74192	1.70
74193	.80
74194	1.10
74195	.65
74196	.85
74197	1.10
74198	1.10
74199	1.30
74221	.90
74290	.90
73293	.90
74365	.80
74366	.80
74367	1.00
74368	1.00
8196	1.80
9314	1.30
9368	1.75
9370	2.00

74LS SERIES

74LS00	.40
74LS01	.40
74LS02	.40
74LS03	.40
74LS05	.40
74LS08	.40
74LS09	.40
74LS10	.40
74LS11	.40
74LS13	.50
74LS14	.90
74LS15	.40
74LS20	.40
74LS21	.40
74LS22	.40
74LS26	.40
74LS28	.40
74LS30	.40
74LS32	.40
74LS33	.40
74LS37	.50
74LS38	.50
74LS40	.50
74LS42	.75
74LS47	.85
74LS48	1.00
74LS49	1.00
74LS51	.40
74LS54	.50
74LS55	.55
74LS58	.65
74LS73	.55
74LS74	.60
74LS75	.45
74LS76	.50
74LS78	.50
74LS83	1.00
74LS85	1.00
74LS86	.50
74LS90	.70
74LS92	.90
74LS93	.80
74LS95	.65
74LS96	1.55
74LS107	.60
74LS109	.60
74LS112	.60
74LS113	.65
74LS114	.50
74LS122	.50
74LS123	.75
74LS125	.50
74LS126	.70
74LS132	.80
74LS133	.50
74LS136	.50
74LS138	1.20
74LS139	.85
74LS151	.75
74LS153	.60
74LS154	1.50
74LS155	1.00
74LS156	1.00
74LS157	.90
74LS158	.70
74LS160	.85
74LS161	.85
74LS162	1.00
74LS163	.85
74LS164	1.30
74LS165	.50
74LS168	1.90
74LS169	1.90
74LS170	2.80
74LS173	.90
74LS174	.90
74LS175	.90
74LS181	2.50
74LS189	3.80
74LS190	1.30
74LS191	1.10
74LS192	.85
74LS193	.85
74LS194	.70
74LS195	.80
74LS196	1.25
74LS197	1.00
74LS221	1.10
74LS245	2.35
74LS247	.90
74LS249	1.30
74LS251	.80
74LS253	.90
74LS257	.65
74LS258	.50
74LS259	2.45
74LS260	.90
74LS266	.90
74LS273	1.60
74LS279	.65
74LS283	1.15
74LS290	1.10
74LS293	1.15
74LS295	1.60
74LS298	1.00
74LS352	1.30
74LS353	1.30
74LS365	.50
74LS366	.70
74LS367	.90
74LS368	.90
74LS373	1.50
74LS374	1.70
74LS386	.50
74LS670	2.70
81LS95	2.10
95H90	11.50
11C90	19.50
81LS96	2.10
81LS97	2.10

TRANSISTORS

2N301	2.20
2N657	.60
2N930	.60
2N1613	1.10
2N1711	.50
2N1893	1.30
2N2219A	.60
PN2222	.20
PN2222	.30
2N2463	.35
2N2484	.65
2N2646	.70
2N2647	1.10
2N2894	.80
2N2904	.45
2N2905	.40
2N2906	.45
2N2913	1.20
PN2907	.30
2N3053	.60
2N3054	.90
2N3055	.90
2N3301	.40
2N3440	1.10
2N3502	.70
2N3503	.70
2N3563	.30
2N3564	.30
2N3569	.30
PN3565	.30
PN3566	.30
PN3567	.30
2N3568	.30
2N3638	.30
2N3639	.30
2N3640	.30
2N3641	.30
2N3645	.30
PN3642	.30
PN3643	.30
PN3644	.30
2N3646	.30
2N3692	.50
2N3693	.35
2N3702	.30
PN3694	.30
2N3704	.30
2N3709	.30
2N3713	2.20
2N3819	.80
2N3866	2.00
2N3904	.30
2N3906	.30
2N4030	1.10
2N4032	.55
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New Products

BWD Instruments has oscilloscope cameras

BWD Instruments is finding more and more applications for the Shackman Super Seven oscilloscope camera system in the medical and electronic fields.

The Model 7000 camera used in the system now has an improved shutter and lens, eight speeds, ranging from 1 to 1/125th of a second and aperture control from F3.5 down to F32. It is available for use as a hand-held camera or for permanent mounting to an oscilloscope using one of BWD's range of adapters.

The camera features interchangeable film backs for either flat pack or film rolls, a variable object to image ratio and a binocular viewfinder for use when the camera is mounted to an oscilloscope.

Further details are available from BWD Instruments Pty Ltd, PO Box 325, Springvale, Vic 3171.

Vero circuit boards, mounts from Warburton-Franki

Newly developed by Vero Electronics Ltd is a range of circuit board drawer units suitable for both free-standing and rack mounting applications. The drawers are designed to make it easy to mount a variety of microprocessor boards horizontally as well as conventional plug-in Eurocards and Vero logic boards.

Basic kits are available from stock in various heights, with an overall depth of 400mm. Each drawer comes complete with optional rack mounting plates and a slide mounting kit can be supplied if required. Mounting kits for cooling fans can also be supplied.

For further details contact your local Warburton Franki distributor.

Tono Theta-9000E communications computer

Tono Corporation of Japan has released a new Theta-9000E, an upgraded version of the popular Theta-7000E radioteletype communications terminal.

A feature of the new 9000E is a word processor built into the terminal, while a graphics function permits graphic patterns to be drawn on a video terminal with a light pen and then transmitted.

Memory capacity has been increased to 16,000 characters, with a battery back-up provided for 256 characters on seven channels.

A brochure on the 9000E is available by writing to Vicom International Pty Ltd, PO Box 366, South Melbourne, Vic 3205.

Satellites show a war-like face . . . from P14

signals. So military engineers in the US are experimenting with laser communications. A laser could send information between ground stations via a satellite at the rate of 1000 million bits per second – equivalent to transmitting the contents of the Encyclopaedia Britannica every second – yet produce a footprint only a few hundred metres across. Such transmissions would be almost impossible to intercept or jam. Last December, the Air Force completed Earth-bound trials with an experimental laser system and will launch it on the P80-1 satellite in about 1984.

Military commanders also need to know where they are: hence the reason for navigation satellites. The Transmit network of navigation satellites operated by the US Navy since the mid-1960s continues to be used by mariners throughout the world, and has recently been updated by the introduction of three new satellites known as Novas. The satellites transmit radio signals on a precise schedule that is corrected as they fly over timing stations on the ground. Receivers on board ships detect the doppler shift – the slight change in frequency of the radio signals as the relative positions and speeds of the vessels and satellites alter – and a computer works out the ship's position to within 200m or so.

In the mid-1980s this arrangement will be replaced by the Global Positioning System, using 18 NavStar satellites orbiting in belts at a height of more than 16,000km. Each spacecraft will carry three atomic clocks accurate to one second in 30 years. Receivers in land vehicles, backpacks, ships, aircraft and even missiles will measure the time that radio signals arrive from different satellites. As the transmission times of the signals are co-ordinated, the receiver can calculate its own position and speed. The network has been reduced from 24 satellites to 18 to save money, but it will still be accurate to within about 16m. With the system, missiles will be able to fly to unseen distant targets (so long as the exact location of that target is known). Landing craft will be able to approach strange beaches in complete darkness. Even squads of soldiers out on patrol will be able to work out their precise position. If there is another World War, satellites – normally thought of as perfectly benign examples of spacecraft – will play a big part in influencing its course.

Radio pioneers . . . cont'd from p22

Amateur radio began to take wings during the early 1920s. A series of trans-Pacific tests in 1923, when many American stations were logged, raised the question as to what distances could be achieved on low power. AWA arranged for Maclurcan and "Jack" Davis, then a teenager, to travel to America and back aboard the "Tahiti" using a small 10 watt transmitter of Maclurcan's own design. The results exceeded all expectations: with a power of only 7.6 watts, coded Morse was received right across the Pacific to San Francisco, and voice and music up to 7680 kilometres.

In November, 1924, Maclurcan logged his first CQ from an American "ham," 6EKY . . . "called him back on 90 metres and he replied immediately. My hand trembled so with excitement that I could hardly separate the dots from the dashes." The same month he transmitted the first amateur greeting from Australia to King George V through 2OD, England. Maclurcan's next triumph was the first 20 metres communication with England using 50 watts of power.

Even assuming that they could be verified, it would be pointless to begin listing the DX achievements claimed by amateurs of that period, but no one has ever questioned Charles Maclurcan's primacy. He remained the paterfamilias of our amateur scene until 1927 when, like Alexander the Great with no more conquests to make, he retired from experimental activities.

One major promotional undertaking of that decade is worth mentioning, because it gave countless country families their first taste of radio. During 1925/6 the Great White Train toured New South Wales advertising Australian-made products. AWA's carriage was equipped with a 500W transmitter, 2XT (for Experimental Train), operating on 850 metres and at each stop, as local dignitaries welcomed the train, the proceedings were broadcast. 2XT was under the charge of a former marine operator, Harry Tuson, whose odyssey on this puffing iron horse was responsible for introducing many Australians to radio.

Public interest in broadcasting assisted other facets of radio. As dealerships multiplied a wider range of components became available and, in response to popular demand, radio journals devoted more space to technical articles. Another source of enthusiasm stemmed from some high school science teachers, who formed radio clubs and initiated their students into the new science of electronics. Many found it so fascinating that it claimed them as staunch devotees.

REVIEWS OF RECENT

Records & Tapes

CLASSICAL ● POPULAR ● SPECIAL INTEREST

VERDI REQUIEM: "Spectacular digital clarity, but . . ."

VERDI — Requiem Mass. Montserrat Caballe, Placido Domingo, Biance Berini and Paul Plishka with the New York Symphony Orchestra and Musica Sacra Chorus conducted by Zubin Mehta on two handsomely boxed digitally recorded discs. CBS Audiophile pressing 36927.

Left: Montserrat Caballe. Right: Placido Domingo.

The first digital recording of Verdi's great Requiem is well suited to show some of the good and not so good features of the process. The work has been described, with some justice, as more theatrical than liturgical in character and Mehta's reading tends to stress the very many violent contrasts that frequently occur. But we'll leave the performance for a moment while we examine the recording features.

Like most – but not all – digital recordings it offers spectacular clarity and a generous amount of audible detail, especially in works demanding extra large resources. In this particular recording the balance between orchestra and vocal performers is usually excellent although there are one or two moments when the choir does overwhelm the orchestra.

However the very clarity of the sound tends to deprive it of some lustre. Indeed, there are moments when it suggests a clinical examination of the score. Also the dynamic range has been widened to such an extent that, to adjust the volume control to where the fortissimos can be endured without causing the listener physical pain, the pianissimos recede into near inaudibility and sometimes disappearing altogether.

I have two other valued recordings of this magnificent mass which, in comparison to that under review, easily prove this point. There is a faint thread of sound that runs through the pause that precedes the wonderful Amen that concludes what might be called the "first half" of the Requiem. One is by Giulini, the other by Bernstein and, in both, this note can be heard, albeit very softly.

In the new recording it disappears altogether, no matter how hard you listen. Moreover both of the analog recordings have the lustre I earlier complained is often missing in the digital job. Digitally the acoustic is too truthful; fails to inspire awe and there is seldom a sense of mystery, despite the general excellence of Mehta's performance.

There is a good example of this in the opening bars. The quiet introductory notes – beautifully phrased, by the way – are followed by the male choir delivering the Kyrie as if it were a command and not a plea. In the vocal quartet soprano Caballe dominates her colleagues mercilessly in her high register.

The Dies Irae explodes with timpani notes so sharply defined that they lose some of their menace and, in the Tuba Mirum section, the trumpets sound so remote that they suggest a hunt rather than a dire threat. And this is one of the movements where the orchestra becomes secondary to the chorus.

I would be sorry if any of my remarks on the recording aspects of the set put you off buying it. If I have been too severe, it is to counter some of the more extravagant praise that has welcomed the digital innovation. At its best it can be wonderful, but then so can the very best examples of analog recording. What I mean to stress is that the word digital does not always put an example automatically ahead of its analog rivals.

But now to the performance, which is not without countless merits that more than atone for the digital features that might well appeal to you more than they do to me. Of the vocal quartet, despite the lovely soft high notes of soprano Caballe reminiscent of Schwartzkopf at her best, and the highly competent singing of Domingo, I was still more attracted to the beautiful tones of a newcomer, the mezzo Bianca Berini, whose warm thrilling voice is always under complete control.

Paul Plishka adds an impressive bass part. Mehta's control of his formidable forces is admirable and most of the passages the orchestra has on its own are beautiful beyond description. To cite one example, listen to the beginning of the Offertory. But if the drum thumps in the Dies Irae call to mind those of De Sabata in what I think was the first LP Verdi Requiem; the rest is full of excitement. The sound at its loudest is overwhelming although I wouldn't describe it as sumptuous. The New York Philharmonic is in top form and the Musica Sacra Chorus obedient in all but a very few brief moments.

A word about Barrymore Scherer's excellent annotations: In my youth I always knew the work as the "Manzoni" Requiem, Manzoni being an Italian poet much admired by Verdi. Until I read Mr Scherer's notes I had no idea of his importance in 19th century Italy, where his literary works brought together many local dialects and went close to establishing the modern Italian language. (J.R.)

☆ ☆ ☆

GERSHWIN — Rhapsody in Blue (original version) incorporating the legendary 1925 Piano Roll and accompanied by the Columbia Jazz Band conducted by Michael Tilson Thomas. An American in Paris. New York Philharmonic also conducted by Thomas. CBS Half-Speed Mastered Audiophile Pressing 44205.

It is unlikely that more than a handful

Reviews in this section are by Julian Russell (J.R.), Paul Frolich (P.F.), Neville Williams (W.N.W.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.), Greg Swain (G.S.), and Danny Hooper (D.H.).

of readers of this column have not heard at some time or other this famous jazz classic. I heard it for the first time myself in the early 1920s in the big band Paul Whiteman version orchestrated by Ferde Grofe and I well remember my astonishment when the solo clarinet took off and slid glissando up to the high ledger lines.

Actually Gershwin wrote the Rhapsody originally for a small jazz band combination – he described it as "for piano and jazz band." But the success achieved by its tunefulness and originality encouraged countles other arrangers to have a go at it themselves.

This present version is unique because the piano part is played by Gershwin himself on a piano roll made in 1925. The fact that the sleeve describes it as the "original version accompanied by the Columbia Jazz Band" emphasises the piano roll's importance. The special pianola rolls of this period gave a pretty authentic account of the user's musical style of phrasing and nuancing when he cut it. We can therefore be reasonably sure that the disc under review reproduces the sound as near as possible to that intended by the composer.

By the way, the fate that overtook the Rhapsody in the forms of its different versions in a matter of comparatively few years might dampen the enthusiasm of the devotees who play antiquarian music in what they describe as an "authentic" style on instruments made at the time of the composition, or reconstructions of them.

I take this opportunity of asking what evidence – real evidence – exists of the period style, the players' techniques, and most importantly the pitch used, for pitch has been continually rising since those far off days.

Much was contributed to the real authenticity of the present version under review by the intense musical research, as set out by the sleeve notes of Andrew Kazdin, the executive producer of CBS Masterworks series. He ran down Ferde Grofe's original jazz band version in the US Library of Congress, also the piano roll, a Duo Art, a company which reproduced best the music entrusted to it.

The accompaniment is conducted by Michael Tilson Thomas, a conductor of repute of more serious music. The audiophile pressing was transferred to disc at half-speed, a process explained in an enclosed pamphlet.

The overall sound is very different from the popular Whiteman version with differences, too, in the piano part. It should make the "authentic baroque" boys think a little harder before they make their extravagant claims.

On the reverse side An American in Paris offers beautifully clear sound, much detail, and some very bright playing. This, of course, features no piano part and no information about it appears in the sleeve notes. Not that any is needed. (J.R.)

Back to the 16th century

THE CAT'S FIDDLESTICK. The Renaissance Players; arrangements by Winsome Evans. Stereo, Cherry Pie audiophile edition L-37746. Released through Festival.

At the risk of using a word that is hard to say, hard to spell and easy to misunderstand, the presentation of this album is unashamedly idiosyncratic, from the mischevous musical cat motif, to the hand-drawn title and the hand-written credits. But why not? Most of us take ourselves too seriously, anyway!

The music itself is explained as "an exposition of the 16th century performance practice arranged by Winsome Evans" and the performance involves such instruments as the shawn, recorder, rackett, viol, harp, harpsichord, crumhorn, lute, mandora and so on, through to a sagbutt!

There are 18 items on the two sides with names and origins as assorted as the instruments. To someone with no special interest in mediaeval music, the sound is unusual, even curious at times, but not difficult to relate to – even without the detailed inner jacket. I am sure that those with greater understanding would find much to enjoy in the skill and dedication of the Renaissance players.

The recording itself was made in the Sydney Opera House and this particular pressing, which sells at the normal catalog price, was mastered at half speed by Festival in Sydney. In fact, Cherry Pie executive Graham Rule discussed this half-speed mastering proposition with me, some months ago, and he was quite outspoken in his praise of Festival's resources.

And the recording is certainly very good – clean and well balanced. (W.N.W.)

Grand Canyon

GROFE – Grand Canyon Suite. Philadelpia Orchestra conducted by Eugene Ormandy. CBS Half-Speed Mastered Extended Range Disc. 40446.

I am reviewing this disc not because of its value as serious music – which is negligible – but because the sound of its half-speed mastering and its general processing brings it very close to some of the merits and drawbacks of digital recording.

The two processes have the same clarity with plenty of air between the instruments the same over-extended dynamic range, the same deprivation of lustre of string tone which at times comes perilously close to wiriness. And this is the famous Philadelphia Orchestra! Has Stokovsky been forgotten so soon? Remember how this band glowed under him, even back in shellac days. Grofe's technique is excellent: his scoring ingenious and colourful. You may remember he rescored the Whiteman version of Rhapsody in Blue for his friend Gershwin.

But, as a composer, Grofe was no Gershwin, although he followed his lead in what might be loosely described as "classical-music jazz." This suite enjoyed great popularity during the 1920s but you don't hear it very often nowadays. It does serve, however, as a good vehicle to display CBS half-speed technique which has much to recommend it, despite my critical remarks above. But I can't imagine the disc appealing very much to regular readers of this column.

On the other hand, those looking for something light in the way of entertainment might well fall for its general expertise and tunefulness. (J.R.)

☆ ☆ ☆

DEBUSSY – Preludes – Volume 1 (12 Preludes). Arturo Benedetti Michelangeli (piano). DG Stereo Disc 2531200.

A new recording by the elusive Arturo Benedetti Michelangeli is always an event, and nearly always for rejoicing. And when it features the music of Debussy, one's highest expectations are invariably rewarded. All one can do is listen with delight and try to convey this without recourse to too many tiresome superlatives.

I think the reason is that Michelangeli relates the music to the title of the Prelude with a perception used by no other pianist – including Gieseking. Another point not to be ignored is his impeccable accuracy, his giving of every note its exact value, his phrasing at once

Historic home recording

During a Christmas party in 1912, the late William Grieve decided to make some recordings which could be a lasting family memento, along with family photos. He could hardly have known that two of the records would feature in a national magazine just on 70 years later.

The recordings were made at Croydon, NSW, on an Edison phonograph, fitted with special attachments for home recordists. Suitable blank cylinders, sold for the purpose by music shops of the day, were coated with a wax-like mixture, soft enough to permit direct recording. They were not very durable, however, and as a result, very few examples of home recorded cylinders remain in Australia.

The Adelaide Museum has a few and others in the Hobart Museum carry recordings of the late Tasmanian aborigines.

William Grieve made quite a few home recordings around the period, but only the four Christmas party cyclinders have survived. On these, portion of the surface has deteriorated with time, to the point where no sound can be recovered.

It fell to William Grieve's grandson, Ray, to try to resurrect and document what remained of the 70-year-old recordings. The first attempt involved using a microphone inside the metal horn of an acoustic photograph, but the result was very "tinny". Sound archivist, Chris Long of Melbourne subsequently came to the resuce with an English player fitted with an electrical pickup.

Once on tape, editing and filtering was done by Ray Grieve himself, by R. P. Barlow at a Sydney recording studio, and by Peter Burgis, sound archivist at the National Library in Canberra. Meanwhile considerable effort was necessary to identify the material on the discs, with help coming from as far afield as the BBC in London.

One item "Bush Flowers" turned out to be an Australian composition previously unknown to Australian folklorists, while a tune on the tin whistle is probably the oldest known recording of this instrument in Australia.

These items, together with snippets of voice and other items of English derivation have been transferred to an 18cm 45rpm disc by Ray Grieve, mainly for historical interest to music clubs, libraries and museums. A few copies remain which can be supplied to interested readers for $7.50 plus $1 for pack and post. The double-fold record jacket background carries details and pictures and a transcript of the contents of both sides.

It would be nice to be able to report that the recording quality is reasonable, considering the age and circumstances of the source material. but such is not the case. The signal/noise ratio is excrutiatingly poor and the entertainment value virtually nil. But the historical interest? That's for the individual to say.

Copies of the record can be obtained from Ray Grieve through PO Box 460, Leichhardt, NSW 2040. (W.N.W.)

An Edison phonograph, complete with an auxiliary metal stand which helped support the "concert" horn.

elegant and revealing, and nuancing that comes close to the miraculous in the subtlety of its rise and fall.

Except in those pieces where it belongs, there is no mystical romantic haze over the sound. Sometimes it is as bare as a Czerny piano exercise. There is no space to review all 12 Preludes separately. Suffice to say there is not a dud among them and all make you aware, as no other pianist can, of Debussy the Innovator who changed the course of music with typical Parisian elegance and not with the hammer blows of the Second Vienna School. Remember the words carved at his request on his tomb?" Debussy, Musicien Francais." (J.R.)

☆ ☆ ☆

FAURE — The Two Sonatas for Violin and Piano. Arthur Grumiaux (violin) and Paul Crossley (piano). Philips Stereo Disc 9500 534.

Those who can recall, or better still, have on their shelves the seraphic set of Beethoven Violin and Piano Sonatas recorded by Arthur Grumiaux a few years ago should be equally delighted by the Faure disc. Despite Faure's classical sense of restraint there is still plenty of passion in the First Sonata composed at a time when Faure's life was in some turmoil.

Although it is an early work, there is nothing obvious about this music. The first movement excepted, it has a distinctly elusive quality. The tranquil andante seems always to strive upwards and, like most of Faure's music, displays the ultimate in refinement, despite its early and not unexpected allegiances.

Although rarely rising above m/f it is gracefully ardent. The Scherzo is dainty but it progresses at a great pace. All through, unlaboured pointing of phrases abound. The Finale is the broadest movement, its impulsiveness often reminscent of Schumann's, although without any likeness to what he ever wrote.

The Second Sonata, much more mature and serious, was written 40 years — not four as the sleeve notes state — after the First. It is not quite so alluring as its predecessor at first hearing but makes up for this by its vastly increased subtlety. Not that it is anywhere heavy going. Grumiaux and Crossley see to that in their sensitive presentation. Together they give a most stylish performance of both sonatas which I can recommend at the expense of any other recording of the works I have heard. (J.R.)

☆ ☆ ☆

THE DREAMTIME SHOW. Vocals by Tony McRae and Royce Edwards. Narration by Holger Brockman and Julie Manning. Stereo. Brook MLR-468. Distributed by RCA.

With no sleeve notes to assist, I did not know quite what to expect of this album. The title, of course, has to do with Australian Aboriginals and the 10 tracks

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Artie Shaw on clarinet

THE BEST OF ARTIE SHAW, Concerto For Clarinet RCA VPM2 7000.

If you list Artie Shaw among your favourite "oldies" be sure not to pass this two record album by. It covers a period in the late 30s and early 40s when Shaw's band was at it's peak of popularity with such hits as: Frenesi – Stardust – Concerto For Clarinet – Blues In The Night – Bedford Drive – My Heart Stood Still – Deep Purple – Begin The Beguine – Carioca – I Surrender Dear – Oh Lady Be Good. In all, there's a total of 30 tracks to enjoy.

Technically, the recording engineers have refrained from attempting to give a pseudo-stereo image to a master that does not have it in the first place. The quality overall is quite good, although it does get a bit tizzy in loud passages. The worst track for background noise is "I'm Confessin", with a fair amount of scratch early on.

The sleeve notes give a fair amount of information on band personnel and recording dates on 11 of the most popular tracks, with a brief note on Artie Shaw's life.

A couple of the famous names appearing in the credits are Ray Conniff and Buddy Rich, as well as Helen Forrest and Billy Holiday on vocals.

It adds up to an excellent collection of vintage Shaw, especially for some like me that can remember the original releases, when the big band sound was king. (N.J.M.)

SATIN DOLL, Jenny Sheard Trio. Stereo, EMI, EMX-105.

Recorded and produced in Australia by EMI, this is a top quality album, which should have a strong appeal to all those who have an ear for jazz, especially as played by a small and tightly knit group.

The trio comprises Jenny Sheard on piano – plus a vocal on all but one track – Lloyd Swanton on bass, and Jack Savage on drums – an American musician who has been on the Australian scene for around 10 years.

The numbers they play have been around for quite a while but the trio has restyled them just enough to blend their familiarity with the trio's own individual and refreshing style. The excellent jacket notes by Eric Myers, Jazz Critic for The Sydney Morning Herald, relates this approach to each individual track.

The titles: Honeysuckle Rose – Fly Me To The Moon – Here's That Rainy Day – Pennies From Heaven – Dindi – Duke's Place – On A Clear Day – Night And Day – Spring Can Really Hang You Up The Most – Satin Doll.

Each member of the trio excels in their roles as individuals as part of a group. And EMI has played its part with a top quality recording. W.N.W.)

BOHEMIAN GIRL — continued

Deane (tenor), and Eric Hinds (baritone). They present a series of excerpts from the three operettas, suggestive of all the usual plots and counter-plots that one would expect from such titles.

If you have a special interest in this old-world music, you could regard the album as an unexpected "find". The sound quality? Well I did say that it was recorded in 1948! (N.J.M.)

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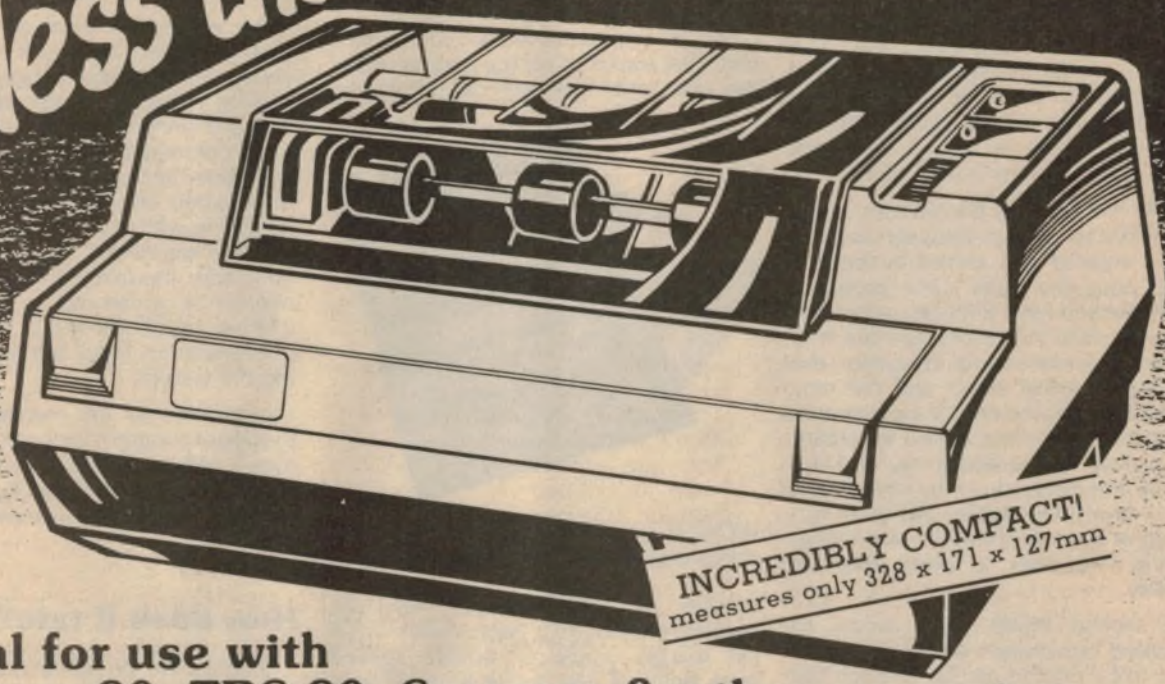

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itself. The WORP-9 disk is inserted in the disk drive and the computer turned on. After a few seconds the word processing program is loaded and comes up in the text enter/edit mode, ready for use.

Features of WORP-9 include automatic text wrap-around, so that text can be entered without regard to the end of lines on the screen. Words which won't fit entirely at the end of a line are automatically moved down to the next line. A flashing block cursor indicates where the next character will appear on the screen. One nice point is that the software automatically sets the keyboard of the System 80 to a "typewriter style", in which all characters are entered in lower case unless the shift key is pressed. There is also a shift lock and an automatic key repeat feature.

WORP-9 is used in two modes, using the F1 key to change between modes. Text is entered and edited in the first mode, using the other three programmable function keys to open up the text for inserts, or to indent or underline text, the arrow keys to control the cursor, the clear key to erase errors and the new line key to mark the end of a paragraph. Text is entered without regard to formatting, except for paragraphing, and appears as it is entered on the computer's 64 x 14 line video display. All other formatting is done at the time of printing, allowing the user a great deal of flexibility.

The second mode gives access to specialised commands which allow the cursor to be moved quickly through the entire text, text to be erased by word, sentence or paragraph or moved around on the screen. Particular words can be found in the text by using the Search function, although replacement of the words searched for must be done manually. Other commands take care of disk and printer operations. Using the "N" command allows a name and address file to be set up. Once this file is set up, names and addresses can be printed on mailing labels or automatically inserted at the top of documents. A specified name can also be merged at any point in a document, simply by setting a marker in the text.

Disk operations are simple but comprehensive, selected from a menu of five commands. Document files can be saved and retrieved by name, with up to 24 characters in a name. A Directory command lists the files on a particular disk by name and indicates the number of characters in each file and the amount of space remaining on the disk. Files can also be deleted, with the program asking for confirmation of the command before removing the file from the disk. Another disk command allows disks to be copied, either to back-up the original WORP-9 disk (a good idea, in case the original disk is later damaged in some way) or to copy documents from one disk to another.

Because of the way the program is designed, quite reasonable results can be obtained with only one disk drive. WORP-9 allows the user to create a single "work disk" which contains both the word processing program and the user's document files. This single disk is then all that is required for everyday use. Documents of up to 75,000 characters can be stored on the same disk that contains the word processing program.

The "P" command is used for printing text. First step is to set the parameters of the print out. The user can select the number of characters per line, the number of lines on a page, width of the left margin, single or double spaced lines, optional right justification (all lines of the same length), proportional printing (if available on the printer being used), address label format and the mail merge option.

WORP-9 on disk is accompanied by a comprehensive users' manual.

To take full advantage of these capabilities a fairly sophisticated printer is required. While any Centronics style printer with a column width of 80 or 132 characters can be used, most business users would require a daisywheel printer for "correspondence quality" printing. Dot matrix printers, while faster and not as expensive, are generally considered to produce type which is hard on the eyes and somewhat lacking in "professional" appearance.

The system we used is identical to the word processing package offered by Dick Smith Electronics. Both the System 80 MkII and the expansion interface and disk drive have been previously reviewed (see EA for May, 1981 and January 1982 respectively). A C. Itoh daisywheel printer is also provided as part of the word processing package.

This printer incorporates an 8085 processor for control of printing functions, and is solidly constructed on a cast aluminium chassis. Print speed is around 25 characters per second, with up to 136 characters per line using Pica typeface and 163 characters per line using the smaller Elite typeface. Type faces can be changed simply by changing the plastic daisywheel. Connection to the computer system is via a 36-way parallel cable with a Centronics style connector to the printer and an edge connector to the expansion interface. The actual print out is crisp and clean – very impressive indeed.

Dimensions of the printer are 62cm x 38cm x 26cm (W x D x H), and it weighs in at a hefty 19.5kg. The noise level is moderately high for an office environment, but there is little perceptible vibration when the printer is in use.

The owner's manual for WORP-9 is clearly written and well organised. It covers loading the program disk and making a back-up copy, entry of text, disk and printer operations, then covers each command separately. The use of the name and address file, printing address labels and merging data from the name file with correspondence are also covered separately. A glossary of terms concludes the manual. Interestingly, the manual is presented in a 150mm x 210mm notebook form, which is very convenient for quick reference while using the system.

In addition to the manual, the word processor program includes a HELP command. When in the command mode, typing "?" results in a display of the commands available and a summary of their effects.

How does it rate?

Overall, the WORP-9/System 80 combination is an excellent word processor. Its most attractive feature is ease of use, although it is quite powerful enough to fulfil the word processing requirements of small businesses. It is designed mainly for the preparation of correspondence, either one-off letters or mass produced form letters, which can be given a personal touch by merging the recipient's name into the text.

Preparation of long documents is handicapped by the limited amount of text that can be held in RAM in a 32k system. Dick Smith Electronics do recommend that for serious use a second 16K memory board be added in the expansion interface, giving a total of 48K of memory.

Some small points of the hardware of the system are hard to become accustomed to. For example, there is no shift key on the right hand side of the System 80 keyboard, so that touch-typists will be a little inconvenienced at first. With the video monitor mounted on top of the expansion interface box, RFI emissions from the computer show up as a series of black flickering lines on the screen of the display. This may be irritating at times.

Continued on p127

A printer and a program give

Word processing for the System-80

Word processing is not just for big business. With the WORP-9 word processing program and a System 80 MkII Business Computer, any small business can take advantage of the speed and efficiency of the word processor. What's more, the same equipment can be used to run accounting and stock control programs — at a much lower cost than many dedicated word processing systems.

by PETER VERNON

We have been using the Dick Smith word processing program WORP-9 on the System 80 in our office for some time now. It does all that is claimed of it, is easy to set up and use, and certainly makes writing easier. In fact, this review was written using the system. In addition WORP-9 has some innovative features, such as a mail list sort/merge function to simplify correspondence and the printing of form letters.

In general, word processing systems allow the preparation of text by making it possible to insert, delete or move any part of the text without re-typing. It has been called "computer assisted typing", but the usefulness of a word processor goes beyond the replacement of typewriters, particularly if data files and accounts etc can be prepared on the same machine and used in conjunction with the word processing.

Hardware required to use WORP-9 is a System 80 MkII Business Computer with expansion interface and a minimum of 32K of RAM, a video monitor and printer and at least one disk drive. Operation is made easier by the use of a second disk drive, although this is not essential. With 32K of RAM, documents of up to 10,000 characters can be held in memory. With a 48K system this capacity is more than doubled. In practice, however, editing text requires more memory space than the length of the document itself would indicate. Inserting text and re-arranging paragraphs with the HOLD command requires some buffer space which limits the length of documents being worked on to around 8000 characters in a 32K system. Longer documents can be manipulated by dividing them into blocks of the maximum size and storing them on floppy disks.

A MkII computer is a definite requirement. Apart from the essential lower case capability of this machine, the word processing program makes extensive use of the four programmable function keys provided by the MkII System 80.

Dick Smith Electronics Pty Ltd is offering the word processing system as a package, using the line "buy Australia's cheapest screen-based word processor – get a business computer free".

While we can't comment on the price comparison, it does seem that a word processor which is also a computer is preferable to a machine which is only a word processor. There are great advantages in running say, an accounting program on the same machine that is used to prepare the invoices. The System 80 in particular is well supported by a range of programs for business and office use, and WORP-9 can only add to its appeal.

Operation of the program is simplicity

System 80 Mk II computer, disk drive and printer are required to run the word processing software. We used the C Itoh FP1500-25P daisywheel printer from Dick Smith Electronics.

are described as "Inspired by the legends of the dreamtime". Here they are: How The Animals Came – The Whale – The Frog – The Playtypus – The Kookaburra – The Caterpillar – The Bat – The Pelican – The Koala – The Kangaroo.

Prodution is by Clive Shakespeare with the assistance of the Music Board of the Australia Council. On the front of the jacket is a reproduction of Ainslie Roberts' painting "Junkgao, The Singer and the Two Suns". On the rear is a photograph of two of the performers with a group of "dreamtime" puppets, including a king-size kookaburra.

And the music? Written by Royce Edwards, it is in a modern but not extreme popular format, the more interesting and listenable because the subject matter provides a welcome change from the repetitious lyrics of so much popular music. What a pity no one got around to writing jacket notes!

The sound quality is fine. (W.N.W.)

☆ ☆ ☆

DAVE GRUSIN. Mountain Dance. Arista L37607. Festival Release.

One could be forgiven for thinking that this is another country & western record, in view of the title "Mountain Dance" and the picture of a gentleman in cowboy garb on the cover. But such is not the case.

Instead we are given an instrumental tour de force, in mainly a rocking idiom with superb digitally recorded sound.

Dave Grusin plays electric and acoustic piano on all the eight tracks, with a six-man backing group. The tracks are: Rag Bag – Friends And Strangers – City Lights – Rondo – Mountain Dance – Thanksong – Captain Caribe – Either Way.

Thanks to the Soundstream digital master and, I would assume, to half-speed disc cutting by JVC engineers, the sound quality is outstanding and well worth listening to, if the contents themselves appeal. (N.J.M.)

☆ ☆ ☆

HIGHLIGHTS From The Bohemian Girl, Maritana, The Lily Of Killarney. World Record Club WRC R 08083.

Listening to this music, one gets the distinct feeling that it might well have provided the substance for countless British musical evenings and parish concerts for generations since the Victorian era. It has about it that "old lace" atmosphere in both content and performance.

Recorded in EMI's Irish Studios, in 1948, with an orchestra conducted by Dr Havelock Nelson, the album features the voices of Veronica Dunne (soprano), Uel

(Continued on next page)

New devotional albums

I CAN BE WHAT I AM. Rose Marie. Stereo, Cornerstone CS-102. [From Cornerstone, PO Box 142, Mosman 2088. Phone (02) 960 3111.]

Sydney singer Rose Marie does a magnificent job on this record with 10 contemporary Gospel songs, with lyrics from the pens of such American writers as David Meece, Omartian, Gaither, Green, Owens-Christian, Terry and Carmichael.

The titles are: I Can't Believe It's True – What Can I Do For You – Gentle Shepherd – This Is The Song – Oh So Wonderful – My Little World – I Can Be What I Am – Look How Far You've Come – Just A Little More Time – Goin' Home.

The unnamed backing group does an excellent job and the record overall is of a very high technical quality. The mood ranges from up-tempo to quiet ballad, making a useful addition to the supply of Christian music. If you're looking for the lyrics, the sleeve has them all. (N.J.M.)

☆ ☆ ☆

B. J. THOMAS. Amazing Grace. Myrrh 6675. (From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135).

B. J. Thomas, the born-again pop singer, presents an enjoyable program of 10 favourite hymns, mainly old favourites, with vocal backing from the Jordanaires and instrumental support from a goodly group of musicians.

The titles: Amazing Grace – His Eye Is On The Sparrow – The Unclouded Day – In The Garden – You'll Never Walk Alone – The Old Rugged Cross – Just A Closer Walk With Thee – I Believe – Just As I am – Beyond The Sunset.

The arrangement, in each case, has been designed to complement the words – an aspect that some Gospel singers tend to lose sight of, with the lyrics buried somewhere in the total sound. Word Record stockists should be able to obtain the songbook to match the album, if you require it.

The technical quality of the recording itself is about average. (N.J.M.)

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If you've been impressed by the Apple computer, but not by the price – you owe it to yourself to have a good look at the Concord II. Take one home and try it out feature for feature against the Apple or any other personal computer. If you're not absolutely happy, you can bring it back within a week for a full refund (as long as it's in original condition and packing.) How can you lose?

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Price comparison based on Apple suggested retail of $1660 including tax February 1982.

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Microcomputer News & Products

Spectacular Applefest exhibition in Sydney

Sydney-siders recently had a unique opportunity to see some of the latest in personal computers at "Applefest", held at Sydney's Centrepoint from January 27 to 29.

Sponsored by Electronics Concepts Pty Ltd, sole Australian distributors of Apple computers, in conjunction with the Festival of Sydney, the exhibition included some of the latest in computer technology, with laser light shows, audio visual presentations, space invaders competitions, holograms and "hands-on" demonstrations of the Apple II and the new Apple III computer.

Applefest was officially opened by Ian Sinclair, Minister for Communications, who afterwards released 4000 helium balloons from the top of Centrepoint Tower. Each balloon contained a ticket which entitled the finder to enter a prize draw for an Apple computer.

According to Rudi Hoess, managing director of Electronic Concepts, Applefest was intended to cut away the mystique associated with computers.

"We wanted to give the public the opportunity to see how fascinating and friendly, personal computers can be" said Rudi.

More than 40 displays of Apple applications and related equipment from leading Australian and overseas manufacturers were on exhibit. In addition a number of organisations currently using Apple computers demonstrated some fascinating applications.

A major star of the show was the Apple III computer, officially launched at Applefest. Designed for business and professional users, the Apple III boasts an expanded memory, built-in floppy disk, new software and an extensive capacity for add-on equipment. Initial bugs and teething problems last year have been overcome, and the Apple III now appears to be a very attractive machine.

Main memory is 128K bytes, with internal expansion to 256K. In conjunction with the ProFile five megabyte hard disk system and the Omninet computer networking system, one or more Apple III computers can meet the computing needs of small to medium size businesses.

The launch of the Apple III has in no way detracted from the usefulness of the Apple II, however. As many of the exhibits showed, the Apple II must be one of the best supported personal computers currently available. A wide and rapidly growing range of software and hardware add-ons is available, from educational programs to games and sophisticated business programs.

With the advent of the Z80 software (exhibited at Applefest by City Personal Computers, 75 Castlereagh St, Sydney 2000) CP/M software is now accessible to owners of the Apple. Further news is the availability of a 6809 board for the Apple, opening up a wide range of 6809 software, including Microware's OS-9 packages, to the Apple user.

Orbital Music (503 Pittwater Road, Brookvale, NSW, 2100) demonstrated their SoundChaser Computer Music System for the Apple II. This system turns the Apple II into an advanced polyphonic synthesiser and multibank sequencer, directed by specially written music software.

Educational applications were well represented by Lothlorien Farming ("Cultivating new concepts") and the NSW Department of Education. More than 1500 Apple computers are already in use in schools around Australia.

Centre Industries (PO Box 184, Brookvale, NSW, 2100) in conjunction with the Spastic Centre of NSW exhibited their Scatt System (Scanner Apple Touch Keyboard Trolley), an integrated system which allows physically handicapped children and adults to use the Apple computer.

Books and magazines were another feature of the exhibition. Computer Gallery, of 66 Walker St, North Sydney, 2060, showed a selection from their stock of over 2000 computer book titles. Butterworths and ANZ Book Company also shared a stand to display some of the latest literature on the Apple, programming languages and microprocessors.

6S Business Advisory Pty Ltd of 39 Gheringhap St, Geelong, Vic 3220 displayed their range of business software, including packages for medical practices, insurance brokers and general business operations. Intelligence (UK) Ltd exhibited their "MicroModeller" package for the Apple II. MicroModeller is a complete financial modelling program for management use.

The NSW Institute of Technology was also on hand to display their new Apple system which will be used in some of the accounting courses offered by the Institute's Master of Business Administration faculty. The University of NSW exhibited equipment used in laboratory work for the first year Electrical Engineering course.

Many other companies and organisations exhibited at the show, a sign of the rapidly growing support for, and interest in, the Apple computer and personal computers in general.

"Applefest" was a spectacular demonstration of the many uses of computers and of the interest that they arouse. Judging by the response of many visitors to the show, Electronic Concepts well and truly met their objectives. They are to be congratulated for a very successful exhibition.

Computers Galore opens for business

A new retail computer store has opened in Neutral Bay, NSW. "Computers Galore" at 99 Military Road caters for the businessman interested in taking advantage of the power of the microcomputer for office tasks.

Manager Steve Coman is enthusiastic about the services the microcomputer can offer the businessman or manager, and after 30 years in the business world he is well qualified to advise on business requirements.

"Businesses which only a couple of years ago were relying on part time book keepers can now afford a computer to give them complete invoicing, stock control and reporting on debtors, creditors and profit and loss figures on a day to day basis. Doctors and veterinarians can also have complete systems, which can be used by their receptionist or nurse".

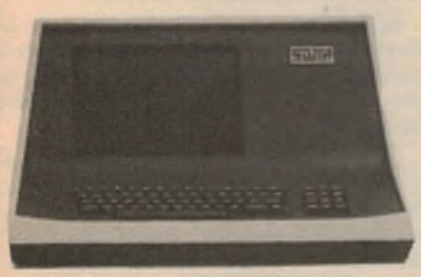
In addition to a large range of microcomputers, Computers Galore also stocks calculators, plain paper copiers and telephone accessories, and has photocopying, instant printing and word processing services available.

Micronews cont'd ►

SWTPC OF AUSTRALIA

DISCOVER THE WORLD OF THE 6809 MICROPROCESSOR

6809 COMPUTER



8212 TERMINAL
(ASS. IN AUSTRALIA)

HARDWARE DESCRIPTION

S/09 6809 Computer w/128K Memory
/09 6809 Computer w/64K Memory
8212 12" Terminal w/monitor
DMF 2 Disk System w/2.5m Capacity
CDS-1 Winchester Hard Disk System
MP-09A 6809 Process/Board (assem)
D5-2 double side/double density 720KB
3809 128K Memory Expansion for S/09
MP-LA Parallel Interface
MP-L2 Dual Parallel Interface
MP-N Calculator Interface
MP-R Eprom Programmer
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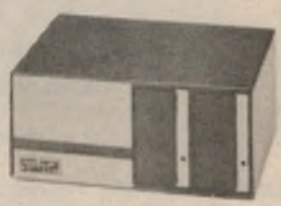

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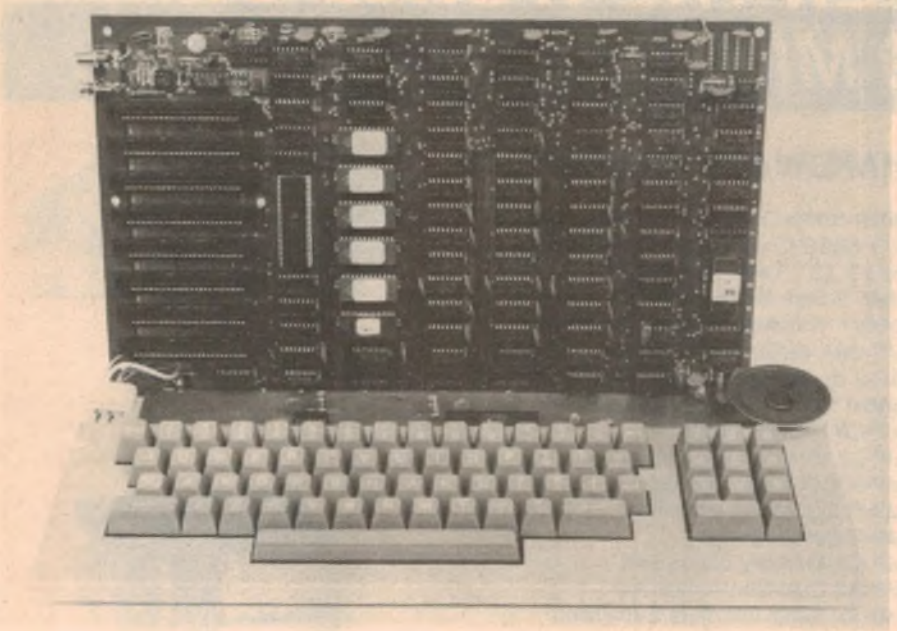
Microcomputer News & Products

Concord II computer from Electronic Agencies



Bill Edge's Electronic Agencies has released a new computer, the Concord II, with some attractive features.

The computer comes fully assembled, but without a case or power supply. The system consists of a 370 x 217mm double-sided circuit board, plated through and fully socketted, and a separate 410 x 170mm keyboard PCB containing a full size keyboard and numeric keypad.

On the main board is a 6502A processor, 48K of dynamic RAM and a system monitor and Basic interpreter in 12K of EPROM. Also on this board is the video generation circuitry, cassette interface and the expansion interface, consisting of eight individually addressable 50-pin edge connectors which carry the 6502 bus.

Video output is 24 rows of 40 characters each, upper case only, although a lower case adapter and an 80 column adapter board are available. With the addition of a PAL colour card, the computer can display graphics in a 40 x 40 display in 16 colours, or in a high resolution 280 x 192 matrix in 8 colours (including black).

Also on the main board is a one-bit speaker output and a connection for an 8Ω loudspeaker, a games interface with inputs for three pushbuttons and a joystick, and a four-bit latched output port.

Power requirements are +5V at 2.5A, +12V at 1.5A −5V at 250mA and −12V at 250mA.

The Concord II computer is said to be fully compatible with Applesoft software and Apple II hardware, so programs and add-on boards will be readily available. Cost is $899 for the basic unit.

For further information contact Bill Edge's Electronic Agencies, 115-117 Parramatta Rd, Concord, NSW. Postal enquiries should be sent to PO Box 185, Concord, NSW, 2137.

NOTE: Apple and Applesoft are registered trademarks of Apple Computer Corporation of the United States.

Microprocessor workshop at Queensland Institute

The Department of Electrical Engineering of the Queensland Institute of Technology is organising a two day workshop (14th and 15th April) dealing with hardware and software design for 6502 and 6809 microcomputer systems. The workshop will consist of a series of papers and demonstrations plus tutorials covering the practical use of the processors.

The keynote speaker will be Professor "Lux" Luxemberg of California State University. Bob Tripp, editor of "Micro" 6502 magazine will also speak, as will Rodnay Zaks.

Applications to register for the workshop should be made to Dr C. J. Chesmond, the Department of Electrical Engineering at the Institute, Box 2434, GPO Brisbane 4001 by March 31. Cost is $50 for the two days.

Courses by radio from University of NSW

The response in 1981 to its two-part course on microprocessors was so great that the Radio University, the radio station of the University of NSW, has decided to rebroadcast the course in 1982. Part 1 is scheduled to begin early this month, with Part 2 beginning in July.

According to lecturer Dr David Mee of the University's School of Electrical Engineering and Computer Science, the course requires no more than a basic understanding of electronic circuits and simple logic networks. By the end of Part 1 of the course students will have covered simple programming and application of microprocessors. Part 2 covers further hardware and software functions used in microprocessor systems. Dr Mee will also demonstrate how to design, develop and debug a simple microprocessor project.

In October, Radio University will go further into microprocessing with a new series of lectures by Dr Mee on microprocessor peripherals and applications.

Each part of the Microprocessor Fundamentals course consists of 10 radio lectures, one television program and two evening seminars which must be attended in person. Cost is $32.50 per part, including extensive lecture notes and facilities for students to test set programming exercises.

Radio University will also be broadcasting a two-part course covering the Pascal programming language, starting this month. The complete course will cover all elements of Pascal, starting with the principles of structured programming and the fundamentals of Pascal. Part 2 of the course will describe data structures such as arrays, lists and trees and recursive programming techniques.

A two-part course on Fortran IV programming will also be offered. The course lecturer, Professor J. M. Blatt, Professor of Applied Mathematics at the University of NSW, suggests that people engaged in research or in dealing with technical and scientific problems in industry will find the course particularly valuable.

Radio University transmits on 1750kHz (1720kHz in the Eastern Suburbs), just off the normal AM broadcast band, and can be picked up in the Sydney area by a radio adjusted to receive these frequencies. Instructions on how to modify a radio are sent out to enrolled students of each course, or they can buy a transistor radio already modified from Radio University for $8.

Further information on this and other radio, television and tape courses can be obtained from the Division of Postgraduate Extension Studies, University of NSW, Kensington, NSW.

More micronews ►

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This program disassembles Z-80 machine language programs i.e. it translates them back into easier to follow assembly language. It is a BASIC program, but may be used to examine any machine language program in the Sorcerer's memory. X-3622

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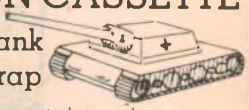
SORCERER GAMES SOFTWARE ON CASSETTE

Tank Trap



A enemy tank is on the rampage. Your job is to build a wall around it - without getting run over. Fascinating! X-3628 $14.95

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Very similar to 'Space Invaders'. A very challenging game, requiring skill & a fast mind. $17.95 X-3626

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An exciting 3D game with real-time animation, allows you to actually SEE the galaxy around you. You must destroy the Grotnik and enemy fighters in all of the 8 galaxies. X-3614 $19.95

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Just like the arcade game. You rotate your ship and fire the laser beam at the moving meteors, but watch out for space ships and asteroids. $29.95 X-3634

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DSE/A162M/PAI

Microcomputer News & Products

Dreamcards for the DREAM 6800

"Dreamcards" has available two new programs for the DREAM 6800 computer. Written in the Chip-8 language, these programs turn your DREAM into a skilled pontoon or gin rummy player, providing all the excitement and suspense of the actual card games along with high quality graphic displays of each hand dealt.

A nice feature of the programs is that they perform an automatic checksum test on loading to ensure that the program has been correctly read from the tape. Documents available with the programs include a fully commented listing of the progam, and each purchaser receives a follow up letter from Dreamcards detailing modifications of the programs which have been requested by other users.

Among the modifications covered so far is an adaptation of the original programs so that they will work with the Dreamsoft EPROM. Both programs are very well written and well organised. Apart from providing good games with eye-catching graphics they are an indication of what can be done with CHIP-8 by a skilful programmer.

For further information, contact Lindsay R. Ford, "Dreamcards", 8 Highland Crt, North Eltham, Vic, 3095.

New Kaga video monitor from Rifa

Rifa Pty Ltd have released details of the new Kaga KG12CBLP video monitor. The new green phosphor monitor offers a bandwidth of 18MHz and a display format of 80 x 24 lines with characters formed in a 5 x 7 dot matrix.

For further information contact Rifa Pty Ltd, 202 Bell St, Preston, Vic 3072.

Electronic typewriter becomes computer terminal

When fitted with an interface from IncaData Systems, the new Olivetti electronic typewriter becomes a full printing computer terminal.

Inca Data Systems Pty Ltd, an independent peripheral design and manufacturing company, has announced that it has available a computer communications interface for the Olivetti ET221 electronic typewriter.

The interface, called the STOL, enables the electronic typewriter to be connected to any computer with an RS232C serial port. It has already enabled connection of the ET221 to microcomputers such as the Apple, TRS-80, National Panasonic, Durango, Zenith and HP systems. Software in ROM aboard the interface recognises the communications protocols of the most popular RS232C routines.

The STOL/ET221 combination can be used as a stand alone typewriter or a send/receive computer terminal. The host computer can call up all the printing characteristics of the Olivetti typewriter, including proportional spacing, tabulation, automatic centring, reverse image (white on black) printing and automatic underlining.

One recent demonstration used the ET221 as an interactive terminal for communication with the US-based Source computer database, sending queries and printing out replies.

Apart from providing an RS232C interface, the STOL can also provide a Centronics compatible, parallel input option and a parallel output option, enabling the production of five channel telex tape.

The STOL electronic typewriter interface is available for immediate delivery. It can be fitted inside new ET221s or to units already in use.

For more information contact Mike McLaren, Inca Data Systems Pty Ltd, 10 Help St, Chatswood, NSW 2067.

AED Microcomputer Products has InfoSoft

InfoSoft Systems Inc, the United States software house, has announced that AED Microcomputer Products is the exclusive agent for the entire line of InfoSoft microcomputer software for Australia and New Zealand.

InfoSoft's fully CP/M compatible family of operating systems includes MultI/NET networking systems, MultI/OS multi-users software and UNI/OS, a single user operating system.

Also available from AED are MicroSoft's WpDaisy word processing program, the Daisy screen editor, MailMerge for mailing lists, a communications package called I/TERM and the structured assembler I/SAL. North Star Basic and InfoSoft's C compiler can also be supplied by AED.

On the hardware side, AED has announced an enhanced version of the SSM VP3 S-100 video board. Called the VB3A, the new board offers all the features of the VB3 plus additional facilities and compatibility with a wider range of video monitors.

Among the features of the new board is a smaller 6 x 7 character matrix which retains full upper and lower case capability but opens up the screen to allow more text to be displayed. Thus the VB3A allows users a display of 24 lines by 80 characters on a standard P4-phosphor monitor. A second mode allows a 25th line to be used as a status display. The new character generator also permits display of 50 lines of 80 characters when the board is used with a video monitor with a P39 long persistence phosphor.

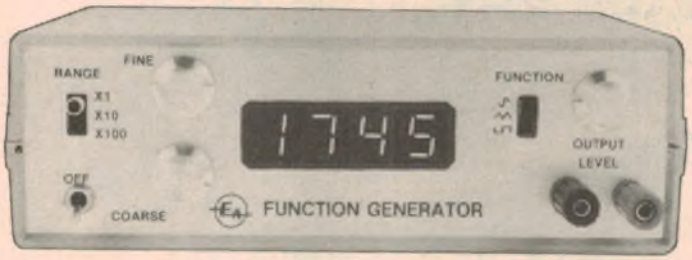
For those who already own the VB3 board, an upgrade kit can be supplied

For further information on these and other S-100 products contact Wayne Wilson at AED Microcomputer Products, 130 Military Rd, Guildford, NSW. 2161.

Micronews cont'd ►

Coming Next Month * * *

Function Generator with Digital Display



Our new Function Generator covers the frequency range from 15Hz to 170kHz in three ranges with coarse and fine frequency controls. An economical 4-digit display has been incorporated to eliminate dial calibration. Sine wave distortion can be trimmed to around 0.5%.

*Our planning for this issue is well advanced but circumstances may change the final content. However, we will make every attempt to include the articles mentioned here.

Vocal Canceller

Use our Vocal Canceller to cancel out the centre vocal component of a stereo record so that you can sing along with a microphone or provide your own instrumental contribution. Only two op amps are used in the circuit.

Dick Smith Catalog

Next month "Electronics Australia" will come to you in a see-through plastic bag together with Dick Smith's biggest ever catalog. Make sure that you do not miss out on your issue!

ON SALE: Wednesday, April 7

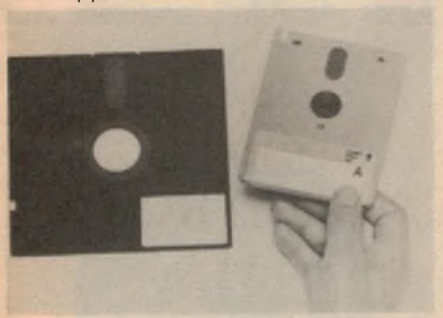
Microcomputer News & Products

Japanese launch "compact floppy disk"

Three Japanese companies have got together to agree on a standard for a new "compact floppy disk" format. Matsushita Electric Industrial Co Ltd, Hitachi and Hitachi Maxwell Ltd have all been conducting research aimed at the development of a small size floppy disk, and have established the format as a standard among themselves. They are currently promoting the format to other disk and hardware manufacturers as an industry standard.

Although there are some similar sized floppy disks already on the market, there is at present no compatibility between companies or with the popular 14cm Mini Floppy disk format. The new move should change that.

The proposed new format for 80mm Compact Floppy disks uses the same rotation speed, data transfer rate, recording capacity per track and other specifications as the mini floppy drive, and can be used in place of conventional minifloppies.



The company disk measures 80 x 100mm, almost half the size of the 14cm mini floppy. Drive systems can be made smaller, reducing the size of the entire computer system. The three Japanese companies anticipate a large market for the compact disk in home and business computer applications.

New journal of law and computers

A new publication, the Journal of Law and Information Science, is now available from the NSW Institute of Technology. Published by the Faculties of Law, and Mathematical and Computing Sciences at the Institute, the Journal is intended to provide a forum for the discussion of the growing legal problems raised by the widespread use of computers and to inform readers of new developments for the legal profession.

The first issue of the Journal contains a very informative article by the Honourable Justice M. D. Kirby on the problems of law reform to cope with computers, and an article on the legal admissability of evidence generated by computers. Additional articles cover setting up a data base of European company law, and "Computer Crime in the Australian Military Environment".

Forthcoming issues will include articles on computerisation of legal material in Australia, theories of information in law and a further discussion of the laws of evidence

Readers interested in subscribing to the Journal should write to The Editor, Journal of Law and Information Science, Faculty of Law, NSW Institute of Technology, PO Box 123, Broadway, NSW, 2007.

Super-80 newsletter

Leanne Ramsay, who runs the "Computer Hotline" at Dick Smith Electronics Pty Ltd has started up a Super-80 Newsletter to provide back-up for users.

The first issue of the newsletter contains a history of the Super-80 project, information on coming hardware add-ons, answers to some queries and modifications to the computer to eliminate problems which have shown up on a few kits. Advice and information from Super-80 users is eagerly sought for the next issue, so don't be afraid to show your knowledge!

Write to Dick Smith Electronics, PO Box 321, North Ryde, 2113 for a copy of the newsletter.

Word processing for the System-80 . . . *from p118*

After using the system for a time two other drawbacks became evident. Firstly, there is no provision for hyphenation at the end of a line. When justification is required the word processing program expands individual words to make up the requested line length, rather than automatically breaking a word with a hyphen at the end of a line. The result is that some justified lines look very "airy", with big gaps between each word. This is less of a problem for office correspondence, as normal practice is not to right-justify letters.

A second drawback is the absence of any provision for pagination. After setting the number of lines to be printed per page, the user has no control over the position of page breaks in the text, apart from the tedious procedure of setting a marker to indicate the end of printing and printing each paragraph separately. This is likely to be a problem when long reports must be printed to a particular format.

These criticisms aside, WORP-9 compares very favourably with comparably priced word processing programs. For the businessman or the home user who needs a sophisticated, cost-effective word processor, a System 80 MkII running WORP-9 would be hard to beat.

The WORP-9 processing program costs $299. As a complete system, with computer, disk drive, daisywheel printer and video monitor, the system reviewed here sells for $4646. An alternative system using a dot matrix printer is available for $3247. For more information contact any Dick Smith store.

Column 80

by JAMIESON ROWE
Technical Director, Dick Smith Electronics

A simple RS-232C Testing Box

Here is a little piece of test equipment which can be of great value when you are trying to get two computers, or a computer and a modem, to communicate with one another via an RS-232C serial interface. Very easy to build, it lets you check the status of all the basic signal lines at a glance.

This past month I've been working with gadgets like modems and speech synthesisers which communicate via an RS-232C serial line. Or more accurately, I've spent quite a lot of time trying to find out why certain gadgets *didn't want* to communicate via an RS-232C line!

One of the things I soon discovered from this was that it can be very frustrating and tedious trying to analyse what is going on (or not going on) on an RS-232C line, with just a 'scope or a multimeter. You find yourself in need of about four hands – two to hold the test probes on to the appropriate pins of a DB-25 connector, one to key in commands to the computer, and one to adjust the controls of your 'scope or multimeter. All of this to check which lines were negative, which were positive and which were at ground.

In short, I discovered the need for a simple testing box like that shown here. It took me only a couple of evenings to put it together, and there's almost nothing in it – but if you're troubleshooting RS-232C lines and equipment, you'll find it invaluable.

As you can see, it's simply a small plastic utility box with a DB-25 plug mounted on one side, and a matching socket on the other. On the front panel are two rows of LEDs – one of red LEDs, the other of green – and a row of banana jacks.

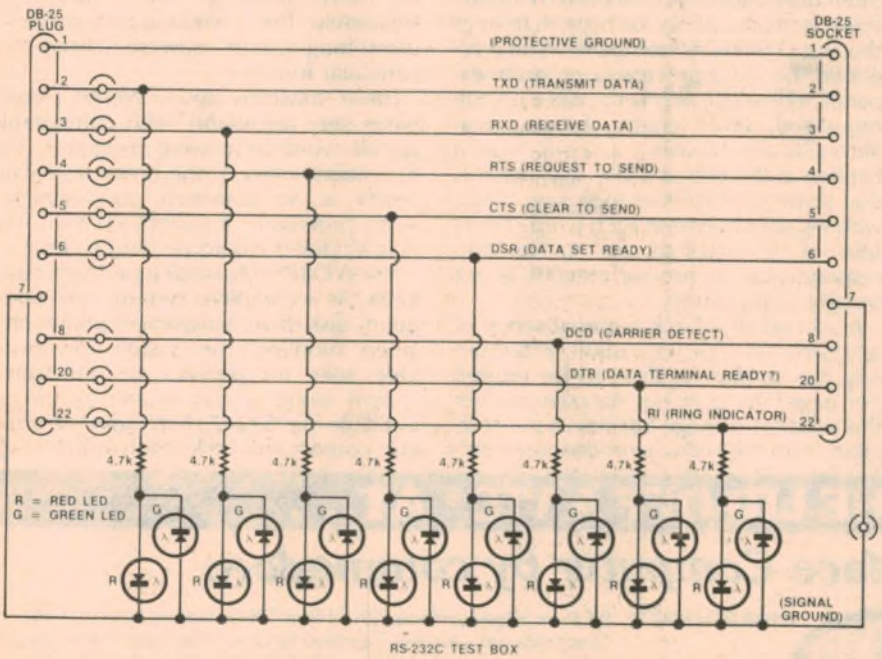
All of the main signal connections on the DB-25 plug and socket are connected together, so that the box can simply be inserted in series with an RS-232C line. At the same time the signals are brought out to the banana jacks, so that if you wish you can easily monitor them with a 'scope or a multimeter.

This should't be necessary very often, however, as the LEDs are also connected to the lines as simple logic indicators. One red LED and one green LED are used for each of the eight main signal lines, connected so that the red LED glows when the line is positive (from +3V to +12V), and the green LED glows when the line is negative (from −3V to −12V). Neither LED glows when the line is "floating" at ground potential, so between the two they make it very easy to monitor the status of all eight lines.

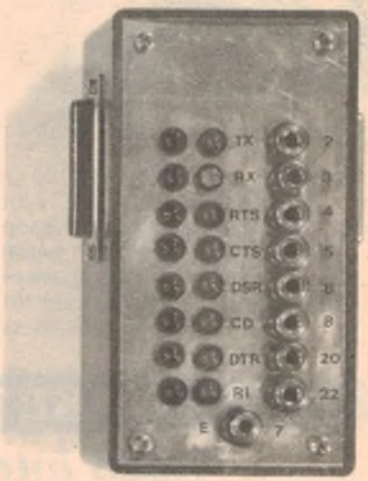
As you can see from the circuit, the two LEDs for each line are simply connected in inverse parallel, and connected to the signal line itself via a series 4.7kΩ resistor. The return circuit for all LEDs is taken to pin 7 of the connectors, which is the RS-232C "signal ground".

Needless to say, all of the parts I used were stock items from the DSE catalog – the LEDs were type Z-4032 with H-1910 bezels, the DB-25 connectors type P-2690 and P-2691, the banana sockets type P-1720 and P-1722, and the 4.7kΩ resistors R-0590. I also used the H-2753 "zippy" box, although I found it a bit of a squeeze; the H-2751 might make things a little easier.

The all-up price comes to just under $21 using the smaller box – so it's hardly an expensive test instrument.



RS-232C TEST BOX



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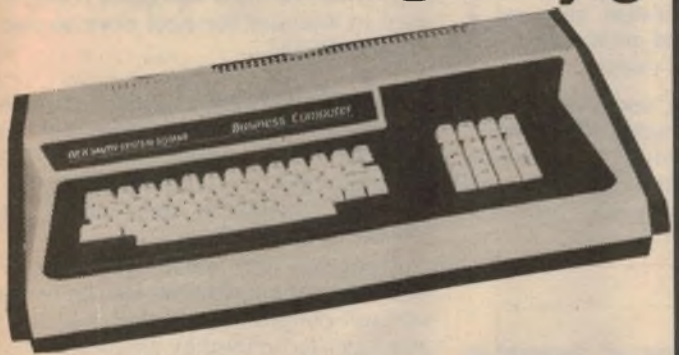

DICK SMITH SYSTEM 80 MK II

Why pay hundreds – or thousands – of dollars more for a computer when the Dick Smith System 80 offers you all the features you're ever likely to need! Widely used by schools, businesses, hobbyists and even housewives, the new model System 80 Mk II offers additional features making it even better value for money!

Features like: a numeric keypad for faster, more accurate data or figure entry . . . lower case display already fitted (not an option!) . . . inbuilt 'screen print' facility . . . programmable function keys . . . and more! The System 80 Mk II is the ideal computer for the serious user – add a video monitor, and a tape cassette (or a disk system) and you've a machine ready to go to work for you! Accounting system – word processing – electronic filing – or even to play games! Compare the System 80 Mk II with the competition – and see the value yourself!

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Yes, the VIC 20 is a truly remarkable breakthrough in computer technology – and it represents outstanding value for money! And what's more, it is backed with Dick Smith's own satisfaction guarantee. Try it for yourself: if you're not completely happy you can return it within 7 days for a full refund. YOU CAN'T LOSE!

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DICK SMITH ELECTRONICS

See elsewhere in this issue for a full list of Dick Smith stores and resellers

INFORMATION CENTRE

DIGITAL CAPACITANCE METER: I am experiencing considerable difficulties in constructing the March 1980 Digital Capacitance Meter, published in your magazine. The problem is this; The . . . thing won't calibrate!!

All other functions seem to work correctly. (Range selection etc). On "switch on" the displays are usually zeroed. If a capacitor (or even a finger) is applied to the input terminals, the display changes to some erratic value, which cannot be altered by adjustment of any of the trimpots.

On removal of this capacitor, the display continues to show the same value, although if the terminals are prodded it does change to some other value (not zero).

I have performed all subsequent errata published, without success. The project is not in kit form and the only components not used which were specified in the parts list were the two 150μF/6.3VW tantalum capacitors.

These were replaced by ordinary 150μF electrolytics, since those specified were just not available anywhere in Perth. (V. C., Midland, WA).

● From your description it would appear that there is a malfunction in the reset circuit for the 74C926. This means that the circuit involved with IC1 or IC2 is faulty. If you connect a 10μF capacitor to the instrument, you should be able to check that the gating oscillator is running and that the housekeeping signals are present on pins 5 and 13 of the 74C926. You can do this by switching your multimeter to the 10V DC range and watching the fluctuations of the meter pointer.

SLIDE CROSS FADER: How do I achieve "Titleing" on the Slide Cross Fader-Auto Advance Unit as per the November issue of EA? Could you please give me a diagramatic sketch and details of the additional parts I would need?

"Titleing" is holding one projector on whilst slides are displayed with the other projector. This would necessitate holding both projector bulbs on, one projector still, whilst the other projector slide advance was in operation. I doubt whether any bulk fade would be necessary with this because normally the slide advance would be operated at maximum speed, thus maintaining a title effect. (R. B., Pialba, Q.)

● If both projector bulbs are required to be on, this can be achieved by connecting the non-inverting inputs (pins 6 and 14) of IC5b and 5b to the +10V rail. In addition, you would need to be able to disable the slide advance circuitry to one projector by interrupting the base drive to one of the BC557s. This could all be achieved by substituting a 4-pole 4-position switch for S2. Two poles would be used to switch the non-inverting inputs of IC5b and 5d, as at present, while the other two poles could be used to interrupt the base drive to one or other BC557.

SLIDE CROSS-FADER: Having had some correspondence with you regarding the possibility of the above project, I was pleased when you announced its forthcoming publication, and awaited its release with interest.

Having now seen the article, I must express my disappointment. No doubt the unit will perform as intended, however, as a fader to be used by practical audio-visual workers (particularly those involved in competition work) it leaves much to be desired. If these seem like hard words, let me detail the main requirements of a suitable fader.

1. The fade rate should be completely variable by means of a hand control, with microswitches at each end to operate the off projector. It should be possible to halt the fade at any point or reverse it. (eg to superimpose titles.)
2. The fade rate should be visually linear.
3. Snap fades (cuts) from projector A to projector B are often required.
4. The hand control should have a flash or "twinkle" button to allow rapid alternation between projectors.
5. The signal when recorded onto tape and replayed, should exactly reproduce the original effect.
6. Adjustments should be provided for the projector lamps so that the off lamp filament just glows. This minimises lamp inertia and prolongs lamp life.
7. Some type of anti-snatch delay should be provided to inhibit a fade rate

Parts for the Mosfet Amplifier

PLAYMASTER MOSFET STEREO AMPLIFIER: Having decided to build the Playmaster Mosfet Stereo Amplifier as described in issues December 1980 to February 1981 inclusive, I set about the task in the manner to which I was accustomed before one store in Adelaide issued complete kits, ie, use whatever parts I had on hand and purchase the rest from the parts suppliers. So far the only parts I cannot purchase are the volume control that the article specified (dual 50k log with 40% loudness tap); 2 x 47μF 50V non-polarised electrolytic capacitors to suit the PC board layout; the front panel; the 0.56Ω 5W resistors (the only store in Adelaide which appears to stock these resistors, is, at the time of writing, presently out of stock); and the 4-pole, 4-position rotary switch.

My reason for writing is to ask, "Why should an article be published in your magazine if some of the parts cannot be obtained?" Shouldn't a check be made that the parts are available in all states before the project is published, or does it mean that in future, all projects in yours and the opposition's magazine be available only in kit form? (K. T., O'Sullivans Beach, SA).

● Each month we advise some 35 electronic parts retailers throughout Australia of projects to be published in coming issues of EA. Each of these retailers is supplied with parts lists for these projects and many take action to stock complete kits. However, if we were to wait until we were sure that there were dealers in every state who would sell separate parts for our projects and not just complete kits, we could not publish any constructional articles at all. As it is, most readers seem to want kits complete down to the last screw and nut, so most suppliers are meeting this demand.

Be that as it may, we understand that Electronic Agencies, of 115-117 Parramatta Road, (PO Box 185), Concord, NSW 2137, have all parts for the Playmaster Mosfet Stereo Amplifier available separately.

Electronics Australia Reader Service

"Electronics Australia" provides the following services:

PHOTOSTAT COPIES: $3 per project, or $6 where a project spreads over multiple issues (price includes postage). Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries. We reserve the right to supply complete back issues instead of photostats, where these are available.

CHASSIS DIAGRAMS: For the few projects which require a custom metal chassis (as distinct from standard cases) dyeline plans showing dimensions are normally available. $3 including postage.

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PROJECT QUERIES: Members of our technical staff are not normally available to discuss individual projects, either in person at our office, or by telephone.

REPLIES BY POST: Limited to advice concerning projects published within the last three years. Charge $3. We cannot provide lengthy answers, undertake special research, or discuss design changes. Nor can we provide any information on commercial equipment.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" or submitted without fee may be answered in the "Information Centre" pages, at the discretion of the Editor.

COMPONENTS: We do not sell electronic components. Prices and specifications should be sought from advertisers or agents.

BACK ISSUES: Available only until our stocks are exhausted. Within six months of publication, face value plus 70c for post and packing for each issue. Seven months and older, $3 (includes post and packing and storage fee).

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Chippendale, 2008.

until the off-screen projector has completed its slide change.

I am enclosing copies of brochures for commercial units which may be of interest to you. I have the impression that your fader was designed by an electrical engineer and not by a practicing audio-visual maker. (J. A., Brisbane, Qld.)

● We must admit that our slide fader does not have all the features required of professional audio-visual presentations, particularly with regard to control by tape. However, under manual operation, virtually all the requirements that you mention are possible. In fact all but being able to halt or reverse the fade and the anti-snatch delay can be achieved with suitable control manipulation. As it stands our slide fader is quite a useful device, a unit that will provide the user with a means to produce professional results at a low cost.

SUPER-80 COMPUTER: I have been a regular subscriber since the earliest days of "Radio and Hobbies" and over the years have built a number of projects which were described in your magazines, the latest being the Super-80 Computer.

Since first getting this project up and running in early October, I have been anxious to interface it with my KSR 33 Teletype, to list programs.

According to the technical manual dated 1/8/81, a serial interface was being developed but after three months it is still not forthcoming. In fact I have been told that I am on my own.

In your November 1980 and February 1981 editions you have published articles by Gerald Cohn on serial interfacing printers with TRS80 and System-80 computers, in which problems of different Baud rates, CR and LF signals are handled by a Basic program.

I hope that I can look forward to seeing a similar project for the Super-80 in Electronics Australia in the near future. (L. K., Corinda Q).

● We do plan to publish a printer interface for the Super-80 in the near future.

(Information continued on p133)

Notes & Errata

CONTROL TIMER (April 1980, File 7/CL/30): Switch S2 should be of the break-before-make type. This ensures that the power supply is not shorted upon changing the switch setting and resetting the clock. The most economical solution to those who have used a make-before-break switch is to insert a 10kΩ resistor between the switch and 0V rail.

LYREBIRD PIANO (December 1981, File 1/EM/35): a wire link has been omitted from the wiring diagram on p85, Dec 1981. This link goes from one side of RV7 (ie, pin 1 of IC3a) to an adjacent copper pad which connects to the 220Ω resistor in series with the headphone socket.

EPROM PROGRAMMER (January 1982, File 2/CC/66): S4a is wrongly depicted on the circuit diagram. Pin 19 of the Eprom should connect to the switch wiper and position 1 is the connection to pin 15 of IC3. The printed circuit board is correct.

PROGRAMMING THE SUPER-80 (January 1982, File 8/M/53): There was a comment to the effect that there are two versions of the Basic interpreter on tape. This is not correct. V1.2A is the only tape-based interpreter. V1.2B is the Eprom version.

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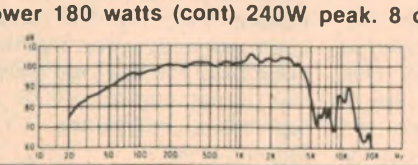

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"Enough is Enough" said the Iron Lady

INCIDENTAL EXTRAS: As Maggie Thatcher is reported to have said with some emphasis, "Enough is Enough!" First, (April '81) we are presumed to have an auto-wind, electronic release 35mm camera or purchase one. Care to name one, and add the price tag to the "estimated cost"? If we are to avoid a 1/60th second "ghost fringe" from ambient daylight, we will also need a fairly substantial output from an auto-flash. Add a minimum of $70!

Both of these criteria are however fairly commonplace on the better Super-8 and 16mm movie cameras. And I would take a lot of convincing that the published strip of "slides" are not indeed from 16mm film, or equipment far more sophisticated than indicated.

Frames one and three from the left of the "Strip" although reversed in the printing, appear to be of a bird with consistent plumage "defects", and the frame sequences far too close for any auto-wind.

Now we are assumed to possess not one, but two auto-focus, remote change projectors. Ever tried carrying the tag for these – or carrying (physically) just one, up two flights or stairs to a meeting? Again, why is the cost of the second projector not included in the "estimated cost".

More seriously, how about an alternative, simple arrangement within the reach of many more readers? If a two-stage timer is used, stage "A" operating a small DC motor and cam, or solenoid could fire the shutter, while stage "B" could fire the flash at a suitable time during exposure. Sure, one may get a bit of "1/60th ghost", and have to manually advance the film, but it can be done. An auto-flash is an advantage, and useful in "normal" situations into the bargain.

Now the slide-changer/fader. Lacking the second projector, a fade-out change, fade-in sequence, occuping about 1-1¼ seconds is not unpleasant to watch and avoids that sideways "slash" of the auto changes. And I find that I can get enough power, virtually inaudible at 15kHz, down one channel to operate the change relay direct from a small amplifier. Could anything be simpler to combine?

Please, however, in spite of these criticisms which are intended constructively, do not sink to the poorly disguised plagiarism and lack of originality of "other publications". I very much like EA, and would like to see it appeal to more. (W. Q., Kuranda, Q.)

● Surprising though it may seem, there are readers who do possess motor-driven cameras and who wish to use them in more innovative ways. Our infrared light beam relay does this and can be used in non-photographic applications, as outlined in the article.

And what must we do to convince you that all the published shots were taken on 35mm film? You must be one of those everlasting unbelievers just as some of our readers seem to think that we present projects in the magazine without ever building them. How do they think we produce the photos for the articles in the first place?

And as far as the Slide cross-fader was concerned, it was presented in response to readers' requests for just such a project. Some of these letters were published in these pages during 1981.

We shall certainly give consideration to your suggestions but please do not criticise us for not including the cost of film in the project, if it is finally published. We do have to make some assumptions.

Fisher PH492K . . . from p36

previous reviews, this reviewer finds this "double" operation a trifle frustrating.

Tape speed was approximately 0.4% high, while fast forward and rewind times were each 95 seconds for a C60 cassette. Peak wow and flutter fluctuated between 0.08 and 0.1% DIN weighted.

Unlike some medium-priced cassette decks which provide five-step bar-graph level meters with each step split into two segments so that the bar graphs appear to have 10 separate steps, those on the Fisher are not "split" and cover nine genuine steps.

A Dolby-B reference level (200nWb/m) cassette played back at the Dolby mark, producing 700mV at the LINE OUT sockets. This would indicate that the normal line output level (at the "0" mark between the last green and first red segments) is intended to be 500mV. Replay frequency response was well within 2dB to 10kHz, the upper limit on our test cassette.

We used a Maxell UD as a sample IEC type I cassette, a TDK SA as a type II, and a TDK MAR as a type IV. Overall frequency response was within ±2dB between 30Hz and 15kHz, with a broad 1½-2dB peak between 4kHz and 12kHz when using the type I cassette. Response fell sharply above 15kHz, being 12dB down at 17kHz.

Response was similar with the type II and IV samples, the main difference being that the high frequency peak was greater, being some 3 to 4dB, and that the roll-off above 15kHz was slightly less being only 8dB at 17kHz. As no front panel HF BIAS adjustment is provided, it is not possible to vary the overall high frequency response.

Overall distortion figures were essentially the same for all three cassette samples. At a recorded level of 160nWb/m at 1kHz, distortion was 1%; and at 6dB above (320nWb/m) was 3% for types I and IV, and 4½% for type II.

Unweighted signal-to-noise ratio below 200nWn/m was 50dB for the type I, 53dB for the type II and 52dB for the type IV. Selecting Dolby B improved these figures to 57, 59 and 59dB respectively.

An additional facility included in the PH492K is the selectable AUTO record level function which effectively puts the record channel in the maximum gain mode for line input levels below 65mV (corresponding to a recording level of approximately 150nWb/m). Higher input levels result in a peak limiter action such that the input has to be raised to 2.3V (approximately 30dB) to increase the recorded level by 3dB, ie a compression ratio of 10:1.

Attack time is not instantaneous, taking several milliseconds, whilst the recovery time is about 4 seconds. Combined with the 10:1 compression ratio, these characteristics provide a very pleasant result when recording speech; and probably enhance all speech recordings other than those by professionally trained voices. However, as much of the dynamic range is compressed, it is preferable to disable the AUTO level facility when recording music, except, perhaps, in special circumstances.

A bonus feature on the PH492K is the Auto Search Function (ASF) which can be used to quickly locate the start of a music track, and then automatically commence play. In common with several other machines this is done by detecting (and counting) the silent spaces between the tracks of recorded music. After loading a cassette onto the machine, any track – up to a maximum of seven, in either direction – may be selected for playback.

In conclusion, we found the Fisher PH492K a most interesting package; and although aimed at the domestic consumer market, in most areas – both in presentation and performance – is about on a par with similar combinations of low-priced high fidelity "separates". Whilst its relatively low power output may be somewhat offputting, this is offset by the variety of power sources from which it may be operated – a feature certainly not available in high fidelity separates. The only area in which its performance is less than adequate is the phono input overload capability. This could be overcome by using an external pickup preamplifier connected to the LINE inputs.

Recommended retail price of this Fisher PH492K portable audio system is $613 including sales tax. Further details can be obtained from department stores or the distributors, Sanyo Australia Pty Ltd, 14 Mars Rd, Lane Cove, NSW, 2066.

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680uF, 35V	50c
0.015uF, 250V	25c
1uF, 100V	25c
1000uF, 16V	50c
220uF, 16V	50c
2000uF 63V	$1
0.47uF, 400V	50c
680K, 250V	25c
012, 250V	25c
15NF, 250V	10c
120K, 250V	20c
10uF, 315V	25c
0.056, 250V	10c
500 MFP 10 VOLT	5 for $1
68uF 63V	5 for $1

SPECIAL TRANSISTORS

AD 161-162	$2.50 pr
BSC 901A	$1.50 ea
BC 548	10 for $1
AD 149	$3 pr
OC9554	50c
BD202N	50c
BD135	50c
2NC055	$1

ELECTROS

470uF, 25V	5 for $1
400uF, 10V	5 for $1
47uF, 63V	5 for $1
350uF, 16V	2 for $1
27uF, 160V	5 for $1
25uF, 63V	10 for $1
22uF, 160V	10 for $1
47uF, 16V	5 for $1
47uF, 200V	5 for $1
220uF, 10V	10 for $1
68uF, 16V	10 for $1
100MFD, 350V chassis mount	$1

Circuit Diagrams supplied

CRYSTALS FOR COLOUR TV 03061 NDK $2.50

COLOUR INFRA RED AUDIO TRANSMITTER $5

FM RADIO AERIALS $1

SPEAKER TRANSFORMERS FOR VALVE RADIOS

5,000-15 ohm	$2.50
7,000-15 ohm	$2.50
10,000-15 ohm	$2.50
7,000-3.5 ohm	$2.50

TV Stick Rectifiers 20SC $1.00

Slide Pots

250K-50K	3 for $1
Dual 500K	3 for $1
1 Meg	3 for $1
2 Meg	3 for $1

Including Fancy Gold Knobs

25K dual	2 for $1

SPECIAL

100 mixed resistors, all useful	$2
100 mixed capacitors, fresh stock	$2

AUDIO LEADS

3.5m to 3.5m, 7ft	75c
3.5m to 6.5m, 7ft	75c
6.5m, 7ft	50c

MICRO SWITCH
5A, 250V AC 75c ea

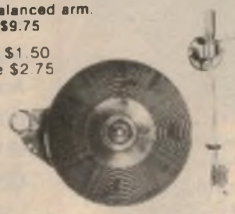
TUNING CAPS

2 and 3 gang	$1 ea
Min 2 gang	50c

SUPER SPECIAL

GRAMOPHONE motor and pickup 3 speed stereo balanced arm. **240 volt $9.75**

PP NSW $1.50
Interstate $2.75
WA $4



SUPER SPECIALS
FM STEREO TUNER KITS

Sets of 3 modules include FM tuner, decoder and IF detector. Circuit diagram supplied. Can be used with amp modules.

ONLY $22
P&P $1.00

Colour deflection boards to suit Kriesler, Philips, Pye etc $35. (Circuit diagrams supplied.)

SUPPLIED

PP NSW	$1.80
Interstate	$3.00
WA	$4.00

BSR DELUX

11 INCH TURNTABLE, CUING DEVICE, SHEILDED MOTOR, MAGNETIC CARTRIDGE, ANTI SKATE, BASE $50 PERSPEX TOP $22 EXTRA

PP NSW $2
INTERSTATE $3.50
WA $4

SPEAKERS 2¼ INCH 2 FOR $1

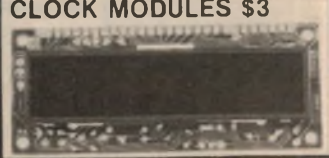
Power Transformers 240V 2.6.3 Windings 0.15 AMP $3.00
Power Transformers 240V 1.30V x 12V 60 Mil $6.00

SPEAKER SPECIAL

Magnavox 10 Inch Woofer, 10 Inch Mid-Range 20W 80HM System I$20 A PAIR

PP NSW	$1.60
INTERSTATE	$3
WA	$4

CLOCK MODULES $3



P&P NSW $1.60 INTERSTATE $2.80

COLOUR FRONT END COMPLETE PUSH BUTTON TUNER SECTION
TO SUIT PHILIPS, PYE, KRIESLER ETC. **$25**

Colour Picture Tube Boards

$6.00

VU & BALANCE METERS

STEREO VU **$3.00**

12Kn 100uA **$2.00**

SPEAKER SYSTEMS

$29.50 PAIR

2 6" Dual Cone Magnavox

P+P NSW $2.50 INT $4.50 WA $5.50

Colour Power Supply Boards $50

PP NSW	$2.00
Interstate	$3.50
WA	$4.50

MICROPHONES DYNAMIC FAMOUS PIEZO DX75 $10

SPECIAL

SPEAKER CROSSOVER NETWORKS 2WAY FREQ 4KHZ 30W 80HM

$2

POTS ROTARY

½ Meg	30c
1 Meg	30c
100K	30c
100K Switch	50c
50K Double Pole Switch	50c
7.500	30c
10K Switch	50c
250K	30c
50K	30c
20K	30c
10K Min Pots	25c
50/ohm	50c
½ or 1 Meg Switch	50c
½ 1 meg dual Concentric tapped at 100K	$1
2 meg ganged double pole switch	$1
1.5 meg dual ganged	50c
2 meg ganged log	$1
1 meg dual ganged	$1
½ meg dual ganged LIN	75c
25K, 50K dual ganged Concentric double switch	$1
200K single line	30c
20K wire wound	75c
dual log 10K	75c
100K dual ganged linear pots	75c
10K sub min log pots	50c
250K ganged pots	75c
25K lin ganged pots	75c

2 Min Transistor 450 IF KC Coils Plus 1 Min Oscillator Coil	3 for $1

TV EHT Leads

4'6" in length	50c each
Transistor sockets	20c each

Pick up Cartridges BSR universal type	
Ceramic Stereo	$5
Diamond stylus stereo magnetic	$12

Cable 4 Strand 5 Metres 50c

DIODES

OA 626	4 for $1.00
OA 662	4 for $1.00
EM 410C	4 for $1.00
DS 150A	50c
DSY 130YO	50c
OA 636	50c
HR 15	50c
Diodes BYX 55, 300	30c
BY 188	30c

DIODES BAV20 10 for $1

Valve sockets 7 pin	10c
Valve sockets 9 pin	10c
OCTAL	10c
09478	5 for $1.00
BZX79	5 for $1.00

Power transformers 240V, 117V, 2/25V Tapps 6.3 — $7.00

SPARK GAPS 500 volt 20 cents
THERMISTERS 20 cents

Transistors AD161-162	$2.50 pair
Transistors AD149	$3 pair

PICK UP ARMS
Mono $3.50
Inc Ceramic Cartridge & Stylus

TRIMPOTS

200 ohm	10c
5K	10c
100K	10c
47K	10c
10K	10c
470 ohm	10c

Miniature speaker and drive output transformers $1 pr

Special mixed tag strips 10 for $1

SPEAKER SPECIALS

5 inch in 3.5, 8 or 15 ohms	$3.50
15 ohm 4"	2 for $2
6 x 9 15 ohm	$5 ea
5 x 7 15 ohm	$4 ea
8 x 4 15 ohm	$4 ea
6 x 4 15 ohm	$3 ea
6 x 4 27 ohm	$4.50 ea
6 x 3 27 ohm	$3.50 ea
5 x 3 27 ohm	$3.50 ea
5 x 3 47 ohm	$3.50 ea
2¼"	2 for $1
6 x 4 3.3 ohm	$3.50

Power leads and sockets 240 volt, suit most tape recorders, radios, etc. $1 each.

455KC IF Transformers for valve radios. $1 each. Also OSC coils, 75 cents each.

Aerial coils	75c

HOR Drive 3021 transformers for colour TV	$2
TV Colour Convergence Units 11270 44 x 6	$3

PILOT LIGHTS

Screw in 6.3V	10 for $1.50
Pilot light holders	10 for $1.00
12V	10 for $1.00

EA Magazine Holders

The binders and magazine holders are available over the counter from Electronics Australia, 57 Regent Street, Sydney, NSW — Price: $5.10 binders, $4.50 holders

Mail orders should be sent to Electronics Australia, PO Box 163, Chippendale, NSW 2008

Prices including postage are:

Holders: $5.40 NSW; $5.50 other states; or six for $28.30 NSW, $30.40 other states, A$32NZ

Binders: $6.20 NSW; $7.90 other states; or six for $32 NSW, $34 other sates, A$36.60 NZ.

EA PC BOARDS AND FRONT PANELS

Some readers have problems obtaining PC boards and front panels for projects. Many of our advertisers sell these items and their advertisements should be checked in the first instance. Failing that, below is a list of firms which produce or sell PC boards and front panels.

NSW

Dick Smith Electronics,
125 York Street,
Sydney, 2000.
Telephone 290 3377.
DSE also has branches and resellers throughout Australia.

Electronic Agencies,
115-117 Parramatta Road,
Concord, 2137.
Telephone 745 3077.

Jaycar Pty Ltd,
380 Sussex Street,
Sydney 2000.
Telephone 264 6688.

Radio Despatch Service,
869 George Street,
Sydney 2000.
Telephone 211 0816.

RCS Radio Pty Ltd,
651 Forest Road,
Bexley, NSW 2207.
Telephone: 587 3491

VIC.

Rod Irving Electronics,
425 High Street,
Northcote, 3070.
Telephone 489 8131.

Kalextronics,
101 Burgundy Street,
Heidelberg 3084.
Telephone 743 1011.

Sunbury Printed Circuits,
10 Counihan Street,
Sunbury 3429.

SA

James Phototronics,
522 Grange Road,
Fulham Gardens, 5024.

WA

Altronics Distributors,
105 Stirling Street,
Perth 6000.
Telephone 328 1599.

Jemal Products,
8/120 Briggs Street,
Welshpool, 6106.

N.Z.

Marday Services,
PO Box 19 189,
Avondale, Auckland.

Mini Tech Manufacturing Co Ltd,
PO Box 9194,
Newmarket.

Printed Circuits Limited,
PO Box 4248,
Christchurch.

ADVERTISING INDEX

THE IDEA BEHIND OUR RADIO CASSETTE RECORDERS.

The stereo headphone represents perfect stereo reproduction.

As well as receiving sound through your ears, you appear to receive sound from above your head.

This added dimension in sound is stereo.

Of course, anyone can get this sound from any good stereo radio cassette recorder if they listen through stereo headphones.

But, at JVC, we realised it was impractical to wear stereo headphones all the time.

So we invented a new kind of sound system just for our stereo radio cassette recorders.

The Biphonic System.

This exclusive system offers 3-dimensional sound effects, so you enjoy true stereo reproduction without headphones.

If you'd like to know more about the many innovations JVC has brought to the stereo radio cassette recorder, write to us for a brochure, or call in to any JVC dealer.

Then you'll see why JVC equipment is recognised as The State of the Art.

JVC

JVC Advisory Service, Private Bag, Kingsgrove, N.S.W. 2208 or phone (02) 750 3777.

JVC0058/EA/FMMH

Marantz Gold.
Your New Recording Standard.

For over twentyfive years the name Marantz has stood for the ultimate in audio engineering brilliance and fidelity.

In keeping with this standard of technical excellence, the new Marantz Gold range of Cassette Decks with stunning designer element of brushed-gold finish now includes a recorder incorporating the latest in noise reduction processing.

The Marantz SD3030 Cassette Deck features the new Dolby C system to provide recordings with far less tape hiss than those made using standard Dolby B.

Unlike some other noise reduction systems, Dolby C recordings can be played back on a deck equipped with standard Dolby only without audible distortion or pumping effects.

Recording enthusiasts will be delighted by the other models in the new range.

Marantz Gold decks offer a variety of advanced features such as LED peak level meters on the SD1030, fine bias adjustment on the SD2030, and a motorized linear skating loading system on the SD5010.

All feature Dolby B noise reduction, compatibility with metal tapes, soft touch controls and DC Servo motors to ensure constant tape speed and silent operation.

So, set your standards high. And your recording standards higher.

See your local stockist and listen to the future. Listen to Marantz.

marantz
Now you're listening.

Decks shown in stack (from top): SD1030, SD3510, SD2030, SD3030 and SD5010. All decks shown with TDK Metal tapes.

Distributed by MARANTZ (Australia) Pty. Ltd. 19 Chard Road, Brookvale NSW 2100
Telephone (02) 939 1900 Telex AA24121 Melbourne (03) 544 2011,
Brisbane (07) 44 6477, Adelaide (08) 223 2699, Perth (09) 276 3706, Townsville (077) 72 2011

Marantz Gold.
The New Audio Standard.