Australia's Top Selling Electronics Magazine

Electronics Australia

JULY 1986
Aust* $2.95
NZ $3.75

Registered by Australia Post — publication No. NBP 0240

FOOLPROOF SPEAKER PROTECTION

Th Th

Building our new stereo amplifier

HYDRO-ELECTRICITY IN TASSIE

SPECIAL FEATURE

SURFACE MOUNTED COMPONENTS

TUNEABLE WHIP ANTENNA TO BUILD

LIGHTS ON REMINDER FOR YOUR CAR

Volume 48, No. 7

Electronics Australia

July 1986

THIS MONTH'S COVER

Your trusty amplifier could lash out at any time and land you with a huge repair bill. Find out how to avoid the risk by turning to page 59.

Features

Entertainment Electronics

Projects and Technical

News and Comment

Departments

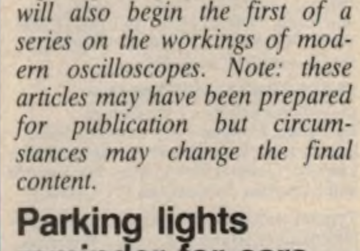
Remote control for the Playmaster Tuner

Add that final touch of luxury to your new Playmaster Stereo AM/FM Tuner. With this infrared remote control you can select any of the 12 programmed stations at will, or tune to any AM or FM station using the up and down tuning buttons.

What's coming

Next month, we intend to describe an engine cool-down timer for turbo-powered cars, a dynamic noise reduction unit for use with VCRs, and a new digital photographic timer. We will also begin the first of a series on the workings of modern oscilloscopes. Note: these articles may have been prepared for publication but circumstances may change the final content.

Parking lights reminder for cars



Ever left the parking lights on in your car and flattened the battery? With this simple project, you'll never leave the parking lights on again.

MANAGING EDITOR
Leo Simpson, B.Bus. (NSWIT)

EDITOR
Greg Swain, B.Sc. (Hons. Sydney)

EDITORIAL CONSULTANT
Neville Williams, F.I.R.E.E. (Aust.) (VK2XV)

TECHNICAL STAFF
John Clarke, B.E. (Elec. NSWIT)
Colin Dawson
Louise Upton

ART DIRECTOR
Brian Jones

ART PRODUCTION
Alana Horak

SECRETARIAL
Carmel Triulcio

ADVERTISING PRODUCTION
Brett Baker

ADVERTISING MANAGER
Selwyn Sayers

PUBLISHER
Michael Hannan

HEAD OFFICE
The Federal Publishing Company Proprietary Limited, 180 Bourke Road, Alexandria, NSW 2015. Phone: (02) 693-6666. Fax Number: (02) 693-2842. Telex: AA74488. Postal Address: PO Box 227, Waterloo 2017. Representative: Norman Palmer.

INTERSTATE ADVERTISING OFFICES
Melbourne: 23rd Floor, 150 Lonsdale Street, Melbourne, Vic 3000. Phone: (03) 662 1222. Representative: John Oliver, B.A. (Hons. Essex).

Adelaide: John Fairfax & Sons Ltd, 101 Weymouth Street, Adelaide 5000. Phone: (08) 212 1212. Representative: Dane Hanson.

Brisbane: 26 Chermside Street, Newstead, Qld 4006. Phone: (07) 854 1119. Representative: Bernie Summers.

Perth: John Fairfax & Sons, 454 Murray St, Perth, WA 6000. (09) 481-3171. Representative: Tracey Tyler.

New Zealand: 3rd Floor, Communications House, 12 Heather Street, Parnell, Auckland, New Zealand, PO Box 37-291. Telex: NZ63122. Telephone: 79 6648. Representative: John Easton.

ELECTRONICS AUSTRALIA is published monthly by the Federal Publishing Company Pty Limited, under licence from Double Bay Newspapers Pty Limited, General Newspapers Pty Limited and Suburban Publications Pty Limited.

Typeset and printed by Eastern Suburbs Newspapers, Joynton Avenue, Waterloo, NSW, for The Federal Publishing Company Pty Ltd.

Distributed by Magazine Promotions Pty Ltd, Sydney.
Registered by Australia Post — publication No. NBP0240. ISSN 0313-0150.

Letters to the editor

Parts for old tape decks

I refer to the article "How to Service Cassette Decks" in the April '86 issue of EA. In my experience, tape transport mechanisms last a long time — much longer than the head(s) — and it is certainly worthwhile, as you imply, to replace heads. I believe you (and your advertisers) could be more specific as to where to attempt to obtain new heads for tape machines; everybody wants to sell you a new machine, nobody wants to know you when you merely want spare parts.

While the article is informative as far as it goes, it omits the very important matter of azimuth alignment of the head.

Personally, as a fairly low grade hobbyist, I would be wary of attempting to work on cassette machines, although I have performed several head replacements on reel-to-reel recorders. I recall prizing out with a large safety pin a harvest of chewed up tape from a cassette deck, and it took about an hour to get it all out, being greatly hindered by a cassette compartment lid which did not have any obvious means of removal.

A salesman to whom I spoke about this said facetiously "Oh, you are not supposed to clear it yourself; you either throw it away and buy a new deck or you have a service man do it at vast cost". Enough said.

Unfortunately, many very adequate medium-priced reel-to-reel recorders have gone to the wall in the face of the all encompassing cassette tyranny. My own Sony portable TC 800B reel-to-reel recorder is now much battered (one head replacement) but the transport mechanism is still as good as the day it was bought and the machine works well.

Again, my monthly reading for the Institute of the Blind is done into a Sony 105 ¼ track reel-to-reel recorder, significantly at the insistence of the Institute which (rightly) dislikes original recordings being done on cassette. This machine was, and still is, a great work

Spark control for torpedoes

How much I enjoyed Peter Jensen's article in the April issue, and my congratulations to him and yourself on this piece of "Technology Preservation".

P.J. mentioned the Coherer in the course of the article, and herewith a portrait of one. It is about 60 years since I saw it, so I will not guarantee detailed accuracy. At the time it was in the attic den of my father, the late C.H. Cooke, MC. Some ten years later I came upon a reference to a coherer in an old book, and quizzed father on the subject.

Apparently the one I have seen (the only one!) had been the heart of a radio-controlled model torpedo constructed about the year 1910 by himself and one of his brothers (John). The transmitter was, of course, spark and the mahogany cased induction coil was still in the junk box at that time.

The modus operandi was as follows: the input winding formed part of a tuned circuit. A terminal attached to the brass column and the terminal atop the ebonite bobbin were the outputs. I can only guess at what was in the bobbin. I imagine there was a flat plate at the bottom connected to the column, and that there was a cup-shaped plate connected to the top terminal, as I gathered that the metal filings in the intervening space were only loosely packed. The metal filings were of nickel.

When a signal was received, the nickel filings lined themselves up and stuck together (cohered, in fact), and allowed sufficient current to pass from a battery to a sensitive relay. This in turn tripped a stepping relay in parallel with the de-coherer (which was an ordinary bell mechanism), which struck a blow and loosened up the filings in readiness for the the next signal.

In this case it was a digital device, and worked well. I can only imagine it horse which has of course disappeared from the market, a victim of the above mentioned tyranny.

Any help you can give in the location of parts for old and usually much loved reel-to-reel machines, particularly heads, would be greatly appreciated by enthusiasts. As you have gathered, I do not really like the cassette system and resent being bullied into it by the trade. The much vaunted convenience of the cassette is arguable, particularly when the machine goes wrong. All in all, they're an abomination!

With best wishes for the continued prosperity of your magazine, hopefully free of future price rises.

M.R. Gamble,
South Yarra, Vic.

Correction to stations list

It is with some consternation that I see in the March 1986 issue of *Electronics Australia,* that Radio 6BY (900 kHz) was left off the list of AM and FM Broadcasting Stations in Australia.

To set the record straight, 6BY has been in operation since January 26th, 1953, and is a part of the "Rainbow Radio" network — the largest country radio network in Western Australia.

I hope this oversight will be corrected in the next issue of your magazine.

Phillip Randall,
Station Manager, 6BY,
Albany, W.A.

being used for CW reception with the de-coherer set at a fast rate, and going continually. No wonder it had a short life as an RF detector!

To complete the story, the model was trialled on a pond, and was a great success, and the brothers were about to dash off to tell the Lords' Commissioner that their worries were over re Kaiser Willy, when it occurred to them that it was not much use being able to control a torpedo unless you knew where it was: no easy task in the fierce North Sea. They never solved that problem.

John was killed in action (R.F.C. 1916) and father survived the years 1915 to 1918 in the trenches of Flanders. Father was rather miffed when the post WWI awards to inventors were made. Someone was given a King's ransom for a device to control a torpedo by wires played from a couple of drums which were capable of being braked!

C.D. Cooke,
Tenterfield, NSW.

Editorial Viewpoint

Export credits could help high technology manufacture

For the last few months the media has been full of bad news about Australia's balance of payments and the poor state of our current account. Indeed, Australia is going through a hard time but in reality our current account has been in debit for quite a few years now. In discussing these terms, it is important to define just what they mean. The "balance of payments" is simply the difference between our total payments to foreign countries and total receipts from foreign sources. The "current account" the difference between total imports and total exports.

The balance of payments is heavily in the red, partly because we have such a high overseas debt and we have to pay high interest on it. For its part, the current account is very unfavourable because the prices we are receiving for our export commodities is low while the price of our imports is high and still rising.

Now there is little that the Government or anybody else can do about the low prices for our exports; there is such a large world glut in all our export commodities. But we can do something about the import side. Now I am not going to suggest that the Government should do anything to actively reduce the quantity of imports coming into the country by raising tariffs or imposing quotas. Those businesses that depend on imports are already finding it difficult enough to survive in the face of high interest rates and the low value of the dollar.

What should be done is to see how the large import bill for computers, telecommunications and instruments may be reduced. As Dr Bill Caelli of Eracom pointed out recently in an article in **The Australian**, our total bill for such information technology represents 14 per cent of our total imports and is actually bigger than our imports of cars or oil, taken separately.

Clearly, more can be done to encourage manufacture of such equipment in Australia. I am not suggesting that Australia should necessarily invest in the manufacture of such mass produced high technology items as disk drives or computer keyboards. Such items are made overseas so cheaply that it would not be worthwhile. But it would be worthwhile to allow such items in virtually duty free to manufacturers who are catering both to the local and export markets. There are many such manufacturers who process imported components to make very competitive high technology products. We need a lot more of them.

Such value-added manufacturers could be given the benefit of export credits in much the same way as the car manufacturers. This would encourage more investment in manufacturing which would have the dual benefit of adding to employment and reducing our import bill. It works for the car industry; why not for high technology?

Leo Simpson

News Highlights

Windmills in the sky

A 'flying windmill' designed at the University of Sydney has undergone field tests at a University farm near Marulan on the NSW Southern Highlands.

Called the Gyromill Mark II, it is designed to fly high in the air like a kite while a helicopter-type apparatus spins in the wind to generate electricity. This is then fed down lines attached to the tether wires.

A smaller version of the Gyromill was successfully tested behind a car last year. The second version weighs 20kg and has twin contra-rotating rotors, each four metres in diameter. The rotors are single bladed with counter weights.

A 'pilot' station on the ground enables collective pitch control on each rotor and tail plane incidence control to rotate the tail. The front tether provides craft attitude control so the whole craft can be tilted back by up to 30 or 40 degrees to the wind, depending on conditions. The rotors rotate at up to 700 revolutions per minute.

In suitable winds, the craft can generate up to 3kW but in principle it should be possible to scale the design up into the megawatt range.

One of the major reasons for flying the windmill is that, at high altitudes, the winds are stronger and more consistent, and there is not the turbulence that exists close to the ground. US trials with large ground based windmills have found that they suffer severe metal fatigue due to ground turbulence.

A major use for the flying windmill, if it reaches the commercial stage, may be to generate electricity in the Antarctic. According to the research team, it would avoid the pollution generated by oil and coal plants, and would be cheaper to run.

Snakes alive

Above: Telecom's UTTB and the diamond python snake.

In the course of a day's work, a Telecom faultman often encounters unusual situations. Such was the case recently when Narara back-up faultman LSM Peter Collins opened an untailed terminal box (UTTB in Telecom jargon) to find that it had become the home for a diamond python snake (non-poisonous).

Quickly recognising the intruder, Peter kept calm and removed it from the box. Then he thought no more about the matter. That is until Narara faultman LSM Kevin Denzel had cause to work on the same terminal box at a later date, only to be confronted by the same intruder. It gave Kevin quite a surprise, and he nearly came to some grief as a result.

To avoid any future accidents, the creature had to be removed from the immediate area due to its insistence on returning to the UTTB. The Erina Depot Abbey gang volunteered for the task and LS1 Bob Hyndes and Lineman Peter Kreis removed the snake and took it to the Eric Worrel Reptile Park in Gosford.

(Text and photograph courtesy of the Telecom staff publication "On the Line").

Nuclear power now Japan's largest source of electricity

Nuclear power plants were introduced into Japan in 1966 and in 1985 produced more electricity than petroleum-fired thermal plants.

The country's 32 nuclear power plants generated 156.9 billion kilowatt hours of electricity in 1985 which is 26% of the nation's power. Petroleum-burning power plants supplied 25% for the same fiscal year, while liquefied natural gas was third with 21%.

During the 1984 fiscal year, petroleum-burning plants produced 30% of the power and nuclear plants 23% of the total output for that year.

Doing it all by ear

Traditional hand-held mobile radios could lose quite a bit of ground to an ear transducer designed and developed in Australia. The ear-mike does away with the speaker and microphone of a two-way radio and enables the user to receive and transmit via the ear.

The transducer picks up vibrations from a speaker's voice as it passes to the eardrum and a membrane vibrates in response to air movement in the canal. This mechanical energy is then converted to electrical energy and is passed down a fine cable to an interface module connected to a standard belt radio or pocket radio.

To transmit, the user presses a talk button on the module. Reception of incoming signals also comes through the radio and then to the ear.

Heyden-Spike Pty Ltd, the developers of the device have found a solid market for it in defence, aviation, fire fighting services and mining companies. It has also been well accepted by such illustrious organisations as NASA and the FBI in the US; and in Japan, by the Department of Civil Aviation and by defence authorities.

Because of the EM-200's small size, it is ideal for work in high noise areas where it can be used in combination with standard industrial ear protectors or hard hats. The device can be used with any radio equipped with an external speaker/microphone.

Big contract to CSA for RAN 'copter program

Computer Sciences of Australia has gained a multi-million dollar contract to design, write and test software for weapons systems to be used in the Royal Australian Navy's Sikorsky S-70B-2 Seahawk helicopters.

The multi-year contract was awarded by the Collins Government Avionics Division of Rockwell International Corporation which is designing and furnishing an integrated avionics system for the new helicopters.

The avionics will include scanning and Doppler radar, a magnetic anomaly detection system, sonobuoy processing, a tactical data link that sends processed information back to the support frigate, radio communications, navigation and other tactical equipment.

Last year the Federal Government signed a $300 million contract with Sikorsky for eight S-70B-2 Seahawk helicopters for delivery during 1987-88.

The RAN's Role Adaptable Weapons System, known as RAN/RAWS, for which CSA will develop software, will be used for antisubmarine search and attack, utility missions, surface surveillance and over-the-horizon targetting.

New Soviet space station

According to a report in the British magazine New Scientist, the Soviet Union recently launched the nucleus of a permanently manned space station.

In 1982, Salyut 7, which had two docking ports, was put into space. This latest effort has six ports and is named Mir, which means "peace".

The ports around Mir will be used to attach 'modules' to the craft on a long-term basis, expanding its size and capabilities considerably. The two end points will retain their function as docking ports for ferry craft link-ups which provide the station with supplies and relief crews.

The new space station will provide the Soviets with a research 'shop' for many of those delicate jobs that are so difficult to set-up on earth. The production and research of super pure crystals for semiconductors is one obvious application.

Western space analysts are surprised that Mir is only about the same size as Salyut 7. This is because the Soviet Union has, for many years, been constructing a "heavy lift rocket" which will be considerably more powerful than the Proton rocket that launched Mir. Many analysts expected that the new rocket would be used to launch a much larger station but now speculate that it may instead be used for a manned mission to Mars.

How to avoid being shot down by your own army

One of the greatest threats to modern combat aircraft comes from faulty identification by "friendly" forces. During the Six Day war in the Middle East, for example, many aircraft were shot down by their own side and, more recently, in the Falklands conflict, a number of Argentine aircraft were destroyed by Argentine air defences.

In order to minimise this danger, all operational combat aircraft carry electronic devices to provide immediate positive identification when located and tracked by friendly air or ground forces. However, if this Identification Friend or Foe (IFF) equipment is not functioning correctly the pilot could take off with a false sense of security.

To overcome this problem, Plessey in the UK has developed a new electronic test system, designed to perform an automatic functional check on the aircraft's IFF equipment prior to take off. The system comprises two units placed adjacent to the taxi-way, one of which is the interrogator and the other a display which informs the pilot of the status of the IFF equipment.

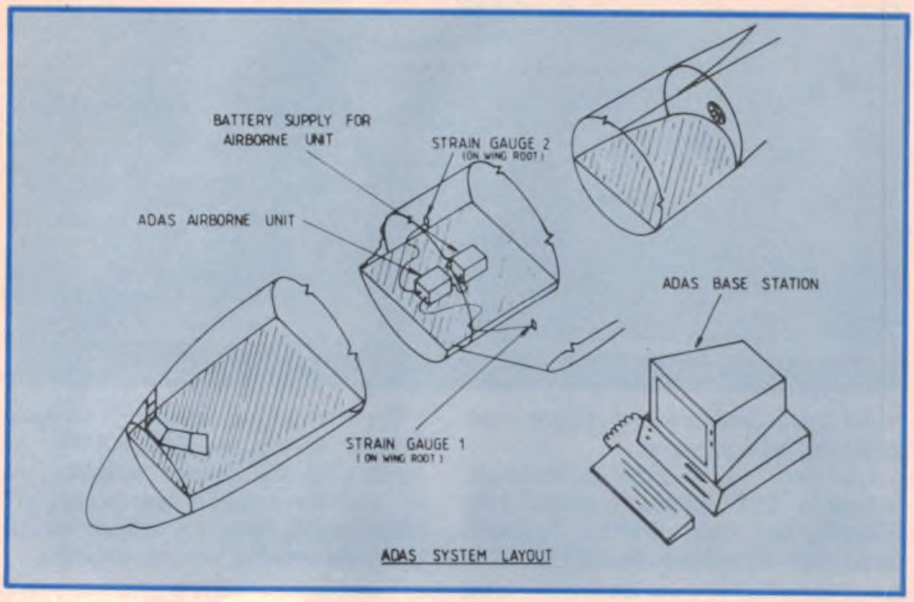
The existing system merely checks the "black box" inside the cockpit without indicating any problems that may have occurred in the cabling. Plessey's test equipment will do away with this potential hazard.

AWA microelectronics gets new head

Dr Brian McClusky has been appointed the new General Manager of the Microelectronics Division of AWA. He was previously the manager of Special Projects in the Microelectronics Division and replaces Dr Lou Davies who retired last December.

Dr McClusky has a doctorate in Solid State Electronics from the University of Southampton in the UK and has held senior positions in semiconductor companies in the UK and the USA. He joined AWA in 1984.

News Highlights



Australian breakthrough in airframe stress monitoring

Electronics engineers at the Australian Defence Force University College in Canberra have developed a prototype Airborne Data Acquisition System (ADAS) that will enable aviation engineers to greatly increase their ability to predict fatigue damage in aircraft.

At present, all aircraft parts are extensively checked either by component testing or full-scale fatigue testing. However, designers still cannot assume that the problems of fatigue have been completely overcome. One of the main reasons for this is insufficient knowledge about the actual stress loads encountered by an aircraft during flights.

The ADAS should overcome most of these problems by electronically monitoring structural load variations of two airframe positions simultaneously by way of strain gauges for up to 20 hours.

Using microprocessors, each position is sampled every one millisecond during a flight to allow the monitoring of load variations. After each flight the airborne unit is removed from the aircraft and taken to a ground-based unit which transfers and processes the recorded data.

The system also incorporates a hand-held "interrogator" that allows pre-flight monitoring of the whole system. Its function is to verify the operation of the airborne unit after installation in the aircraft or to check the system's operation prior to a logging sequence.

News Brief

The George Brown Group consisting of George Brown Sydney, Melbourne, Canberra, Newcastle and Protronics Adelaide and Perth has been purchased by the G.B.S. Falkiner Group. The Falkiner Group with an asset backing in excess of $20m includes the famous Haddon Rig Merino Stud Property. Haddon Rig has been an outstanding performer in the Australian Wool Industry since 1882. This has been achieved through diversification, adaption and innovative management and aggressive marketing.

Bill Edge rejoins Jaycar

Bill Edge has recently rejoined Jaycar Electronics and will be working as a purchasing officer. Readers may remember that Jaycar purchased Bill's company Electronic Agencies some time ago.

At the same time, Jaycar has also announced the appointment of Brian Francis as kit manager. Brian hails from Sussex in England and has a background in electronics distribution with Philips Industries.

Aussat 3 launch on schedule

An Ariane III rocket is scheduled to carry Aussat's third satellite into orbit from the Kourou (French Guyana) launch site in mid July. According to Aussat, the successful launch of the European Ariane rocket last April augers well for the new satellite.

Construction work on Aussat 3, the final satellite in Aussat's first generation system, was completed in April and the satellite has since been readied for airlifting to French Guyana where it will be incorporated into the payload of Ariane flight V19.

Once operational, Aussat 3 will direct broadcast the Regional Commercial Television Service (RCTS), thus providing Australians living in remote areas of the country with a commercial television channel to supplement the existing ABC direct broadcast service.

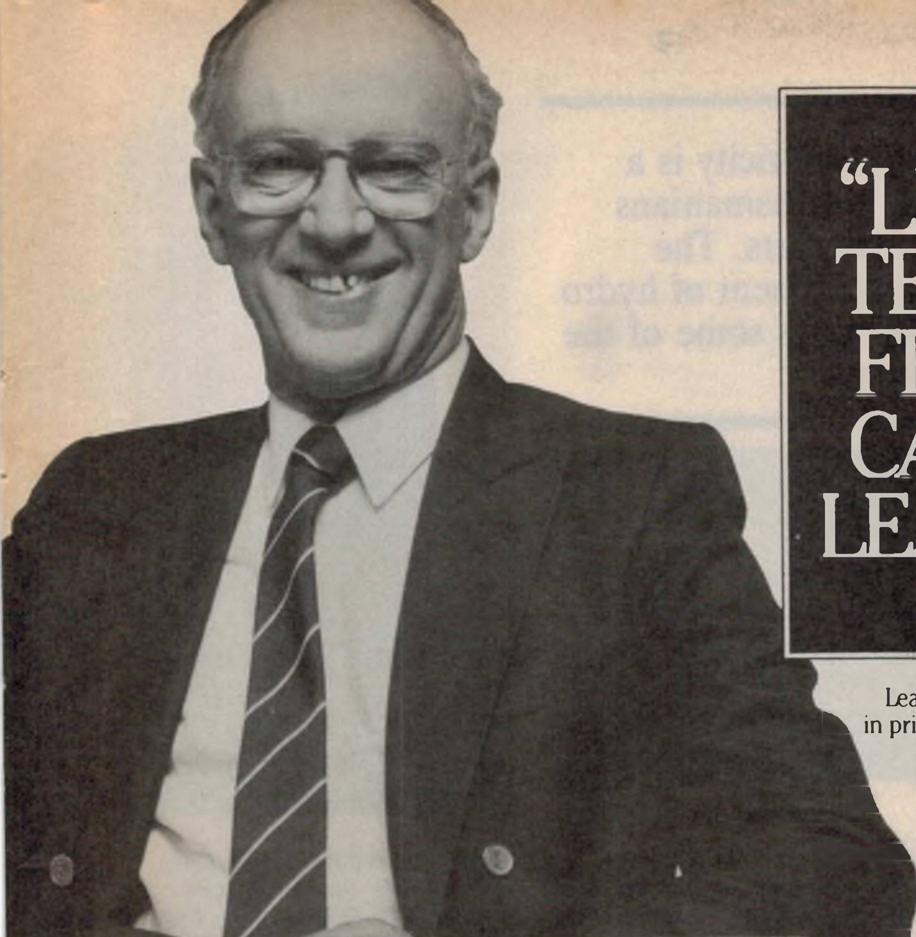
Electronic device monitors sleep patterns of babies

A post-graduate electrical engineer from Monash University, Mr Albert Fu, recently won the US-based Institute of Electrical and Electronic Engineers' top award for a device which monitors the sleeping patterns of babies.

Work on the device was prompted by a complaint from the Centre for Early Human Development at Queen Victoria Hospital which felt that the existing analog filters for monitoring baby sleep were cumbersome. In these units, a different circuit is used to monitor each different type of sleep, which in adults constitutes four stages known as quiet sleep, and a rapid eye movement (or active stage).

In new babies the various stages of quiet sleep are yet to develop, while pre-term infants have little or no quiet sleep. Doctors are happier about the progress of pre-term infants if they can detect the development of 'quiet sleep'.

The new digital filters developed by Mr Fu are microprocessor-based and their characteristics can be changed by software command. They are used to separate electrical signals from sleeping babies into four major frequency components so that doctors can check that pre-term infants are developing satisfactory sleeping patterns.




EPSON

Converting mountain water into electricity is a simple, if expensive process and the Tasmanians have excelled at this for nearly 100 years. The article that follows traces the development of hydro electricity in the Island State and notes some of the highlights along the way.

Hydro electricity in Tasmania

by JIM LAWLER

In 1895 the streets of Launceston were illuminated by electricity generated by a new-fangled water generator located at Duck Reach on the South Esk River, just three kilometres from the City.

This was only three years after the world's first hydroelectric power station was opened on the Niagra Falls in the USA.

Niagra and other water power stations of the time worked on a low head of water, usually a metre or two below a weir across a river. The Tasmanian system was unusual in the 1890s, with a head of 32 metres. It established a technological lead which the Tasmanian hydroelectric system has maintained to this day.

The original Duck Reach installation contained eight generator sets, five of '21 horsepower' and three of '158 horsepower'. In today's figures, that equals about 430kW — hardly enough to serve 50 homes today!

Later, the station was enlarged to nearly two megawatts but not before it had been overtaken by 50 and 100MW stations in other parts of the state.

It was not until 1909 that plans were made to build other hydro stations in the Tasmanian highlands. The idea was to utilise the waters of Great Lake by diverting its outflow from the Shannon River to the Ouse River. This would increase the flow of the Ouse and utilise the steep fall in the river at Waddamana.

The Hydro-Electric Power and Metallurgical Co Ltd was formed in that year to build a power station to supply energy for the electrolytic refining of zinc ore to be mined at Rosebery, on the Tasmanian west coast.

Construction of the Waddamana power station began in 1911 and proceeded sporadically until completion in 1916. A particularly severe winter stopped construction in 1912, and World War I interrupted the flow of capital needed to keep the project going.

Tasmania's first hydroelectric power station, at Duck Reach, was built within easy reach of a large city. There were no problems with getting workers from home to the job site. Most walked. But from Waddamana onwards, the HEC construction story is paralleled by the story of highland villages that appeared, thrived and died, all within a few years.

Hydro villages (and in some cases hydro towns) lasted only as long as it took to build the particular scheme. The town and workers then moved on to the next job and only the legends remained — like the shepherd in the late 20s who came down out of the hills to have his radio batteries recharged at the Waddamana power station.

He came down each week, complaining that the radio only worked for a day before the batteries were flat again. The riddle was solved when he was overheard telling another shepherd: "Mr Koerbin (the Engineer) thinks he's smart filling my battery with water instead of electricity. So I tip it out and I don't have to carry it all the way back home!" (1)

The first two machines at Waddamana were of 3.5kW each and began service in May 1916. In the 1920s construction began on another power station, on the Shannon River, upstream from the Waddamana station.

This was to utilise the fall in the Shannon between the Great Lake outfall and the intake to the Waddamana station. This drive to utilise every bit of

Tasmania is a mountainous little island off the south coast of mainland Australia. Its total population is less than half a million people and it has little in the way of natural resources. The one thing it does have in abundance is rain on high mountainous country.

Photo: H.E.C.

A view of a small part of Lake Gordon and the 140 metre Gordon Dam. The octagonal building on stilts is the visitor reception centre.

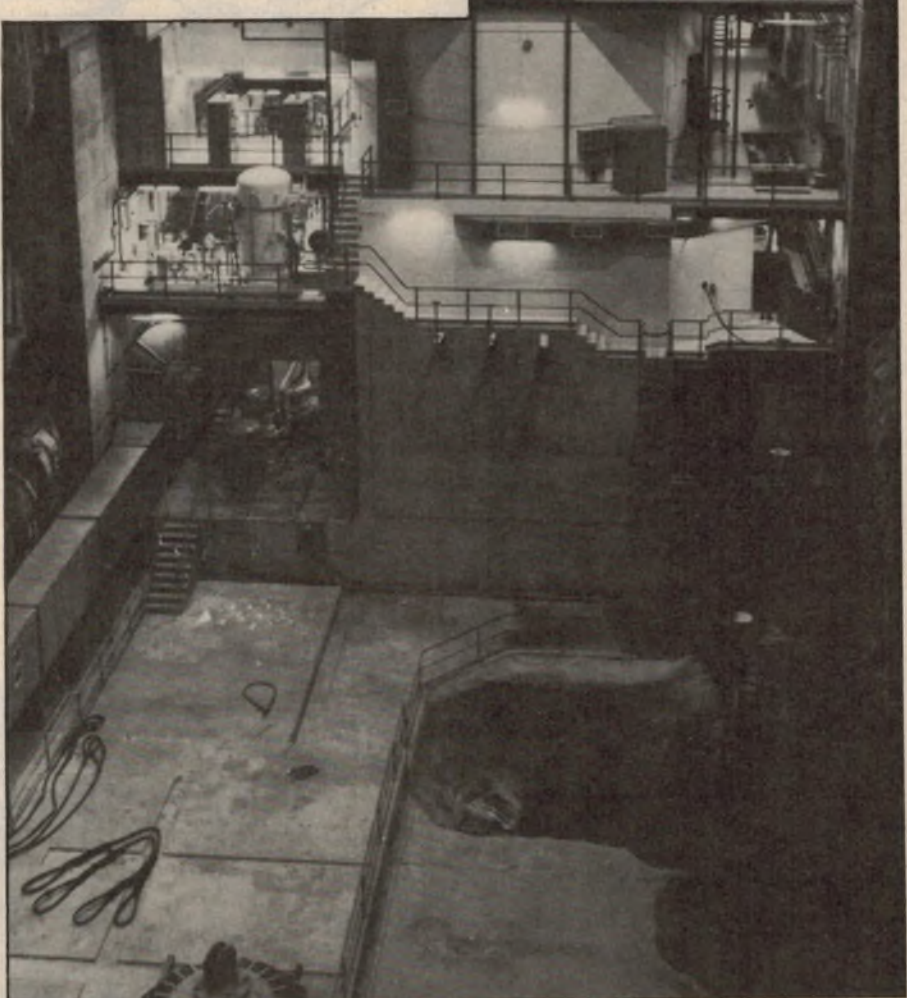


Photo: H.E.C.

Interior of the Gordon Power Station showing the two 144MW generators presently operating. The control area is at the top level, just under the gentry. The generators are in the space in the middle, while the turbines are behind the concrete wall in the lower centre. Excavations for the third machine can be seen at the bottom.

head available has been a mark of Tasmanian hydro development ever since.

On January 18, 1930 the 'Hydro-Electric Commission Act 1929' came into effect and the new Commission took over responsibility for generation and distribution of electricity in Tasmania. It acquired the Waddamana station, which by 1930 had been enlarged to about 50MW.

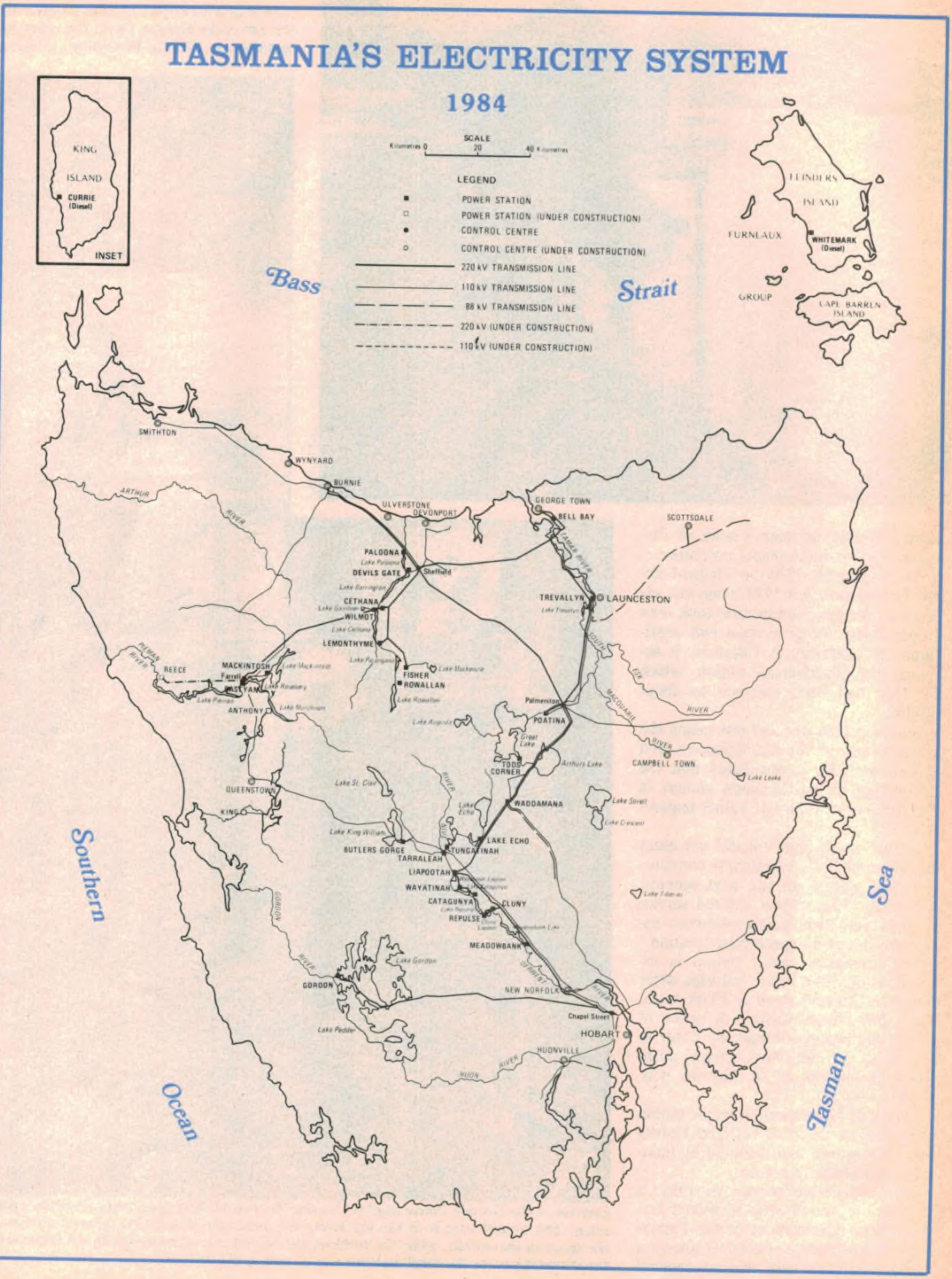
But even then demand was taxing the capacity and in the Commission's first report, in 1930, it was noted that the completion of the Shannon station in the Autumn of 1931 was 'rather imperative'. (2)

In the event, Shannon did not enter service until 1934, but already construction had started on the next scheme, Tarraleah. This station entered service in 1938 and immediately attracted notice because of it's spectacular location.

The Tarraleah power station is located on the Nive River, but uses water from the Derwent River at Clark Dam, some 300 metres higher. A series of canals and pipelines brings the water to the brink of the Nive gorge, down which it plunges in six massive penstocks.

Tarraleah has become a major tourist attraction on the road between Hobart and Queenstown and is visited by thousands of tourists each year.

Tarraleah began service in 1938, a year before World War II slowed further major development of the Tasmanian Hydro Electric system for almost a decade. To assist with wartime demand


TASMANIA'S ELECTRICITY SYSTEM
1984
SCALE
Kilometres 0
20
40 Kilometres
LEGEND
POWER STATION
POWER STATION (UNDER CONSTRUCTION)
CONTROL CENTRE
CONTROL CENTRE (UNDER CONSTRUCTION)
220 kV TRANSMISSION LINE
110 kV TRANSMISSION LINE
88 kV TRANSMISSION LINE
220 kV (UNDER CONSTRUCTION)
110 kV (UNDER CONSTRUCTION)
KING
ISLAND
CURRIE
(Diesel)
INSET
FLINDERS
ISLAND
FURNEAUX
GROUP
WHITEMARK
(Diesel)
CAPE BARREN
ISLAND
Bass
Strait
SMITHTON
WYNYARD
BURNIE
ULVERSTONE
DEVONPORT
GEORGE TOWN
BELL BAY
SCOTTSDALE
PALOONA
DEVILS GATE
Sheffield
CETHANA
WILMOT
LEMONTHYME
TREVALLYN
LAUNCESTON
MACKINTOSH
REECE
FISHER
ROWALLAN
ANTHONY
Palmerston
POATINA
CAMPBELL TOWN
TODS
CORNER
QUEENSTOWN
KING
WADDAMANA
LAKE ECHO
BUTLERS GORGE
TUNGATINAH
TARRALEAH
LIAPOOTAH
WAYATINAH
CATAGUNYA
CLUNY
REPULSE
MEADOWBANK
NEW NORFOLK
GORDON
Chapel Street
HOBART
HUONVILLE
Southern
Ocean
Tasman
Sea

for electric power, the Waddamana "B" station was constructed under great difficulty, with extreme shortages of manpower and materials. It opened in 1944 and added 48MW to the system.

The late forties brought renewed development and new construction began in several locations. Between 1951 and 1957 five new power stations were opened.

The largest of these, Tungatinah, is located on the Nive River, a hundred metres or so from Tarraleah. It uses water from the Central Plateau, to the west of Great Lake.

By 1960, the pioneering stage of Tasmanian hydro power development was over. To this time much of the hard work was done by men and horses. Where machinery was available, it was always smaller than desirable and manpower made up the difference.

This feature of the early construction work was highlighted in the booklet "Hydro Construction Villages," where a report about the Tarraleah development states "most of the work was done with pick and shovel — labour was cheap and machines expensive. Even with such a large workforce (1000 men) there were only eight Commission cars and eleven Commission trucks on site in October 1935, with an additional 16 trucks on hire. The inventory of minor equipment included six excavators, 11 compressors, 53 jackhammers and seven concrete mixers, figures which make one wonder how the job was ever completed". (3)

From 1960 on machinery was modern, powerful and adequate to the job in hand. The Hydro-Electric Commission entered the decade with its Poatina underground power station, the first such station in the State.

Poatina uses water from the Great Lake and is fed through 11km of tunnels. The water falls 1000 metres from the edge of the Western Tiers, to the generator hall 153 metres below ground level.

The six machines in Poatina have a total capacity of 300,000kW and this is the largest station in the Tasmanian system. Its opening in 1964 marked a milestone in Tasmanian hydro development. It brought the total installed capacity of turbines to 1,000,000 horsepower.

The name "Poatina" is an aboriginal word meaning 'cavern' and the cavernous generator hall is a popular tourist attraction. Entry to the station is now

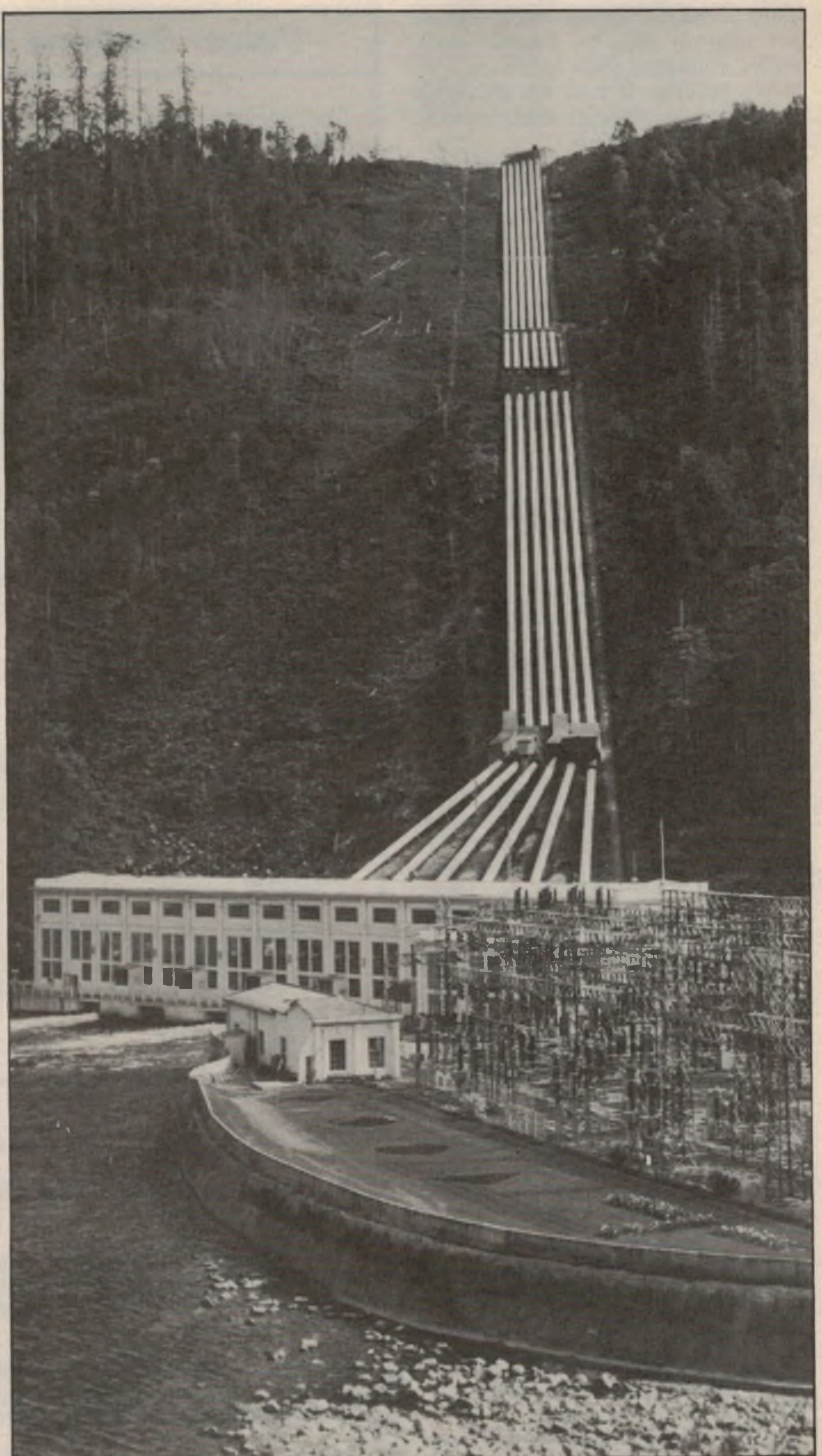


Photo: Jim Lawler.

Tarraleah, one of the earliest of Tasmania's hydro electric power stations, is surely the most spectacular and most characteristic hydro station anywhere. The six massive penstocks bring water into the turbines from the brink of the gorge, 300 metres above the station.

Hydro electricity in Tasmania

along a steeply sloping access tunnel, but there is also an elevator which covers a distance equal to that in a 40 storey building. It even has the lights for each floor, although there are only top and bottom landings.

As mentioned earlier, the 60s saw powerful new machinery working on many hydro projects. The most spectacular of these machines was the tunnel boring 'Mole', first used at Poatina.

The Mole looked something like a heavy diesel railway locomotive pushing a large rotating shield on which were mounted several heavy rock cutters. At Poatina, the Mole averaged more than a metre an hour day and night and completed a two kilometre tunnel in six months.

A curious aspect of the Poatina power development is that it incorporates the largest and smallest power stations in the Tasmanian system.

When planning the Great Lake works in association with the Poatina scheme, it was realised that the waters of Arthurs Lake, south east of Great Lake, would make a useful addition to the total supply of water available if only it could be lifted over the 30 metre hills intervening.

It was decided that a pumping station could lift the water over the hills, and some of the energy used could be recovered as the water ran down into Great Lake. That is how Tods Corner at 1,600kW and Poatina at 300,000kW came to be parts of the same system.

The Arthurs Lake water returns a net profit when it is later used at Poatina, the extra head there more than repaying the energy used in the pump house.

After the major effort at Poatina, the HEC started planning what was to become the controversial Gordon River Power Development. In the meantime there were several smaller power schemes to be completed.

The first of these was the Lower Derwent system. This consists of several low level dams and associated power stations. The last of these stations discharges into the river only a few metres above tidal water. Of the more than 1000 metres from the Derwent headwaters to sea level, all but 40 metres are utilised in power generation.

Another of these smaller systems was in the north of the State, on the Mersey and Forth rivers. This system uses water from the Central Plateau area, to the west of Great Lake.

Power Stations in the HEC Scheme

The following list is taken from HEC sources and oes not include the original Duck Reach or Waddamana "A" stations which were not Commission owned.

Power Station Name	Date Commissioned	Turbines No.Types	Installed Capacity (kW)
Waddamana "B"	1944	4 Pelton	48,000
Tarraleah	1938	6 Pelton	90,000
Butlers Gorge	1951	1 Francis	12,200
Tungatinah	1953	5 Francis	125,000
Tevallyn	1955	4 Francis	80,000
Lake Echo	1956	1 Francis	32,400
Wayatinah	1957	3 Francis	38,250
Liapootah	1960	3 Francis	83,700
Catagunya	1962	2 Francis	48,000
Poatina	1964	6 Pelton	300,000
Tods Corner	1966	1 Francis	1,600
Meadowbank	1967	1 Kaplan	40,000
Cluny	1968	1 Kaplan	17,000
Repulse	1968	1 Kaplan	28,000
Rowallan	1968	1 Francis	10,450
Lemonthyme	1969	1 Francis	51,000
Devils Gate	1969	1 Francis	60,000
Wilmot	1971	1 Francis	30,600
Bell Bay No.1	1971	1 Steam	120,000
Cethana	1971	1 Francis	85,000
Paloona	1972	1 Kaplan	28,000
Fisher	1973	1 Pelton	43,200
Bell Bay No.2	1974	1 Steam	120,000
Gordon 1	1978	2 Francis	288,000
Macintosh	1982	1 Francis	80,000
Bastyan	1983	1 Francis	80,000
Lower Pieman	1986(*)	2 Francis	231,000
Total installed capacity			2,171,400

(*) Estimated completion date.

The turbine types listed above are chosen for their efficiency under different heads of water.

The Pelton turbine is used for very high heads. The water is directed in jets under very high pressure onto buckets arranged around the rim of the turbine wheel. It consumes less water for a given power than either of the other types.

The Francis turbine is a vane type machine, suitable for medium heads of water. The water enters through a spiral conduit around the turbine runner and exhausts from the centre of the machine.

The Kaplan turbine is similar to the Francis machine except that the turbine vanes are adjustable to allow more efficient use of very low pressure water.

WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR C

GRAND OPENING SPECIALS

Yes we're practically back to normal in our new, enlarged premises. So come and try some of these specials -

CONNECTORS

D-Types

DB25 Chrome-plated plastic RFI backshell	$ 1.95
DB25P plug	$ 2.50
DB25S socket	$ 3.00
DB25 right angle plug	$ 4.30
DB25 right angle socket	$ 4.50
Centronics 36 way male with backshell	$ 5.00
IDC 34 way card edge connector	$ 4.00
IEC cord set	$ 5.00
IBM/Centronics cord set (2m)	$21.70

MULTI-TURN POTS

For applications requiring really precise adjustment you couldn't beat these panel mounted ten turn pots

Up to 50k	$12.50
100k	$17.50

CHIP SPECIALS

World modem chip		$27.50
Speech chips	CTS 256-A-2	$28.00
	SPO 256-A-2	$15.95

HEAT SHRINK TUBING PACK

A handy pack of various sizes and lengths. Black and colours. Ideal for tidying up cable ends and a thousand and one other applications **$8.65**

DATA BOOKS

As we always say - be quick because our supplies are limited.

National Semiconductor		
Advanced Bipolar Logic		$ 9.95
High Speed CMOS		$ 7.50
Data Conversion		$15.00
Interface		$15.00
Linear Applications (1980)		$16.00
Linear Supplement		$ 9.50
Logic Vol 2		$20.00
Motorola		
Interface		$ 4.95
Linear & Interface	***NEW!***	$15.00
Schottky		$10.00
T.I.		
High Speed CMOS	***NEW!***	$12.00
Linear & Interface Applications		
Vol 1	***NEW!***	$ 5.95
Vol 2	***NEW!***	$ 5.95
Linear	***NEW!***	$15.00
Memory & Supplement	***NEW!***	$15.00
Opto-electronics	***NEW!***	$15.00
TTL Vol 1	***NEW!***	$15.00
Vol 3	***NEW!***	$15.00
Vol 4	***NEW!***	$15.00

TEMPERATURE SENSOR

The AD590JH is a 2-wire current output temperature sensor giving a linear current output proportional to temperature. Ideal for many temperature measuring and control applications. See ETI June 83 **$5.95**

NOW YOU CAN SEE WHY OUR SLOGAN IS "WOOD FOR CHIPS"

From the commonest NAND gates and BC107's right through to microprocessors, converters and peripheral chips, Geoff's probably got the semi' you're looking for - and he can also give you technical advice on it too!

EXPANDED DATA LIBRARY

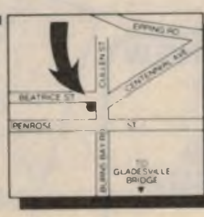
For the benefit of personal callers we've added more volumes to our comprehensive set of data books for you to peruse. Check the specs or look for possible substitutes before you buy!

8.30 to 5 Monday to Friday. 8.30 to 12 Sat.
Mail Orders add $5.00 to cover postal charges.

All prices INCLUDE sales tax.

Tax exemption certificates accepted if line value exceeds $10.00.

BANKCARD, MASTERCARD, VISA, CHEQUES



GEOFF WOOD ELECTRONICS P/L
INC IN NSW
(02) 427 1676
229 BURNS BAY RD.
(CORNER BEATRICE ST.)
LANE COVE WEST N.S.W.
TWX 71996
P.O. BOX 671
LANE COVE N.S.W. 2066

OR CASH CHEERFULLY ACCEPTED

specialising in electronic components for the professional and hobbyist.

WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ...
... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ...

TOLLFREE TELEMAIL 008 022 888 FOR COST OF A LOCAL CALL

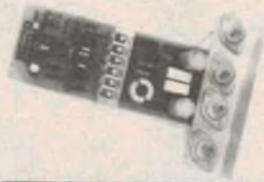
DON'T JUST SIT THERE

Now that winter has finally arrived, and it's too cold to leave the fire, why waste your time watching TV. WHY NOT BUILD A KIT. Jaycar stocks over 150 different kits, many of which are listed on these pages.

BUILD SOMETHING

SOUND BARGAINS IN SOUND KITS

UNIVERSAL MOSFET AMP MODULES AEM 6500 60/120 WATTS
Ref AEM July 1985
Cat KM-3010 60 WATTS **$55.00**
Cat KM-3012 100 WATTS **$69.50**



MUSICOLOR IV
Ref EA August 1981
Cat KA-1010 .... **$109.90**

8 CHANNEL AUDIO MIXER JAYCAR 8002
A balanced input/output 8 channel mixer with features found in units costing well over $2000!
MAIN FEATURES: ● Balanced (600 ohm mic inputs/line inputs ● Input attenuators ● Cannon connectors included in the price ● Bass, mid and treble equalisation on each input ● "Effects" (i.e. echo, etc) capability ● Foldback on all 8 inputs ● Stereo pan on all 8 inputs ● 60mm slide faders used throughout ● 19" rack mount capability (or console mount) ● Professional black front panel with format borders and multicoloured knobs to assist function identification ● Designed for quick and easy service ● VU metering ● Only high quality components used ● 5534A OP amps used for low noise and very low distortion.
Cat KJ-6504 **$560.00**

2801 ⅓rd OCTAVE EQUALISER
● 240V operated ● Cannon Sockets ● Pro quality
Cat KJ-6531 .... **$225.00**

AM/FM STEREO TUNER SYNTHESISED
Ref December '85 - Feb '86
Cat KA-1635 .... **$499.00**

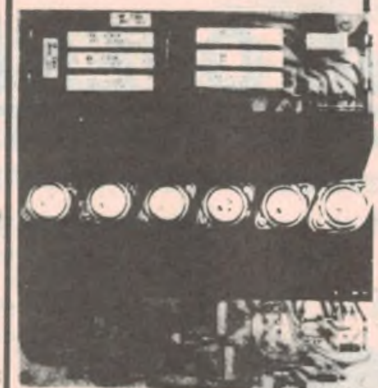
ETI 5000 ⅓rd OCTAVE EQUALISER
Cat KE-4204 .... **$209.00**

HURSTVILLE OPEN TILL 8.30pm THURSDAYS

REMOTE CONTROL FOR ABOVE TUNER
Ref EA April 1986
Cat KA-1636 .... **$89.50**

2010 10 BAND STEREO EQUALISER
Cat KJ-6535 .... **$159.00**

300 WATT PLAYMASTER AMPLIFIER
Ref EA June 1980
This rugged design provides 200 watts rms into 8 ohms and 300 watts rms into 4 ohms
Cat KA-1115 .... **$99.95**



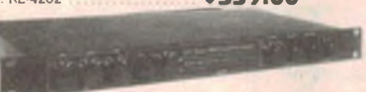
ETI 5000 POWER AMP "BLACK MONOLITH"
Cat KE-4200 .... **$359.00**

DIRECT INJECT BOX
Ref ETI Sept 1985
Cat KE-4708 .... **$39.95**

300W AMP POWER SUPPLY KIT
Cat KA-1116 .... **$99.95**

SPEAKER PROTECTOR for PLAYMASTER 300W AMP
Ref EA July 1980
Cat KA-1117 .... **$15.95**

ETI 5000 PRE-AMP "BLUE PRINT"
Cat KE-4202 .... **$339.00**



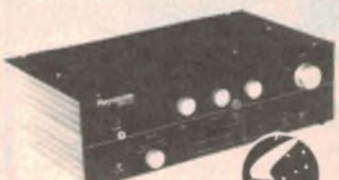
AEM 6102 - 2 WAY VIFA KIT
SPEAKER KIT Cat CS-2460
ONLY **$499.00**
CABINET KIT Cat CB-2650
ONLY **$179.00**
OR TOGETHER
***FOR* $599.00**
SAVE $79.00
COMMERCIAL UNITS COST ABOUT $1,400

"ULTRA FIDELITY" PREAMPLIFIER
Ref AEM Oct - Dec 1985
Cat KM-3030 .... **$289.00**

COMPACT DISC PLAYER ATTENUATOR
Cat KA-1624 .... **$7.95**

DRUM SYNTHESISER
JOIN THE DRUM REVOLUTION
Cat KJ-6502 .... **$39.50**

PLAYMASTER SERIES 200 HI FI MOSFET AMP
Ref EA Jan - March 1985
100 WATTS RMS (CHANNEL)
Cat KA-1500 .... **$449.00**



PLAYMASTER 60 + 60 AMP
Cat KA-1650 .... **$249.00**

ETI 480 SERIES AMP MODULES
Ref ETI Dec 1976 & ETI's 30 Audio Projects
ETI 480/100 WATTS
Cat KE-4052 .... **$29.50**
ETI 480/50 WATTS
Cat KE-4050 .... **$25.00**
Suitable power transformer 28-0-28V @ 2A
Cat MF-1095 .... **$34.50**
POWER SUPPLY Cat KE-4048 .... **$25**

AEM 6103 - 3 WAY VIFA KIT

SPEAKER KIT Cat CS-2465
ONLY **$790 pair**
CABINET KIT Cat CS-2652
$319.00 pair
SAVE A MASSIVE $110.00
BUY BOTH TOGETHER

STEREO AM DECODER (AUSTRALIAN STANDARD)
Ref EA October 1984
This unit uses the Australian standard Motorola CQUAM decoder chip. It will decode the new AM stereo transmissions (with suitable AM tuners)
Cat KA-1555 .... **$26.50**

You will need two whistle filters. You can use the one already in your radio for one channel and we can supply the other one.
Cat LF-1300 .... **$23.95**

STOP PRESS - NEW
LIGHT SAVER
Ref EA June 1986
Without plate and epoxy
Cat KA-1670
ONLY $14.99

PHONE CONTROLLER
Ref EA June 1986
Cat KA-1672
$P.O.A.

MAIL ORDER HOTLINE (02) 747 1888

BRAND NEW 100 page 1986/7 ENGINEERING CATALOGUE OUT NOW SEND LARGE S.A.E.

STORES LOCATED AT GORE HILL, SYDNEY, CARLINGFORD, HURSTVILLE, CONCORD, BRISBANE

DIE CAST HEATSINKS

Jaycar is proud to announce a range of 'Made in Australia' die cast heatsinks. They are gravity cast in Aluminium, have the area where semiconductors mount milled flat and are fully finished in powdercoat black. They are low cost for the performance offered. Size: 134 x 65mm (high) x length (see below)

8FNF SERIES

Cat. HH-8540 (50mm long)	$3.95
10 or more $3.75 each	
Cat. HH-8541 (75mm long)	$5.95
10 or more $5.50 each	
Cat. HH-8542 (100mm long)	$7.95
10 or more $7.50 each	
Cat. HH-8543 (150mm long)	$9.95
10 or more $9.50 each	

MF10 - 2F - 75

74(H) x 144(L) x 46(W)mm (bracket 34mm wide)
Cat. HH-8548 $7.50
10 or more $6.95 each

KEYLESS ALARM CONTROL PANEL

Keys have been made redundant with this panel, offering 5040 combinations for switching.

FEATURES AND SPECIFICATIONS
★ Five protection circuits ★ Emergency 1 x 24 hour N.C. instant circuit, 1 x 24 hour N.O. circuit ★ Burglary 1 x N.C. instant circuit, 1 x N.C. delay circuit, 1 x N.O. delay circuit ★ Intelligent siren driver changes alarm tone for different events ★ Adjustable entry delay and siren duration timer ★ Separate siren timers for burglary and emergency circuits ★ Two independent N.O. relay output contacts ★ Auxiliary 12V/500mA DC output ★ 6 LED lamps on panel indicating alarm status ★ 24 hour panic button mounted on panel ★ Alarm on/off digital access key ★ Complete tamper proof system ★ Heavy duty steel cabinet baked on paint finish ★ Dimension 230(H) x 170(W) x 70(D)mm ★ Net weight 1.9kgs
Power pack to suit 16V AC Cat. MP-3021 $27.50
Cat. LA-5168

ONLY $179

ULTRASONIC INSECT & PEST REPELLER

PESTREPELLER is effective in controlling mice, rats, roaches, ants, fleas, crickets, silverfish, waterbugs, moths and most other common pests.
Complete with 240V power adaptor
Cat. YS-5510

ONLY $55.00

C20 COMPUTER CASSETTES

Good quality blank cassettes in plastic case.
Cat. XC-4715

$1.20
SPECIAL PRICE
FOR 10 OR MORE
$1.00 each

MAGGY LAMP

DESK MOUNTED LAMP/MAGNIFIER
Cat. SL-2700
ONLY
$169.00

PRE BUILT MODULES

6 WATT "MICRO" AMPLIFIER - MONO

Amplify your Walkman. ★ 6 watts RMS into 4 ohms ★ high or low inputs ★ volume control ★ operates 4 - 16 volts.
Cat. AA-0340

ONLY $13.95

MINI PHONO & MIC PREAMP

This module will bring up a magnetic phono cartridge or dynamic microphone to line level with very low distortion.
Cat. AA-0324

ONLY $16.95

LIGHT OPERATED SWITCH

This controller detects an ambient light level, when the light level reaches a certain value (which is adjustable) the relay switches on (N.O. or N.C. outputs). Ideal use an an event counter.
Cat. AA-0344

ONLY $8.95

SOUND OPERATED SWITCH

This compact switch will detect a sharp sound and latch a relay with N.O. and N.C. output. It runs from 9 - 12 volts and has adjustable sound level sensitivity.
Cat. AA-0342

ONLY $16.95

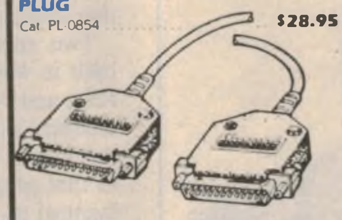
CHECK OUR CATALOGUE FOR ALL OTHER PRE BUILT AMPLIFIERS, PREAMPS ETC.

COMPUTER LEADS

25 WAY D MALE TO MALE
Cat. PL-0855 $28.95

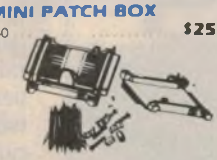
25 WAY D MALE TO FEMALE
Cat. PL-0856 $28.95

25 WAY D MALE TO CENTRONICS PLUG
Cat. PL-0854 $28.95



COMPUTER ACCESSORIES

RS232 MINI PATCH BOX
Cat. PA-0880 $25.95



MALE/MALE GENDER CHANGER
Cat. PA-0882 $19.95

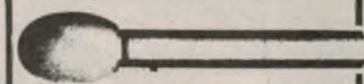
FEMALE/FEMALE GENDER CHANGER
Cat. PA-0884 $19.95

GORE HILL OPEN TILL 4pm SATURDAYS

FM WIRELESS MIC ELECTRET CONDENSER

If you want an FM mic to experiment with or use in a small public address system, this is the one. Only 100 available. Transmitting frequency range 88.1MHz to 106MHz. Omnidirectional. Field strength is less than 50uV/m at 50 feet. Supplied with windscreen, frequency adjuster. Lavalier and battery.
Cat. AM-4072

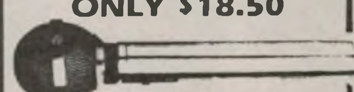
NORMALLY SELLS FOR $27.95
½ PRICE SAVE $14
ONLY $13.95



FM WIRELESS MIC ELECTRET CONDENSER CARDIOID

This is a top quality FM mic. Frequency transmitting range 88MHz - 106MHz. Unidirectional.
Cat. AM-4073

NORMALLY SELLS FOR $38.50
LESS THAN ½ PRICE
SAVE $20.00
ONLY $18.50



OMNIDIRECTIONAL DYNAMIC

With 155mm gooseneck on heavy base with on/off switch. Frequency response 50-13,000Hz. Impedance 400 ohms. Sensitivity −78dB. 4 metres of cable with plug.
Cat. AM-4077

LIMITED STOCKS

USUALLY SELLS FOR $34.50
SAVE $19.50
NOW ONLY $15.00

MICROPHONE MADNESS

Cat. AM-4077

UNI-DIRECTIONAL ELECTRET CONDENSER MICROPHONE

High quality, dual impedance 1k and 10k. Frequency response 40 - 18,000Hz. Complete with cable & plug.
Cat. AM-4082

NORMALLY $45.00
SAVE $17.50
NOW ONLY $27.50

NEW PRODUCTS FROM ELECTROLUBE

POSITIVE PHOTORESIST AEROSOL

● Fast drying for one to one production of circuits etc., on metals from transparent positive masters ● Easy to use aerosol ● Up to 50% cost saving over pre coated boards ● Covers approximately 2.2 sq metres.
Cat. HG-9976 $7.25

PHOTORESIST DEVELOPER

● Use this to achieve best results with positive photoresist aerosol.
Cat. HG-9978 $7.95

NICKEL SCREENING COMPOUND

By simply spraying any plastic box or enclosure you will make it effectively shielded against RFI and EMI. It's expensive, but so are die cast boxes. It will do dozens of average boxes.
SPRAY CAN
Cat. NA-1014 $26.95

JAYCAR - LEADER OF THE PACKS...

LED PACKS

100 - 5mm RED LEDs
Cat. ZD-1690 $15.50
100 - 3mm RED LEDs
Cat. ZD-1692 $19.50
100 assorted LEDs consisting of: 20 x 5mm RED, 20 x 5mm MIXED COLOURS, 40 x 3mm RED, 20 x 3mm MIXED COLOURS - **BONUS:** 10 x 5mm mounting hardware.
Cat. ZD-1694 $19.50

5mm LED MOUNT CLIPS

Those ever popular 2 piece black mount for 5mm LEDs - PKT of 20
Cat. HP-1102 $1.50
PKT OF 100
Cat. HP-1103 $5.00

CLIPS ARE HEWLETT PACKARD BRAND

TRANSISTOR PACK

100 mixed BC series transistors. More of the common ones. 15 x BC547, 20 x BC548, 20 x BC549, 15 x BC557, 15 x BC558, 15 x BC559
Cat. ZT-2170 $11.95

IC SOCKETS

The economical way to purchase quality tinned IC sockets.

100 x 8 pin Cat. PI-6478	$15.50
100 x 14 pin Cat. PI-6480	$16.95
100 x 16 pin Cat. PI-6482	$19.95
100 x 18 pin Cat. PI-6484	$23.95

MIXED PACK IC SOCKETS

Consists of: 15 x 8 pin; 20 x 14 pin; 20 x 16 pin; 10 x 18 pin; 5 x 20 pin; 10 x 22 pin; 5 x 24 pin; 5 x 28 pin; 10 x 40 pin - MORE OF THE COMMON TYPES
PACK OF 100 - Cat. PI-6490
NORMALLY $37 VALUE
ONLY $24.95

CAPACITORS

ELECTROLYTIC PACK
55 quality RB type
PACK OF 55 - Cat. RE-6250
ONLY $6.50

GREENCAP PACK
60 greencaps supplied
PACK OF 60 - Cat. RG-5199
ONLY $6.75

CERAMIC PACK
60 ceramic capacitors supplied
PACK OF 60 - Cat. RC-5399
½ PRICE - $4.95

RESISTORS

METAL FILM PACK
150 quality 1% ¼W 50ppm resistors.
PACK OF 150 - Cat. RR-0650
ONLY $5.95

RESISTOR PACK
Over 300 ¼W 5% - at less than 2¢ each!
Cat. RR-1680
$5.90 - ½ PRICE!

RESISTOR NETWORKS
50 assorted types. Works out at 20¢ per network!
50 IN PACK - Cat. RR-3380
ONLY $10.00

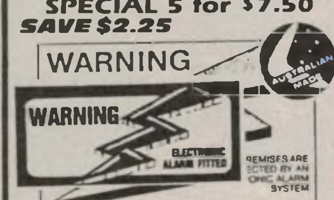
PLESSEY POT PACK
BRAND NEW STOCK
50 assorted potentiometers (mostly English made by Plessey) in a pack weighing just under ½ kilo!
50 IN PACK - Cat. RP-3900
ONLY $5.95

MONOLITHIC CHIP CAPACITORS

0.01uF PKT OF 100
Cat. RC-5495 $12.50
0.1uF PKT OF 100
Cat. RC-5496 $16.50

ALARM STICKERS

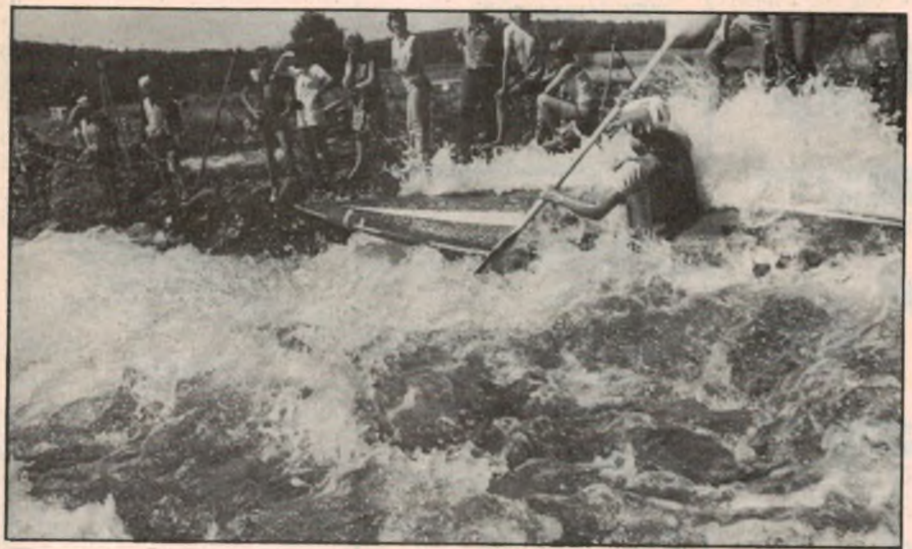
LARGE 125mm x 75mm
Suitable for house, factories, caravans etc. Will stick on the outside i.e. sticky on the back.
Cat. LA-5102
ONLY $1.95 each
SPECIAL 5 for $7.50
SAVE $2.25



SMALL 73mm x 33mm
Specifically designed for cars. Sticky on the front so you can stick them on the inside glass. Thieves will not know whether you have an alarm or not.
Cat. LA-5100
ONLY 95¢ each
SPECIAL 5 for $3.50

OVER THE PAGE FOR STORE ADDRESSES AND PHONE NO'S

Hydro electricity in Tasmania



White water flowing out of Brady's Lake provides a magnificent canoeing course for those intrepid enough to tackle the run. As part of the storage for the Lake Echo hydro-electric scheme, the waters can be turned on and off at will. Photo: H.E.C.

Tasmania's rivers are short by comparison with the Murray, the Darling or the Snowy, but the volume of water flowing in the least of the island rivers would dwarf the mainland streams. From the earliest days of settlement Tasmanians have looked to their rivers to provide power for agriculture and industry.

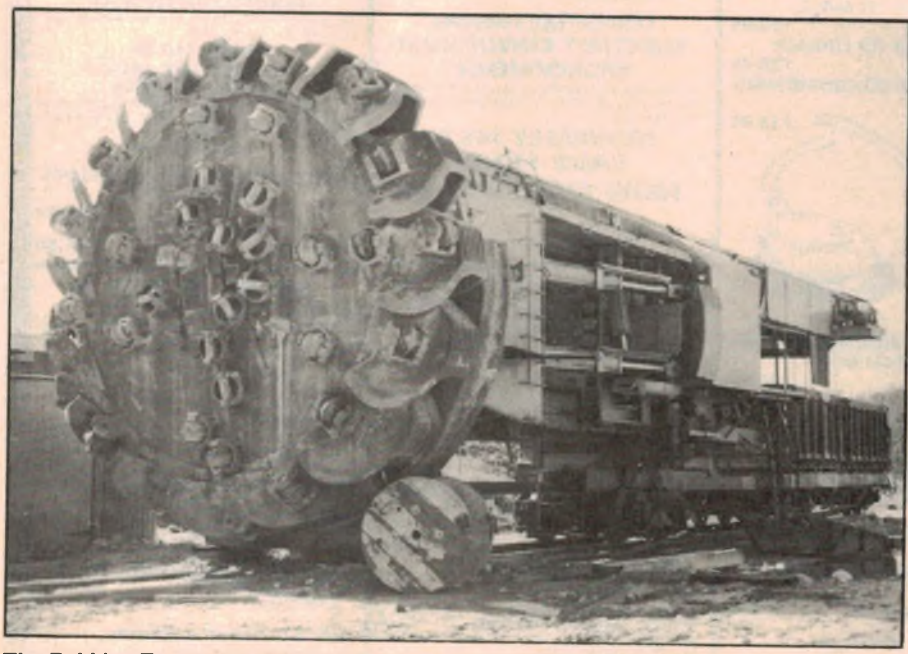


Photo: H.E.C.

The Robbins Tunnel Boring Machine, ready for the job of boring the tailrace tunnel at the Poatina power station. The machine was later modified and used to enlarge a tunnel on the Tasmanian mainline railway between Hobart and Launceston.

One of the Mersey-Forth storages, Lake Barrington, has been developed into an international standard rowing course and a World Championship regatta is being planned for the lake in November 1990.

If the Gordon Power Development had not required the flooding of the original Lake Pedder, there would have been none of the controversy that eventually surrounded it. In any event the old lake has been transformed into one of two magnificent storages that now dominate south-western Tasmania.

The machine hall of the Gordon Power Station is underground like that at Poatina, but is situated deep within the mountain, at the foot of the 140-metre Gordon dam. Although the head of water available is much less than the 1000 or so metres at Poatina, the greater volume of water available allows almost as much power to be produced in the newer station.

The Gordon power scheme brings our hydro story almost up to date because the next major scheme is still under way. The Pieman River development, in the far west of the State, consists of four large storages and three power stations.

The first of the stations was completed in 1982, another in 1983 and the third will be commissioned during 1986. The Pieman River is the last of Tasmania's large rivers to be harnessed. Its total flow, channeled through the Lower Pieman power station, will generate almost as much power as does the Gordon station.

Two smaller schemes are now being built in western Tasmania. They are the King and Anthony developments. These schemes were to be started after that on the Lower Gordon but the cancellation of that project has allowed the advancement of the smaller works.

From the start of this story we have been discussing hydroelectric power generation which relies on either steady rainfall or adequate storages to hold periodical rainfall. But if the rain stops falling and the storages run dry, there can be no power. This was the situation in which Tasmania found itself in the middle sixties.

For several years the winter rains had failed on the central highlands where the main storages are located. At that time only one station did not use water from the Central Plateau. This was the Trevallyn station, near Launceston, which used water from the South Esk River draining the north east of the State.

Although Trevallyn ran at full bore throughout the drought, it could not avert severe power restrictions everywhere in the State. Domestic and commercial users were rationed so that industry might retain some sort of activity, but nothing could obviate the need for heavy and continuous rain.

The rains eventually came, but not before some unusual stopgaps were pressed into service. One of these was the installation of two 10MW oil fired gas turbine machines at Macquarie Point in Hobart.

Another was the purchase of the Turbine Vessel "George H. Evans", a steam turbine/electric powered former passenger ship. This was moored in the Tamar River at Bell Bay and its generators contributed 10MW to the state power grid.

None of these were ever considered as a permanent feature of the State's power network. But the need for some form of generation other than water power was recognised. It was decided to build the Bell Bay thermal station as a permanent standby plant. The first machine at Bell Bay came on line in 1971 and the second in 1974.

A thermal station cannot hope to produce power as cheaply as can a hydro station, but there are times when the price just has to be paid. For the most part Tasmania runs on hydro electricity, but Bell Bay is occasionally steamed up, just enough to keep it in good order. At present it is oil-fired but it is capable of conversion to coal firing, if the need ever arises.

One aspect of hydroelectric development that deserves a mention is the recreational facilities that are opened by the various works. As mentioned, Lake Barrington is a world class rowing venue but there are others. Meadowbank Dam, on the Derwent River a few kilometres upstream from New Norfolk is a popular water skiing venue.

Most hydro waters are stocked with trout, either Browns or Rainbows, and some mighty fish have been taken from the lakes. Particularly in the early years, soon after the lakes first fill, there is plenty of food for the fish and they grow to giant size. Later, the average size is less but the quality of the fish and the fishing is world famous.

One HEC development provides sport only for the bravest. This is the white water canoeing course at Brady's Lake. This spectacular waterway has attracted canoeists from all over Australia and from overseas.

And if your only interest in water is to look at it, then the roads built by the HEC to allow access to its construction sites remain after the work is done. Most of these roads become public thoroughfares giving easy travel into some of Australia's most magnificent mountain scenery.

Tasmania's Power In The Mountains is an example of civil engineering on a massive scale. It has created storages much larger than Sydney Harbour and generates more power per head of population than most other countries on earth. For a population that would only make a fraction of Sydney's, Tasmanians have tackled and completed the building of a hydroelectric system closely approaching the size of the Snowy Mountains scheme.

(1) "Hydro Construction Villages, Volume 1". Sarah Rackham. HEC 1981 Page 24.

(2) "A Million Horses". HEC 1962 Page 21.

(3) "Hydro Construction Villages, Volume 1". Sarah Rackham. HEC 1981 Page 57.

UTOPIATRONICS: The hobbyist's dream could come true!

FORUM

Conducted by Leo Simpson*

Our story on this subject in the May issue caused a number of readers to whip out their pens and send us some letters dripping in vitriol. We were taken aback. We're the good guys really. Stop shooting for a moment while we attempt to explain this situation.

Boyoboyoboy! When Neville Williams wrote his May Forum piece on Utopiatronics we did not know what we were letting ourselves in for. It all started innocently enough. Reader N.M., of Rosebud, Victoria, had a go at us for producing a $400 tuner kit which was not available in any other form. He then stated, rather strongly, that he wanted to build kits, one section at a time, so that there was no large one-time outlay.

In other words, he didn't want to, or couldn't, spend $400 in one hit. And he finished by making an appeal to EA, to revert to the good old ways, when "we were a great magazine".

Well, fair enough. We rushed to reply, via Forum, and proceeded to defend the overall project policy of EA, and in particular, the design approach used in the Playmaster stereo AM/FM tuner. We were, and are, particularly proud of this tuner design and I am painfully aware of just how many man-hours we took to achieve it.

Therefore, it was perhaps natural that we would strongly defend the design concept of having the whole tuner built on one large board, as is the practice in all modern synthesised hifi tuners. We went on to point up the impracticality of designing the tuner to fit on a number of board assemblies. In fact, not to put too fine a point on it, we ridiculed the whole idea.

That is where we came unstuck!

Now that other letters have arrived in the EA office supporting the letter by N.M., it is quite clear that he was not suggesting that the tuner should have been designed to fit on half a dozen boards. Far from it. No, he just wanted to buy the bits gradually, say $20 one week, $30 the next and so on. Now that I can identify with.

While I can no longer be regarded as a true electronics hobbyist, since I work at it all day, I do have another hobby. And being fairly tight-fisted, I don't lash out and spend big dollars at one time. I do it gradually, so that after a year, the amount of money I've invested in the hobby is quite respectable. (And my wife doesn't kick up too much of a fuss.)

In the same way, an electronics enthusiast spending around $20 a week on his hobby could easily tot up $1000 at the end of the year. OK. So we admit that we did not get the message from N.M. of Rosebud (such a pleasant-sounding place too) but the letters from other correspondents reproduced here have put us right.

So let us just have a look how our fixation on kits, or Kittronics, as one of our readers refers to it, came into being. Gary Johnson of Jaycar gave some of the history of this development last month in the "Letters to the Editor" pages but that is not the whole story, as far as we are concerned at EA.

When we design a project such as the Playmaster tuner or the Playmaster Sixty/Sixty currently being described in this issue, we are delighted when Jaycar, Altronics and others decide to do it as a kit. That's great. It means that a large number of people will be able to build the unit and gain satisfaction from what we think is a great project.

Naturally it makes our job easier too, if the suppliers concerned immediately start to advertise the availability of such a kit, because then we don't have to answer numerous enquiries along the general lines of "where do I get the kit?"

As I write we have a problem with the Digital Strobe described in our March issue. As far as we know, no kit is available for this project and so a number of enquirers have been disappointed. Nor have they been really consoled when we have pointed out that all parts should be readily available from suppliers. They want the kit.

We also have a vested interest in seeing as many suppliers as possible make each project available as a kit. The more that are available as kits, the more we are seen as a successful magazine operation. And yes, the more suppliers who advertise kits, the more advertising revenue we receive which is important in maintaining our viability. The costs of having a technical staff to develop these projects are really quite onerous and we can only afford to meet these costs while we are viable.

In fact, as an aside, Australian electronics magazine are the only ones in the world, as far as we can determine, that maintain full-time technical staffs. Overseas technical magazines depend on contributors for their constructional articles. Perhaps that is the overriding reason for our continuing success while

**Neville Williams is on holiday and will be back next month.*

many overseas magazines are having enormous problems with drastically-falling circulation, plummetting advertising revenue and, in some cases, final closure.

But back to the question of kits: we also like to see more than one supplier decide to kit up for projects so that readers have as much choice as possible and so that an element of competition is maintained.

Bombshell price

So that is how we have been happily running along for at least 10 years now and the large majority of constructors would appear to have been more than satisfied with the system. Then along came the Playmaster tuner with all its specialised components and "bombshell" price of $400 (which, incidentally, compares more than favourably with inferior commercial units).

The tuner crystallised a number of issues which have been simmering in the background for a while now but which people are now focussing on strongly.

Firstly, quite a few of the major kitset suppliers have been maintaining a policy of not making specialised parts available unless they are purchased as part of a kit. While this has not necessarily been a problem when people decide to build the kit, it can be a very frustrating problem for a kitset constructor who needs to buy some parts to repair a kit which has had component failures.

Generally, when readers have approached us with this problem, we have been able to sort it out with the kitset supplier concerned but it has sometimes generated very bad relations all round. Understandably, constructors have felt that the kitset suppliers have been unreasonable in refusing to be more helpful in these cases.

As a related problem, there are often parts associated with a particular kit which may be absolutely "bog-standard" (I like that expression) but not listed as standard items in the supplier's catalog. The components may be quite standard in every way, and could be resistors, capacitors, semiconductors or chassis hardware.

A classic example of this occurred quite a few years ago with the Playmaster Twin Twenty Five. This was the first project by any magazine to use PCB-mounting fuse clips. The main supplier concerned at the time, Dick Smith Electronics, had thousands upon thousands of these clips in stock for the amplifier but anybody who was rash enough to go to one of the DSE stores and ask for fuse-clips got no help at all.

Sir,

I am writing in response to your magazine's Forum article entitled "Utopiatronics".

As a reader of your magazine for the past 18 months, I too have noticed the trend towards what I call "Kittronics". I also eagerly looked forward to the next article of your Playmaster Tuner, until the issue advising readers that "it" was a kit. To put it bluntly, I was hopping mad. I considered you were engaging in dirty journalism, leading readers along with articles only to drop the bombshell in the last issue that it would cost readers $399 up front.

N.M. states he has built many projects one section at a time. Neville Williams misses the point, may I suggest, because he chooses to, to suit his point. N.M. is saying he takes his time building a project and "section" means another batch of components when he can afford the time and money, not as Neville Williams seems to think. I too build my projects when I can afford the time and money for parts.

Three of my friends and I have purchased from your magazine the circuit films for the Playmaster tuner in question and we have produced four sets of circuit boards. We are now in the process of building the tuner "section by section". We cannot afford $400 up front. I mean, we live in the real world, you know; the one with low pay, the kids' education, the mortgage, etc. In this world, any hobby one indulges in has to take a back seat. So please, EA, get back into the real world before it is too late!

One final point: surely if EA produces a project for its readers it could line up supplies of parts from the kit supplier for those who have to build projects section by section.

It would be interesting to know how many readers would build the tuner if they knew the kit supplier would also supply individual components. Also, how many requests have you had for the circuit films? Remember, from our set we have produced four sets of circuit boards, including the double-sided ones.

So far I have spent less than $30 and the power board is complete; the front end is two thirds complete, and the main board has all resistors, capacitors, diodes and transistors in position. Now I am into the meat of the tuner — ICs, coils and the control hardware. However, as these are the costly parts, progress will have to slow-up until I can afford it. This is what I call building section by section and so does N.M. I think.

J. M. (Seven Hills, NSW).

Those fuse-clips weren't listed in the catalog and therefore they didn't exist, as far as the store staff were concerned. As it happened, Dick Smith himself eventually became aware of the problem, agreed that it was silly not to have the clips on sale and so they were given a catalog number. Miraculously then, fuse-clips then became available from DSE stores and still are today (DSE Cat H-1700, for a packet of eight).

There must be literally hundreds of otherwise quite standard components being maintained in suppliers' inventories but not experiencing much turnover because they are only called for in such and such a kit. From a strict accounting viewpoint, this is stupid.

It is also unhelpful (silly, stupid, extremely annoying; select your own description) for counter staff to be so inflexible as to deny the availability of parts unless they have a catalog number. Each store should have a system for procuring such parts when they are asked for by customers. To refuse to do so (and we know it happens) is the worst of public relations.

For their part, the management of major kit-sellers may deny that they get many requests for non-standard parts but it is doubtful whether they have canvassed their counter staff on this question. Nor would counter staff necessarily know that a person buying a certain collection of parts was actually building the Railmaster project, for example, unless the customer had the article spread out in front of him while he ordered.

Parts suppliers would no doubt also state that it costs quite a bit more to sell parts in small quantities than to sell them in kit form and, at first sight, this is probably correct. But is it really?

We have had many long discussions on this subject with suppliers over the years and they have often pointed up the problems and costs of kits. These include obtaining metalwork, ordering all parts not presently in stock, preparing kit instructions, packing and checking and, last and certainly not least, the cost of advertising and promotion.

So it would seem that, for some projects at least, there could be a beneficial alternative strategy for parts suppliers to follow. Rather than kitting up for the whole project, they could "pick the eyes" out of the published parts list and stock the special, hard-to-get bits instead.

EA's position

So what's this bit in one of the accompanying letters about EA announcing that a project is available as a kit for a "bombshell" price? Well, we don't do that at all for projects developed by EA staff, in house. We don't make any announcement about kits or their prices, with one exception, which we'll get to in a moment. It is the advertiser who announces the price of a kit.

Up until about 12 months ago, it was our custom to incorporate a little panel in each project article giving a cost estimate. It was very carefully worded: "We estimate the current cost of parts for this project to be approximately X dollars. This includes sales tax." There was no mention of the word kit.

The panel was included as a guide to readers. It seemed like a good idea to us but too many readers took it to be the recommended retail price of the kit of parts. They would argue with any kitset supplier who had the temerity to price his kit a little higher. So since it was not serving its purpose as a guide and was a source of contention between suppliers and customers, we decided to omit it altogether. Perhaps if he had included a cost estimate with the Playmaster tuner, people might have had less of a shock.

Supplier kits

There is one instance where we do actively promote the concept of a kit of parts. It occurs where a project design is accepted from a supplier such as Dick Smith Electronics. In these cases, the company concerned has commissioned the design and usually retains copyright in the design. This means that usually the easiest and most straightforward way of obtaining all the parts is to buy from the designated supplier.

We accept these projects because we do not have the resources to develop them ourselves. Projects like the teletext decoder, UHF transceiver and the stereo TV decoder, all from Dick Smith Electronics, or Algernon, the quaintly-named robot from Jaycar, all take a lot of man-hours. However, most of these projects are subject to discussion with us before the design is frozen so we do have some input.

We also often suggest modifications to designs that have been submitted to us. So we get the best of two worlds in effect. We are able to publish project articles which we otherwise would not have the resources to produce; and we have a hand in their development so they broadly conform to our design philosophy.

We are also aware that not a few enthusiasts build these projects without resorting to buying the kit from the designated supplier, so they get the benefit of these articles as well as the kitset buyers.

Special parts

Before concluding, I should reply to a specific comment by reader E.M., of Manly West, Qld, who states that projects should only be designed using readily available standard parts. Clearly, if we had pursued that policy over the years, the number of projects which would have been possible would have been very much reduced. Without specialised parts, most of the larger projects, especially the Playmaster AM/FM tuner, could not be countenanced.

I can give a very good example of this. For a number of years now, several members of the EA staff had wanted us to publish a state-of-the-art synthesised AM/FM tuner. I had refused to consider the possibility because I am painfully aware of the time needed to develop the software for the microprocessor control.

Then we became aware that Eurovox had a custom NEC microprocessor which it used in all their AM/FM stereo car radios. We approached Eurovox for permission to use this microprocessor in a design of our own and, to their very

Sir,

I read with great interest N.M.'s comments regarding your construction articles in the May edition of EA. I must say from the onset that I agree with him. I too have been disappointed after buying your magazine with a particular project in mind only to have discovered that the project is in kit form and cannot be purchased any other way.

The 100W Linear Amplifier in the March issue was particularly disappointing for this reason. I am not prepared to outlay $249 in one hit. The retailers might claim to have sold 'x' number of kits but I will bet they've missed out on just as much revenue by restricting it to kit form.

While on the subject of kits I would like to add my two cents' worth. The kits that I have seen and built to date are fairly pathetic. The instructions are nothing more than photocopies from the original magazine article. I have never seen any magazine give a list of procedures to follow in case it does not work. Overall presentation is no better than I can produce in my own workshop.

The only kit I have ever seen that really looked smart, came with a comprehensive construction manual (I mean manual, not scraps of photostat paper), gave details of what to do if your project did not work and left the constructor with a feeling of having produced a first class professional looking piece of gear wasn't Australian-made but instead came from the United States under the name of Heathkit. By comparison, Australian kits are not kits at all. They just have all the bits stuck in a box.

I.G. (Myrtleford, Vic).

Sir,

N.M. of Victoria has my wholehearted support regarding constructional articles which are only available in kit form.

My problem is also the Playmaster Tuner but I only wish to build the FM section with manual tuning. At first Jaycar informed me all parts would be available but have now said they will only be available in the kit.

As I am not prepared to spend $400 on the kit and throw two thirds of it away, I will not be building it, much to my disappointment.

While taking Neville William's point that the kit suppliers have quite a financial investment in importing the special components, surely they could increase their turnovers on them by supplying them to scratch builders. Why act like dogs-in-the-manger and only supply them in kits?

Anyway, I think such articles should only be designed around readily available components.

E.M. (Manly West, Qld).

great credit, they were extremely helpful.

But if we had not been able to use this one special part, the project would never have eventuated. Of course, other special parts have had to be specified in order to obtain the high performance level we thought readers would want, if they were to go to the bother of building rather than buying a unit off the shelf.

So while we try to use standard parts wherever possible in our designs, there are instances where a much more elegant and practical design is possible by using a non-standard part. And of course, once we specify a part, the likelihood is that, in a year or so, it will be regarded as a standard part. As for parts being readily available, even the most standard parts can become extremely hard-to-get at times.

It should be clear by this time that it is not EA who determines whether a project will be available in kit form or otherwise. It is the parts suppliers who make these decisions. We cannot force them to make specific parts available or otherwise determine their marketing strategy. Up till now we have been happy if a project is available in kit form or, if not, all the parts are at least readily available for most projects. Where the kitset supplier owns the design, they clearly make all the running in this regard.

Now it seems as though we have to strongly provide for a third possibility: that of having the project available in both kit or fragmented form. Perhaps where kits are likely to cost $100 or more, there should be an alternative in the form of a short-form kit, containing the principal parts of interest.

But these few letters published here will not be enough to convince most kit-suppliers that specialised parts should be made available. They will have to be convinced that there is enough demand to make such a policy worthwhile.

So here is the challenge. If you are a reader who would be encouraged to build more projects, if only you could buy more of the tricky bits and pieces, please write to us and say so. We need a wad of letters that we can wave under the noses of the parts suppliers. They are reasonable men. If they can see that there is a potential demand, you can bet that they will move to meet it. So go to it.

And thank you to those readers who have so far written on this subject. We do appreciate the feedback, even though some of it is more negative than positive.

IBM* COMPATIBLES from $799*

Incredible deals to suit everyone including special package deals!
*256K RAM single drive, graphics disk controller and printer cards **$799**

256K RAM: Colour Graphics, Disk Controller Card, 1 parallel port, 2 disk drives and 3 months warranty **only $1,350**

640K RAM: Colour graphics, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports, 2 disk drives and 3 months warranty **only $1,450**

256K PACKAGE DEAL: Includes Colour Graphics Card, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports. A 120 C.P.S. printer and a monochrome monitor and 3 months warranty! **only $1,899**

640K PACKAGE DEAL: Includes Colour Graphics Card, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports. A 120 C.P.S. printer, a monochrome monitor and 3 months warranty! **only $1,999**

*IBM is a registered trademark

IBM* AT COMPATIBLE!

- 6/8 MHz (switchable)
- 80286 CPU
- 8 slots
- 1 M/Byte main board
- 1.2 M/Byte Floppy disk drive
- 20 M/Byte Hard disk
- Colour graphics display card
- Floppy and Hard disk controller card
- Printer card and RS232
- 200W Power supply
- Keyboard
- Manual

All this for just $2,995

NEW INTRA HIGH RESOLUTION RGB COLOUR MONITOR!

Size: 14 inch
Sync. Horiz. Scan Freq: 15.75 KHz
Sync. Vert. Scan Freq: 50 Hz
Band width: 18 MHz
Resolution: 640 x 400 dots
Display Format: 80 x 25 Characters
Display Colours: 16 colours
Input Connector: 9 pin D type
Cat. X14520 **only $695**

RITRON 2 MONITORS

Stylish, swivel base monitor available in amber or green
Green Cat. X14506 **Normally $215**
Amber Cat. X14508 **Normally $219**
SPECIAL, ONLY $199

JOYSTICK FOR IBM

Features Selectable "Spring centering" or "free floating". Electrical trim adjustments on both axis. 360 degree cursor control.
Cat. C14205 **$39.95**

APPLE JOYSTICKS

Ideal for games or word processing. Fits most 6502 "compatible" computers.
Cat. C14200 **$34.95**

TRANSISTOR AND IC's SPECIALS

2N4240	$0.50
MPSA93	$0.25
MJ15004	$2.90
2N4033	$0.30
2N3055	$0.80
2N3772	$2.90
2N3773	$2.90
FND507 C.A.	$1.00
6845	$6.00
MJ802	$2.90
BF469	$0.40
BF470	$0.40

BARGAINS!

SOLDER ROLLS

Absolutely top quality, unlike our opposition's!
60/40 Resin cored.

Cat.No.	Description	Price
T31000	.71mm 250gm	$8.95
T31002	.71mm 500gm	$15.95
T31010	.91mm 250gm	$7.95
T31012	.91mm 500gm	$14.95
T31020	1.6mm 250gm	$7.50
T31022	1.6mm 500gm	$13.95
T31030	.71mm 1 metre	$1.50
T31032	.91mm 1 metre	$1.25
T31034	1.6mm 1 metre	$1.00

MICRO PIEZO SIREN

- Very small and easy to install
- High impact plastic (white)
- Input 12V DC 150mA
- Output 110dB at 1 metre, dual tone

Cat. S15069 **$13.95**

IBM COMPATIBLE CARDS

TURBO CARD!!
Switchable 5 MHz / 8 MHz IBM* compatible motherboard
Cat. X **$495**

MOTHER BOARD!
XT compatible mother boards. 8 slots, room for 256K RAM
Cat. X18020 **$295**

GAMES ADAPTOR CARD
Features 2 joystick ports
Cat. X18019 **$49**

MULTIFUNCTION CARD
(384K RAM) Parallel, serial and game port. Plus battery backup clock
Cat. X18013 **$329**

DISK CONTROLLER CARD
Controls 2 slimline drives
Cat. X18005 **$89**

HIGH RESOLUTION MONOCHROME GRAPHICS CARD
Give your IBM real graphics capability
Cat. X18007 **$249**

512K RAM CARD
Including RAM Cat. X18015 **$299**
Excluding RAM Cat. X18016 **$129**

APPLE* COMPATIBLE CARDS

Printer Card	Cat. X17029	$89
Drive Card	Cat. X17019	$95
80 Column Card	Cat. X17025	$109
Speech Card	Cat. X17009	$69
Music Card	Cat. X17011	$99
Super Serial	Cat. X17035	$129
RGB Card	Cat. X17039	$79

VOLTAGE REGULATORS BARGAINS

Description	1-9	10+
LM309KC	$1.80	$1.60
7805KC	$1.80	$1.60
7812KC	$1.80	$1.60
78H05KC 5V 5A	$7.80	$6.95
78H12KC 12V 5A	$7.80	$6.95

WIPER DELAY CONTROLLER AND LIGHT ON REMINDER

- Triggers if lights are left on and ignition is turned off
- Has both an audible and visible alarm
- Allows windscreen wipers to be delayed for up to 20 seconds
- Underdash or on dash mounting
- Designed for 12 volt negative earth electrical systems
- Complete with mounting hardware

Cat. A15070 **Normally $24.95**
SPECIAL, ONLY $19.95

SPECTROL 43P

Equiv (Bourns 3006)
Essential for precision work.

R14200 10R	R14290 10K
R14210 20R	R14300 20K
R14220 50R	R14310 50K
R14230 100R	R14320 100K
R14240 200R	R14330 200K
R14250 500R	R14340 500K
R14260 1K	R14350 1M
R14270 2K	R14360 2M
R14280 5K	

1-9 **$1.95** 10+ **$1.75**

5¼" FLOPPY DISK SPECIALS!

All prices 10 disk boxes!

	1-9	10+
XIDEX		
S/S D/D Cat C12401	$29.95	$29.95
D/S D/D Cat C12410	$38.95	$36.95
High Density Cat C12520	$125	
VERBATIM DATALIFE		
S/S D/D Cat. C12501	$27.95	$26.95
D/S D/D Cat. C12504	$34.95	$32.95
VERBATIM VALULIFE		
S/S D/D Cat. C12421	$24.95	$22.95
D/S D/D Cat. C12425	$29.95	$25.95

3½" DISK SPECIALS

Verbatim S/S Cat C12610	$69.95
Verbatim S/S Cat C12612	$89.95
Xidex S/S Cat C12600	$65.95
Xidex D/S Cat C12602	$89.95

NEED HIGH DENSITY DISKS FOR YOUR IBM AT?

"Buy your High Density disks at below recommended retail prices from Rod Irving Electronics and SAVE"!!
R.R.P. $113 **Our Price $99.95**

SCOPE 60W SOLDERING SYSTEM

- Infinitely adjustable temp. 200 C to 470 C. Sliding control selects desired tip temperature (LED readout monitors tip temp.)
- Safety holder features ceramic burn-proof bush and can be converted to left-hand-side.
- Soft and cool hand grip in pliable rubber.
- Screw type connector prevents accidental plug removal and guarantees solid contacts.
- Temperature lock allows production supervisors to control soldering temperatures.
- Anti seize tip retention design reduces risk of thread seizure by removing locking nut to cooler end of barrel.
- Optional 30W soldering pencil is available for finer work.

Cat. T12900 **Normally $159**
NOW $149

INDUCTORS

As used in the Series 5000!

L12040 0.8mm	$8.95
L12048 3.0mm	$14.50
L12056 12.6mm	$29.50
Base plate	$14.50
Circuit Board ETI 496	$12.50

CRAZY SPECIAL!

CRYSTALS SPECIALS

We simply have too many of these prime spec. crystals in stock!

Description	Cat.No.	1-9	10+
1MHz	Y11000	$6.00	$5.20
1.8432MHz	Y11003	$6.00	$5.20
4MHz	Y11020	$2.00	$1.60
4.194304MHz	Y11022	$2.00	$1.60
4.433618MHz	Y11023	$2.00	$1.60
4.75MHz	Y11025	$2.00	$1.60
4.915200MHz	Y11026	$2.00	$1.60
5MHz	Y11030	$2.00	$1.60
6MHz	Y11040	$2.00	$1.60
6.144MHz	Y11042	$2.00	$1.60
6.670MHz	Y11045	$2.00	$1.60
8MHz	Y11050	$2.00	$1.60
8.867238MHz	Y11055	$2.00	$1.60
10MHz	Y11060	$2.00	$1.60
12MHz	Y11070	$2.00	$1.60
14.31818MHz	Y11072	$2.00	$1.60
15MHz	Y11075	$2.00	$1.60
18MHz	Y11082	$2.00	$1.60
18.432MHz	Y11085	$2.00	$1.60
20MHz	Y11090	$2.00	$1.60

SAVE!

FREE STANDING, FOLD UP MAGNIFIER

An economically priced "hands free" magnifier, lets you take care of all those tricky fine detailed jobs so often encountered in electronics, or any of many other practical uses such as home, work, hobbies etc.
Cat. T12083 **Normally $14.95**
SPECIAL, ONLY $12.95

WIRELESS INTERCOM

This quality 2 way handset type FM wireless intercom, automatically calls the other phone the moment the handset is picked up. Simply plugs into any 240V wall outlet and can be wall or bench mounted. Features LED indicators for transmit and recieve, and P.L.L. circuitry to ensure reliability. Carrier frequency 95.125kHz.
Cat. A11506 **Normally $139**
SPECIAL, ONLY $109

RECHARGEABLE 12V GELL BATTERIES

Leakproof and in 3 convenient sizes, these long service life batteries are ideal for burglar systems, emergency lighting or as a computer backup power supply. Ideal for many power needs.

Cat. S15029	12V 1.2 AH	$12.95
Cat. S15031	12V 2.6 AH	$39.50
Cat. S15033	12V 4.5 AH	$49.95

RITRON 19" RACK CASE

Tremendous Value! Dimensions 480(W) x 134(H) x 250(D)mm.
Cat. H10415 **Normally $47.95**

10 TURN WIRE WOUND POTENTIOMETER

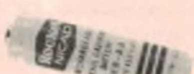
Spectrol Model 534 ¼" shaft.
Equiv (Bourns 3540S, Beckman 7256)
Dials to suit 16-1-11, 18-1-11, 21-1-11

R14050	50R	R14100	5K
R14055	100R	R14110	10K
R14060	200R	R14120	20K
R14070	500R	R14130	50K
R14080	1K	R14140	100K
R14090	2K		

1-9 **$13.50** 10+ **$12.50**

ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A Cat. M12155	$6.75	$5.95
2156 240V 6-15V 2A Cat. M12156	$9.50	$8.95
2851 240V 12-6V CT 150mA Cat. M12851	$4.50	$3.60
6672 240V 15-30V 1A tapped Cat. M16672	$9.95	$9.30
2860 240V 15V CT 250mA Cat. M12860	$4.95	$3.95

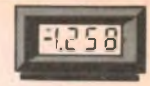


NICADS!

Size	Desc.	1-9	10+
AA	1.2 A.H.	$1.95	$1.75
C	1.2 A.H.	$7.95	$6.50
D	1.2 A.H.	$7.95	$6.50

UNIVERSAL BATTERY CHARGER AND TESTER

Save money on expensive batteries with this universal battery charger. Features include meter tester, and provisions for D, C, AA, AAA, N, button and cell batteries, 9V and 6V (square types). Comes complete with detailed instructions.
Cat. M23533 **$27.95**



3½ DIGIT ECONOMY LCD CPM

- **Ultra-Low Power**
- **Bandgap Reference**

An ultra-low power, extremely stable LCD CPM suitable for a wide number of different applications. Features Auto-zero, Auto-polarity, 200mV fsd, User adjustable Low Battery indication, 12.5mm digit height, programmable decimal point. The QP-5513 has an external bandgap reference for extra temperature stability, with connections brought out, allowing use in single ended, differential or ratiometric mode. The fsd can be easily rescaled by the user to indicate volts, amps, ohms or many other engineering units. Supplied with a beezel mounting, clips connectors and full data sheet.

SPECIFICATIONS:
Accuracy: 0.1% + -1 count
Linearity: + -1 count
Samples/sec: 3
Temp. Stability: 50 ppm typical
Temp. Range: 0 - 50C
Supply Voltage: 5 - 15V DC
Supply Current: 200uA typical
Max. DC Input Voltage: + - 20V
Cat. Q15513 **$69.95**

TELECOMMUNICATIONS AUSTRALIAN STYLE ADAPTOR CABLE

- Australian socket to plug/socket
- Length 10 metres

Cat. Y16015 **Normally $15.95**
$12.75

TELEPHONE ADAPTOR

- Australian plug to U.S. socket
- Length 10cm
- Cream colour cable

Cat. Y16026 **Normally $6.95**
SPECIAL, ONLY $5.55

TELEPHONE CURL CORD

- U.S. plug to U.S. plug
- Replacement hand set cord
- Length 4.5 metres
- Colours: cream, dark brown

Cat. Y16022 **Normally $7.95**
SPECIAL, ONLY $6.35

TELECOMMUNICATION PLUG TO 2 SOCKETS.

Ideal for modem connections
Cat. Y16014 **Normally $12.95**
SPECIAL, ONLY $10.35

RS232 GENDER CHANGERS

Saves modifying or replacing non-mating RS232 cables by changing from male to female to male. All 25 pins wired straight through.
Male to male: Cat. X15650
Female to female: Cat. X15652
Normally $19.95
SPECIAL, ONLY $15.95

INLINE SWITCHING BOX

- 25 pin "D" plug to 25 pin "D" socket (RS232)
- DIP switches allow easy switching of internal wiring

Cat. P **Normally $32.95**
SPECIAL, ONLY $26.35

Don't flatten your battery. Build a

Parking lights reminder for your car

Incorporating a pleasant chime sound, our headlight reminder will save you the hassle of a flat car battery. If the headlights or parking lights are on, it will sound as soon as the ignition switch is turned off.

by JOHN CLARKE

During overcast and rainy weather, many motorists switch their parking lights on during the day. While this is a worthwhile safety measure, it's all too easy to forget about the lights at the end of the journey. Many a motorist has returned to his vehicle at the end of the day to find it with a flat battery and the parking lights switched on.

Just ask the NRMA (or RAC) about the number of calls they receive on a rainy day. Most of them are for flat batteries. It can happen to the best of us.

But why wait for the inevitable to happen? By installing this simple circuit, you can avoid the hassle of a flat battery.

Most headlight reminder circuits described in the past use a harsh-sounding buzzer to warn the motorist. Our latest circuit has a simple chime sound that is easy on the ear while still conveying a warning.

An extra feature of the headlight reminder is that the chime sound switches off after about five seconds rather than sounding continuously until the headlights are switched off. This feature allows intentional use of the lights without the reminder circuit continuously objecting.

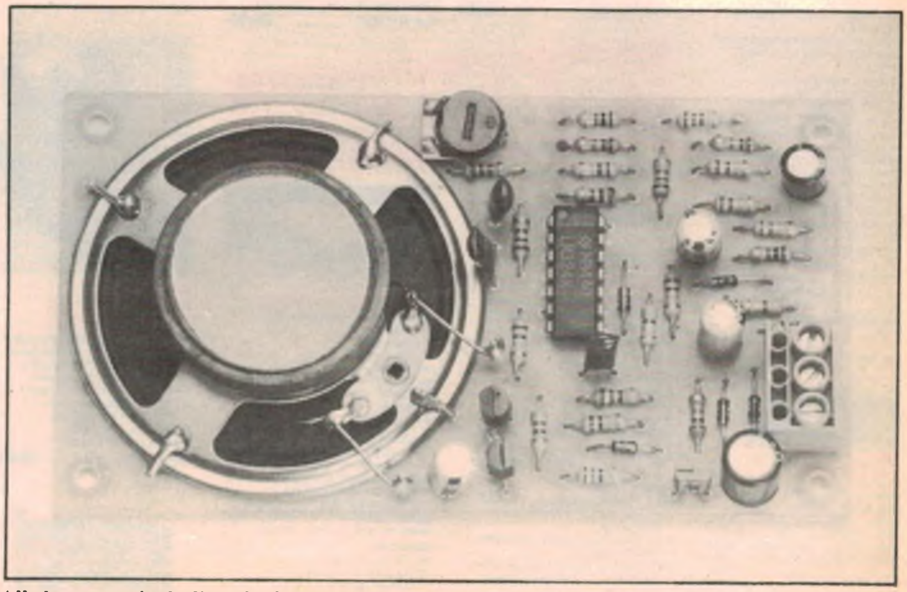
The entire circuit, including the miniature loudspeaker, is contained on a small PC board which is small enough to fit beneath the dashboard. Only three wires are necessary to connect the circuit to the car wiring — one to the headlight switch, one to the ignition switch and one to earth.

How it works

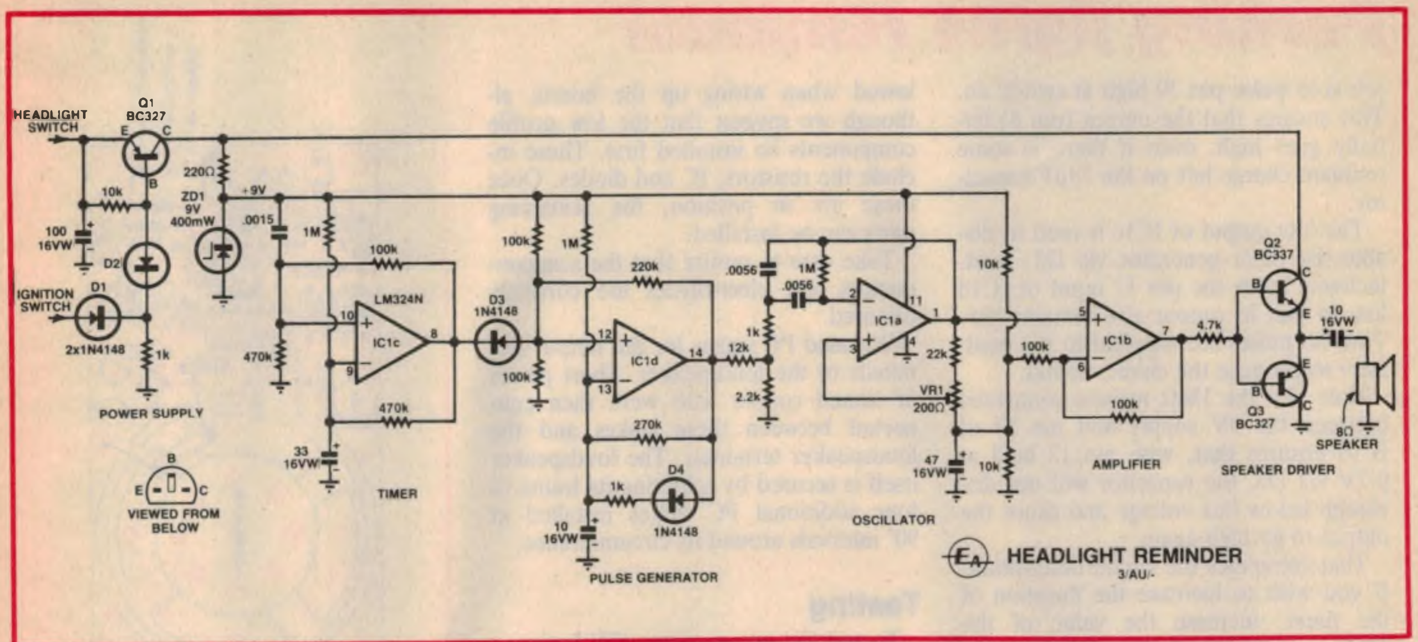
Although the circuit may seem unduly complicated for a headlight reminder, it is entirely based on low-cost easy-to-get parts. A single quad op amp forms the basis of the circuit, along with three transistors, a few diodes and a handful of resistors and capacitors.

The circuit can be divided into several distinct sections: a power supply (Q1), oscillator (IC1a), amplifier (IC1b), a speaker driver stage (Q2 and Q3), timer (IC1c) and a pulse generator (IC1d).

Power for the circuit is derived from the headlight supply of the vehicle. When the headlights are switched on, transistor Q1 turns on due to the base current flowing through diode D2 and the 1kΩ resistor. The battery voltage to



All the parts, including the loudspeaker, are accommodated on a small PCB.



The circuit is based on an LM324 quad op amp and requires only three connections to the car wiring.

the headlights is thus applied to the circuit.

If, however, the ignition switch is on, the voltage at the anode of diode D1 removes bias from Q1 by reverse-biasing D2. Consequently, Q1 is on only when the headlight switch is on and the ignition switch is off.

The 100μF capacitor filters the supply to Q1, while the 10kΩ resistor between the base and emitter ensures that it remains off with no base bias. ZD1, a 9V zener diode, is used to regulate the supply to the op amps.

The oscillator is formed using op amp IC1a. This is connected in a multiple feedback bandpass filter configuration with a centre frequency of about 1kHz. A small amount of positive feedback is supplied from the output via the 22kΩ resistor and VR1 which is adjusted so that the filter is just below the point of oscillation.

Two 10kΩ resistors connected in series across the 9V supply provide bias for the non-inverting input of IC1a. Filtering is via the 47μF electrolytic capacitor.

Whenever a pulse is supplied to the filter input, the filter output will resonate at its centre frequency. Because VR1 is not adjusted for self-sustaining oscillation, the oscillation will gradually die out until there is no signal at the output. Fig.1 shows what happens when the pulse generator sets the filter oscillating. This effect is called ringing.

The output from the oscillator is amplified by op amp IC1b which is connected as a non-inverting amplifier with a gain of two. This, in turn, drives a complementary transistor output stage consisting of Q2 and Q3. The output from this stage is then AC-coupled to the loudspeaker via a 10μF electrolytic capacitor.

The pulse generator consists of IC1d which is connected as a Schmitt trigger oscillator. The hysteresis is set by the 220kΩ resistor between the non-inverting input at pin 12 and the output at pin 14, and the two 100kΩ resistors connected to pin 12 and the supply rails.

Here's how it works: initially, when power is first applied, the 10μF capacitor on pin 13 is discharged and the output of IC1d is high at 9V. The non-inverting input is at about 5.3V. The capacitor now begins to charge via the 1kΩ resistor and diode D4.

Note that the 270kΩ and 1MΩ resistors also help charge the capacitor, but the effect of these is quite small during this part of the cycle.

When the capacitor voltage reaches 5.3V, the output of IC1d goes low and the 10μF capacitor begins discharging via the 270kΩ resistor. The 1kΩ resistor plays no part here since D4 is now reverse biased.

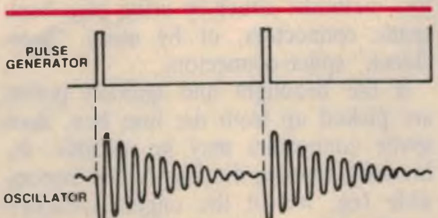


Fig. 1

Fig.1: the output waveform from the pulse generator (IC1a).

During the discharge time, pin 12 is at 3.7V due to the low output at pin 14. Thus, when the capacitor voltage reaches 3.7V, the Schmitt output again goes high and so the cycle is repeated indefinitely.

The result of all this electronic skulduggery is a pulse train consisting of short-duration pulses with a relatively long period between them.

These pulses are attenuated by a voltage divider consisting of 12kΩ and 2.2kΩ resistors and applied to the inverting input of the oscillator.

The remaining op amp, IC1c, forms the timer circuit. Its non-inverting input (pin 10) is initially held at 7.4V due to the high output at pin 8 and the voltage divider formed by the 100kΩ and 470kΩ resistors on pin 10.

When power is applied, the 33μF capacitor at pin 9 charges towards the positive supply rail via the 470kΩ and 1MΩ resistors on pin 9. When the voltage reaches 7.4V, the output of IC1c goes low.

Pin 10 is now held at ground potential and the 33μF capacitor discharges via the 470kΩ feedback resistor to 2.9V. Note that it does not completely discharge due to the 1MΩ resistor connected between pin 9 and the 9V rail.

The output of IC1c thus goes low about five seconds after power is applied and remains low while ever this power is left connected. Once this has happened, the timer can only be reset by disconnecting the power (ie, by switching the headlights off).

Note the .0015μF capacitor between pin 10 and the positive supply rail. Its

Parking lights reminder

job is to pulse pin 10 high at switch on. This ensures that the output (pin 8) initially goes high, even if there is some remnant charge left on the 33μF capacitor.

The low output of IC1c is used to disable the pulse generator via D3. It effectively holds the pin 12 input of IC1d low so that its output also remains low. Thus no pulses are supplied to the oscillator to produce the chimes sound.

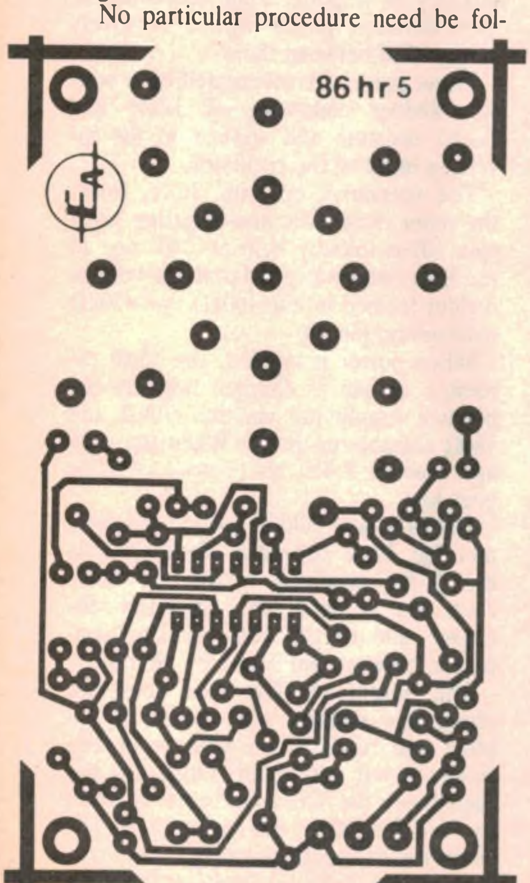
Note that the 1MΩ resistor connected between the 9V supply and pin 13 of IC1d ensures that, with pin 12 held at 0.7V via D3, the capacitor will not discharge below this voltage and cause the output to go high again.

That completes the circuit description. If you wish to increase the duration of the timer, increase the value of the 33μF capacitor on pin 9.

Construction

They don't come much easier to build than this project. The parts are all mounted on a small PC board coded 86hr5 and measuring 59 x 107mm. Construction simply involves installing the parts in the correct locations and soldering the leads.

No particular procedure need be followed when wiring up the board, although we suggest that the low profile components be installed first. These include the resistors, IC and diodes. Once these are in position, the remaining parts can be installed.



Here is an actual size PC artwork.

Take care to ensure that the semiconductors and electrolytics are correctly oriented.

We used PC stakes for the output terminals to the loudspeaker. Short pieces of tinned copper wire were then connected between these stakes and the loudspeaker terminals. The loudspeaker itself is secured by soldering its frame to four additional PC stakes installed at 90° intervals around its circumference.

Testing

To test the circuit, apply 12V between the headlight input and ground and check that the IC supply rail is about 9V. This done, adjust trimpot VR1 until the correct chime sound is obtained from the loudspeaker. The correct setting is one where each chime starts out quite loud and gradually dies away. Do not turn the trimpot so far that the circuit oscillates continuously.

After about five seconds, the chimes should stop due to the output of timer IC1c going low. You can reset the circuit simply by removing and then re-applying power.

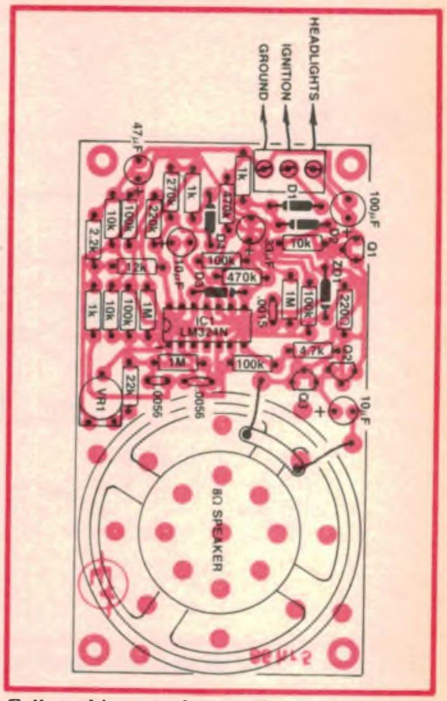
Finally, check that the circuit is disabled if the ignition input is connected to the positive supply rail.

Installation

Although the PCB has been designed to fit into a 130 x 68 x 41mm plastic utility box, it is not strictly necessary to house the unit in this manner. Instead, we suggest that you sandwich the PCB between a couple of pieces of foam rubber which can then be taped together.

The best place to mount the unit is under the dashboard, preferably adjacent to the fuse box. Connections to the vehicle wiring can be made using one of two methods: either by using piggyback spade connectors, or by using "Scotchlock" splice connectors.

If the headlight and ignition points are picked up from the fuse box, then spade connectors may be suitable. If, for some reason, the fuse box is inaccessible (eg, it's in the engine compartment), then the Scothlock splices will be required. You can use your multimeter to track down the appropriate wiring points.



Follow this parts layout diagram when wiring up the Headlight Reminder.

The chassis connection can be made to any convenient point under the dash, but make sure that the point is actually at chassis potential and not insulated.

When installation is complete, switch on the headlights and check that the chimes sound. The chimes should stop after five seconds or if the ignition switch is turned on.

PARTS LIST

1 PC board, code 86hr5, 59 x 107mm
1 55mm 8Ω loudspeaker
1 3-way PCB terminal block
3 lengths of automotive hookup wire

Semiconductors
1 LM324 quad op amp
2 BC327 PNP transistors
1 BC337 NPN transistor
4 1N4148, 1N914 diodes
1 9V 400mW zener diode

Capacitors
1 100μF 16VW PC electrolytic
1 47μF 16VW PC electrolytic
1 33μF 16VW PC electrolytic
2 10μF 16VW electrolytic
2 .0056μF metallised polyester
1 .0015μF metallised polyester

Resistors (¼W, 5%)
3 x 1MΩ, 2 x 470kΩ, 1 x 270kΩ, 1 x 220kΩ, 5 x 100kΩ, 1 x 22kΩ, 1 x 12kΩ, 3 x 10kΩ, 1 x 4.7kΩ, 1 x 2.2kΩ, 3 x 1kΩ, 1 x 220Ω, 1 x 200Ω miniature horizontal trimpot.

• PHONE YOUR ORDER — ALTRONICS TOLL FREE 008 999 007 •

ALTRONICS PRESENTS

For full details see Electronics Australia Magazine May, June, July '86

Distortion at normal listening levels is typically .005%

In many respects the performance of this fine design cannot be exceeded by commercial Amplifiers costing $1000 and more.
My personal congratulations to John Clarke and the design team at Electronics Australia
Jack O'Donnell
Altronics

THE PLAYMASTER 'SIXTY — SIXTY' INTEGRATED AMPLIFIER KIT

Never before has such a high performance Amplifier been so affordable or so easy to build. It's hard to imagine even the most ardent Audiophile being less than delighted with the audio purity of this fine Amplifier.

K 5060

$249

Plus $8.00 Pack & Post

150 Watts Plus Music Power!!

"For short term power capability (Music power), as measured by the Institute of High Fidelity specification IHF-A-202 the Amplifier can deliver 105 watts into an 8 Ohm load for a single channel, and no less than 153 watts into a 4 ohm load under the same conditions"

Features of the Sixty-Sixty

* 60 watts per channel with both channels driven into 8 Ohm loads * Very low noise on phono and line level inputs—better than CD performance * Very low harmonic and intermodulation distortion * Excellent headroom * Tape monitor loop * Tone controls with centre detent and defeat switch * Mono/stereo switch * Toroidal power transformer * Easy-to-build construction * Very little wiring.

Perfect CD Player Companion

Hum and noise levels for line level I/P is actually better than any currently available CD player at 103db plus. You can't hear a thing with your ear right on the speaker cone and the volume up full!! The volume control is calibrated "CD Clip" at a level corresponding to 2V signal level or full amp output power with CD player input.

PERFORMANCE SPECIFICATION

Power Output - (One Channel) 4 ohms 88W, 8 ohms 74W - **(both channels)** 4 ohms 72W, 8 ohms 62W
Harmonic Distortion - Less than .01% for all powers up to 60W into 8 ohm loads — Less than .015% for all powers up to 70W into 4 ohm loads.
Intermodulation Distortion — Less than .01% for all powers up to 60W into 8 ohm loads — Less than .012% for all powers up to 80W into 4 ohm loads.
Frequency Response — *Phono Inputs* - RIAA/IEC equalisation within + - 0.5db from 40Hz to 20kHz *Line level Inputs* — -0.5db at 20Hz and -1db at 20kHz
Input Sensitivity — * Phono inputs at 1kHz - 4.3mV (overload capacity at 1kHz - 140mV), * Line level inputs — 270mV
Hum & Noise — * Phono (with respect to 10mV at 1kHz) - 89db unweighted, with typical moving magnet cartridge. * High level inputs (with respect to 270mV) - 103db unweighted with 20Hz to 20kHz bandwidth.
Tone Control — Bass — +-12db at 50Hz
Treble - +-12db at 10kHz
Damping factor - At 1kHz and 30Hz - greater than 80
Stability — Unconditional

It Looks So Good Your Friends Won't Believe You Built It!

"This New Amplifier offers a standard of performance far ahead of anything we have previously published and ahead of most commercial integrated Stereo Amplifiers".
"It is half to one third of the cost of an imported Amplifier with equivalent power output and performance".
Says Leo Simpson
Managing Editor
Electronics Australia
Magazine

Our Very Finest Kit to Date

The Altronics Kit K 5060 is our very finest Kit product produced to date. The chassis, PCB and front panel are all pre-drilled and punched, everything fits beautifully. The end product is protective packaged in foam styrene - we guarantee it will arrive in perfect shape even if it does get accidently "dropped" along the way.

Money Back Guarantee

Should you buy the kit and before commencing construction, you feel that the task is beyond you simply return to us in **as sold condition** with all packaging and instructions and we will refund your purchase price less transport charges.

Beginner Constructors can Build this Amplifier

If you can use simple hand tools and a soldering iron you can build this project. The designers at EA believe (as we do) that many 1000's of audio enthusiasts, with little or no electronic constructor experience would want to build this amp — so its designed on one large printed circuit board. Virtually everything is board mounted i.e. even input sockets and switches!! There is no shielded wire, in fact there is only a handfull of soldered connections external to the PCB. So by simply following the step by step instructions and inserting components with the pre-drilled PCB and soldering thereafter the amp is thus constructed. **YOU WILL BE PROUD OF THE END RESULT—AND IT WILL LAST YOU A LIFETIME.**

BANKCARD HOLDERS — PHONE ALTRONIOS TOLL FREE 008 999 007 FOR NEXT DAY JETSERVICE DELIVERY

BANCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008 999 007 FOR NEXT DAY JETSERVICE DELIVERY

• FOR DESPATCH P&P CHARGES AND ADDRESS DETAILS PLEASE REFER TO OUR AD. ON PAGE 109 •

More Exciting Kits to Build

Beat Triggered Strobe

Add Some Life To Your Next Party

Designed by Australian Electronics Monthly. Flashes in time to your music. Will also work as normal strobe. Exclusively customised by Altronics into our H 0480 Instrument Case, making construction a breeze and improving stability and overall appearance. Includes silk screened panel.

K 5790 .... **$59.95**

Two Tube Option For Increased Power

K 5795 .... **$9.95**

EA Drill Speed Controller MK 11

For Universal Brush Type Motor Drawing up to 3 Amps

Varies motor speed from a few RPM to full speed while maintaining good torque. Suitable for—Drills and Drill Presses—Circular Saws—Jig Saws —Food Mixers—Movie Projectors.

Altronics Kit comes complete with Mains Flex Lead and Plug and Quality "ABS" Jiffy Box.

• Pre-punched and screened steel front panel • Flush mount mains socket. **K 6005**

$15

Zener Tester

Used with your multi-meter - Reads exact zener voltage up to 60V. **K 2620**

$9.95

Invaluable for Students

Overload Protected Bench Top Power Supply Kit 0—30 Volt 1 Amp

This Great Little power supply is a must for every Electronic Enthusiast and Electronic Student. Use it to power and test circuits and 1000 other uses. Very easy to build - even the beginner constructor should have no trouble - Just follow the plain step by step instructions.

FEATURES:

• Output variable between 3 and 30 volts • Short circuit Protection • Full 1 Amp output over entire voltage range • Load switching • Current limiting fully variable-twin selectable ranges • Dual Dcale Meter
• Separate earth terminal provided
• Housed in Deluxe "ABS" instrument case.

SPECIFICATIONS:

• Output Voltage -3 to 30 volts
• Output Current - 0 to 1 Amp (fully variable) • Load Regulation - Better than 0.29% from 0 to full load
• Output Ripple - Less than 2mV RMS
Cat.3210

Fantastic Value **$69.50**

Checks audio & RF circuits

Signal Tracer for Trouble—Shooting

(See EA Aug.'85)

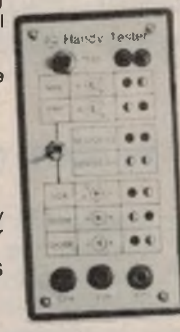
This simple signal tracer makes a valuable servicing aid and can be used to trouble-shoot both RF and audio circuits. It features an RF probe, battery operation and an in-built loudspeaker

K 2560

$19.50

Transistor Tester

For In Circuit Testing



$15.00

"NO NEED TO UNSOLDER SUSPECT TRANSISTORS"

Have you ever de-soldered a suspect transistor only to find that it checks OK? Trouble shooting excercises are are often hindered by this type of false alarm. Now this can be avoided with our handy little tester.

FEATURES:

• Tests both NPN and PNP transistors in circuit at the touch of a switch • Tests Diodes and SCRS as well • No need to switch between NPN and PNP—its automatic.
Two LED indicators are used to show condition of device being tested.

Altronics Kit Feature - "ABS" jiffy box and test leads supplied.
Cat.K 2530

Low-Cost Unit Checks Values from 1pF to 100uF

Upgraded Digital Capacitance Meter

Digital Capacitance Meter Checks capacitor value from 1pF to 99.99uf over three ranges. Features include a nulling circuit and bright 4-digit LED display. (See EA Aug. '85)

$69

The readout consists of a bright 4-digit LED display and the full scale readings for each range are 9999pF, 99.99uF. No adjustments are necessary when taking a reading. You simply connect the capacitor to the test terminals and select the appropriate range. The circuit can accurately measure capacitance down to one picofarad (1pF). This is made possible by the internal nulling circuit which cancels any stray capacitance between the test terminals or test leads. So when you measure a 5pF capacitor, the unit will display 5pF. **K 2522**

Transistor and Fet Tester

Electronics Australia Project, tests Bipolar Transistors, Diodes, Fets, SCR's and PUT's. Excellent service aid for the hobbyist and serviceman complete kit and instructions. **K 2525**

$19.75

Ideal For Radio Amateurs Will Power Your Mobile Rig Back At Home

13.8V High Current Supply

Massive 10 Amps

$119.95

• Output 13.8V DC.7.5A Continuous — 10A Intermittent • Regulation: — 0-7.5A -50mV — Now includes — Custom Designed Printed Circuit Board as opposed to Vero Board in original article. • Supplied in a quality instrument case. • Silk screened front pannel — for that professional look. • LED overload indicator. **Cat.K 3250 (ETI July'83)**

Cheap Insurance for That $1000 Speaker System

Speaker Protector Kit

Value **$22.50**

Protect your valuable loudspeaker system with this easy to build kit. Based on the ETI design (Oct.'82) provides both DC and overpower protection for your valuable Hi-Fi speakers. Self-powered unit disconnects the speakers within 1/10th of a second of a fault occuring yet in no way effects the sound quality.

Install it in minutes — No AC or DC connections required — Simply connects into the left and right channel speaker lines. **K 5051**

AM Stereo Decoder

Almost all AM Stations now transmit in Stereo so why should you miss out on that extra sound realism.

• Uses Genuine Motorola CQUAM Decoder Chip.
• Can be built into present HiFi Tuner.

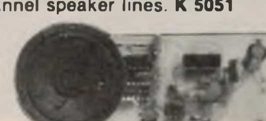
Please Note: Circuit diagram of your tuner and possibly a CRO will be required to install this Kit.

K 5630 .... **$19.50**

COMPUMUSE

Obtain Fantastic Music and Sound Effects From Your Computer

A computer music synthesizer that is **easy to build** and **easy to use**, connects to any computer with a Centronics-style parallel port and provides music over five octaves and a wide variety of sound effects.



Now Only $20

Was $26.50

Here are the construction details for the

Playmaster 60/60 stereo amplifier

Pt.3

This is the easiest to build Playmaster amplifier ever. Virtually all the parts, including the pots, mount on a single large printed circuit board (PCB) and there is very little wiring. Here we present the full construction details.

by JOHN CLARKE & GREG SWAIN

Our prototype amplifier was built into a standard rack mounting case measuring 430 x 82 x 254mm with a front panel measuring 88 x 482mm. Most kit suppliers, however, will be supplying special folded metalwork for the chassis. This will have the same dimensions as the rack mounting case but will make assembly simpler.

The printed circuit board (PCB) measures 420 x 249mm and is coded 86sa5. In the left hand corner is a cutout measuring 111 x 111mm which provides clearance for the toroidal transformer.

The chassis layout of the amplifier can be seen in the photographs. The PCB occupies most of the chassis and is supported at the rear by the PCB-mounted RCA sockets and at the front by the PCB-mounted potentiometers.

Running across the full width of the PCB is a large U-shaped heatsink. This provides heat dissipation for the output transistors and is secured to the PCB with the power transistor mounting bolts. Additional support for the PCB is provided by securing the whole assembly to 25mm standoffs installed on the chassis at either end of the heatsink.

The only components not on the PCB are the power transformer, indicator LED, loudspeaker binding posts, and the power and selector switches. In fact, we have gone to considerable lengths with this design to keep wiring to an absolute minimum.

This has been done to relieve this tedious aspect of construction and to eliminate wiring errors.

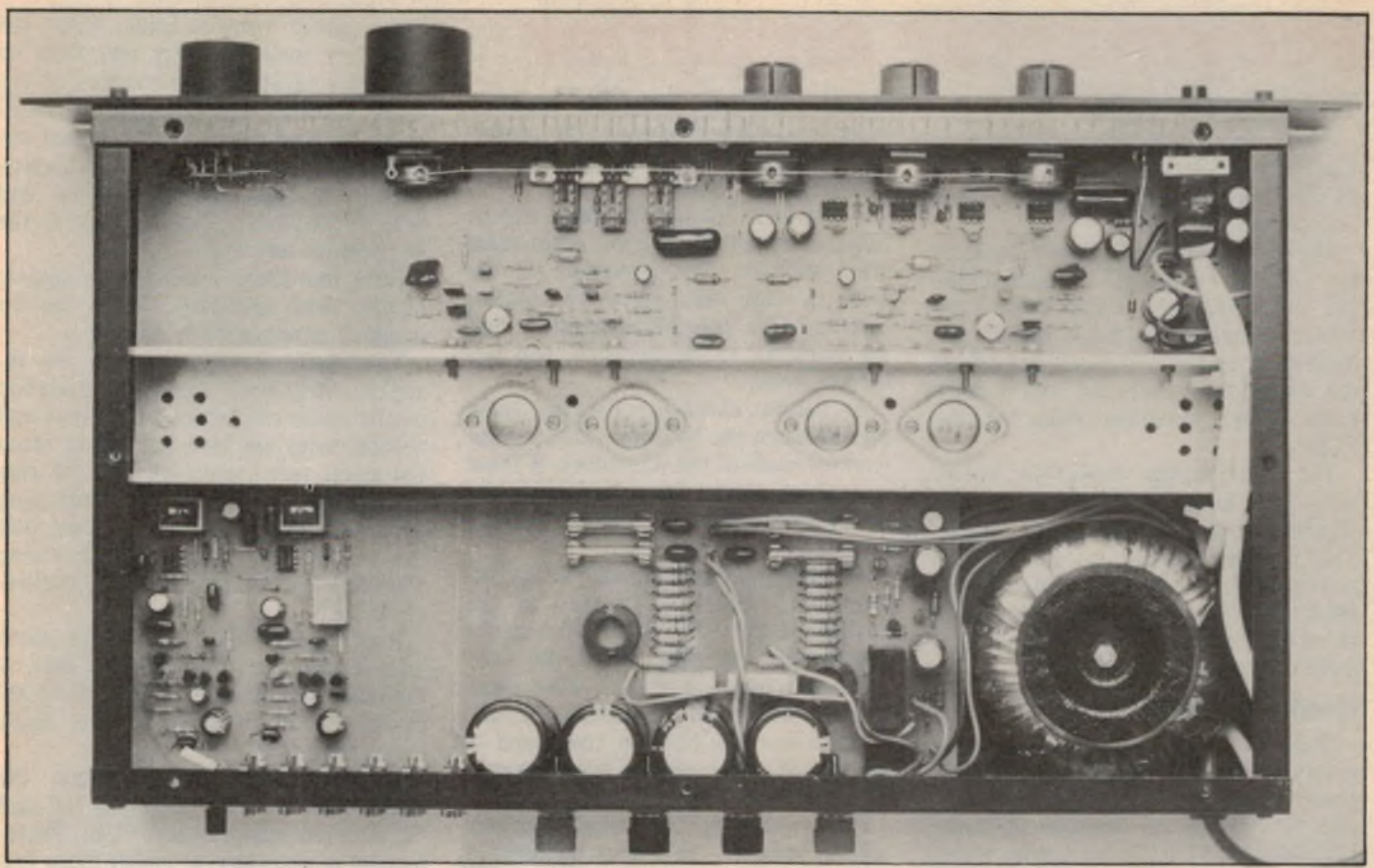
Complete kits will be available from several retailers and will include screen printed front and rear panels, prepunched metalwork, a drilled heatsink and all the necessary parts.

Of course, constructors can make their own metalwork or use an off-the-shelf rack mounting case, and purchase the remaining parts from various sources. Be warned, however, that certain individual parts may be difficult to purchase separately, so check carefully before adopting this approach.

Consider this also: if you have to buy all the parts separately (not having any in your junkbox), the cost is likely to far exceed the price of a complete kit.

PCB assembly

Before installing any parts on the PCB, check the copper pattern carefully for possible defects. A thorough check at this stage could prevent a lot of problems later on. Note that there are quite a few earthed guard tracks on the PCB which are only terminated at one end — don't join these to adjacent pads or tracks by mistake.



The new Playmaster 60/60 is easy to build yet offers superb performance. Take care with mains wiring.

The low profile components should be installed first. These include the wire links, diodes and resistors. Follow the parts layout diagram carefully and make sure you orient the diodes correctly.

Use insulated single-strand wire for the long wire links adjacent to the heatsink. Alternatively, you can use tinned copper wire fitted with insulating sleeving for this job. This is to prevent possible shorts between the links and to the heatsink.

Most of the resistors are 0.25W types but be sure to use higher wattage types where specified. These are clearly indicated on the parts layout diagram.

The 1Ω 1W resistors in the amplifier output stages are best installed by first mounting every alternate resistor. The remaining resistors can then be installed by pushing them down onto the board as far as they will go, between the resistors already in place.

PC stakes are used at all external wiring points on the PCB and these can be installed next. There are 26 PC stakes in all and these terminate connections from the source switch, indicator LED, loudspeaker terminals, power supply, and between the power amplifier outputs and the relay contacts.

The ICs and most of the transistors can now be installed but do not mount the power transistors or Q12, Q13 and Q14 at this stage. Check the transistor pinouts against the circuit diagram published last month and make sure that you install the correct type at each location.

Push each transistor down onto the board as far as it will comfortably go before soldering. Note carefully the orientation of the ICs when they are being installed. The bridge rectifier (PO-4) can also be installed at this stage.

Capacitors

The next step is to install the capacitors. This job is straightforward but note that the electrolytics must be oriented correctly and must have the correct voltage rating for each position. Check the parts layout diagram against the circuit diagram if in doubt.

The bipolar electrolytics can be installed either way round.

The main filter capacitors used in the prototype were Elna 2500μF 63V types. However, provision has also been made on the board to accommodate the physically smaller Philips 2200μF 63V capacitors and these may be substituted for a slight loss of output power (about 2W in each channel). Apart from this power loss, no other performance specification will be affected.

Note that 2% capacitors have been specified in the RIAA feedback networks in the phono preamplifiers. Now 2% capacitors are quite expensive and difficult to obtain. For this reason, parts suppliers will be selecting 2% capacitors from standard stock.

These selected capacitors will be marked with a small blob of paint and packaged separately.

The RCA socket panel, fuse clips, relay, headphone socket, trimpots and potentiometers can now be installed. Push the headphone socket and pots down onto the board as far as they will go, so that they will later line up correctly with the front panel.

In some kits, the Tone Defeat, Mono and Tape Monitor pushbutton switches will be supplied in a bank, supported by a metal channel. This metal channel should be bolted to the holes provided in the PCB. If, on the other hand, the switches are not in a bank, they are simply installed separately.

To the uninitiated, the RCA socket panel can be an awkward beast to install. The trick is to install the leads at one end first then, using pliers, progressively locate each of the remaining leads. A short length of tinned copper wire will be required to connect the earth terminal to the PCB.

Playmaster amplifier

Winding the coils

There are only four simple coils to wind: the two ferrite beads at the inputs of the phono preamplifier, and the two output chokes.

The ferrite beads are wound by feeding 5.5 turns of 28 B&S enamelled copper wire through the centre of the bead. When complete, the leads should exit from each end of the bead. Scrape off the insulation at each end with a sharp knife before mounting them on the PCB.

The 6.8μH output chokes are wound with 24.5 turns of 0.8mm enamelled copper wire on an 11mm plastic former. This involves winding on three layers such that the leads exit from opposite sides of the former at the bottom edge. Bend the leads at 90° so that the chokes mate with the holes on the PCB.

Heatsink transistors

Now for the heatsink-mounted transistors. The MJ15003 and MJ15004 power transistors (Q15, Q16) mount inside the "U" of the heatsink while the MJE340 and MJE350 transistors (Q13, Q14), together with the +15V 3-terminal regulator, are bolted to the side of the heatsink.

In addition, the two BC547 quiescent current setting transistors (Q12) are clamped to the side of the heatsink using solder lugs.

First, check that all the holes in the heatsink are free of burrs and metal swarf. This done, mount the heatsink on the top of the PCB and secure it at each end with a bolt and 25mm tapped standoff. Note that the heatsink must be oriented so that the transistor mounting holes align with the holes in the PCB.

The four output transistors (Q15, Q16) can now be installed. These must all be isolated from the heatsink using mica washers and insulating bushes, as depicted in Fig.1. Smear all mating surfaces with heatsink compound before assembly and solder the mounting nuts to the PCB pads after assembly to ensure reliable long term contact.

Note that while the mounting screws must be isolated from the heatsink, they must also connect the transistor cases to the PCB tracks. In some kits, the insulating bushes will be supplied with integral washers. If this is the case, remove the plastic washers from eight of the insulating bushes using a sharp knife (do not touch the remaining ninth bush).

As each transistor is mounted, use your multimeter to check that its case is indeed insulated from the heatsink. When everything is correct, the transistor leads can be soldered to their respective copper pads.

Transistors Q13 and Q14 must also be isolated from the heatsink, again using mica washers. The procedure is the same in each case: smear the mating surfaces with heatsink compound, bolt the transistor to the heatsink, and solder the leads.

As before, check for electrical isolation between the heatsink and collector (centre) leads of the transistors. If there is a short, check the mica washer for punch-through by a piece of metal swarf.

As previously stated, the two BC547 transistors (Q12) are clamped to the heatsink using earth lugs. The colour photographs on page 29 of the May issue and page 35 of the June issue clearly show the mounting details. Apply a smear of heatsink compound to the face of each transistor before installing it on the board.

Finally, the 7815 3-terminal regulator can be installed. This must be isolated from the heasink using a mica washer and an insulating bush with integral washer. The washer goes under the screw head so that no part of the screw can contact the metal tab of the regulator. Don't forget to smear the mating surfaces with heatsink compound.

That completes the PCB assembly. Before moving on to the next stage, it is a good idea to check your work against the parts layout diagram. In particular, check that all resistor and capacitor values are correct and that all diodes, transistors, ICs and electrolytics are correctly oriented.

Wiring

Attention can now be turned to the chassis. Begin by installing the loudspeaker binding posts on the rear panel. Incidentally, these binding posts should be of a reasonable size to accommodate heavy gauge speaker leads. Once the posts are installed, they can then be wired for subsequent connection to the PCB. Connect 12cm lengths of 24/.20 green hookup wire to the negative terminals, 15cm of 24/.20 brown hookup wire to the right positive terminal, and 8cm of 24/.20 blue hookup wire to the left positive terminal.

Note that these leads are all slightly longer than necessary. They can be trimmed as appropriate later on.

The mains wiring can now be installed. Strip back the outer insulation on the mains cord so that the active and neutral wires are long enough to reach the mains switch position from the rear panel, then secure the mains cord using a cord clamp grommet. That done, bolt two solder lugs to chassis (see wiring diagram) and connect the green/yellow earth lead.

It is a good idea to make the earth lead longer than necessary so that, if the mains cord is ever pulled out by accident, the active and neutral leads come adrift first.

The two connections between the chassis and the PCB at points 'D' and 'K' are run beneath the PCB. Therefore, it is necessary to install these two earth leads before installing the PCB in the chassis. Connect a 40cm green/yellow earth lead to point 'D' on the PCB and a 20cm earth lead to point 'K'.

The PCB can now be manoeuvred into position and secured by bolting the 25mm standoffs and the RCA socket panel to the chassis. This done, bolt the toroidal transformer to the chassis using the hardware supplied. One large rubber washer is sandwiched between the transformer and the chassis, while the other goes between the top of the transformer and the metal disc.

Follow the wiring diagram closely when soldering the transformer secondary leads to the PCB. The colours indicated on the layout diagram correspond with the transformer lead colours. The PCB earth leads and the leads from the loudspeaker terminals can also be terminated at this stage.

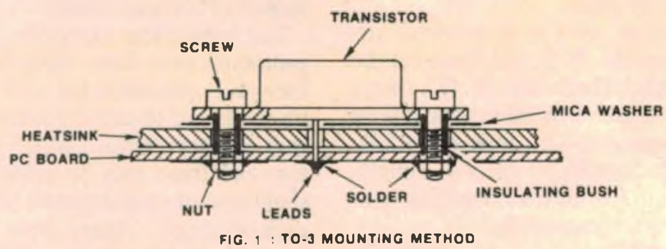
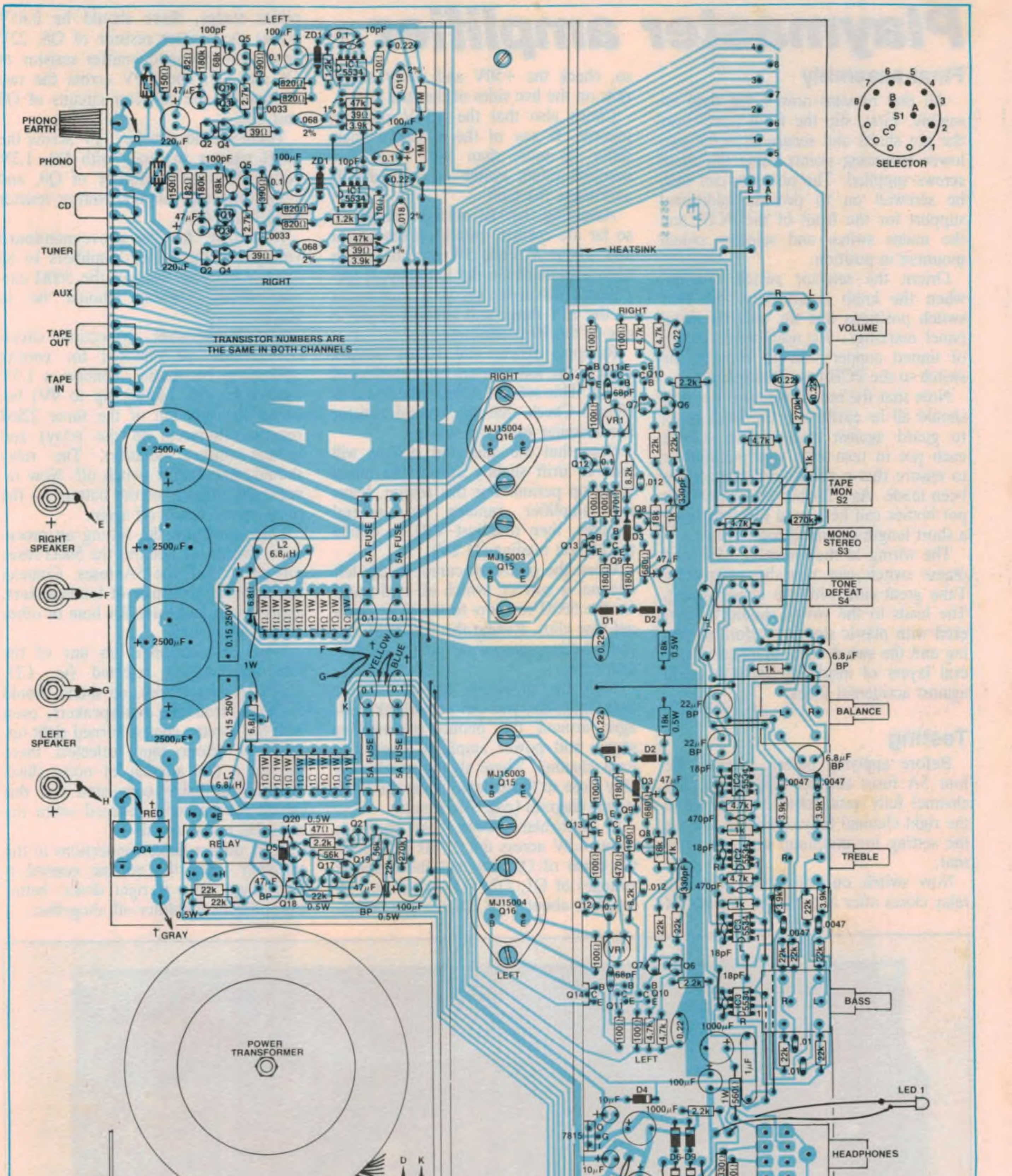


FIG. 1 : TO-3 MOUNTING METHOD

Fig.1: this diagram shows how the Mosfet output transistors are mounted.


LEFT
RIGHT
PHONO EARTH
PHONO
CD
TUNER
AUX
TAPE OUT
TAPE IN
TRANSISTOR NUMBERS ARE THE SAME IN BOTH CHANNELS
SELECTOR
S1
HEATSINK
VOLUME
TAPE MON S2
MONO STEREO S3
TONE DEFEAT S4
BALANCE
TREBLE
BASS
LED 1
HEADPHONES
RIGHT SPEAKER
LEFT SPEAKER
MJ15004 Q16
MJ15003 Q15
5A FUSE
YELLOW
BLUE
RED
GRAY
RELAY
PO4
POWER TRANSFORMER
CORD CLAMP GROMMET
MAINS CORD
EARTH
BLACK
BROWN
GREEN
PINK
ORANGE
POWER S5
COVER MAINS ACTIVE AND NEUTRAL AND TRANSFORMER PRIMARY LEADS WITH SUITABLE SIZE SPAGHETTI
† COLOURS INDICATE TRANSFORMER SECONDARIES

Playmaster amplifier

Final assembly

All that remains now is the final assembly. First, slip the front panel over the pot shafts and secure it to the two lower mounting points using the dress screws supplied. The pot nuts can then be screwed on to provide additional support for the front of the PCB, and the mains switch and selector switch mounted in position.

Orient the selector switch so that, when the knob is attached, the four switch positions line up with the front panel markings. We used short lengths of tinned copper wire to connect the switch to the PCB (see photograph).

Note that the metal bodies of the pots should all be earthed to the front panel to guard against hum pickup. Check each pot in turn with your multimeter to ensure that a good earth contact has been made. As a further precaution, the pot bodies can be joined together using a short length of tinned copper wire.

The wiring to the indicator LED and mains switch can now be completed. Take great care with the mains wiring. The leads to the switch should be covered with plastic sleeving before soldering and the switch then wrapped in several layers of insulation tape to guard against accidental shock.

Testing

Before applying power, remove the four 5A fuses and set VR1 in the left channel fully anticlockwise and VR1 in the right channel fully clockwise. This is the setting for minimum quiescent current.

Now switch on and check that the relay closes after about three seconds. If so, check the +50V and −50V supply rails on the live sides of the fuse clips.

Check also that the +15V rails are present. If any of the supply voltages differ by more than 10% from their nominal value, switch off immediately and locate the fault.

Assuming that all voltages measured so far are correct, switch off the power and solder a 560Ω 5W resistor across each fuse holder in the left channel amplifier. This done, set your multimeter to the 20V range and connect it across one of the 560Ω resistors.

Re-apply power and adjust trimpot VR1 in the left channel for a reading of 11.2V. This sets the quiescent current to 20mA. Check that the second resistor has a similar voltage across it.

Note that the quiescent current will tend to drift slightly during the initial warm-up period. For this reason, leave the amplifier running for several minutes, then re-adjust VR1 to obtain the correct reading (11.2V).

When the quiescent curent in the left channel is correct, switch off and transfer the 560Ω resistors to the right channel fuse clips. Repeat the quiescent current setting procedure for the right channel.

With the quiescent current set for both channels, you can now check voltages around the phono preamplifier stages and power amplifier stages for each channel. These should be reasonably close to those depicted on the main circuit diagram (page 37, June).

In particular, check that there is about 4.8V across the 2.7kΩ resistor in the drain of Q5 and that the collector voltages of Q1, Q2, Q3 and Q4 are all equal at about 4.9V. In the power amplifier stages, there should be 0.65V across the emitter resistor of Q8, 22V across the common emitter resistor of Q6 and Q7, and 1.9V across the two resistors in the collector circuits of Q6 and Q7.

There should also be 1.1V across the 180Ω resistor in series with D3, 1.2V across the emitter resistor of Q9, and 1.3V across the common emitter resistor of Q10 and Q11.

Note that, for the above-mentioned voltages in the power amplifiers to be valid, either the fuses or the 560Ω current-limiting resistors should be in place.

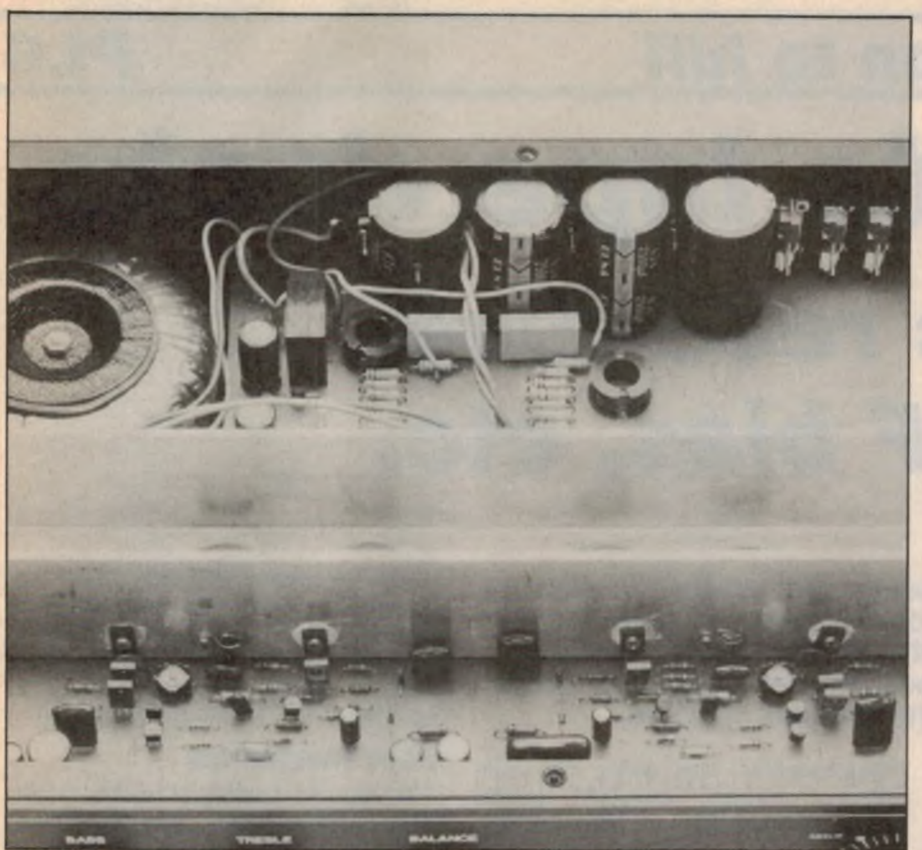
The loudspeaker protection circuit should now be checked for correct operation. To do this, connect a 1.5V battery (or any battery up to 9V) between the junction of the three 22kΩ resistors (adjacent to the relay) and ground (either polarity). The relay should immediately switch off. Now reverse the polarity of the battery — the relay should switch off again.

That completes the setting up procedure. Switch off, remove the 560Ω resistors and install the 5A fuses. Connect the amplifier to a pair of loudspeakers, apply power and listen for hum or other unpleasant sounds.

When the amplifier has any of the line level inputs selected (ie, CD, Tuner, Aux or Tape), no sound should be heard from the loudspeakers, even with the volume control turned right up. With the phono input selected, there will be a fair amount of noise (hiss) with no turntable connected but this should be markedly reduced when the turntable is connected.

Note: do not make connections to the amplifier when the volume control is turned up. Turn it right down; better still, turn the amplifier off altogether.

The rear panel carries the RCA input sockets and the loudspeaker terminals. Make sure that the mains cord is securely clamped.



This close-up view shows how the driver transistors (Q13 and Q14) and the quiescent current setting transistors (Q12) are mounted on the heatsink (see text).

Assuming everything checks out, connect a suitable signal source (CD player, tuner etc) and check all controls for correct operation. The amplifier should deliver clean undistorted power.

Troubleshooting

For those who don't reach the happy state of affairs outlined in the previous paragraph, the following troubleshooting procedure will help track down the cause of your woes. We'll assume that all component values are correct and that all parts have been correctly installed.

Let's start with the preamplifier stage. Ths first thing to do is to check the ±15V supply rails. If the +15V rail is incorrect, check the 7815 regulator. Similarly, if the −15V rail is incorrect, check the 7915 regulator. Note that the pinouts for the two regulators are different. They are both installed with their metal tabs facing towards the heatsink.

Next, check the voltage across the two zener diodes (ZD1) in the phono preamplifier. You should get a reading of 5.6V. If the voltage is incorrect, the zener may be faulty.

If there is a fault in the phono preamplifier, check the voltages marked on the circuit diagram. If you can't get −5.5V on the drain of Q5, then Q5 is suspect. If the voltages on the collectors of Q1, Q3 and Q2, Q4 are incorrect, then IC1 or one of the transistors could be faulty.

Perhaps the most likely source of trouble in the preamplifier stages are the NE5534 ICs. Our experience with these devices indicates that they can be rather fragile. They may not fail completely but may exhibit symptoms of distortion, poor gain, and high noise.

If noise and distortion is evident on all inputs but disappears when the tone defeat switch is pressed, then IC3 is suspect. If the problem persists regardless of the position of the tone defeat switch, IC2 is suspect. If the problem is only present when phono is selected, IC1 is suspect.

The loudspeaker protection circuit is quite easy to troubleshoot. This circuit uses several different types of transistors so check first that the correct transistor has been installed at each location.

If the relay fails to operate at switch on, short the collector and emitter of Q20. If the relay still refuses to operate, Q21 is suspect. If, on the other hand, the relay now operates, the fault lies in either Q17, Q18, Q19 or Q20. You can check Q20 by temporarily removing Q18 and Q19.

If the relay fails to operate when the positive terminal of the 1.5-9V battery is connected to the junction of the three 22kΩ resistors, Q19 is suspect. If the relay fails to operate when the negative terminal is connected to the same point, Q17 and Q18 are suspect.

Troubleshooting in the power amplifier stages should be carried out with the 560Ω resistors wired across the fuse-holders in place of the 5A fuses. Begin by checking the ±50V supply rails. Note that these rails can vary by about ±5%, depending on the mains.

If the supply voltages are incorrect, check the transformer connections, the PO-4 bridge rectifier and the 2500μF filter capacitors.

The remaining voltages should all be fairly close to those marked on the circuit (within ±10%). Note that all transistors in the power amplifier stages should have a base-emitter voltage of 0.6-0.8V. If not, then the transistor is suspect or there is a fault in the preceding stage.

There should be about 22V across the 22kΩ resistor in the collector circuit of Q8. If this voltage is much higher, Q8 may be short circuit. If the voltages across the 4.7kΩ resistors are much higher than 1.9V, check Q6 and Q7.

Similarly, if the voltage across the 100Ω resistor is much higher than 1.3V, check Q10 and Q11. And if the voltage across the 180Ω resistor in the emitter circuit of Q9 is higher than 1.2V, check Q9.

Check the offset voltage at the amplifier output — ie, across the loudspeaker terminals. If there is a large positive offset voltage, Q9 or Q10 may be short circuit. If there is a large negative offset voltage, Q11 is suspect.

Q12 sets the quiescent current. If there is little or no quiescent current (ie, no voltage across the 560Ω resistor), then Q12 is suspect. Q12 is also suspect if the quiescent current cannot be varied by VR1 (ie, the voltage remains constant).

Note that an open circuit driver or output transistor (Q13-Q16) will also result in zero quiescent current.

Finally, if the voltage across the 560Ω resistor is almost at full supply (ie 50V), check the corresponding output transistor and its driver stage (Q13-Q16). One of these transistors may be short circuit between collector and emitter, or may be shorted to the heatsink. The 560Ω resistor will become quite warm under these conditions.

That's it. You'll find that this is a superb amplifier.

An introduction to hifi Pt.6

Cassette tape decks

Magnetic recording, heads, HF bias, etc.

by NEVILLE WILLIAMS

For ultimate sound quality, cassette tape decks fall short of the standard set by compact disc players but they tend to make up for it in all-round utility. In this chapter, we take a preliminary look at magnetic recording and playback, before turning attention specifically to the compact cassette.

As with conventional "black" discs, magnetic recording and playback has its own colourful history, dating back over 100-odd years.

As long ago as September 1888, the magazine "Electrical World" published an article by Oberlin Smith, entitled "Some Possible Form of Phonograph". In it, he suggested coating cotton thread with steel dust, so that it could be used for magnetically recording sound.

Whether Smith ever pursued the idea is not known but, in December, 1898 Vlademar Poulsen quite independently filed a landmark patent in Denmark under the heading: "A device for effecting the storing up of speech or signals by magnetically influencing magnetizable modies".

In Poulsen's "device", referred to as the "Telegraphone", the signal was magnetically impressed upon, and recovered from, 0.5mm steel wire. It was envisaged primarily as an adjunct to the telephone, as a way of recording messages, but its development was hampered by a lack of convenient means to amplify the signals.

Wire recorders did ultimately find considerable use in the field during World War II but, even then, they proved to be rather trouble prone, due to the tendency of the fine steel wire to rust, tangle or break.

In Germany, meanwhile, a number of major companies, including AEG, I. G. Farben and BASF, had developed magnetically coated plastic tape, along with prototype but distinctly practical "Magnetophon" tape decks. The technology, however, remained largely unique to Germany until after the war, when it was taken up and developed on a worldwide basis.

Tape recording equipment soon became routine in broadcasting and recording studios and, at a non-professional level, found its way also into many homes during the '50s, mainly by reason of its novelty and potential utility.

However, as we shall see later, a proliferation of formats and speeds tended to confuse domestic buyers and to convince them that they would be better advised to spend their money on the then new LP discs. Tape recorders were in danger of missing out on the mass market — but more of that later.

Deck mechanics

It may be helpful to pause at this stage and take a look at the mechanical configuration of a typical tape deck, as illustrated in Fig.1. While it depicts a conventional "open reel" layout, it will nevertheless serve to illustrate the fundamental principles involved, largely irrespective of format.

During normal recording and playback, the tape is drawn from the supply spool (or reel) passing, thereafter, around a guide post (or roller) and across the face of at least two magnetic

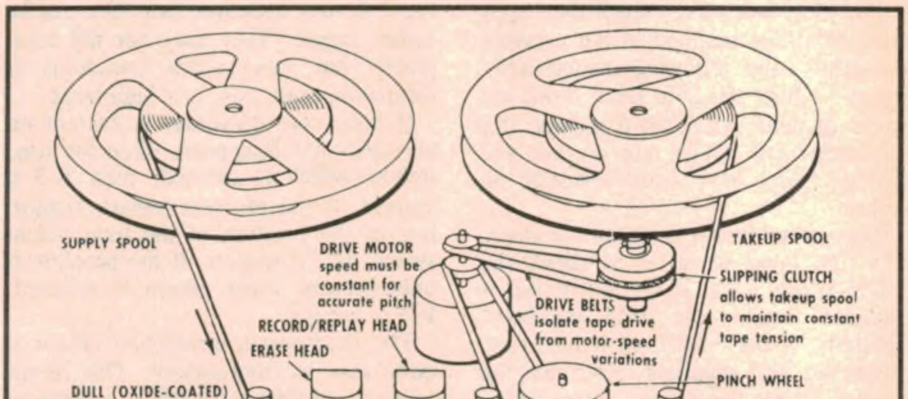
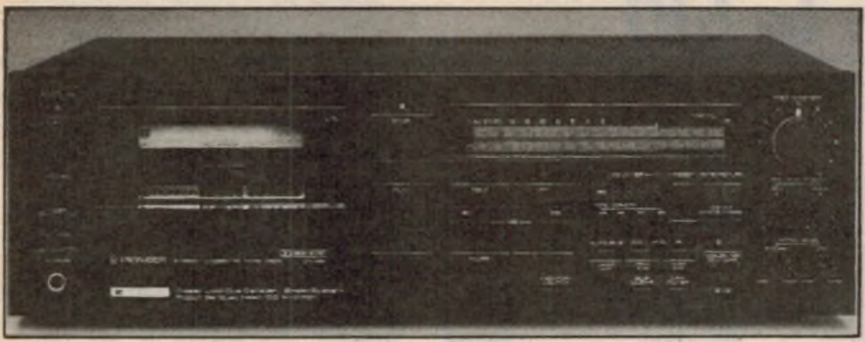


Fig.1: The basic mechanism of an open-reel domestic tape deck. A compact cassette deck is similar in principle, except that the tape is totally enclosed and the rest of the mechanism is scaled down to size.



Manufactured by Pioneer Electronic Corporation, the model CT-A9X (BK) cassette deck is typical of modern upmarket machines. Among its many features are three heads, a quartz PLL-controlled direct-drive capstan motor, Dolby B & C noise reduction, and automatic bias adjustment.

heads (Erase and Record/Play). Depending on deck geometry, the tape may be held in contact with the heads by natural tension and/or by felt-surfaced pressure pads, as shown.

On leaving the head assembly, the tape is gripped between a free-running resilient "pinch" wheel and an accurately ground capstan, the latter sharing a common drive shaft with a flywheel and pulley, belt-driven by a constant speed motor. To the right of the capstan, the tape passes around a further guide post (or roller) to the take-up spool, also belt driven by the capstan motor.

For the tape to run smoothly, the supply spool must maintain an even back tension, calling for some kind of friction brake. Equally, the takeup spool needs to be driven by a very smooth slipping clutch, to maintain an even but adequate takeup tension.

Should the supply or takeup tension vary erratically, it can affect the speed of the tape past the heads and cause "wow" — a relatively slow variation in the pitch of the recorded sound, as mentioned previously in the context of disc players.

Equally, eccentricity or unbalance in the capstan can produce a rapid variation in tape speed (therefore in pitch), described as "flutter" — an effect to which tape is prone, because of its low inherent mass (therefore inertia). As normally measured and specified, wow and flutter should not exceed 0.1% RMS for good quality reproduction.

Spooling provisions

While Fig.1 depicts the tape traverse configuration for normal record or replay functions, it does not show any provision for spooling the tape at high speed in either direction — in short, for "fast forward" and "rewind".

In many decks, the facility is provided by means of additional belts, pulleys and idler wheels, actuated directly by panel tabs and levers, which serve to retract the pressure pads and to spool the tape rapidly from one reel to the other.

More pretentious decks use "feather touch" panel buttons in conjunction with electronic "logic" circuitry and solenoids to operate the mechanism. Either way, it needs to keep the tape under sufficient tension to ensure even winding and prevent spillage.

A still further approach is to use one or more motors, separate from the capstan drive, to drive the spools. With two such motors, either one can operate at normal power for fast forward or rewind, while its opposite number can have just enough voltage applied to apply torque in the opposite direction, thus maintaining tension on the tape.

While up-market decks commonly feature "feather touch" logic control and multiple motors, it does not follow that less pretentious models need be open to question. The "bottom line" is whether they operate smoothly and reliably, providing a good, clean signal, free from perceptible wow and flutter.

Speeds and formats

In the immediate post-war period, it was common practice to use the full width of 0.25in (6.3mm) tape for a single mono track in the interests of good signal/noise ratio, and to run the tape at 15 inches per second (38cm/sec) or higher for adequate frequency response.

As tape technology improved, decks were released which had two and, later, four tracks side-by-side on the tape — used in some models for mono, in others for stereo.

At the same time, tape speeds were progressively reduced to 19, then 9.5 and 4.8cm/sec.

As if that wasn't enough, some decks required that the tapes be spooled with the magnetic layer facing out rather than in (as in Fig.1).

While professionals and devotees were able to cope with all this, it is of little wonder that the proliferation of speeds and formats, and the "fiddling" nature of open-reel decks prejudiced their appeal to other potential buyers.

Appreciating the problem, various companies came up with prototype tape cassettes and cartridge formats but none of their efforts achieved sufficient acceptance.

Ironically, it was Philips that finally hit the jackpot with an "unofficial" concept, developed by an engineering group in Eindhoven that was supposed to have been concentrating on a quite different project — a tape dictation machine.

No less ironically, when Philips showed it to the Japanese, Sony in particular induced them to licence its manufacture, gratis, in return for the support necessary to have it adopted as a world standard! (See EA for March '84.)

The compact cassette

And so the compact cassette format came into being in the early '60s, as an inexpensive, easy-to-use, general-purpose audio recorder, excellent for speech and with a performance on music promising enough to qualify as medium-fi.

Initially, hifi devotees scorned it because of its narrow tracks (four tracks on 3.8mm wide tape) and its low speed (4.8cm/sec), seemingly condemning it permanently to a poor signal/noise ratio and a limited frequency response.

What few foresaw was the acceptance which the format would win, the rivalry that would develop between manufacturers and the intensive research and development that would ultimately boost it from a medium-fi role to a place in domestic hifi installations, worldwide.

As will be apparent from Figs.2&3, the compact cassette format is broadly similar to the open reel approach, as already described, except that the supply and takeup spools are smaller and, along with the tape, tape guides and pressure pad, are totally enclosed in a cassette housing.

The tape itself never needs to be touched and the cassette can be slipped into or out of the deck at any time without threading or rewinding — an obvious boon to non-technical or handicapped users.

An introduction to hifi

When pushed into place, the spool hubs engage matching supply and takeup spindles. At the same time, a hole in the cassette admits a capstan spindle to a position just behind the tape, which is accessable, coated side out, through slots in the front of the housing.

When the "Play" button is activated, the heads move forward against the coated surface while, at the same time, the pinch wheel presses the tape against the drive capstan. For fast forward and rewind, they are disengaged, allowing the tape to be spooled at high speed, as described for Fig.1.

An important feature of the compact cassette system is its mono/stereo compatibility. The heads are so positioned that, in mono mode, the R/P head imposes a track 1.5mm wide along one edge of the 3.8mm tape. In stereo mode, a dual head assembly with its gaps aligned, one above the other, impose two tracks in the same area, each 0.6mm wide and 0.3mm apart.

If a stereo recording is played in a mono deck, the mono head scans both tracks and produces a sum (L+R) signal. Conversely, a mono recording played in a stereo deck produces identical signals in the respective channels.

Flipping a cassette over in a deck, exposes the alternative edge of the tape to the head gaps for recording and/or playback. The tracks can be protected against accidental erasure by breaking out small tabs at the rear of the cassette. (Fig.3)

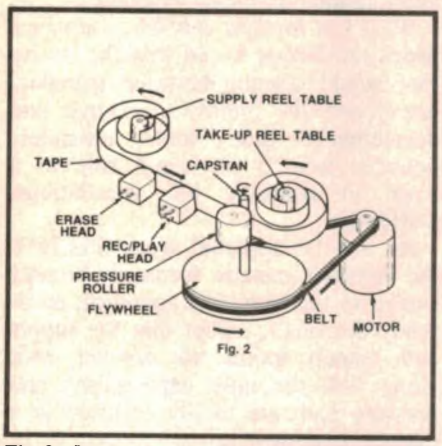


Fig.2: In a cassette deck the heads are in front of the tape and cassettes are accordingly spooled with the magnetic coating facing outwards. DD (direct drive) capstan motors are now commonly used rather than belt drive, as shown. (Technics diagram.)

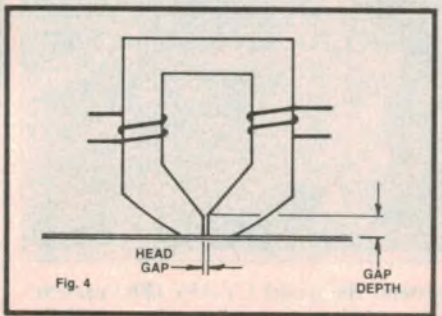


Fig.4: The head gap is discussed in the text. A deep gap takes longer to wear down but can adversely affect head performance.

Magnetic heads

Conceptually, as in Fig.4, the magnetic heads used in a tape deck are disarmingly simple, involving suitably shaped pole pieces, and windings by which electrical signals can be fed into or recovered from the magnetic system. An active gap is provided at the front, over which the magnetically coated tape passes, while one or two passive gaps serve to stabilise the permeability.

In the early days of magnetic recording, with 6mm wide mono tracks and high tape traverse speeds, the heads could be relatively primitive in their construction, to the extent that enthusiasts often used to contrive their own from a discarded transformer lamination and a few metres of fine wire!

But those days are no more. With track widths down by 10:1 or so and speeds by at least 4:1, modern heads require extreme precision in their manufacture, because of their diminutive size and the need to ensure the most efficient possible signal transfer from head to tape and vice versa.

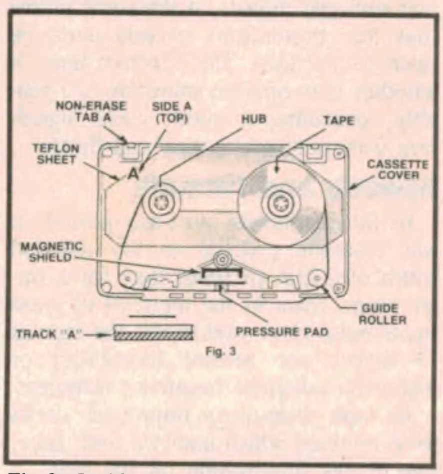


Fig.3: Inside a compact cassette. Looking down on side "A", the appropriate break-out tab and the position of the A-track(s) is shown. Flip the cassette over and the "B" side, tab and track(s) occupy the same relative positions.

Record and/or Play heads for stereo compact cassette decks pose a special problem because they have to be stacked one above the other, with their gaps aligned vertically and only 0.3mm apart.

Fig.5 gives a general idea of how a modern stereo head might be assembled. The coils for the respective channels are mounted as close together as possible but the relative position of the active gaps depend on the use of specially shaped front cores.

A variety of materials have been developed over the years for cores and pole tips, with a view to combining acceptable wear resistance with good magnetic characteristics. By way of example:

PERMALLOY, an iron alloy containing nickel and molybdenum, was very popular in the early stages, and is still used in some professional decks because of its outstanding magnetic characteristics. It suffers the disadvantages, however, of inferior wear resistance, even in "high hardness" form.

FERRITE (HPF, GX) consists of powdered metal oxides (MnO, ZnO, NiO and Fe_2O_3). It has a glass-like surface finish with outstanding wear resistance and lends itself to very precise assembly. Its magnetic performance in actual use is claimed to be excellent.

SENDUST (SX), an alloy containing iron, silicon and aluminium, is also very hard, although with somewhat lower wear resistance than ferrite. It is created by many manufacturers with superior magnetic properties, including low distortion, and is often preferred on that account for record and/or play heads.

Head functions

Most compact cassette decks use two heads only, as in Fig.2: an erase head and an R/P (Record/Play) head, mono in the case of basic equipment, stereo otherwise. However, separate Record and Replay heads can be accommodated, either by combining them in a single assembly or by making use of one of the spare access slots in the front of the compact cassettes.

Salient features of the various heads, as used in domestic cassette decks, can be summarised as follows:

Subscribe NOW to Electronics Australia and WIN!!!

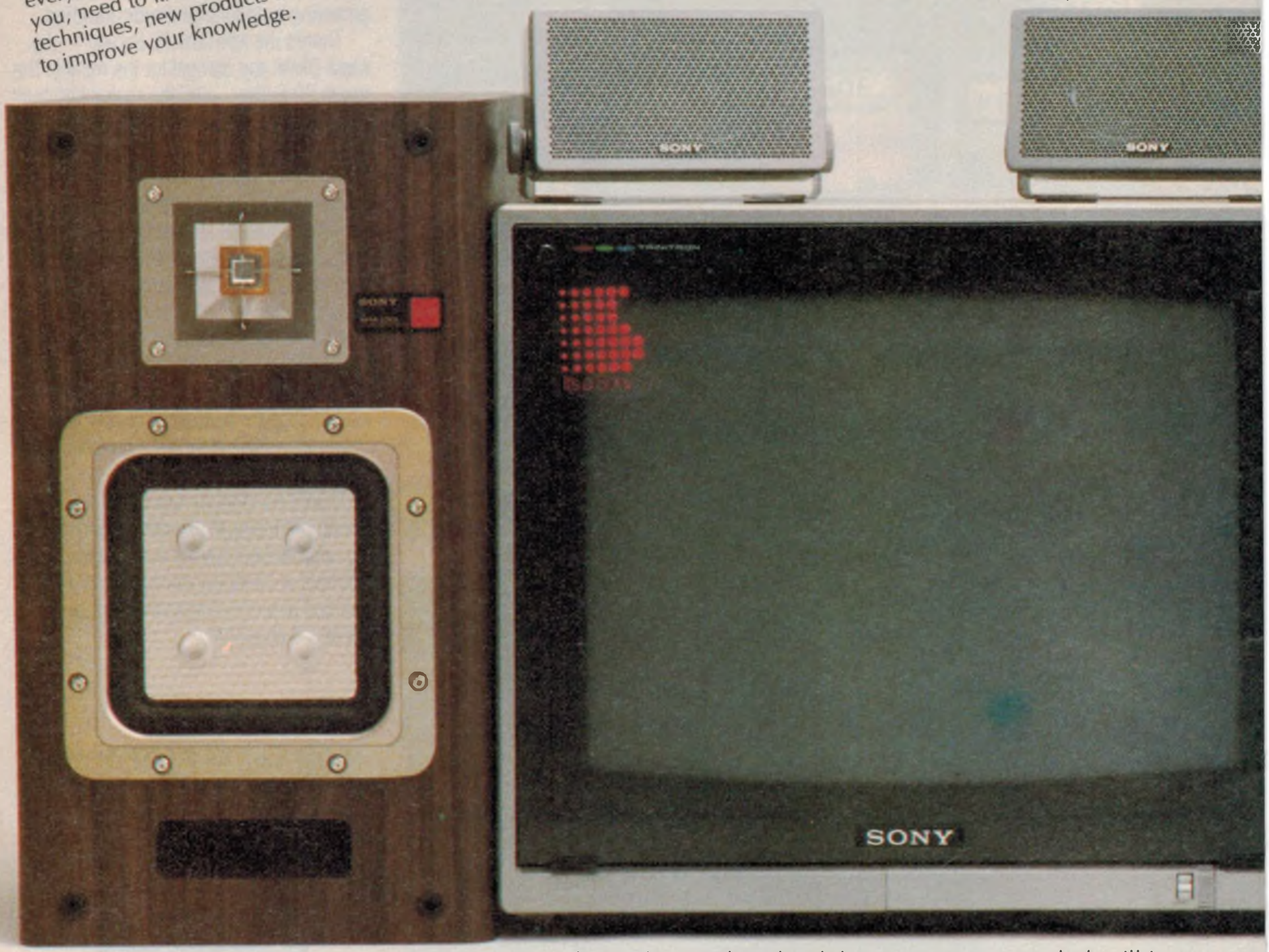
Subscribe for 2 years and enjoy a special saving of almost $6!

IMPROVE YOUR LIFESTYLE BY MAXIMISING YOUR LISTENING AND VIEWING PLEASURE!

By subscribing to Electronics Australia you will be kept up to date with feature-packed articles, the latest news and everything that Electronics enthusiasts, like you, need to know. There are always new techniques, new products and helpful stories to improve your knowledge.

This superb Sony Hi-Fi and Video combination could be yours!

Worth over $10,000!!



This ultimate in sight and sound reproduction you've only ever dreamed of before could be yours if you decide to subscribe to Electronics Australia magazine. By subscribing to Electronics Australia, you may very shortly be relaxing in front of your own Sony system, enjoying the superb listening pleasure that can only come from Compact Disc technology, and while basking in richer listening pleasure you could be watching, filming, or recording your selection using your new Sony Video-8 video system, both systems designed to be fully integrated with each other.

This magnificent Sony Component System represents true, leading edge, technology. The 100 watt RMS per channel integrated stereo amplifier will give you plenty of power and can reproduce the most demanding in CD fidelity. The discrete three head design stereo cassette deck will improve the faithfulness of your recorded sound. Improved frequency response will be evident as your AM/FM precision quartz tuner eliminates interference. With 20 key direct music selection and infra red remote control, the Digital Compact Disc player satisfies your most demanding requirements in fidelity and convenience. The digital compatible APM speaker system has been specially designed to cater for near perfect CD reproduction. A 20" high resolution Profeel monitor, including speakers, represents the best in video display monitors while the complete Video-8 system combines quality with portability. To complete the system a tuner/timer for the PAK 88 is included.

YOUR FREE GIFT
— JUST FOR SUBSCRIBING!

This super-versatile Swiss Army Knife has seven different features — from a wire stripper to a can opener — and is that indispensable tool you'll find hard to do without.

The Swiss Army Knife features include a large blade, small blade, can opener, screw driver, cap lifter, wire stripper and key ring.

You will receive 12 issues of Electronics Australia (one every month) for $35.40 or better still subscribe for 24 months and save $5.90 — that's equal to 2 issues for free!

WIN THE HI-FI/VIDEO SYSTEM OF YOUR DREAMS!

Simply complete the subscription card in this magazine and send it FREE to us. Within six weeks you will receive your Swiss Army Knife and be enjoying articles in the first of your home-delivered ELECTRONICS AUSTRALIA magazine. (Magazine and gift sent separately.)

SONY®

SHARE THE VISION

YOU MUST ACT NOW

NSW Permit No TC86/532 issued under the Lotteries and Art Unions Act, 1901
VIC Raffles and Bingo permits Board Permit No 86/270 issued on 13/3/86
ACT Permit No TP86/162 issued under Lotteries Ordinance.
(Offer valid until 31 August, 1986.)

The exciting prize draw is also open to all subscribers who renew before the closing date. If the prize is not claimed within 12 months, a second draw will be run.

YOUR NO-RISK GUARANTEE

If, for any reason you are not completely delighted with ELECTRONICS AUSTRALIA . . . simply let us know, and we'll gladly refund the unused portion of your subscription.

An introduction to hifi

ERASE HEADS wipe out previously recorded signals, leaving the track marginally neutral and ready for re-use. In a cassette deck the erase spans one half of the tape, preparing it either for a mono recording or for twin stereo tracks which occupy essentially the same space.

Erasure involves feeding the head with a high level supersonic sine wave between about 50 and 100kHz (typically 85kHz). The head gap is relatively wide (up to 100μm) ensuring that the high frequency magnetic field will thoroughly penetrate and saturate the magnetic layer on the tape.

Passing across the gap, the magnetic particles are typically subjected to 200-odd cycles of erase energy, rising from a low level to full saturation and then diminishing to zero, leaving them magnetically inert.

Erase heads commonly use ferrite cores, being provided in many cases with twin parallel active gaps to ensure more effective erasure — a particular problem with tapes using pure metal particles.

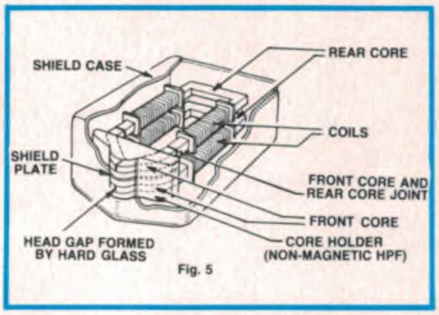


Fig.5: Imagine this stereo head reduced in volume to less than one-half cubic centimetre and you have some idea of the precision required in production. (Technics diagram.)

RECORD ONLY heads may use sendust, preferred for its magnetic properties, or ferrite for its wear-resistant, mirror-like surface. The gap is nominally set at around 1μm but the effective gap width depends on the material, the precision of the pole faces and the signal frequency.

In general, the narrower the gap, the better will be the high frequency response — provided the playback gap is also precisely perpendicular to the tape path; in short, provided there is no azimuth error relative to the tapes being played.

RECORD/PLAY heads involve design compromises which can often be handled more easily with sendust rather than with ferrite. In particular, the gap has to be wide enough to avoid head saturation and to ensure adequate penetration of the tape coating when recording; yet it must not be so wide as to unduly compromise treble response during playback.

Superficially, azimuth error is not a great problem with an R/P head which is only ever used to play its own cassettes. But it is important if the cassettes are to interchange between decks.

In practice, manufacturers of current model cassette decks would appear to have achieved an excellent compromise with the design of R/P heads — sendust or ferrite— such that they can typically rate the frequency response as 20-16,000Hz ±3dB.

Tape recording "bias"

If a normal audio signal is fed to a Record or R/P head and a magnetic pattern imposed on a tape, the recording would be found, on replay, to be seriously distorted.

Without venturing too deeply into magnetic theory, Fig.6a suggests, in graphical form, the relationship between the magnetising force (H) — or (say) the current through a recording head — and the remanent flux density (Br) of the tape coating; in effect, the flux density which remains after the particles have moved out of the magnetising field.

Starting from zero (H=0) the remanent flux (+Br) rises slowly at first as the current is increased (+H). The relationship thereafter becomes substantially linear until Br flattens out, indicating magnetic "saturation", beyond which there is no further increase remanent flux, irrespective of magnetising current.

The behaviour for −H and −Br is similar, producing an overall B/H characteristic with a pronounced discontinuity in the centre. Fairly obviously, a sine wave input signal fed, to the recording head, will produce a distorted magnetic resultant on the tape, as shown.

The effect can be countered by using "DC bias", obtained with the help of a permanent magnet or by passing direct current through the head, along with the signal. Re-centring the signal on a linear portion of the curve (dotted in 6a) avoids the distortion but restricts operation to half of the transfer characteristic.

More seriously, the movement of up to 1500 billion particles per second across the replay head, all magnetised with a similar polarity, produces a cumulative noise effect, resulting in a very poor signal/noise ratio, ie, a noisy recording.

High frequency bias

Modern practice is to use high frequency (supersonic) bias, normally obtained from the same source as the erase frequency, and fed to the recording head along with the audio signal. The result is depicted graphically in Fig.6b.

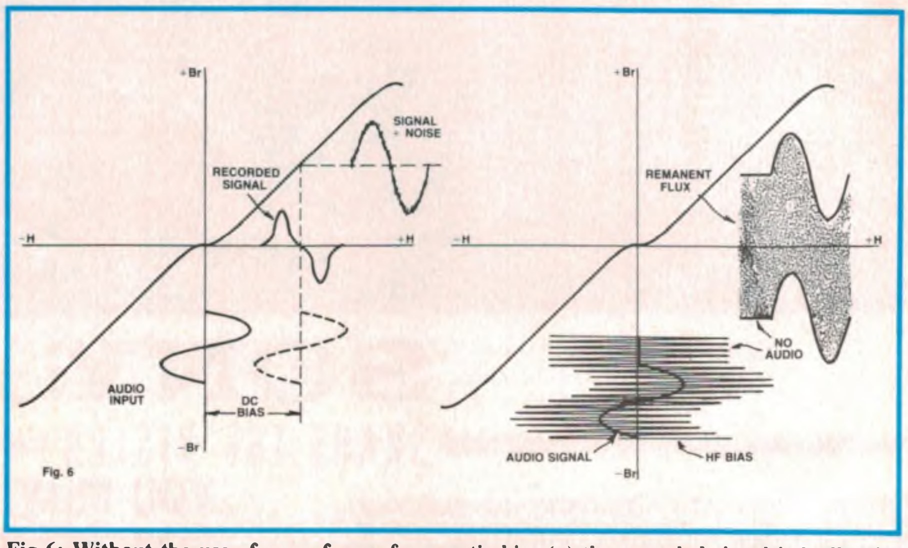


Fig.6: Without the use of some form of magnetic bias (a) the recorded signal is badly distorted. The use of high frequency (supersonic) bias (b) overcomes the problem but the bias amplitude is critical to the end result.

When there is no audio present, the tape particles are simply cycled through a portion of their B/H characteristic at the bias frequency.

At 85kHz, the relationship between the current and the remanent flux may not be as simplistic as depicted but, more to the point, the remanent flux will be symmetrical, as shown, with a similar distribution of particles magnetised +Br and −Br. Passing over the replay head, their noise contributions will tend to cancel, rather than add, resulting in a much better S/N ratio.

When an audio signal is present, as depicted, it adds arithmetically to the high frequency signal, moving it alternatively into the +H and −H regions. This, in turn, affects the remanence so that, instead of being in a state of balance, the flux alternates into the +Br or −Br regions, with a contour conforming to that of the audio waveform.

A replay head interprets this shift in aggregate flux as an audio signal — with a residual HF component — and delivers a corresponding output voltage from its associated winding.

Bias amplitude

If the HF bias is to play its intended role, it must obviously have the correct amplitude relative to the particular B/H curve. In short, for any given recording head, the amplitude of the bias current must produce a magnetising force appropriate to the tape coating being used — a requirement that is not easy to quantify.

For efficient recording of high frequencies (circa 10kHz) a sharply defined magnetising field is required, most easily realised by using a relatively small bias amplitude and thus restricting the field to the immediate vicinity of the recording gap.

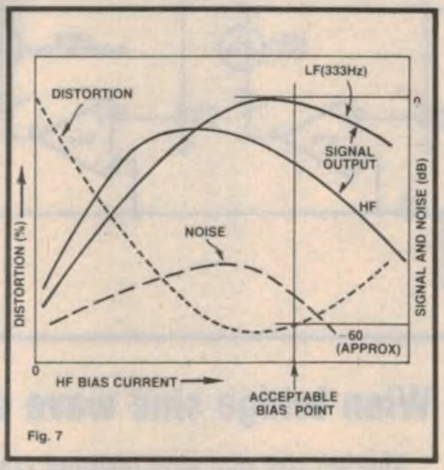


Fig.7: Indicating factors which need to be considered when selecting the HF bias level. The curves are illustrative only and vary in detail with the nature of the magnetic coating.

For middle and especially for low frequencies, a higher level of bias is desirable to ensure greater penetration of the magnetic layer, yielding higher signal output (therefore a good S/N ratio) and minimum distortion.

The nature of the compromise is illustrated in Fig.7, which shows the maximum output level (MOL) for high frequencies (8-10kHz) occurring at a much lower bias current than for a low/middle frequency (333Hz). A simple compromise between the two is not the answer because, while it offers low distortion, it also coincides with a region of high noise!

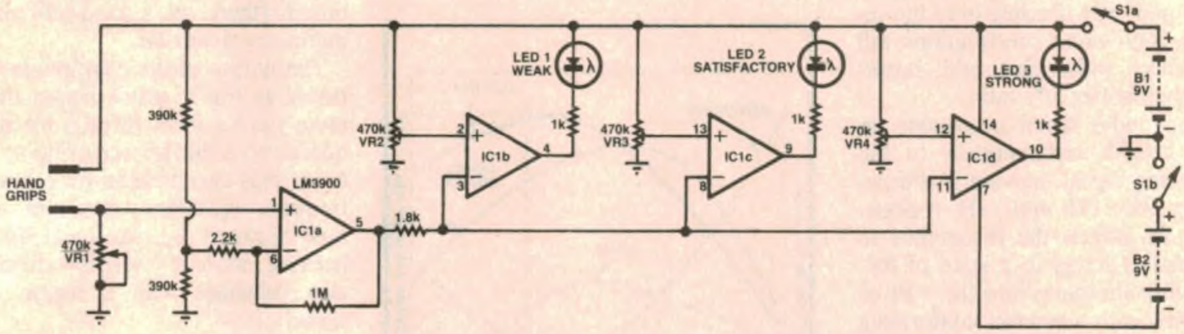
Standards and procedures have been adopted by the industry to define optimum bias, which are beyond the scope of this article. However, as implied by Fig.7, the optimum bias current is usually marginally above the setting that produces maximum output level for a frequency at or close to 333Hz.

We shall be referring again to HF bias when discussing actual cassettes.

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.

Strength meter for parties



Farm gate movement detector

The problem: how to detect movement through a gate on my farm some 350 metres away? The solution: a limit switch attached to the gate.

This was installed and a cable temporarily run along the ground until the cows began chewing the wire. A better solution was needed. Economy ruled out digging a trench 350 metres long, so a system based on a modified portable CB radio was devised.

Subsequently installed, along with its associated tone decoder, it has worked reliably over the last 12 months. The "D" size batteries have to be changed every few months.

Obviously, some sort of rechargeable battery and solar panel would be the long term solution and, to this end, a 6V 12A sealed battery was subsequently installed. A solar panel is soon to be included.

P. Laughton,
Albion Park, NSW. **$12**

Wien bridge sine wave oscillator

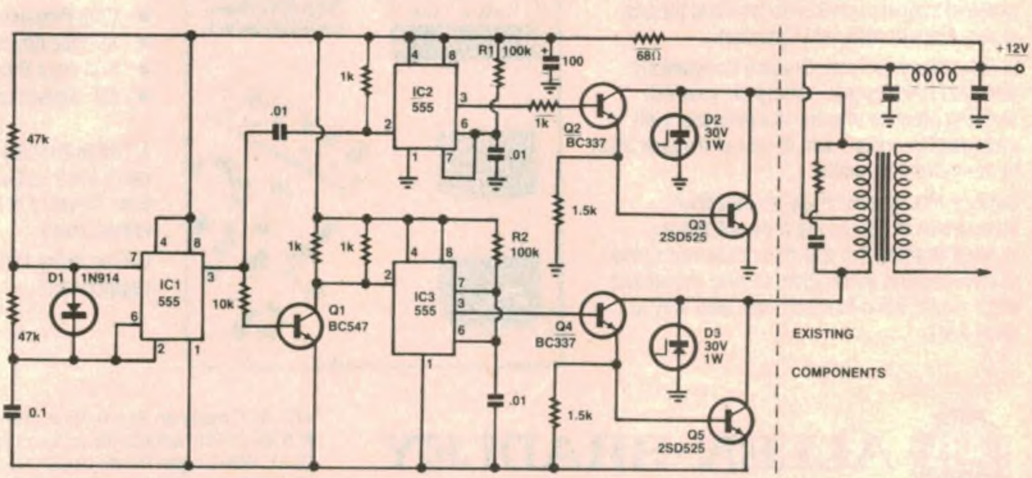
This low cost sine wave oscillator can be varied from 20Hz to 25kHz over four ranges. It has a current drain of less than 5mA and an output voltage of up to 2V RMS.

The oscillator is based on a 741 op amp followed by a BC547 emitter follower (Q1). Rather than using a thermistor in the biasing circuit for stability, a 12V 25mA lamp is used (Tandy 272-1141). Trimpot VR2 is used to set the initial symmetry.

Three output levels (x1, x0.1 and x0.01) are available, with fine control provided by VR3. The output voltage remains reasonably constant except at the extremes of adjustment (output level is down to 20% at 20Hz and 20kHz).

The capacitor values shown will give ranges corresponding to 20-150Hz, 200-1500Hz, 1-7kHz and 4-25kHz. A dual-ganged linear potentiometer is used for

Electronic vibrator for car radio



This simple circuit is not really a strength meter. Instead, it measures skin resistance but, if you label the three LEDs "weak", "satisfactory" and "strong", your friends won't know the difference.

The circuit is based on a single LM3900 quad op amp IC. IC1a is wired as a non-inverting amplifier with bias applied to the inverting input via two 390kΩ resistors. Its output (pin 5) drives the inverting inputs of comparators IC1b, IC1c and IC1d via R5.

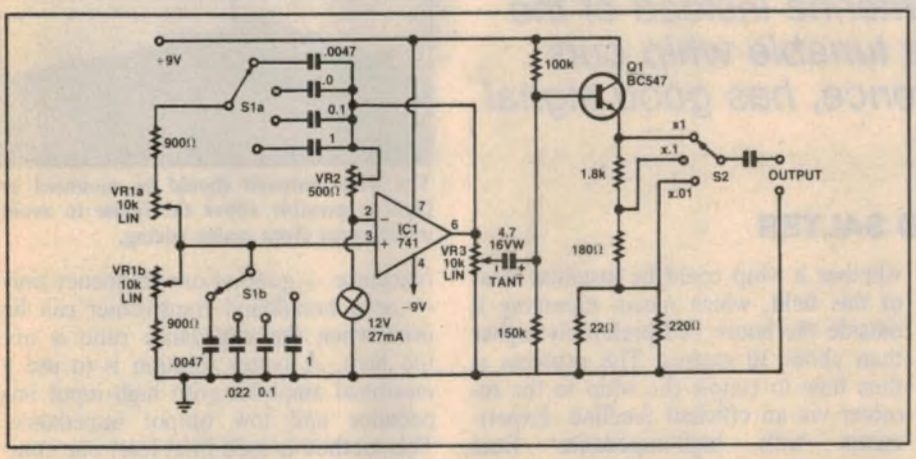
VR2, VR3 and VR4 set the bias on the non-inverting inputs of IC1b, IC1c and IC1d respectively. In practice, these trimpots are adjusted so that progressively higher voltages are required to trip the comparators.

When the contestant holds the hand grips, current flows through VR1 and the resultant voltage is amplified by IC1a. Depending upon the degree of skin resistance, pin 5 is thus pulled towards the positive supply rail.

If this output voltage exceeds the bias on pin 3 of IC1b, pin 4 switches low and lights the "weak" LED. Similarly, if the output voltage exceeds the bias on pins 13 and 12, the outputs of IC1c and IC1d switch low and light the "satisfactory" and "strong" LEDs.

In practice, VR1 should be adjusted so that the "weak" LED is just off with VR2 set to about one-third rotation. VR3 and VR4 can be adjusted for progressive orders of difficulty. The two hand grips can be made from 20mm dia. brass or aluminium tubing.

S. May (13 years),
Lakemba, NSW. **$15**



fine adjustment. As with all Wien Bridge oscillators, a settling time of about two seconds is needed when changing frequencies. The value of the output capacitor will depend on the application.

J. Emery,
Bullcreek, WA. **$25**

This circuit was developed to restore a 1940s Buick car radio to working order and to convert it to 12V operation. The heaters were simply rewired to a series/parallel arrangement and the electronic 'vibrator' built to supply AC to the existing transformer.

IC1 provides a square wave at approximately 150Hz, while monostables IC2 and IC3 are driven by complementary signals so that one of them triggers on each transition of the input waveform. Q1 provides the necessary phase inversion to IC3.

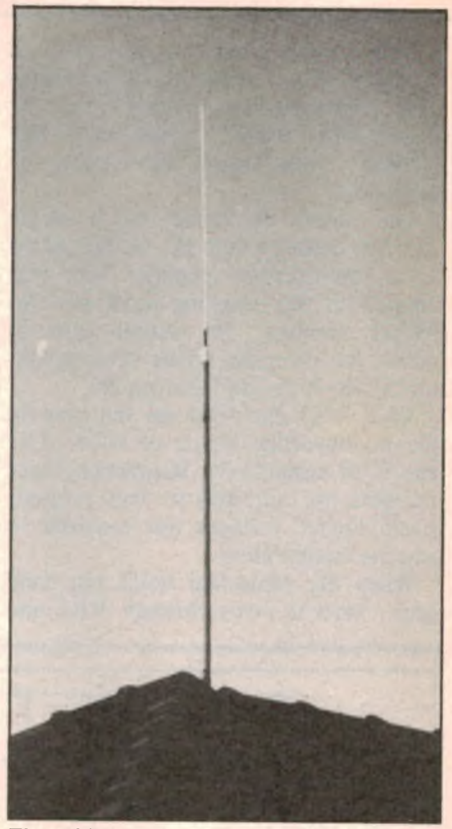
The outputs of IC2 and IC3 drive Darlington output stages Q2, Q4 and Q3, Q5 and these in turn drive the existing inverter transformer in the car radio. The two 30V zener diodes protect the transistors from switching spikes.

As the transformer was originally intended for 6V operation, the duty cycle of the oscillator has been reduced. Resistors R1 and R2 control the duty cycle and can be adjusted to control the HT voltage.

W. J. Nickols, VK7EM,
Penguin, Tas. **$25**

A tunable whip antenna for shortwave listening

What is the best type of antenna for shortwave listening? This article suggests the use of a tunable whip antenna instead of the classic "long wire". The tunable whip cuts down noise and interference, has good signal pickup and is compact.



The whip antenna should be mounted as high as possible above the house to avoid interference from mains wiring.

by RONALD SALTER

In contrast to the large number of refined antennas for the amateur bands, the shortwave listener is not well catered for. The usual text-book approach is to suggest a random length wire mounted as high as possible. Sometimes a noise-reducing feedline is mentioned, and occasionally an array of dipoles of different lengths is discussed.

There is little incentive to do better, because any reasonable length of wire will produce a wealth of signals. But this approach is sometimes impractical, firstly because it requires a fair amount of space, and secondly because a long antenna can often pick up broadcast band signals strong enough to cause splatter across most of the shortwave spectrum. The writer, who lives near the broadcast transmitters at Lower Plenty, is well aware of this problem. Furthermore, the radiation pattern of a long wire is random, and changes with frequency.

Many receivers are fitted with telescopic whips, which are non-directional, and generally do not pick up broadcast band signals of sufficient magnitude to cause splatter.

Whips, however, often do have a poor signal-to-noise ratio, because they are immersed in the household electromagnetic field. The writer wondered whether a whip could be installed clear of this field, which meant mounting it outside the house and preferably higher than about 10 metres. The problem is then how to couple the whip to the receiver via an efficient feedline. Experiments with high-impedance lines showed that only coaxial cable would give immunity to broadcast band pickup and other noise. So a device to match the high impedance of the whip to a 50 or 70Ω cable was needed.

A whip antenna, which can be defined as a vertical antenna shorter than a ¼-wavelength at the highest frequency to be used, exhibits a high impedance which can be broken into three parts — the radiation resistance, the earth resistance and the free-space capacitive reactance, which is the largest of the three. If a whip is connected to the usual low-impedance input of a receiver, much of the signal will be lost across the capacitive reactance. For example, a whip two metres long and 9 mm in diameter, the size used here, will have a capacitance of about 22pF, giving a reactance of 3500Ω at 3MHz. Connection direct to a 70Ω input will result in an attenuation of 17dB to an already small signal.

There are several existing methods of dealing with this problem; a coil in series with the whip will tune out the reactance — good at one frequency only — or a broadband transformer can be used when the impedance ratio is not too high. A better solution is to use a masthead amplifier with high input impedance and low output impedance. This method is used in at least one commercial "active antenna" and several types have been described in the literature. The writer tested two different designs but in each case cross-modulation was a problem. A high-pass filter ahead of the amplifier was only partly successful and made use of the broadcast band out of the question.

The writer uses an impedance matching device for an internal whip, consisting of no more than a tuned circuit with switched coil taps, and a low-impedance link winding. There is no observable cross-modulation, because of the short antenna length and extra selectivity of the coupler. So I wondered whether a similar system could be placed at the masthead.

Switched coils were out, so a system based on the multi-resonance circuit was considered.[1,2] But what to use for the tuning capacitor(s)? Varicap diodes, which change capacity in proportion to an applied DC bias, looked promising and it was apparent that they had other advantages. A drawback to the multi-

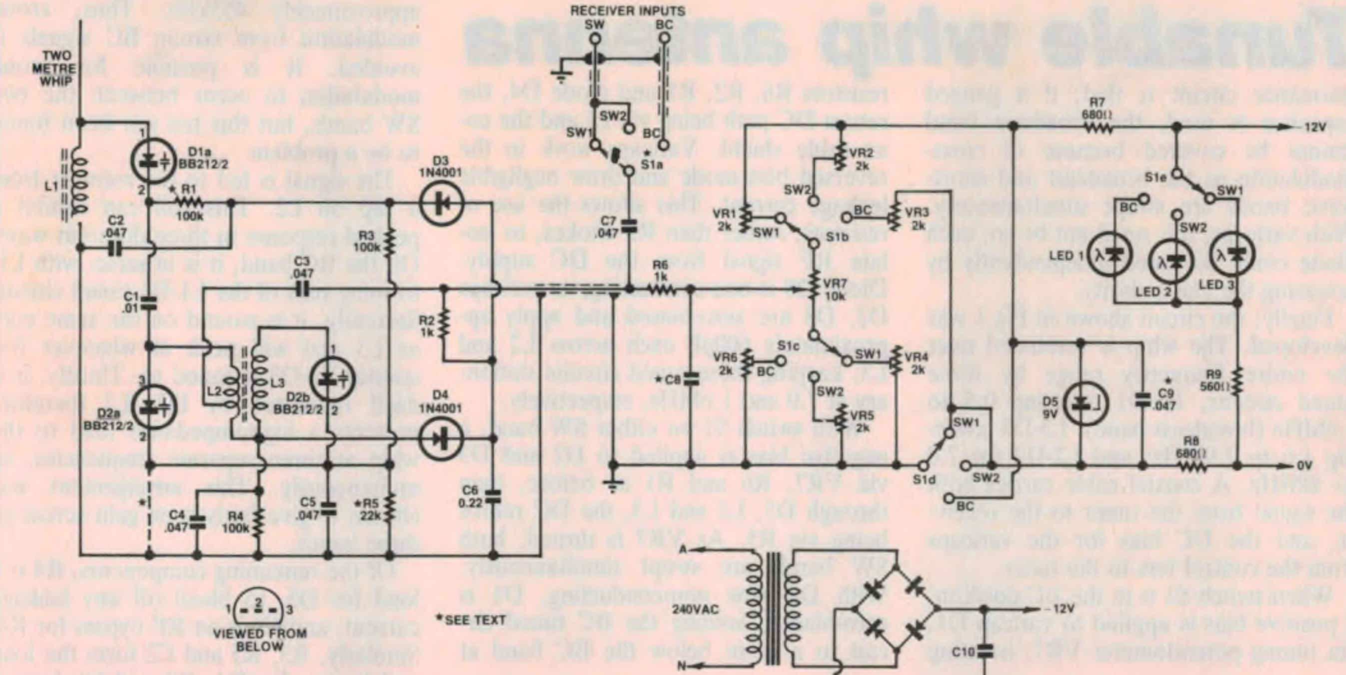


Fig. 1

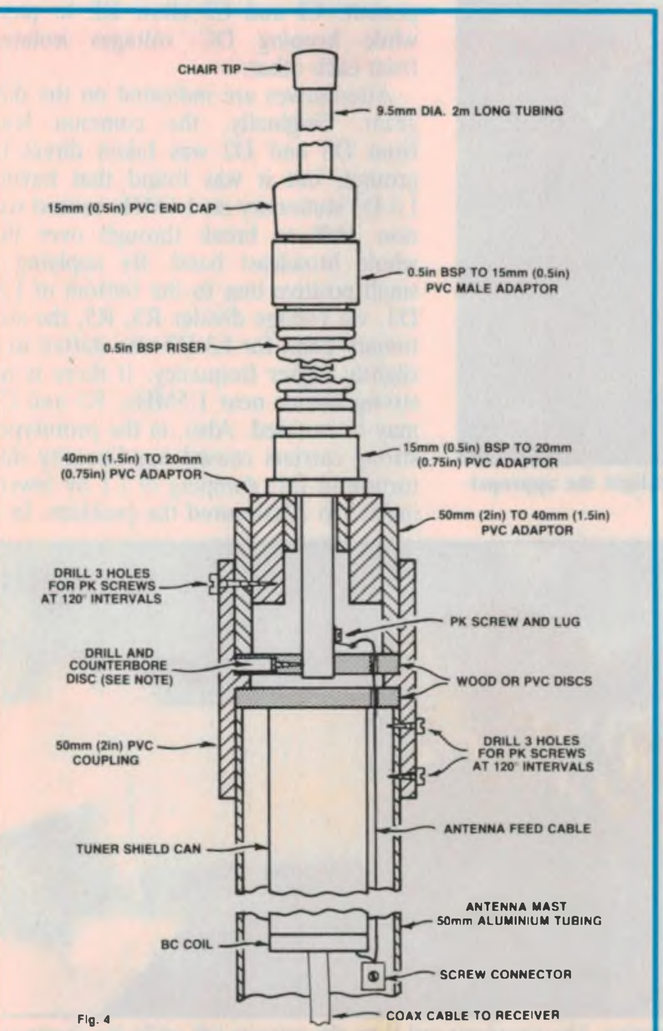
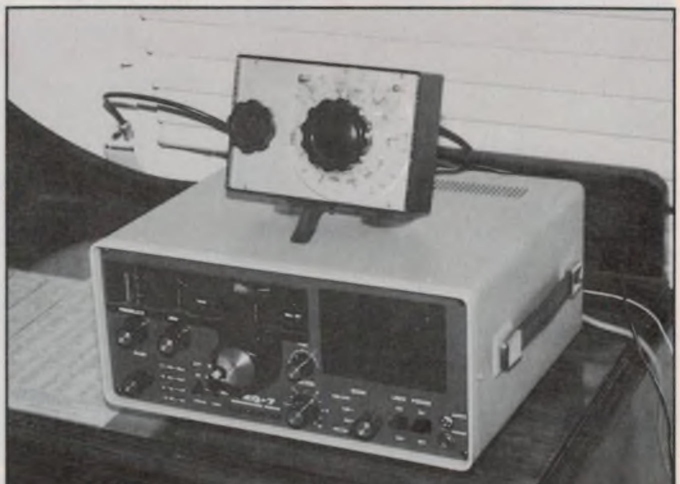


Fig. 4


This photo shows the antenna control box in position on top of the receiver and connected with coax cable to the wall socket.

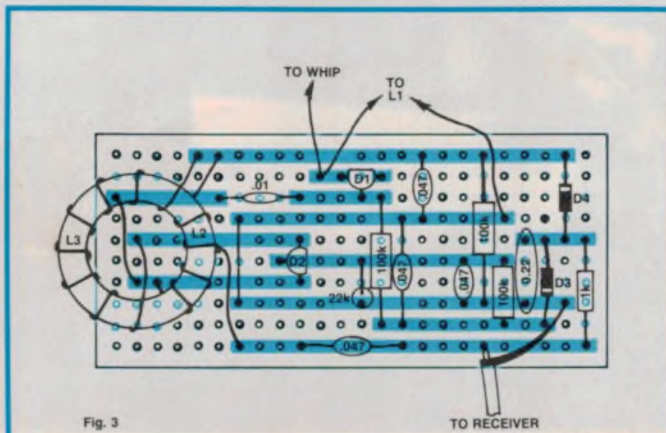


Fig. 3

Tunable whip antenna

resonance circuit is that, if a ganged capacitor is used, the broadcast band cannot be covered because of cross-modulation as the broadcast and short-wave bands are swept simultaneously. With varicaps, this need not be so; each diode could be tuned independently by reversing the bias polarity.

Finally, the circuit shown in Fig.1 was developed. The whip is resonated over the entire frequency range by three tuned circuits, L1-D1 covering 0.5 to 1.6MHz (broadcast band), L3-D3 covering 1.6 to 7.0MHz, and L2-D2 for 7.0 to 30MHz. A coaxial cable carries both the signal from the tuner to the receiver, and the DC bias for the varicaps from the control box to the tuner.

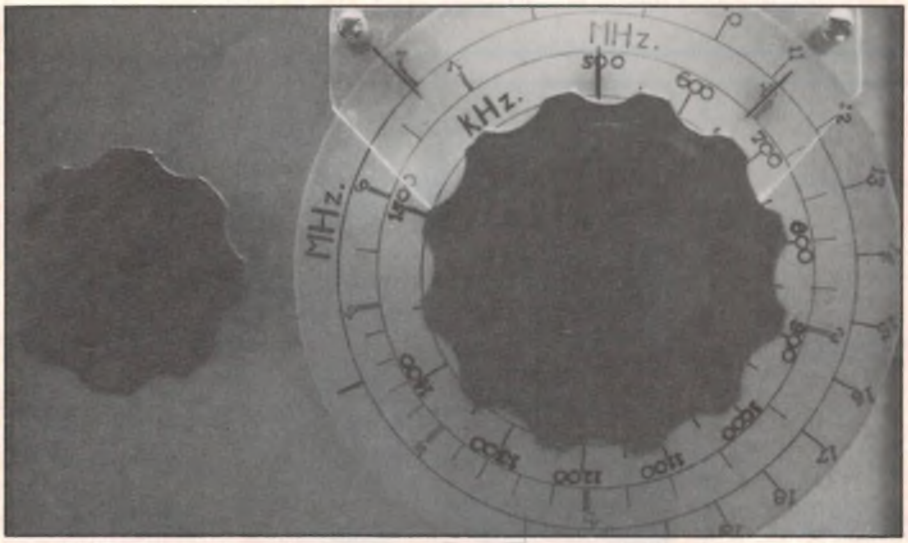
When switch S1 is in the BC position, a positive bias is applied to varicap D1, via tuning potentiometer VR7, isolating resistors R6, R2, R1 and diode D4, the return DC path being via LI and the coax cable shield. Varicaps work in the reversed bias mode and draw negligible leakage current. This allows the use of resistors, rather than RF chokes, to isolate RF signal from the DC supply. Diode D5 is non-conducting, so varicaps D2, D3 are zero-biased and apply approximately 600pF each across L2 and L3, keeping these tuned circuits stationary at 7.0 and 1.6MHz, respectively.

With switch S1 on either SW band, a negative bias is applied to D2 and D3 via VR7, R6 and R1 as before, then through D5, L2 and L3, the DC return being via R5. As VR7 is turned, both SW bands are swept simultaneously. With D4 now non-conducting, D1 is zero-biased, holding the BC tuned circuit to a point below the BC band at approximately 455kHz. Thus, cross-modulation from strong BC signals is avoided. It is possible for cross-modulation to occur between the two SW bands, but this has not been found to be a problem.

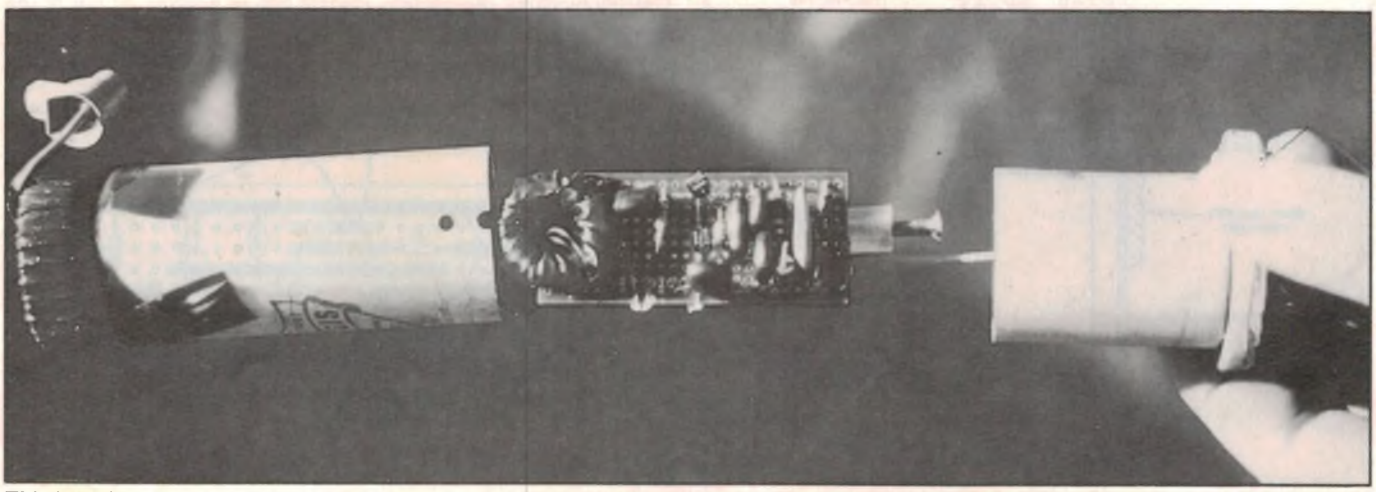
The signal is fed to the receiver from a tap on L2. This coil can exhibit a peaked response in three different ways. On the BC band, it is in series with L1, forming part of the L1-D1 tuned circuit. Secondly, it is wound on the same core as L3 and will peak at whatever frequency L3-D3 is tuned to. Thirdly, it is itself resonated by D2. L2 therefore presents a high-impedance load to the whip at three separate frequencies, simultaneously. This arrangement was chosen to give fairly even gain across all three bands.

Of the remaining components, R4 is a load for D5, to bleed off any leakage current, and C4 is an RF bypass for R4. Similarly, R3, R5 and C2 form the load and bypass for D4. R2 and C6 form a low-pass filter, allowing DC to pass to D4 and D5, while blocking the RF component. CI and C3 allow RF to pass, while keeping DC voltages isolated from each other.

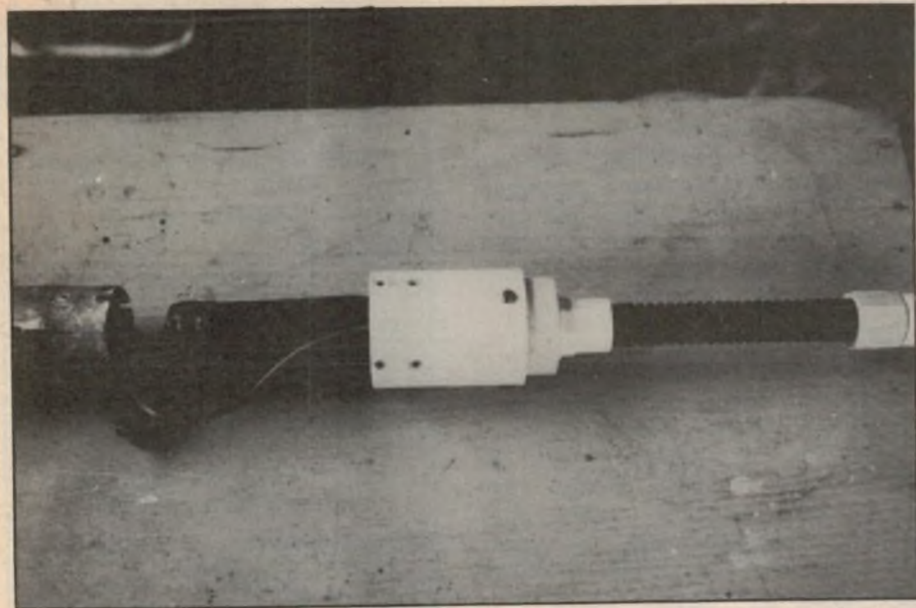
Alternatives are indicated on the diagram. Originally, the common lead from D3 and D2 was taken direct to ground, but it was found that having L3-D3 stationary on 1.6MHz caused station 3AK to break through over the whole broadcast band. By applying a small positive bias to the bottom of L3-D3, via voltage divider R3, R5, the stationary point for L3-D3 was shifted to a slightly higher frequency. If there is no strong carrier near 1.5MHz, R5 and C5 may be omitted. Also, in the prototype, strong carriers caused non-linearity distortion in D1; damping of L1 by lowering R1 to 27kΩ cured the problem. In a



This is a close-up view of the control box. The LEDs are used to backlight the appropriate cursor mark.



This is a view of the masthead shield can opened to show tuner construction. The broadcast coil is on the extreme left while the shortwave coils are on the Veroboard. The antenna feedline from the tuner has a screw connector (left) to make assembly easy.



This is the masthead assembly with shield can in position and bound in black plastic tape. The screw connector joins the feedlines from the tuner and whip.

location remote from BC stations, R1 should remain at 100kΩ.

At the receiver end, all that is needed to control the tuner is a DC supply, a means of varying this between 1V and 8V, and a switch to reverse the polarity. In addition, the writer's control box includes preset alignment pots to allow use of a calibrated dial, a switch bank to route the signal to the appropriate antenna terminal and three LEDs to give band indication and on/off indication. The writer used a 12V packaged supply, but since 20mA of the total drain of 22mA is LED current, a battery supply may be used if the LEDs are omitted. (See Fig.5.)

Control features

From right to left, the LEDs indicate each band, as selected by the switch bank. R7 and R8 serve the dual role of current limiting for the zener diode D6 and, in conjunction with C9, filtering any RF from the power supply leads.

S1, a 3-position 5-pole rotary switch, performs several functions. Pole S1a switches the RF to the BC or SW receiver inputs as required; for a receiver with one antenna terminal, the pole for S1a is not required.

With the switch set to shortwave band SW1 as shown in Fig.1, −9V is applied across alignment pot VR1, switch bank SWB, tuning pot VR7 and trimpot VR4. Fig.2 shows that about −1 to −9 volts is required across VR7, so 0.5V is dropped across each trimpot. A similar path is followed for band SW2, the trimpots now being VR2 and VR5. In the BC band position, the polarity across VR7 is reversed, +9V now being applied across VR3, VR7 and VR6 in that order. Some potentiometers used for VR7 were found to superimpose a rustling sound on the signal when being turned, which was annoying when trying to peak the tuning. The addition of C8 cured the problem; values between 0.1μF and 1μF can be tried. R6 and C7 allow separation of the signal coming from, and the DC bias going to, the coax cable.

The performance of a short antenna can be marred by accidental pickup, either via the power leads, building earth wire, or metal near the antenna, such as guttering or guy wires. Such signals are often noisy and it is worthwhile to reduce them as much as possible. One measure, the usefulness of which appears to depend on the band in use, is to use an earth system separate from the building's electrical earth. The writer's system consists of three 1.2 metre lengths of 25mm galvanised pipe, driven until only 100mm is above ground. These are spaced two metres apart and sited to allow the shortest cable run to the receiver. Seven-strand cable (the old "7/.029 earth wire") is used to bond the electrodes, the antenna pole, the coax, cable sheath, and a wall-mounted terminal near the receiver. The system has a DC resistance to earth of 10Ω with moist soil.

The writer also uses a line filter fitted with low current fuses (1A) to ensure good electrical fault protection when using the separate earth.

To evaluate the performance of the whip, two other antennas were erected — a 9.6MHz dipole and a long wire approximately 30 metres long. Comparative tests for gain, signal/noise ratio and fading depth, were run on signals selected at random from 2.5 to 21MHz, using a pen recorder coupled to the receiver's AGC line. Because of the difficulty of making such measurements in a domestic situation, only general conclusions can be drawn. Even so, the whip compared well with the other antennae.

At 9.6MHz the whip averaged +3.5dB gain over the dipole; however in the direction of the dipole's maximum response — due north and south — the whip was 3dB down. Compared to the long wire, the whip was about −5dB at the lower frequencies, rising to +4dB at the top end.

TABLE 1. COIL DATA

Coil	Band	Frequency Range	Inductance	Iron Powder Cores	Ferrite Cores
L1	BC	0.5-1.5MHz	210μH	92 turns on TI30 core, type 2 matl, 24g (max)	51 turns on FT114 core, type 61 matl, 20g (max)
L3	SW1	1.5-7.0MHz	18μH	36 turns on T106 core*, type 2 matl, 20g (max)	16 turns on FT50 core*, type 61 matl, 20g (max)
L2	SW2	7.0-30MHz	0.9μH	8 turns on T106 core*, type 2 matl, tapped 22 turns from "cold" end.** 20g (max)	4 turns on FT50 core*, type 61 matl, tapped 1 turn from "cold" end.** 20g (max)

*Coils L2 & L3 wound on same core.
**Try tap from 2 to 5 turns on T106 core, or from 1 to 2 turns on FT50 core.

Tunable whip antenna

Signal/noise ratio was measured by comparing carrier strength with the S-meter noise reading on the nearest clear frequency. The whip gave better figures than either the dipole or long wire — not the expected result for a vertical antenna. Listening tests showed that the whip was more susceptible to impulse noise, such as car ignition pulses, whereas the other antennae were victims of the BC cross-modulation hash mentioned above. Fading depth was measured as the difference, in dB, between the maximum and minimum signal strengths over a two-minute period. The whip averaged 2dB down against the long wire over the whole frequency range and was +6dB better than the dipole at 9.6MHz.

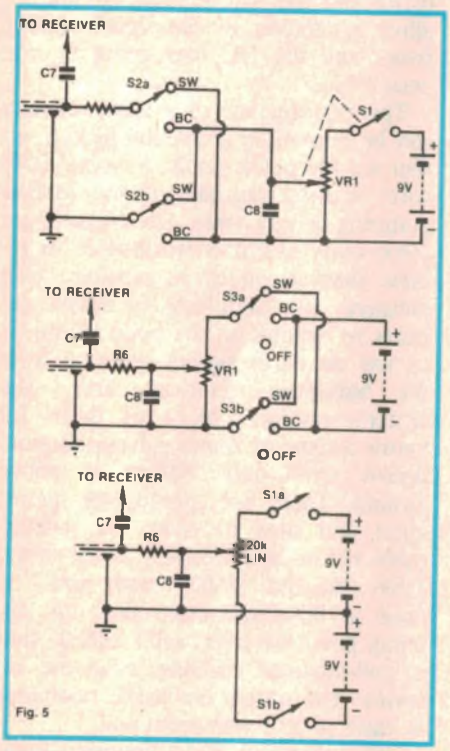


Fig. 5

Construction

The masthead circuitry is mounted on Veroboard (Fig.3) and housed in a cylindrical container made from two old shield cans. The layout isn't critical, but you should minimise leakage from tracks carrying RF by cutting away unused sections of track. Use epoxy fibreglass board, or similar, to reduce RF losses.

Coils for the prototype were wound on toroid cores too old to classify. Coil data in Table 1 is for Amidon cores, calculated from measurements made on the prototype. Minor adjustments to numbers of turns may be needed, to get correct band coverage with the trimpots near the centre of travel. This isn't as hard as it sounds — being a short antenna, the whole masthead assembly can be set up horizontally on the bench.

The writer's antenna pole is made from two aluminium tubes having a total height of 11 metres; it is held upright by a bracket screwed to the house eaves and guy wires are not needed. The masthead mounting was made up from PVC pipe fittings from the local

Continued on page 114

PARTS LIST

3 BB212 varicap diodes
2 1N4001 silicon diodes
1 1N757 9V 400mW zener diode
3 red LEDs
1 3-pole 5-position switch

Resistors
(0.5W, 10% tolerance)
3 x 100kΩ, 1 x 22kΩ, 2 x 1kΩ/0.25W, 2 x 680Ω/0.25W, 1 x 560Ω/1W, 1 x 10kΩ (lin) potentiometer, 6 x 2kΩ trimpots

Capacitors
1 0.22μF/50VW ceramic
6 .047μF metallised polyester
1 .01μF metallised polyester

Miscellaneous
1 plastic zippy box
1 dial and cursor
2 knobs
Veroboard for circuit components (see diagram)
1 12V DC mains plugpack
Coax cable, enamelled copper wire for coils

Hardware
2 metres of 9.5mm diameter aluminium tubing
2 aluminium shield cans (see text)
1 15mm PVC end cap
1 ½in BSP to 15mm PVC adaptor
1 ½in BSP to 20mm PVC adaptor
1 20mm to 40mm PVC adaptor
1 40mm to 50mm PVC adaptor
1 ½in BSP riser
1 50mm PVC coupling

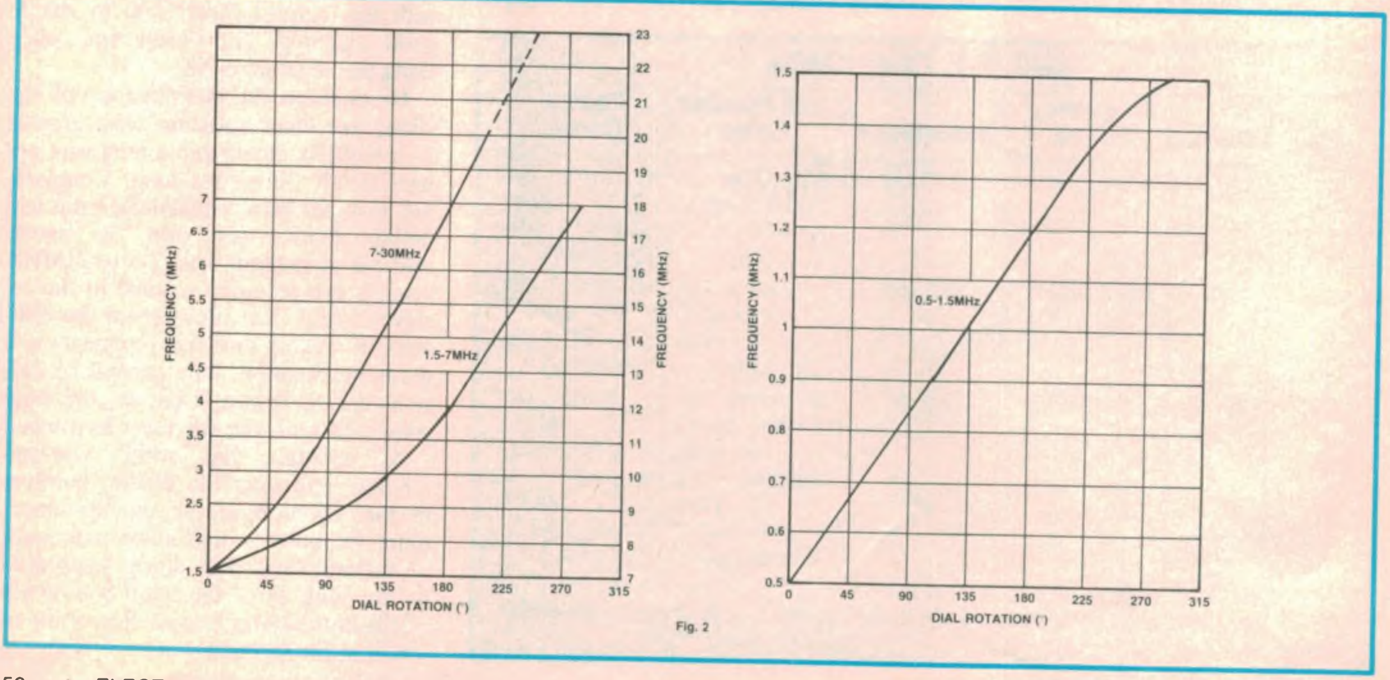
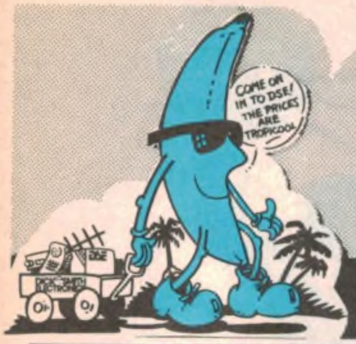


Fig. 2



we've gone

AT DICK SMITH ELECTRONICS YOU MAY BE EXCUSED FOR

Wow! Sensational savings on amateur radio kits... everything for enthusiasts.

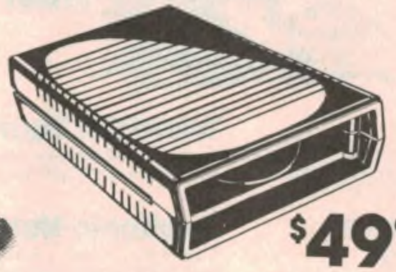
2 m AMATEUR TRANSCEIVER

Popular kit that matches most commercial units feature-for-feature — but costs a fraction of the price! Covers the full 144-148MHz band in 10kHz steps (5kHz offset). Features built-in repeater capability (+/-600kHz), mic and mobile bracket. Impressive 10-15W power output, 0.5uV or better sensitivity and selectivity rated at better than 60dB at +/-25kHz. No wonder over 1500 have been sold! Cat K-6308

$199

Save even more... BUILD A POWER SUPPLY!

Complete your home brew UHF or VHF station with our economy power source. Easy to build, it supplies 13.8 volts regulated at 2 amps continuous. Cat K-6310

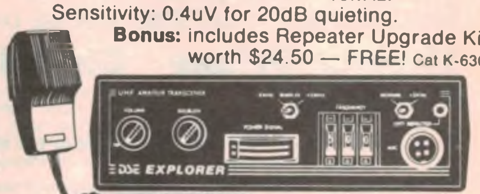


$49.95

One you can afford... A 70cm TRANSCEIVER

Why pay double, even triple, when our feature-packed UHF Explorer delivers the action... backed by impressive specs. Provides access to 40 channels covering 438.025-439MHz freq. range (in 25kHz steps). Typical 5W power output. Selectivity: -6dB at 7.5kHz and -60dB at 15kHz. Sensitivity: 0.4uV for 20dB quieting.

Bonus: includes Repeater Upgrade Kit worth $24.50 — FREE! Cat K-6300



SAVE $20 WAS $199 **$179**

UHF PREAMP KIT

What a bargain! And what an improvement to your transceiver! Designed around the BFR91, our preamp 'soups-up' that soggy front end by achieving a noise figure of 2dB or better between 400-500MHz with a high margin of stability. Excellent dynamic range coupled with input and output impedance close to 50 ohms when biased for best noise figure.

Cat K-6306 **BARGAIN $19.95**

VIDEO ENHANCER

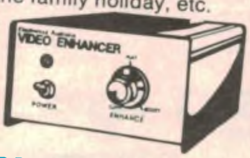
If you've been chasing that elusive perfect video picture here's the way to do it! This affordable kit enhances picture quality by cutting or boosting colour and imagery for 'perfect' results. Ideal for dubbing 'home video' recordings of the family holiday, etc.

* As described in EA.

Cat K-3463

$34.50 **$29.50**

SAVE $5



HEAR AM-STEREO ON YOUR OLD TUNER

AM-STEREO DECODER

It's a marvel! Affordable decoder kit transforms flat AM into sensational AM-Stereo sound by taking AM IF output, decoding the C-QUAM signal and providing left/right channel audio outputs.

Cat K-3415

VALUE $29.50

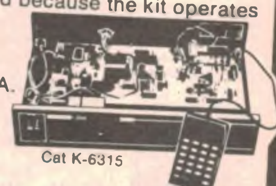
TELETEXT TURNS TVs INTO INFO CENTRES

TELETEXT DECODER

At the touch of a button your TV displays latest news, sporting results, stock exchange figures and even program subtitles for the deaf... thanks to our Teletext Decoder kit! Saves the cost of buying a Teletext compatible TV. And because the kit operates through your VCR, costs are kept way down.

* As described in EA.

$239



Cat K-6315

INFRARED REMOTE CONTROL REPEATER

Control applicances — VCR, TV, Hi-Fi, etc — from any room with this handy remote control. It may seem a luxury, but it's very practical. Imagine viewing videos on a second TV while leaving the VCR in the living room... our R/C offers total control. Uses existing 75 ohm cable on your antenna system.

Cat K-3426

$29.95

GREAT SAVINGS

TV MASTHEAD AMP FOR A BETTER PICTURE

Just the thing for poor TV reception areas. Our Masthead Amp (Mk 2) dramatically improves image by reducing, and in many cases eliminating, snow and annoying ghosting. Covers UHF/VHF bands plus FM for superior Hi-Fi reception. Super low price includes 240V supply.

* As described in EA

Cat K-3232

ONLY $34.95

ADD 'STEREO' TO YOUR OLD TELLY AND SAVE!

STEREO TV DECODER

There's no need to buy an expensive new TV to enjoy thrilling stereo. Our Stereo Decoder kit does the job on your old set. Use either its own amps or feed the output into your Hi-Fi. Whichever way you'll hear true stereo for a fraction of the cost of a new set.

Cat K-6325 **$179**

THINKING WE'VE BEEN TOUCHED BY TOO MUCH SUN! WE'VE GONE BANANAS!

BARGAIN PRICED DELUXE ALARM

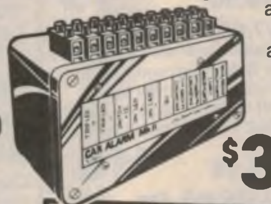
Total protection with 9 of the 10 features recommended by NRMA's Open Road magazine: multiple alarm inputs • delayed entry/exit times • siren output (in case horn alarm disabled) • flashing dash lamp • internal key operated on/off. Add our ignition killer for 10 out of 10 protection.

Cat K-3252

$69.50

DRIVE THIEVES BANANAS!

MK2 car alarm costs even less and still provides above average protection. Reliable triggering system senses voltage drop... opening the door, applying jumper leads, etc. Features visual alarm 'on' warning and comes in a die-cast case with a terminal block.



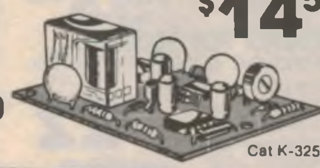
Cat K-3253

$32.50

ECONOMY ALARM FOR TIGHT BUDGETS!

Budget tight? Then you can't afford to have your car pinched! You need our super economy alarm: senses voltage drop in your car, triggers the alarm and scares off thieves. Ideal for second family cars too! And you save even more by building it yourself.

$14.50



Cat K-3250

MOVEMENT DETECTOR

Add our Ultrasonic movement detector to your car's existing alarm system for added protection. Prevents thieves doing a 'smash 'n grab' on valuables left in your car. Any movement in the cabin instantly triggers the main alarm system. Intended for use with our Deluxe Car Alarm (K-3252), it should adapt to most wired car alarm systems. Cat K-3251

$24.50

IGNITION KILLER... IT'S SELF DEFENCE!

Wow! One of the most affordable defences against car theft. Simple circuit, based on a 555 timer, automatically cuts the ignition making the thief think something's wrong so he'll give up on your car. Cat K-3255

$19.50

MOISTURE REMOVER

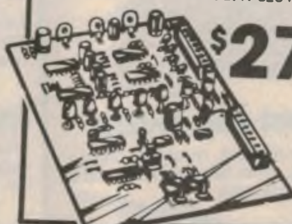
CRC 2-26 Spray — an effective cleaner that leaves a protective film. Ideal for pots, switches and contacts... use it to loosen bolts... protects your car from damaging salt air and treats the ignition for easy wet weather starts. Cat N-1060

$12.50

EFFECTIVE HOME SECURITY YOU CAN AFFORD

4 SECTOR ALARM

Our simple, affordable yet very effective alarm module is the foundation of a full security system. Connect reed and magnetic switches, etc. Depending on the type and number of sensors used, you can secure an average home for well under $100! Cat K-3254



$27.50

IS YOUR MICROWAVE OVEN SAFE?

LEAKAGE DETECTOR

You'll never know until you built this handy microwave detector! Checks oven door seams and instantly warns you of any leak... and remember escaping microwaves can be dangerous! Cat K-3095

$12.95 WAS $14.95

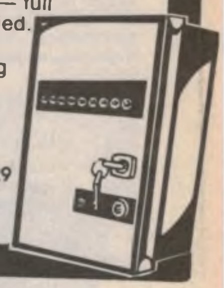
BUILD IT YOURSELF AND SAVE A FORTUNE

SECURITY CENTRE

Professional featured security centre priced so low it's a 'steal'! Versatile control provides 2 instant and 6 delay sectors. Just add the sensors and alarm devices you want — full instructions supplied. Tamper protected heavy metal casing and security key operation maintains sure protection.

Cat K-3424 WAS $129

$119



SPRAY FREEZE

Hey, that's cool! Just spray to lower component temperature down to — 50 degrees Celsius – ideal for service work shrinking shafts and bushes or while soldering. 350g can with long reach tube. Cat N-1056

$5.95

CIRCUIT LACQUER

Specially formulated spray puts a protective coating on valuable PCBs. And it's 'solder through' so you can assemble or re-solder. Handy 350g spray can. Cat N-1045

$7.50

DSE PVC TAPE

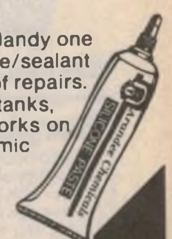
High quality tape for a hundred-and-one hobbyist uses in the home and workshop. 18m long x 19mm wide x 0.2mm thick. Cat N-1362

$1

SILASTIC

No mess, no fuss! Handy one part silicon adhesive/sealant for a whole range of repairs. Mend leaks in fish tanks, patch roof tiles... works on metals, glass, ceramic and most plastics. Cat N-1225

$5.20



FLUX REMOVER

Brilliant! Easy spray can of flux remover makes servicing so much easier and it's a 'neat' trick for handling messy soldering jobs. 400g spray can that's worth its weight in gold. Cat N-1055

$9.95

SPRAY CLEANER

Degreases while it cleans. Use it on delicate electronic components, plastic and jewellery. Completely safe, doesn't leave a residue. 250g can. Cat N-1051

$3.75

CLEANING SOLVENT

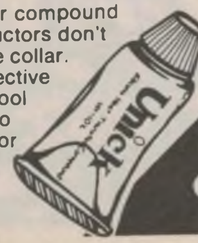
Non-corrosive solvent for thorough electronic cleaning... brings a new lease of life to tuners, switches, plugs, relays and so on! 300g spray can with long reach tube. Cat N-1040

$6.25

HEATSINK COMPOUND

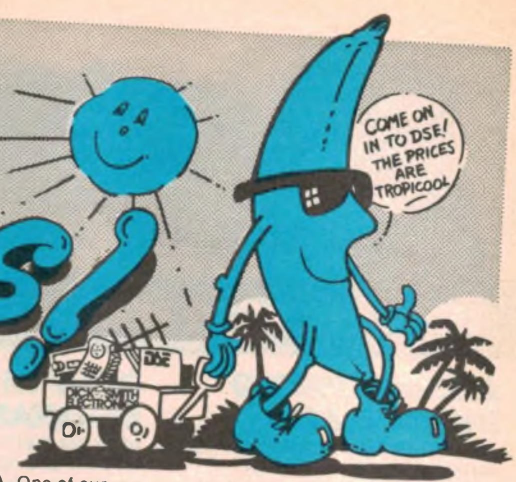
Versatile heat transfer compound to ensure semiconductors don't get too hot under the collar. Even use it as an effective thermal coupler to cool heatsinks: heatsink to chassis application for example. 10g tube. Cat N-1205

$2.95



CHECK OUT OUR SUPER LOW PRICES

we've gone Bananas!



Need to solder?

We've got just what you need... more solder types for every job!

Corrosion-free, multicore solder — premium grade alloy prevents damaging oxidization. Two sizes: 1.25mm (19g) 200g. Cat N-1619 0.75mm (22g) 200g. Cat N-1623 **$7.50 each**

ALU-SOL solder — when you need to solder dissimilar metals; perfect for aluminium and steel, etc. Value 1.6mm 100g roll. Cat N-1625 **$10.95**

Hobby pack solder — real value-for-money with a liberal amount of solder for all project needs.
1.25mm (18g) pack. Cat N-1638
0.71mm (22g) pack. Cat N-1636
$4.95 each

Big savings on power packs... 10% and more!

Panther Pack

13.8V/4A Peak
Real versatility! Adapt CB's, car equipment, etc. to mains power... use it as a bench supply too! Housed in a ventilated plastic case with colour coded banana terminals and 2m mains cable.
Cat M-9545
Was $59.55 **$53.95**

Perfect for home...

3/6/9/12V DC @ 1Amp STOCKS DUE AUGUST
The type of power pack that hobbyists can always use for any number of applications. Just plug into 240V power socket and you're in business: DC screw terminal connections are at front of the unit. Cat M-9530
$22

Was $24.50

3/6/9V DC200 mA. One of our most popular packs because it has 3 output voltages used by a variety of items in everyday life: 3, 6 and 9V DC. Cat M-9525
Was $14.50 **$13**

3/4.5/6/7.5/9/12V @ 300 mA. Truly versatile pack with switchable output for 6 different voltages and 5-way connector that will suit virtually all common power sockets — including 9V battery connectors. Cat M-9526
Was $17.95 **$16**

9V DC @ 200 mA. The economical alternative for powering equipment, especially hobby models, requiring 9V battery types. Cat M-9514
Was $9.75 **$8.75**

Slow blow fuses

Inexpensive M-205 Type.

250mA	Cat S-4300
315mA	Cat S-4305
500mA	Cat S-4310
1 amp	Cat S-4315
2 amp	Cat S-4320

All 75c each!

New for '86

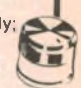
Buy more than 10 all just .65c each!

Knobs

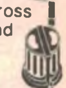
Coloured: 16mm dia., metric fluted shaft.
Red Cat H-3800
Orange Cat H-3802
Blue Cat H-3804
Green Cat H-3806
$1.35 each!

Metric

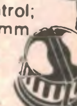
Satin finish aluminium knurled body; 25mm dia., 17mm deep. Cat H-3843 **$1.10**



Small knob with integral pointer across the top; 11mm body, 15mm skirt and 15mm overall. Cat H-3850 STOCKS DUE AUGUST **70¢**



Large knob, ideal as a main control; 20mm wide with 25mm skirt, 16mm deep. Cat H-3860 **$1.05**



Imperial

Ideal instrument knob; wide skirt, 1-10 calibration; 37mm dia., 15mm deep. Cat H-3770 **$1.10**

Popular choice; pointer running through from the top to skirt's edge; 24mm dia., 14mm deep. Cat H-3772 **80¢**

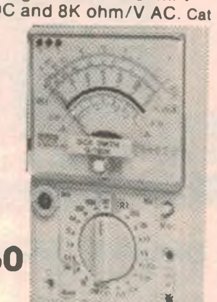
Small knob and skirt with fluted sides and dot pointer; 19mm dia., 13mm deep. Cat H-3762 **75¢**

Multimeter with audible continuity

Superb 20,000 ohms per volt meter with added benefits. Like a built-in buzzer for continuity checking, 10A DC range (not normally found in low cost meters), mirrored scale, and large banana plugs for sure contact. Cat Q-1022
$29.95

... Here's one with a logic tester!

Excellent value because it's like having two instruments in one! Logic tester's LEDs give HIGH, LOW and PULSE states of logic. 18 range multimeter measures current and resistance ranges with 20K ohm/V sensitivity DC and 8K ohm/V AC. Cat Q-1026



DSE — The One-Stop Supermarket of Electronics

$39.50

Plus many more available!

Self retracting coiled test leads

Coiled leads prevent tangles! Red and black pair with 1.5mm plugs. Cat W-4520 **$5.65**

IC test clip leads

Ideal for IC work. Insulated clip on one end, 4mm banana plug on the other. Cat W-4509

$3.95

Bargain 6.5MHz CRO

Superb oscilloscope for hobbyists or professionals. Retrace blanking, 10mV per division vertical sensitivity with 500mV per division horizontal sensitivity, 10-100KHz timebase (in 4 ranges) and many other impressive features. Usable response to 6.5MHz.
Cat Q-1280 **$229**

Save money & valuable time... DSE component packs have what you want!

1% MF E24 resistors. Metal film types designed for close tolerance work. Excellent value: worth well over $21! Pack of 300. Cat R-7020 **$17.95**

Electrolytic pack. 55 Single ended beauties... mixed values: from 2.2-470uF; voltage rating from 10-25V. Over $18 worth! Cat R-7030 **$7.95**

5mm LED mounting bezels. Value pack of 15...works out to less than 9c each! Cat H-1910 **$1.20**

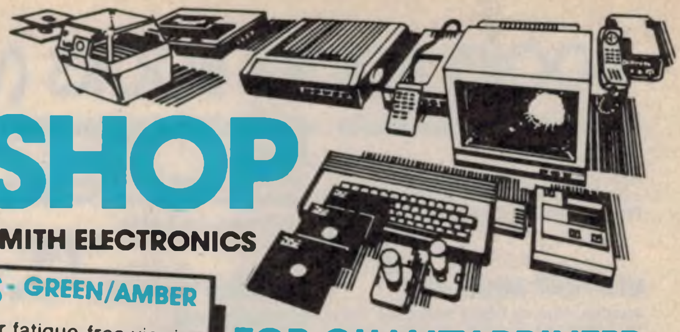
¼W CF E12 resistor pack. 300 pieces, all popular values at a bargain price. Cat R-7015 **$15.95**

Polyester green caps. 60 in all with mixed values: 100V from .001uF — 0.22uF. You'd expect to pay $15, packs now... Cat R-7040 **$11.45**

Assorted spade lug pack. Approx. 100 plated finished lugs; various sizes. Normally $5.50 Cat H-1994 **$4**

DICK SMITH ELECTRONICS

ONE STOP COMPUTER SHOP



A COMPLETE RANGE OF PERIPHERALS FROM DICK SMITH ELECTRONICS

DATAPHONE 300

Super economy 300 baud, full duplex modem that comes with its own push button phone. Complete with leads.

Cat X-3301

NEW FOR '86

$199

Telecom Authorisation No: C85/37/1373

BLUE BOX VALUE

INTELLIGENT RS-232 SWITCH BOX

Serial interface with logic circuitry which automatically reconciles RS-232 data and hand shake lines. Cat X-3561 $149

RS-232 INTERFACE ADAPTOR

Make custom RS-232 connections. Also acts as a quick connect RS-232 interface test set, status activity monitor and configuration device. Cat X-3560 $199

DATASETTE RECORDER

A cassette recorder specially designed for saving and loading computer programs and data! Fixed recording level for optimum recording, adjustable play level to let you load from cassettes recorded at different levels. Cat X-7206 $49.50

Available August

DATA CASSETTE

Verified computer cassette tape Cat X-3502

XIDEX DISKS

Single sided — double density Cat X-3510 ... $3.95 EACH

Box of 10 Cat X-3512 .... $44.50

Double sided — double density Box of 10 Cat X-3514 .... $49.95

Available August

PRINTER PAPER FANFOLD TYPE

8" x 8½" — 2000 sheets (Suits GP-80) Cat X-3254 .... $42.50

9½" x 11" — 2500 sheets Cat X-1189 .... $47.50

15" x 11" — 2500 sheets Cat X-1188 .... $64.95

MONITORS - GREEN/AMBER

For fatigue-free viewing over long periods you need a green or amber hi-res monitor. Suits 99% of computers.

$349

Green Screen Cat X-1222 — Amber Screen Cat X-1227

MAINTENANCE KITS

Anti-Static Spray Cat X-3562 $4.95

Lint-Free Wipes Cat X-3563 $7.50

Disk Drive Head Cleaning Kits

3½" Drive Cat X-3553

5½" Drive Cat X-3554

DISK STORAGE BOXES

Protect those valuable disks from loss or damage! While it's not being used keep it safe and clean in one of our fantastic storage files. Both constructed of firm shock resistant plastic and designed for easy access. A must for any disk user!

Holds 40 disks for easy access and recognition. Cat X-3530 .... $34.50

Room for 30 disks in sturdy box for easy filing Cat X-3528 .... $13.95

Plastic case and lid holds 10 disks. Cat X-3515 .... $6.95

PC TUTORIAL — A WINNER

Whether you're an experienced programmer or a beginner who wants to be a hacker, the PC Tutorial Program trains you in every aspect of computer hardware and software. The two disk pack teaches beginners all the basics; Cat X-8752 $69.95

CAT TOUCH TABLET

Plug it in and draw — the image will appear on the screen! Play games, draw pictures and graphics.

Cat C-7580

ONLY $79

TOP QUALITY PRINTER

When you need quality — look no further! Here's the top of our dot matrix range. The Dataproducts 8012 gives you the choice of Draft, Type or Letter quality. With up to 180CPS, 6 print ptiches, inbuilt tractor feed, 10 inch carriage, and variable line feed, you'll never need any more.

Cat X-3200

$995

DSE's OWN DISKS

Huge savings on DSE Floppy Disks! You know how much you pay for the others so look at DSE disks for the quality, reliability and incredible savings.

Made for DSE by Xidex!

Single sided — double density Box of 10 Cat X-3500 .... $27.50

Double sided — double density Box of 10 Cat X-3501 .... $29.50

DATAPHONE 1200 MODEM

$349

Coming Soon

Easy data transference without the high cost! Features its own RS-232 serial interface, push button phone with 12 number memory and last number redial. 300/600/1200 full or half duplex modes. And it's Telecom authorised. Cat X-3300

Telecom Authorisation No: C85/37/1353

BITS & PIECES

Monitor swivel base Cat X-1193 .... $37.50

Male gender changer Cat X-3565 .... $14.19

Female gender changer Cat X-3566 ..... $14.95

Female/Male 25 pin serial cable Cat X-3564 ....

Mains filter Cat M-9850 .... $125

RCA-Belling Lee lead Cat W-1286 .... $6.95

A SMALL SELECTION OF OUR INCREDIBLE RANGE OF COMPUTER PERIPHERALS!

DICK SMITH ELECTRONICS

COMPUTERSTOP ™

Want to know more? Send for your FREE information pack. It's obligation free

☐ DSE Multitech

☐ Olivetti M-24 ☐ TOSHIBA T1100

Name: ....

Address: ....

Postcode: .... Phone: ....

Drop into any DSE store or send to DSXpress, P O Box 321, North Ryde, NSW, 2113, Phone (02) 888 3200

BOOKS BOOKS BOOKS (Value too big to mention)

Radio Communications Handbook
Highly recommended for all AOCP students, a must in the amateur's library. From the RSGB. Cat B-2033

$34.50

UHF/VHF Manual
Another popular RSGB reference. For the "Z" or full call who likes working upstairs. Cat B-2054

$34.50

Confidential Frequency List
All those hard-to-get frequencies of HF stations you can listen in to with a good general coverage receiver. Cat B-9602

$19.95

World Radio TV Handbook
The definitive reference for all world radio and television stations. Cat B-2086

$32.50

Understanding Amateur Radio
The perfect book for the newcomer to amateur radio. Great for novice licence candidates. Cat B-2232

$14.95

Satellite Experimenter's Handbook
From the ARRL. Covers amateur, broadcast and weather satellites. Cat B-2235

$26.50

Complete Guide to Satellite TV
Everything you need to know about commercial satellite reception. Superb! Cat B-1841

$20.95

ARRL Antenna Book
Theory and practice. Everything from DC to light (almost!) with dozens of different antenna types. Cat B-2207

$24.95

Design of PLL Circuits
With experiments. Theory, design and practical applications of PLL's. 250 pages Cat B-1249

$20.95

Active Filter Cookbook
One of the famous Lancaster Cook Book series. 240 pages of data, how-to, types, etc. Cat B-1250

$22.95

Design of OP-AMP Circuits
All about the ubiquitous op-amp. With experiments to help you learn as you go. Cat B-1251

$20.95

Transistor Spec. Manual
Not just the specs of transistors — it also shows you how to properly interpret the data and choose the correct type. Cat B-4508

$14.50

STORE LOCATIONS

NSW

Swift & Young Sts	**Albury**	21 8399
T55 Terrace Level	**Bankstown Sq**	707 4888
Shop 1, 65-75 Main St	**Blacktown**	671 7722
613 Princess Hwy	**Blakehurst**	546 7744
Oxford & Adelaide Sts	**Bondi Junction**	387 1444
531 Pittwater Rd	**Brookvale**	93 0441
Campbelltown Mall Queen St	**Campbelltown**	27 2199
Shop 235, Archer St Entrance	**Chatswood Chase**	411 1955
147 Hume Hwy	**Chullora**	642 8922
164 Pacific Hwy	**Gore Hill**	439 5311
315 Mann St	**Gosford**	25 0235
4 Florence St	**Hornsby**	477 6633
Elizabeth Dr & Bathurst St	**Liverpool**	600 9888
450 High Street	**Maitland**	33 7866
621-627 The Kingsway	**Miranda**	TBA
173 Maitland Rd, Tighes Hill	**Newcastle**	61 1896
Lane Cove & Waterloo Rds	**North Ryde**	88 3855
George & Smith Sts	**Parramatta**	689 2188
The Gateway High & Henry Sts	**Penrith**	32 3400
818 George St	**Railway Square**	211 3777
125 York St	**Sydney City**	267 9111
Treloar's Bldg, Brisbane St	**Tamworth**	66 1711
263 Keira St	**Wollongong**	28 3800

ACT

96 Gladstone St	**Fyshwick**	80 4944

VIC

Creswick Rd & Webster St	**Ballarat**	31 5433
145 McCrae St	**Bendigo**	43 0388
Shop 46, Box Hill Central, Main St	**Box Hill**	890 0699
Hawthorn Rd & Nepean Hwy	**East Brighton**	592 2366
260 Sydney Rd	**Coburg**	383 4455
1150 Mt Alexander Rd	**Essendon**	379 7444
Nepean Hwy & Ross Smith Ave	**Frankston**	783 9144
Shop 9 110, High St	**Geelong**	43 8522
291-293 Elizabeth St	**Melbourne City**	67 9834
Bridge Rd & The Boulevarde	**Richmond**	428 1614
Springvale & Dandenong Rds	**Springvale**	547 0522

QLD

157-159 Elizabeth St	**Brisbane City**	229 9377
166 Logan Rd	**Buranda**	391 6233
Gympie & Hamilton Rds	**Chermside**	359 6255
2nd Level Western Entrance Redbank Shopping Plaza	**Redbank**	288 5599
Queen Elizabeth Dr & Bernard St	**Rockhampton**	27 9644
Gold Coast Hwy & Welch St	**Southport**	32 9863
Bowen & Ruthven Sts	**Toowoomba**	38 4300
Kings Rd & Woolcock St	**Townsville**	72 5722
Cnr Pacific Hwy & Kingston Rd	**Underwood**	341 0844

SA

Wright & Market Sts	**Adelaide**	212 1962
Main South & Flagstaff Rds	**Darlington**	298 8977
Main North Rd & Darlington St	**Enfield**	260 6088
24 Park Terrace	**Salisbury**	281 1593

WA

Wharf St & Albany Hwy	**Cannington**	451 8666
66 Adelaide St	**Fremantle**	335 9733
William St & Robinson Ave	**North Perth**	328 6944
Raine Square, 125 William St	**Perth City**	481 3261

TAS

Shop 40A, Lower Level Cat & Fiddle Arcade	**Hobart**	31 0800

NT

17 Stuart Hwy	**Stuart Park**	81 1977

Dear Customers,

Quite often, the products we advertise are so popular they run out within a few days, or unforseeen circumstances might hold up shipments so that advertised lines are not in the stores by the time the advert appears. And very occasionally, an error might slip through our checks and appear in the advert (after all, we're human too!) Please don't blame the store manager or staff: they cannot solve a dock strike on the other side of the world, nor fix an error that's appeared in print. If you're about to drive across town to pick up an advertised line, why not play it safe and give them a call first ... just in case! Thanks. Dick Smith Electronics.

MAJOR DICK SMITH ELECTRONICS AUTHORISED RESELLERS

NSW: • **Ballina:** A. Cummings & Co. 91-93 River St 86 2284 • **Ulladulla:** Pauls Electronics, 10 Wason Street, 55 3989 • **Bowral:** F.R.H. Electrical, 28 Station St 61 1861 • **Broken Hill:** Hobbies & Electronics, 31 Oxide St 88 4098 • **Charlestown:** Newtronics 131 Pacific Hwy 43 9600 • **Coffs Harbour:** Coffs Harbour Electronics, 3 Coffs Plaza, Park Ave. 56 5684 • **Deniliquin:** Deni Electronics, 220 Cressy St. 81 3672 • **Gosford:** Tomorrows Electronics & HiFi, 68 William St, 24 7246 • **Lismore:** Decro 3A/6-18 Carrington St. 21 4137 • **Port Macquarie:** Hall of Electronics, Horton Centre, Horton St, 83 7440 • **Orange:** Fyfe Electronics 173 Summer St, 62 6491 • **Springwood:** Wellington's Electrical Discounts 115 Macquarie Rd, 51 4888 • **Taree:** Brad's Electronics Shop 6, Civic Cinema Centre, Pulteney St, 52 6603 • **Tumut:** Tumut Electronics Wynyard St. 47 1631 • **Tweed Heads:** Stuart Street Electronic Sales, Stuart St, 367 5744 • **Wagga:** Phillips Electronics 60 Forsyth St, 21 6558 • **Windsor:** M & E Electronics, Sh 7, Mc Ewans Arcarde, 206 George St. 77 5935 • **Young:** Keith Donges Electronics 186 Boorowa St 82 1279 **VIC:** • **Hamilton:** John Thompson & Co, 138-148 Gray St, 72 2000 • **Echuca:** Webster Electronics, 220 Packeham St 82 2956 • **Mildura:** McWilliams Electronics 110A Langtree Ave, 23 6410 • **Morwell:** Morwell Electronics, 95 George St, 34 6133 • **Shepparton:** GV Electronics Centre 100 High St, 21 8866 **QLD:** • **Bundaberg:** Bob Elkin Electronics, 81 Bourbong St, 72 1785 • **Cairns:** Electronic World Shop 27 K-mart Westcourt Plaza, 51 8555 • **Gladstone:** Purely Electronics Shop Cnr. Herbert & Auckland Sts 72 4321 • **Mackay:** Stevens Electronics, 42 Victoria St, 51 1723 • **Maryborough:** Keller Electronics, 218 Adelaide St, 21 4559 • **Mt Isa:** Outback Electronics Shop 71 Barkley Hwy 43 3331 • **Nambour:** Nambour Electronics Shop 4, Lowan House, Ann St, 41 1604 • **Rockhampton:** Purely Electronics, 15 East St, 21 058 **SA:** • **Mt Gambier:** Hutchessons Communications, 5 Elizabeth St, 25 0400 • **Whyalla:** Eyre Electronics Shop 2 Forsythe St, 45 4764 **WA:** • **Albany:** Micro Electronics 133 Lockyer Ave 41 3432 **TAS:** • **Launceston:** Wills Electronics 5A The Quadrant, 31 5688

DSXPRESS ORDER SERVICE

Use your Bankcard, Mastercard or Visacard.
Just Phone **008 226610** (toll free) for, despatch of your orders. Enquiries: By mail or phone (02) 888 2105
Fax (02) 888 3631 Telex AA20036

ORDERS OVER $75 FREE DELIVERY

POST & PACKING CHARGES	Order Value	Charge	Order Value	Charge
	$5.00 - $9.99	$2.00	$50.00 - $75.00	$6.50
	$10.00 - $24.99	$3.50	$75.00 or more	N.A.
	$25.00 - $49.99	$4.50		

Terms available to approved applicants

SA Customers: Credit facilities available through AGC
Adelaide: 10 Pulteney St Adelaide

VISA · MasterCard · bankcard welcome here

DICK SMITH ELECTRONICS PTY LTD

P.O. Box 321, North Ryde N.S.W. 2113. Tel: 888 3200

Offer concludes on 31/7/86 or until stocks last. Prices can be increased without notice due to fluctuations in currency, high interest rates, government taxes and imports.

Foolproof loudspeaker protection

Your trusty docile amplifier is a dangerous menace to your speakers. It could lash out at any time, to damage both itself and your loudspeakers and land you with a repair bill running into thousands of dollars. Does this sound like exaggeration? And if it is not, is there a way to avoid the risk? Read on.

by LEO SIMPSON

Your ever-faithful stereo amplifier really does present a risk to your loudspeakers and to the rest of your home. Hard to believe? Consider the following case history which demonstrates just how big a risk there is.

It happened fairly recently. A reader phoned to ask how a loudspeaker could catch fire. He explained that it had happened to one of his well-loved speakers which were part of a system of European origin and impeccable reputation. The speaker had caught fire which then ignited the curtains and then the pelmet. The timber window frames were well on the way too by the time the fire was luckily discovered. Well, you might think it was lucky until your hear the rest of the story.

The luckless reader also wanted to know what to do about some new loudspeakers and then just casually mentioned that his amplifier was also in for repair. While he didn't know it, he had just fingered the culprit in this unhappy turn of events.

Loudspeakers by themselves do not catch fire. They can't. But amplifiers can and do fail. When they fail, they often take the loudspeakers with them. And occasionally, if there is no one present when the failure occurs, the speakers catch fire.

An internal fault in the amplifier, which may be caused by the failure of a very minor part such as a 40 cent transistor, is often to blame. It effectively turns your low-distortion, high power amplifier into a very large battery. This very large battery is then able to deliver a great deal of power to the loudspeaker, causing the voice coil to become red-hot. If you are lucky, the voice coil will burn out before any more damage can be done. If you are not, the process can go a lot further.

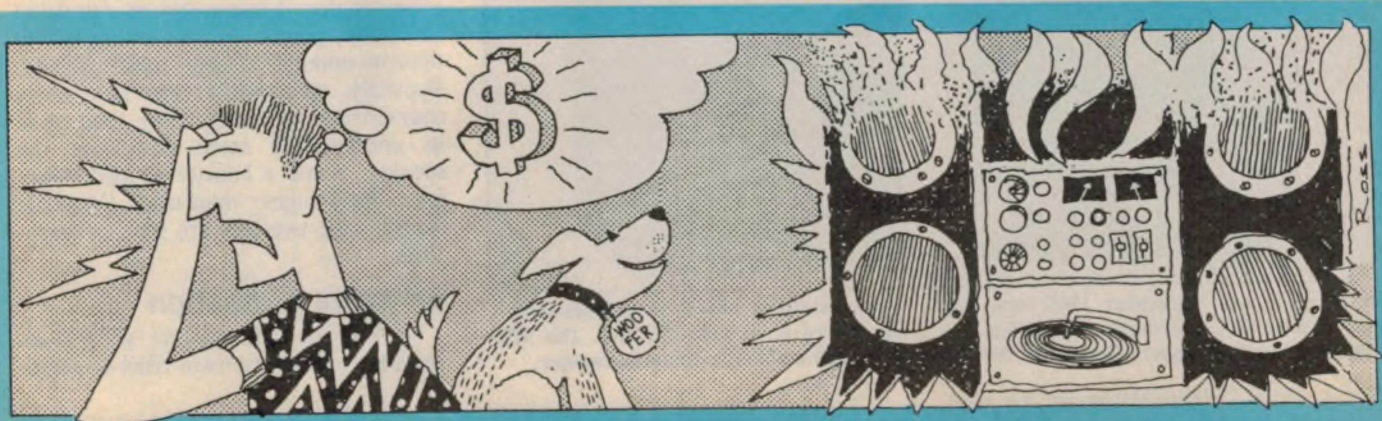
The red-hot voice coil sets the cone on fire. This is usually the woofer which has a large cone of paper or plastic. It can then set the grille cloth alight and the filling material behind the cone also starts to smoulder. This produces a lot of smoke.

Smoke damage

Our luckless reader said that the amount of smoke produced was incredible, filling the whole house. It was so bad that the whole inside of the house eventually had to be repainted. As you might expect, the burnt curtains weren't cheap to replace either, and cost the best part of a thousand dollars.

That all sounds bad enough but the list gets longer. All the carpets in the house had to be taken up, steam-cleaned and then relaid. And all the clothing had to be sent out to specialist dry cleaners to remove the dirt and smell of the fire.

Just imagine the disaster it would have been without contents insurance.



Loudspeaker protection

Now before you go and rip out your hifi system, let me reassure you. Such catastrophes don't happen very often. In fact, they happen very rarely. This was by far the worst case that I had ever heard of. And usually, when an amplifier does fail, someone is on hand to turn it off immediately, before things get out of hand.

The problem of failing amplifiers blowing loudspeakers really only arose about 10 or 12 years ago, when direct-coupled amplifiers started to become commonplace. Before that, most amplifiers were capacitively coupled to the loudspeakers, typically via a $1000\mu F$ electrolytic capacitor. This effectively stopped any DC voltage from getting to the loudspeaker(s) in the event of an amplifier fault.

Why not fuses?

With the advent of direct-coupled amplifiers, many designers recognised the inherent risks to the speakers and incorporated relay protection circuits. The problem with fuses is that, whether they are placed in series with the amplifier supply lines or the speaker outputs, they must have sufficient rating to allow the amplifier to deliver full power. If this criterion is met, as it must be if fuses are not to blow prematurely, there is little protection for the speakers in the event of an amplifier fault.

Consider the case of the current Playmaster Sixty-Sixty which is typical as far as this argument is concerned. It delivers up to 105 watts into an 8Ω loudspeaker on musical transients and over 150 watts into a 4Ω loudspeaker under the same conditions.

To do that reliably, each power amplifier is fitted with 5A fuses in the positive and negative supply lines. Now what happens if the amplifier develops a fault whereby the output is latched up to the positive or negative supply rail! This means that the full 50V rail is applied to the loudspeaker although it is likely to droop somewhat, to say 40 volts or so. With the typical voice coil DC resistance of around 6Ω, the current flowing will be approaching seven amps and so the fuses are likely to hold forever. But with this current flowing, the voice coil power dissipation will be up around 280 watts!

No wonder the voice coil gets red-hot.

This is why relay protection circuits have become standard in most but by no means all high fidelity amplifiers. And there are lots of older direct-coupled amplifiers which don't have this protection.

The relay protection circuit which has been a feature of Playmaster amplifiers is fairly typical of commercial practice but has one refinement. The relay is arranged to not merely disconnect the amplifier but also to short the loudspeakers out. The significance of this is that when the heavy fault current flows through the loudspeaker voice coil, an arc will be drawn across the opening contacts of the relay and the arc is likely to maintain itself rather than voluntarily extinguish.

By arranging the relay to short the loudspeaker, the arc is effectively taken to the 0V line of the amplifier. This then blows the abovementioned fuses (and possibly also the output transistors) but then no further damage occurs.

The foregoing demonstrates just how intractable a large hifi amplifier can be when it develops a fault and why relay protection is so worthwhile. The bill for repairs to loudspeakers is usually much more than that for the amplifier.

The compact disc risk

But even if it has relay protection your amplifier can still destroy your loudspeakers. We had a recent call from a reader who had just completed the Playmaster Series 200. He was delighted with the amplifier but reported that he had just blown his tweeters with the first playing of the 1812 Overture on Telarc compact disc.

A number of loudspeaker distributors we have spoken to have stated that this particular compact disc ought to be banned — it is so dangerous. People whack the disc on the player, wind up the volume and sit back to enjoy the lashings of sound. Then the cannons let go and there really are wisps of smoke coming from the speakers. Or the tweeters are open-circuit.

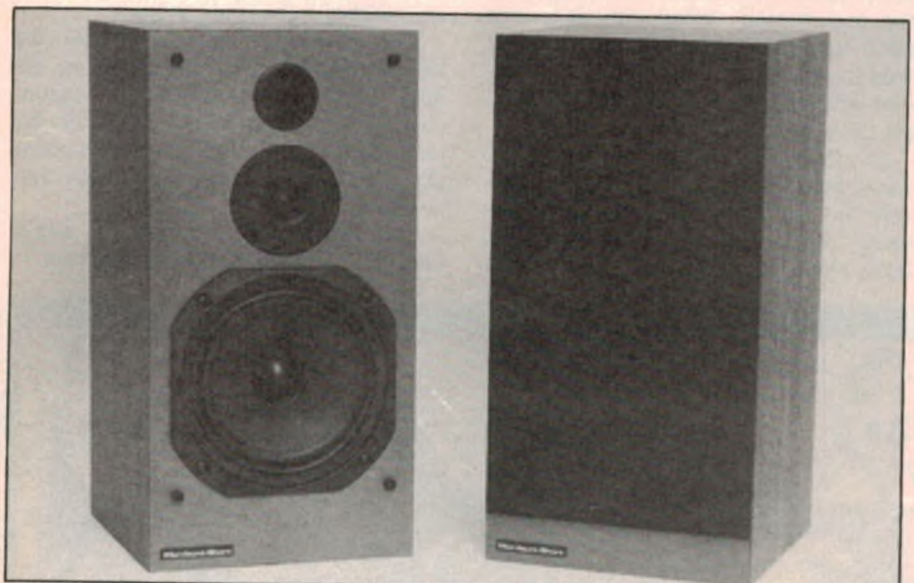
Another scenario in which compact discs can blow speakers is where the user merely advances the volume control too far before the music starts. You can be lulled into doing this by the extreme silence from the compact disc player.

This is why the new Playmaster Sixty-Sixty has an index mark on the volume control to show where clipping occurs with the maximum CD output signal of 2 volts RMS. We predict that this will become a common feature on amplifiers in the future so that there will be less likelihood of people subjecting their loudspeakers to severe over-drive.

The problem with an over-driven amplifier is that it is capable of delivering far more power to the loudspeakers than its nominal ratings would indicate. Typically, an amplifier that is severely over-driven will deliver more than twice its continuously rated power to the speaker. Since a heavily clipped waveform has a higher than usual harmonic content, the tweeters are the first casualties.

Effective protection

So how do you protect your loudspeakers against the twin risks of ampli-



Reviewed in our September 1985 issue, these Mordaunt-Short MS-30 loudspeakers employ Positec PTC thermistor protection which has proved to be very effective. The MS-30s have now been superseded by the MS-35 model which employs a titanium tweeter.

fier faults and CD over-drive? Until now, there has been no truly effective answer. A number of loudspeaker systems are available with inbuilt protection systems but these have usually been only on the more expensive systems. Usually, the protection has been based on relays. For the reasons outlined above, these are more or less effective against amplifier DC faults but less effective against straight over-drive.

One British loudspeaker manufacturer has come up with the answer. Mordaunt-Short has Positec. Last year, in the September issue of *Electronics Australia* we reviewed the Mordaunt-Short MS-10 and MS-30 loudspeakers. Apart from their good sound qualities we were particularly impressed with their Positec protection system.

We gave the Mordaunt-Shorts a torture test which included connecting them directly across a 30V high-current supply. No problems at all. The current immediately rose to about six amps which almost as quickly was knocked back to less than an amp. Neat.

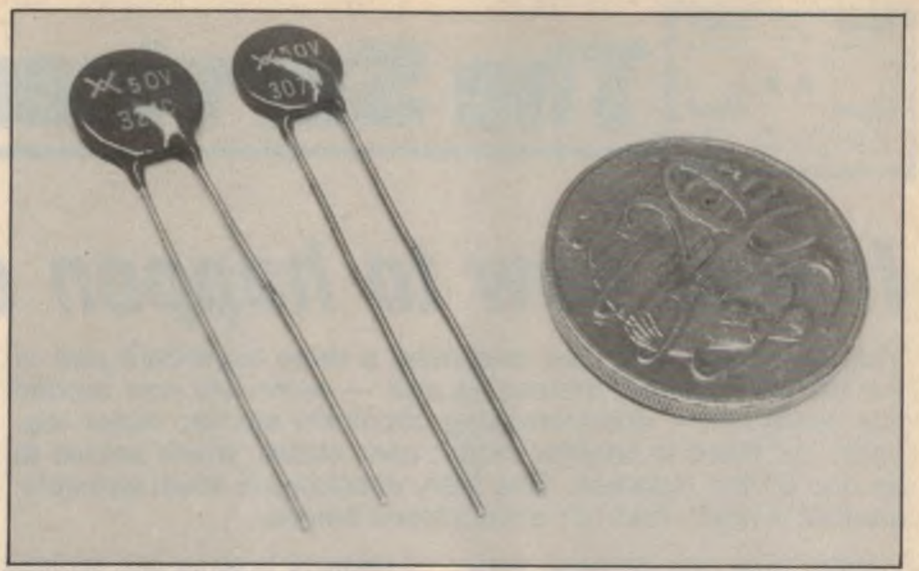
At the time we determined that the Positec system was based on positive temperature coefficient (PTC) thermistors. These are connected in series with the woofer and tweeter and normally present a very low value of series resistance, ie, less than 1Ω. However, once their designated current rating is exceeded, they suddenly go very high in resistance, so that the damaging current is reduced to a negligible value which can't cause any damage.

Removing the current allows the thermistor to resume its very low resistance value and normal speaker performance is restored.

As such, these PTC thermistors are far more effective than fuse or relay protection and have the virtue of extreme simplicity. That is the story as we perceived it last year and that is where it would have remained except that these thermistors are now available in Australia.

The devices in question are made by Raychem Corporation of the USA and are referred to as Polyswitch Protectors. Instead of being based on barium-titanate, as many thermistors are, these new devices are based on conductive polymers. They look like ceramic disc capacitors (coated in blue) but act like resettable solid-state circuit breakers.

The new PTC thermistors are composed of crystalline polyolefin or fluoropolymer matrices in which carbon black particles are dispersed. At normal temperatures, the carbon black particles form chains in the polymer, giving it a very low resistivity. Typical resistivity is one ohm-cm at 20° Celsius and is determined by the type of conductive particles as well as by the volume ratio of conductive particles to polymer.



Pictured are the two Polyswitch Protectors which will be initially available from parts stockists. They are the RDE 050 and RDE 115A.

Small variations in the particle-to-polymer volume ratio produce very large changes in resistivity. And the volume of the crystalline polymer changes abruptly at temperatures near the polmer melting pot. The melting pot temperature is around 120° Celsius.

So what happens when the operating current of the Polyswitch is exceeded is that the interior of the device partially melts, which suddenly increases the volume and disrupts the chains of conductive particles. This increases the resistance drastically and reduces the current.

The device stays in this state while the current is maintained because its temperature is elevated. Once the current is removed, the conductive particle chains re-establish themselves almost immediately, so that the low resistance value is restored.

Other applications

As such, Polyswitch Protectors have much wider applications than for loudspeaker protection. They are available in a large range of current and voltage ratings to protect all sorts of devices which need resettable overload protection.

For the purpose of loudspeaker protection though, they are ideal. Their normal resistance is so low that their effect on speaker performance is negligible. And, with correct device selection, they give virtually foolproof loudspeaker protection.

An indication of this is the service record of Mordaunt-Short loudspeakers in Australia. With many hundreds of Positec protected speakers sold, Concept Audio, the distributors have not had to replace a single tweeter or woofer. That is a remarkable record.

We have been able to arrange for two of these Polyswitch devices to be made available immediately in Australia. They are the RDE 050A and RDE 115A. These are 50V devices with ratings of 0.5 and 1.15 amps respectively. Their respective nominal resistances are around 0.4Ω and 0.12Ω.

The RDE 050A is suitable for protection of tweeters in systems with music power ratings up to 100 watts while the RDE 115A will protect midrange drivers and woofers up to around the same rating.

Installation is simply a matter of soldering the respective thermistors in series with the woofer and tweeter. For the cost of a few dollars per device, it's simple and elegant.

As far as hobbyists are concerned, these Polyswitch Protectors should shortly be available from parts stockists such as Jaycar Electronics and Dick Smith Electronics. Dealer enquiries should be directed to S.F.I. Australia, PO Box 50, Dyers Crossing 2429. Phone (065) 50-2254.

Acknowledgements

We thank Trevor Wilson of North Shore Hifi for his assistance in the sourcing of material for this article. Mordaunt-Short loudspeakers are distributed in Australia by Concept Audio Pty Ltd, 98 Old Pittwater Road, Brookvale, NSW 2100. Phone (02) 938-3700.

The Serviceman

It was dew to happen eventually

Video recorders are now becoming a more significant part of the servicing scene. Increasing age — some are now around five years old — and increasing popularity are two major reasons, but there is another factor; user abuse, which seems to be one on the increase. One story describes a novel example; another a fault I had not encountered before.

Almost since their inception, video recorders have been branded as likely to need more service than any other domestic appliance. There was good reason for such an assumption. They are undoubtedly the most complex device yet offered to the general public and, by reason of the precision mechanical section involved, it would be reasonable to expect that they would require more service than TV receivers.

While this is undoubtedly true, my impression is that it has not proved to be nearly as bad as was expected. Some of the five year old sets I am encountering are in for their first service — which is not bad by any standards. And, if we discount physical damage and abuse, the difference in reliability between recorders and TV sets is not all that great.

Having said that, here are the stories. The first describes a fault I had not encountered before. It should have been routine — and doubtless it will be next time — but lack of experience sent me off on a false trail.

It concerned a Sharp VC-9300X. The customer rang me, described the machine, and complained that it would fail intermittently. He went on to enquire as to what a repair was likely to cost, apparently imagining that I possessed a crystal ball — and the necessary modem to connect it to the telephone line — whereby I could make an instant diagnosis.

When I explained that there was no way I could give him any kind of figure at this stage he seemed to understand, but went on to say that he was worried about the likely cost of repair. He had had the machine for some time and, if repairs looked like costing several hundred dollars — which he heard could happen — he would rather put such a sum towards a new machine.

I countered by saying that, barring a catastrophic failure — which didn't seem to be indicated — I seriously doubted whether any normal repair would cost much more than $100; or $150 at the very outside. In any case, if I found something so serious as to involve this kind of cost I would advise him before making any commitment, so that he could cut his losses.

This seemed to set his mind at rest and, in fact, he indicated that he would be quite happy to spend up to $150 if that was necessary. I can only imagine that he had a much larger sum in mind to start with. Anyway, he agreed to bring the machine into the shop at the first opportunity, which he did a couple of days later.

I was rather busy when he arrived, but I switched the machine on and pushed a cassette into it. It accepted the cassette readily enough but that was all. All attempts to make it play were fruitless. So I advised the customer to leave it with me until I had time to examine it properly.

When I did look at it again results were much the same; it accepted a cassette, but would go no further. Looking along the controls on the front to make sure that I hadn't neglected to push an appropriate button I suddenly realised that a beady little red LED was blinking at me. Closer examination confirmed that it was the dew sensor indicator.

Dinki di dew?

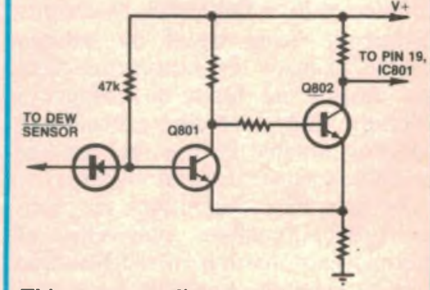
Well, that explained the failure, at least in broad terms. The question was, was there a fair dinkum dew problem, or was it a false alarm? I strongly suspected a false alarm, if only because the weather was warm and dry and several other machines on hand were behaving properly, at least in this respect.

But if it was a false alarm, what form was it likely to take? The truth was I had had no practical experience whatever with dew sensor systems, and this was the first time I had ever seen one activate. About all I knew — mainly from hearsay — was that the actual sensor was basically a resistor which changed value with humidity, but I had no idea what values were likely to be involved.

Fortunately I have a circuit for this machine, so I unfolded it and began looking for the dew sensor section. I found it readily enough, but it didn't tell me a great deal. It involved two transistors, Q801 and Q802, in a direct coupled configuration, the input being fed from the sensor, and the output going to an IC — pin 19 of IC801.

Analysing the Q801, 802 network I concluded that, if the dew sensor was in a low resistance condition it would pull the base of Q801 down towards chassis and, presumably, far enough to turn it off. With Q801 turned off, the base of Q802 would rise towards the positive rail voltage, turn the transistor on, and pull its collector down towards chassis. Since the collector was connected directly to pin 19 of IC801, this pin would be deprived of any significant voltage.

On the other hand, if the dew sensor went high, the reverse would apply. Q801 would be turned on, 802 would be turned off, its collector would rise towards the positive rail, and apply this voltage to pin 19 of the IC.



This two-stage direct coupled amplifier connects the dew sensor to IC801.

That much established I assumed that the dew sensor would go low under high humidity conditions, so that a false alarm would be most likely due to either a fault in the sensor, in the base circuit of Q801, in Q801 itself, or in or around Q802.

So the first thing to check was the sensor, by the simple process of removing it. It is located in the vicinity of the recording drum and it was a simple matter to trace the leads to a nearby board and unsolder them. Then I pushed a cassette in and tried again.

But no joy. The machine remained as stubborn as ever. So it looked as though I would have to delve deeper into the Q801, 802 circuit. However, I had to leave the job at that stage to attend to house calls and honour other jobs I had already promised by a certain time. So the Sharp was covered with a protective plastic sheet and pushed to one side.

Talking shop

A couple of days later, before I had had time to look at the machine again, I met a colleague at a social function and, inevitably we talked "shop". I mentioned the dew sensor problem, hoping that he might be able to offer some suggestions, but it transpired that he had even less experience with these circuits than I had.

However, our conversation was overheard by yet another colleague who, by his own admission, had had ". . . a lot of experience with this problem." Unfortunately, it transpired that all his experience had concerned genuine humidity problems. "All you have to do is direct some hot air into the machine to dry it out."

When I emphasised that the problem was almost certainly a false alarm, and that the machine had not responded to removing the dew sensor, he agreed that it was not as simple a problem as it had at first sounded. But the interesting point is that, had he been as familiar with the circuitry as he seemed to be, he would have immediately spotted the flaw in my reasoning, because I had been caught.

The solution came about quite by accident. Before I could get back to the job and really get stuck into things, I happened to be looking through another manual, for a completely different fault in a completely different machine (National NV-450), when the words "Dew Sensor" seemed to leap out of the page.

Naturally, I stopped to look in the hope that this description might be more helpful. And it was; in particular there was a graph showing the resistance of the dew sensor plotted against humidity. More importantly, it indicated that the resistance increased with increasing humidity; exactly the opposite to what I had assumed.

So disconnecting the dew sensor was the wrong thing to do, whether it was faulty or not. Doing so would simply simulate a situation of high humidity, and turn the relevant functions off.

Gotcha

So what would happen if I connected the dew sensor terminal to chassis? Leaving the job I was on I grabbed a soldering iron and, in a few moments, had made the necessary patch. And that was it; the machine came to life immediately and did everything it was supposed to do. I kept it going for the rest of the day, on and off, and it didn't miss a beat. On that basis I concluded that the sensor had an intermittent fault.

Unfortunately, I had none in stock and had to put them on order. When they arrived a couple of days later I took the opportunity to make some resistance measurements of my own. In broad terms these agreed with what was shown in the graph, although the exact values differed slightly.

Under ambient conditions, which were not particularly humid, resistance was around 1500Ω. Breathing lightly on the sensor would send it up to between 5kΩ and 10kΩ and a really heavy breath could send it up towards 50kΩ. Not very scientific perhaps, but very effective.

But I must confess to being puzzled as to how these devices work. The idea of moisture increasing the resistance of any substance is completely contrary to all generally accepted ideas. I can only assume that some brilliant backroom boffin has come up with some completely new substance or compound.

Incidentally, I did try spraying the device with freezer, to see whether they are temperature sensitive. I am still not sure of the answer, but the result was most interesting. Nothing happened initially but, after about 20 seconds, the needle suddenly shot hard across the scale to the region 100kΩ. I assume this was caused by the formation of frost on the sensor.

After that, of course, it was all plain sailing. I fitted a new sensor, gave the machine a routine clean-up, put it through its paces several times during the day, then rang the owner to tell him he could collect it. Naturally, he was very happy with the result. Not only was the machine back in operation, but it had not cost anything near the amount he had expected, or that we had talked about.

So I had another satisfied customer.

User abuse

I have already related some stories of user abuse in previous notes. Remember the character who built his recorder into a cabinet assembly that shut off all ventilation, then stored his tapes in the freezer to make them play? And, more recently, the family who used a faulty cassette salvaged from the local tip?

Well, here's another one. It concerns a Rank model RV-340. A young housewife brought it to the shop in her car, accompanied by two children, one a baby and one a little girl of about three or four years — certainly no more than four. The basic complaint was simply that the machine would not operate, but the lady went on to say that she suspected that the little girl had ". . . done something to it", to use her own words. (A point to note here is that this machine is a top loading model, rather than the more popular front loading variety.)

She had no direct evidence of this, or any idea what might have happened, but she explained that the youngster had learned how to open the cassette cage, insert a cassette, and operate the necessary buttons and controls on the recorder and TV set to make the system play. (I couldn't help wondering whether I could have learned to operate a video recorder at four years of age — I'd only just learned to light a Primus stove!)

Anyway, it was after the child had used it that the machine suddenly refused play, so the natural assumption was that she might be responsible. And she added that the cassette cage had been quite sluggish in opening of late, to the point where it sometimes had to be assisted.

I gave the machine a quick check while the lady was there. The cassette cage opened readily enough on this occasion, so I inserted a cassette and pressed the "PLAY" button. Nothing happened except the red indicator LED marked play lit up. The same thing happened when I pressed the "FAST FORWARD" and "REWIND" buttons; the indicators lit up, but nothing happened.

There was little more that I could do at that stage, so I simply suggested that the lady leave it with me. One point that was worrying me was the fact that I had no manual for this machine so, un-

The Serviceman

less it turned out to be something fairly obvious, I might have to send it back to Rank.

No lamp

I had to put it aside for the moment, but eventually found time to get the main cover off and examine the drum, transport system, cassette cage mechanism, etc. At first I could see nothing obviously wrong and even went through the motions of trying to make it play. It wouldn't, and then I suddenly realised that the cassette sensing lamp — which works in conjunction with a photocell — was not glowing.

Hoping that it was a simple case of a burnt out lamp, I reached for the meter leads and checked the supply points feeding the lamp. Unfortunately, there was no voltage here, suggesting the loss of at least one supply rail, and a more serious fault.

There is a bunch of fuses adjacent to the power supply, and this was my next check point. Sure enough, fuse F4, rated at 2.5A, was blown. I inserted another fuse of the same rating, crossed my fingers, and switched on. There were no fireworks, the cassette sensing lamp came on, and the machine responded immediately when I pressed the "PLAY" button.

I put it through its various functions several times and it performed faultlessly, but I wasn't very happy. The fuse had obviously blown, as distinct from simply fracturing, and there had to be a basic fault which had caused this. Since it was obviously intermittent in nature, finding it could prove a headache.

At the same time I had noticed a slight tendency towards the other fault the lady had mentioned; the cassette cage sticking in the eject mode. Mainly to give me time to think about the main problem, and also in the hope that I might chance upon a clue, I decided to investigate this problem next.

Unlike front loading systems, where the cage is motor diven, most top loading systems are simply spring loaded and held closed by a catch attached to the eject button. However, it is usual to provide a restraining mechanism to prevent the cage from opening with a violent jerk. In this case it is a gear train, including a worm gear, which provides a very high ratio and ultimately drives a small fan, which provides a braking action.

This mechanism was housed in a rather flimsy sheet metal frame, and this had become distorted. I suspect that, inititally, the cage had failed to open properly and that someone, probably the little girl, had forced it.

Anyway, the assembly was held by only one screw and was easy enough to remove and straighten. Provided it is treated with normal care it should give no further trouble.

Dead again

I had to leave the job at this stage and when I came back to it a couple of hours later, and tried to play it, it had gone dead. A quick check confirmed that fuse F4 had blown again. Well, at least that dispelled any lingering doubts as to the existence of a fault. But where was it?

I replaced the fuse, which held initially, then watched it carefully as I pressed the "PLAY" button. Sure enough, as the loading motor wrapped the tape around the drum, the fuse glowed a dull red — but it held. I pressed the "STOP" button and the tape unloaded normally with no sign of distress at the fuse. I went through this load and unload process a dozen times or more, but was unable to create any further signs of overload at the fuse.

At this stage I was inclined to suspect the loading motor. If it was faulty, and tending to stall, it could be drawing excessive current during the load operation, when the fault seemed to occur. But why was it intermittent? And, more importantly, could I justify replacing it on such flimsy evidence?

I left the machine overnight, came back the next morning, pressed the "PLAY" button, and — "splat" — out went the fuse. I fitted yet another fuse and tried again, watching the fuse carefully this time. And everything was back to normal, at least as far as the loading function and fuse behaviour were concerned. But when I looked at the picture I realised that we had yet another fault.

The picture had a series of streaks across it, similar to those produced by some machines in the fast forward mode. But the picture wasn't running fast. If anything — I turned up the sound and confirmed what I suspected — it was running slow! At this point I really felt that I was getting out of my depth. Surely it was time to bow out and pack the whole thing back to Rank and let them sort it out.

It was only when I realised the difficulty of trying to explain what had happened so far, and convincing anybody else that it had happened, that I hesitated. Having come this far I decided to stick with it a little longer. It proved to be a wise decision.

I turned the machine off, then on again, went through load and unload cycles a couple of times, and came up with exactly the same performance. I left the machine running while I contemplated what to do next and this is when I received the first real clue as to the fault. I observed what appeared to be a tiny wisp of smoke coming from the recorder.

It was only a tiny puff and I could quite easily have missed it, but I was quite sure it had happened. More importantly, I had seen where it came from. This machine has the usual printed board along the front, carrying the various control buttons, and which sits behind a dress panel. Behind this again is another smaller board in front of the cassette cage mechanism. It is about 18cm long by 7.5cm wide.

This board sits in two slots moulded in the main case, with the component side to the front. Behind it is a fibre insulating panel, supported separately and about 3mm clear of the print side of the board. Its exact purpose is not clear because, behind it again, is part of the plastic case moulding, and there is nothing metallic to foul the print pattern. But its presence is important to the story.

It was from the vicinity of this board that I felt sure I had seen the smoke and, as one does automatically in such circumstances, I had hit the power switch immediately. I looked down into the space but could see nothing, so I gingerly turned on the power again. The machine came to life again, but still running slow and, yes, there was another little curl of smoke.

Trying to see from where it was originating I more or less accidentally put my finger on the top edge of the board and moved it slightly, whereupon the picture fault vanished and the machine was back to normal. Hot on the trail I disconnected a couple of plugs feeding the board and pulled it out of its slots.

I fully expected to find a charred component, or something equally obvious, but there was nothing to be seen. I went over the component side, device by device, even using a glass where appropriate. I found nothing. Then I went over the copper side, again with a glass, looking for dry joints, hairline cracks, or slivers of solder. Once again I drew a blank.

It all makes cents

I realised that, if the worst came to the worst I could replace the board, but I decided to try putting it back and wiggling it around, while energised, in an effort to pinpoint the fault. And it was then that everything became clear. As I looked down into the space to align the board in its slots what did I see, sitting on edge against the fibre insulating panel, but a 20c piece!

Yes, it had been sitting between the copper side of the board and the insulating panel, and resting against various parts of the copper as the machine was moved around. Little wonder that it was intermittent, or that it caused more than one fault. The wonder is that it didn't create more havoc.

It was with mixed feelings that I fished the thing out. While glad that the fault had been finally found, I'm afraid I said some quite rude things about that 20c piece — and about its parent too, and their nuptial state; that is, if 20c pieces have parents!

Anyway, that was it. The only remaining puzzle was how it got there. While I have no doubt that the little girl was responsible, I am surprised that it finished up where it did. With the cassette cage open, a coin dropped into the opening provided would be more likely to finish up underneath the cassette cage. It would have to be deliberately angled forward to finish up where it did.

Even then, it had a choice of falling behind the insulating panel, where it would have caused no problems of any kind; falling on the component side of the board, where it would have been almost as harmless; or falling where it did and creating chaos. So it had three choices, and Murphy saw to it that it chose the worst one.

Finally, I must award full marks to the lady concerned for warning me as to the likely cause of the trouble. As it happened, it probably didn't help much, but at least she tried. I wish more customers would be as outgoing, particularly where unusual circumstances are involved.

I have another story along similar lines which I intended to tell this month, but space does not permit. It will have to wait for next month, but I think it's worth waiting for.

TETIA Fault of the Month

Hitachi CEP-388

Symptom: Set comes on with a short burst of sound then shuts down. Power stays on, but line oscillator is dead.

Cure: TR710 (EHT protector) and the network around it has become over sensitive. The protection network causes more trouble than does the circuit it is designed to protect. The network should rightly be restored to normal, but provided there are no abnormalities in the EHT system operation can be recovered simply by removing the transistor.

ALTRONICS COMPONENTS

Fantastic Savings From The Importer

TOLL FREE PHONE ORDER NEXT DAY DELIVERY

Capital Cities and Suburbs - Country areas allow extra 24-48 hours. With Jetservice

Now Only $89
D 1450

UV Eprom Eraser

Erase your EPROMS quickly and safely. This unit is the cost -effective solution to your problems It will erase up to 9 x 24 pin devices in complete safety in about 40 minutes for 9 chips (less for less chips). • **Erase up to 9 chips at a time** • Chip drawer has conductive foam pad • Mains Powered • High UV intensity at chip surface ensures thorough erase • Engineered to prevent UV exposure • Long Life UV tube • Dimensions 217 x 80 x 68mm • Weight 670 grams

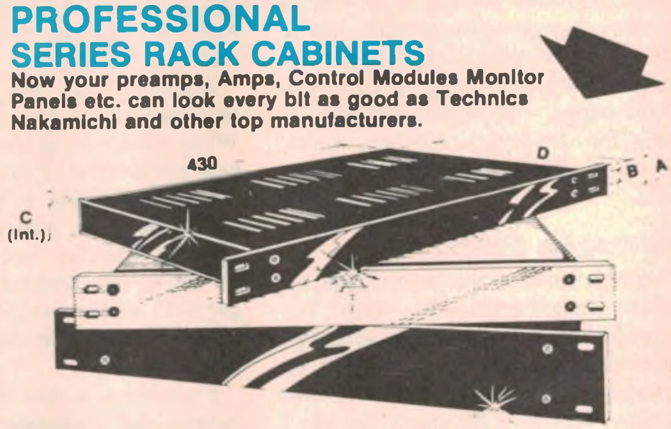
Huge Savings on Popular D Range Connectors.

Items marked • are less than 1/2 Price

DB9		Were	Now
P 3000	Male 9 Pin	2.75	1.25 •
P 3010	Female 9 Pin	3.25	1.75
P 3020	Male PCB Rt/L	3.75	1.85 •
P 3030	Fmale PCB Rt/L	4.50	2.75
P 3040	Male PCB mnt.	2.95	1.45 •
P 3050	Fmale PCB mnt.	3.95	1.85 •
P 3090	Backshell cover	1.95	.95 •
DB15			
P 3100	Male 15 Pin	3.25	1.95
P 3110	Female 15 Pin	3.85	2.25
P 3120	Male PCB Rt/L	4.35	2.15 •
P 3130	Fmale PCB Rt/L	5.50	2.95
P 3140	Male PCB mnt.	3.85	1.90 •
P 3150	Female PCB	4.85	2.40 •
P 3190	Backshell cover	2.20	.90 •
DB25			
P 3200	Male 25 Pin	4.95	2.40 •
P 3210	Female 25 Pin	5.50	2.70 •
P 3220	Male PCB Rt/L	4.95	3.95
P 3230	Fmale PCB Rt/L	6.95	4.95
P 3240	Male PCB mnt.	4.95	2.45 •
P 3250	Fmale PCB mnt	6.25	3.10 •
P 3290	Backshall cover	2.20	.95 •

PROFESSIONAL SERIES RACK CABINETS

Now your preamps, Amps, Control Modules Monitor Panels etc. can look every bit as good as Technics Nakamichi and other top manufacturers.



ALL ALUMINIUM CONSTRUCTION

FEATURES: These beautifully crafted rack cabinet boxes will give your equipment a real Ist class appearance with removable top and bottom cover panels • All dimensioning conforms to the International Standard • Natural or Black finish • Ventilated lid • Deluxe finish front panel • Individually cartoned • Supplied in Flat Pack Form - Easily assembled in minutes - **Side Elevations:-** D=254mm C (Internal Chassis Height) • B (mounting Bolt Centres).

SIX NATURAL AND BLACK FINISH MODELS — The Black or Natural finish cabinets are each available in 44mm, 88mm or 132mm high models. Mounting hole centres conform exactly to International Racking Specifications both vertically and horizontally.

Cat. No.	Finish	A	B	C	Were	Now
H 0401	Natural	44	34	38	$49.95	$47.50
H 0402	Natural	88	57	82	59.50	56.00
H 0403	Natural	132	89	126	69.50	62.95
H 0411	Black	44	34	38	55.00	50.00
H 0412	Black	88	57	82	65.00	59.50
H 0413	Black	132	89	126	75.00	69.50

Mini Bench Vice

Direct Import Price Quality
Die Cast Alloy **T 2365**

$8.95

DIL SWITCHES

GOLD PLATE SELF WIPING CONTACTS — SAVE UP TO 30%

		ea.	10 Up
S 3050	4 Way	1.50	1.40
S 3060	8 Way	2.00	1.75
S 3065	10 Way	2.85	2.40

Look at This!

Superb Quality Nicad Rechargeable's

From an Incredible
From **$1.75**

Cat S 5020

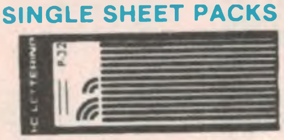
Save Up to 50%

1-9	$2.40
10-99	$1.85
100 plus	$1.75

PRESSURE SENSITIVE—ETCH RESISTANT PC ART AIDS BY IZUMIYA

FANTASTIC IZUMIYA PCB ARTWORK AIDS—The incredible feature of IZUMIYA tapes, symbols etc. is, unlike most others, they are etch resistant—that is you can lay artwork direct on to the copper face of the PCB and etch directly with ferric chloride! — Naturally you can use them to prepare finished artwork to paper, film, metal in the normal manner.

SINGLE SHEET PACKS



ALL $2.25 ea or 10 Up SAVE OR MIX $1.95

DOUGHNUTS

2mm	H 8601
3mm	H 8604
4mm	H 8605

OVAL PADS

3 x 2mm	H 8610
4.5 x 3mm	H 8611

DIL IC PADS

Single	H 8641
Triple	H 8642

TRACKS

0.5mm	H 8621
0.8mm	H 8624
1mm	H 8625
2mm	H 8630

T-CONNECTORS 1mm Gauge — H 8635

EDGE CONNECTORS 3.17mm Pitch — H 8646

NUMERIC
2.7mm/H — H 8658

ALPHA
3.2mm/H — H 8673
3.8mm/H — H 8659

CREPE DESIGN TAPES

H 8700	0.5mm x 16M	$ 3.25	$ 2.95
H 8701	0.8mm x 16M	3.25	2.95
H 8707	1.0mm x 16M	3.25	2.95
H 8708	1.5mm x 16M	3.25	2.95
H 8709	2.0mm x 16M	3.25	2.95
H 8710	Pack of any 4	11.00	10.00

ART TAPE CUTTING KNIFE

	T 2390	$5.75
SPARE PACK OF 6 BLADES	T 2392	$1.50

ROLL PACKS

Ideal for Trade Users
Contents vary each style as dimensions differ. As a guide doughnuts contents 250 PCs

		ea	10 Up
DOUGHNUTS			
2mm	H 8802	$ 3.95	$ 3.60
3mm	H 8803	3.95	3.60
4mm	H 8804	3.95	3.60
TEAR DROPS			
3mm	H 8830	$ 5.50	$ 4.95
4mm	H 8840	5.50	4.95
T-CONNECTORS			
1.6mm	H 8816	$ 6.35	$ 6.05
2.5mm	H 8825	6.35	6.05
IC PADS			
4 x 2.8mm	H 8841	$ 3.95	$ 3.60
4 x 2.5mm	H 8842	3.95	3.60

FOR DESPATCH P&P CHARGES AND ADDRESS DETAILS PLEASE REFER TO OUR AD. ON PAGE 109

Our Top Selling Alarm System - Uses No Wires

Just Imagine a Security/Alarm System you can Install in about an hour — Uses no Wiring or Cables and Costs less than $1 for the mounting Hardware

New UHF 305MHz Microprocessor Control Wirless Security Alarm System

Commercial grade, quality alarm systems are expensive — Just phone one of the "Name" security firms and get a quote for your home—our estimate is that it will be anything up to $1,000 just for the equipment-**then there is the installation**-countless holes punched through walls, miles of wiring and a day or two of installers labour and **that's around $25 per hour these days. Hardly worth the effort is it? After all what have you got to loose?—Only the Video Player, CD Player, Camera, Hi Fi, TV, Jewellery and so on!!**

Well all that is now changed—with our brilliantly engineered Home Guard Wirless Security System Read On—

Take It With You If You Move

Apart from the flawless operation of the Home Guard System—One of the great features is its application with rented or leased premises—Lets face it, money spent on installing a wired system in your Home or Office, Factory etc. is irrevocably lost when you move on. With the Home Guard you simply take it with you.

This alarm system is a brand new design that features completely wireless connection to all accessories, even the reed switches. Think of how easy it is to install a "Wireless" alarm system. The benefits are endless, e.g. arming your Flat or Townhouse with an alarm you don't need to run wires through the roof or drill great holes through your walls. When moving house the alarm is simple to dismantle and re-install elsewhere.

The system divides protected areas into either perimeter zone or internal zone, programmable by dip switches in each transmitter/detector. **Pocket remote control** can simply arm or disarm your house perimeter from your bedside when retiring etc. this allows essential protection while cancelling internal zone as desired. Each transmitter/detector unit can be programmed into interior or perimeter zone. Zones can be programmed for instant or delayed trip. The system has a built-in ear piercing siren for intrusion and panic alarm signals. It also has another dry relay output with normally closed, normally open contacts for connecting to other alarm reporting devices such as telephone dialer, additional outdoor siren etc.

System Is Comprised Of :

Main Control Receiver

S 5265 .... **$299.00**

Features:

- Wireless reception of external or internal sensors or detectors.
- Selectable home or away modes for selecting internal and external arming or just external to allow movement inside the building
- Built in Piezo electric siren gives different signals to indicate different functions.
- N/O + N/C Contacts.
- Sends signal down power line to activate one or more remote sirens.
- Programmable Arm/Disarm switch buttons.

The main control receiver runs on 240V AC with a 12V 1.2AH battery for emergency backup. All other units with the exception of the line carrier, run on a 9V battery each. The average life expectancy is approximately one year. System works around the 305MHz frequency where there is less chance of false alarm. The range of the unit is normally 80 metres in open space.

Alarm and Indication Sounds

Intrusion Alarm — Panic Alarm — Arm Tone — Disarm Tone — Exit Click Tone — Monitor Tone — Tampering Alarm.

Detector/Transmitter Unit (Reed Switch)

Suitable for Windows and Doors

This consists of an enclosed reed switch and compact UHF transmitter and a removable enclosed magnet. The unit is at rest when magnet and reed are side by side (within 25mm or 1 inch). When the magnet is moved away more than approximately 1 inch the alarm signals to the Main Control Receiver and the alarm is sounded. In practise the Reed/Transmitter is mounted on the door or window frame with the magnet on the moving door or window.

S 5270 .... **$49.50**

Passive Infra Red Movement Detector

Ideal for the lounge room, family room or hallways e.g. anywhere where an intruder is likely to pass through. Mounts up on the wall or on top of bookshelves etc. Detects movement within an area of 9M by 9M by sensing intruder body heat movement through the protected area Should not false trigger with the family cat or curtain movement etc. — as is the case with the cheaper Ultrasonic alarms.

S 5280 .... **$99.00**

Remote Piezo Siren

This unit is an optional line carrier receiver. Receives signal through 'AC' line i.e. it would ideally be located in, say, the roof space and plugged into mains power.

S 5290 .... **$99.00**

Complete System Special Package Price

Comprising:

One S 5265 Main Controller
One S 5270 Reed Switch
One S 5280 Passive I/R Detector
One S 5290 Siren
Including Batteries

System Cat.No. S 5260...... **Value $499**

Accessories

Note: For larger installations your system may well require several Reed switches, movement detectors and 2 or more sirens. Also the remote door controller and or pocket remote controls could be very worth while accessories. The fantastic thing about the Altronic system is you simply add more detectors as you discover the need — no wiring, no expensive technicians, no modifications to equipment.

Hand Held Control Transmitter Unit

A real joy to use — keep it at the bedside table — allows you to, say, alarm the house perimeters when retiring or you can take it with you when you go out, arming your system after you lock the door. Unit is a function control transmitter — to send 4 different signals.

Off — To disarm the system before entering. **Home** — To instantly arm the system with 'Perimeter' detection only. **Away** — To arm complete system after a given exit delay time of about 40 seconds. **Panic** — To start an emergency signal whenever needed, in any mode.

S 5275 .... **$49.50**

Front Door Keypad Control Unit

This handy accessory virtually duplicates the function of the Master Controller unit but at a more convenient location i.e. just inside your entry door etc. System can thus be armed or disarmed without the need to go to Master unit. Especially handy for larger homes or offices.

S 5285 .... **$79.00**

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008 999 007 FOR NEXT DAY JETSERVICE DELIVERY

• FOR DESPATCH P&P CHARGES AND ADDRESS DETAILS PLEASE REFER TO OUR AD. ON PAGE 109 •

Remote control for the Playmaster tuner

For the final touch of luxury on your Playmaster Stereo AM/FM Tuner you need the Infrared Remote Control. With this you can sit back and select any of the 12 programmed stations at will or tune to any FM or AM station with the up and down tuning buttons.

Are you an impatient radio listener, dodging from one station to another trying to find the music to suit your mood? Are you a lazy listener, not wanting to shift from your chair when the station you have selected started putting out the wrong notes? If so, you need this remote control accessory if you are to obtain full enjoyment from the Playmaster stereo AM/FM tuner.

You can be far more selective with the remote control. If a particular piece of music or advertisement is not to your liking, then you can zap onto another station with a flick of your button-pushing digit. S'wonderful, S'marvellous!

by JOHN CLARKE

Although the remote control does not mimic all the control functions available on the tuner, it does allow remote tuning to any station. There are two ways to do this.

Firstly, each of the six AM and six FM stations in memory can be selected. This is done using the six memory switches in conjunction with the AM/FM switch on the remote control. Secondly, to access unprogrammed AM or FM stations, use the Tune up or Tune down switches.

The functions not available on the remote control are Seek, Mono, ME (memory enable) and Power on/off.

The remote control transmitter unit consists of a small plastic case incorporating nine pushbutton switches. Two infrared (IR) transmitting diodes located behind a small red window at the front of the case emit coded infrared light. Power for the unit is supplied from a small nine volt battery.

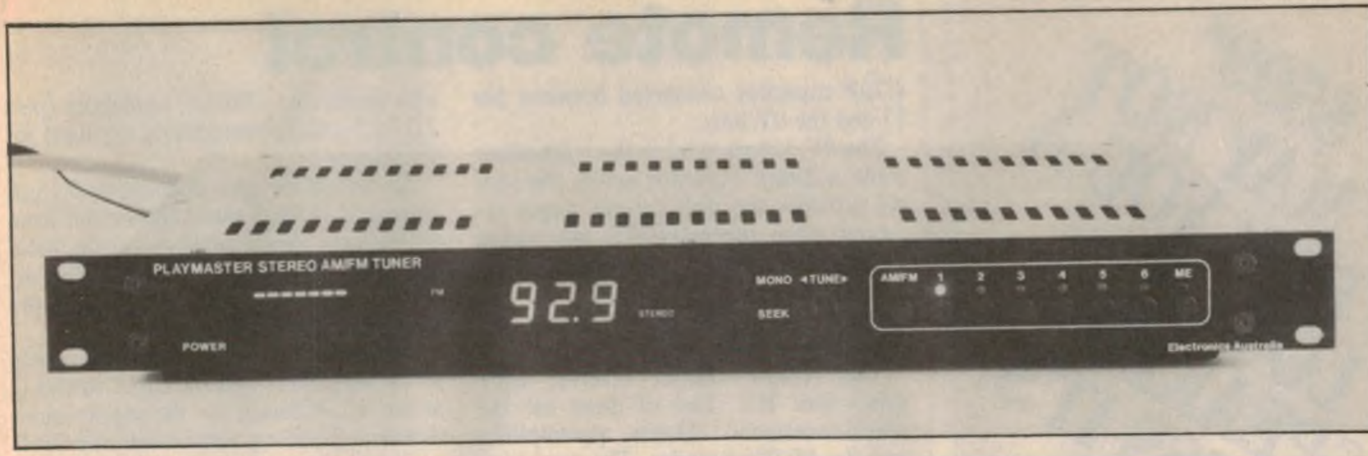
The remote control receiver circuitry is part of the main printed circuit board for the tuner. For receiving the IR transmission an IR detector diode is located directly behind the neutral density plastic screen used for the tuner display.

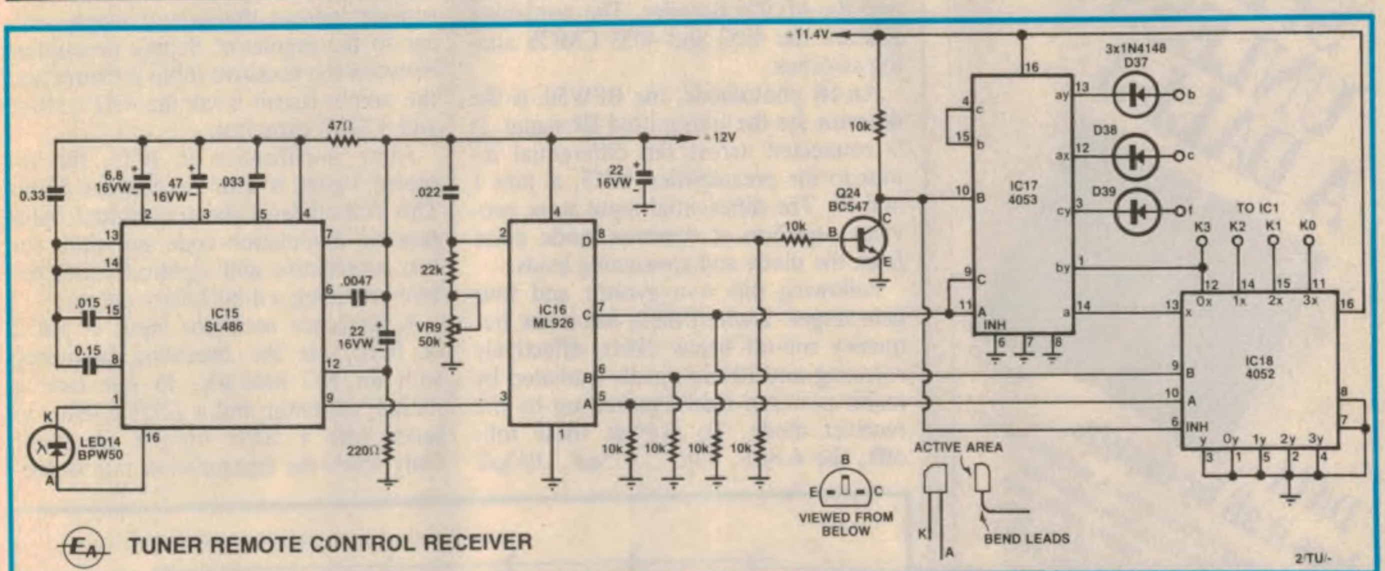
The transmit and receive circuitry is based on the Plessey range of remote control ICs. There is one transmitter and one preamplifier IC in this range, and ten different receiver ICs. These are suitable for TV remote control, models, computers and other general applications.

We used the SL490B transmitter, SL486 preamplifier and the ML926 receiver.

Transmitter circuitry

The transmitter circuit comprises the SL490B, IC14, two transistors and two IR LEDs plus a few capacitors and resistors. The IR LEDs transmit a pulse position modulation (PPM) 5-bit code whenever one of the switches is pressed.





The remote control receiver circuit is based on the Plessey SL486 and ML926 preamplifier and decoder ICs.

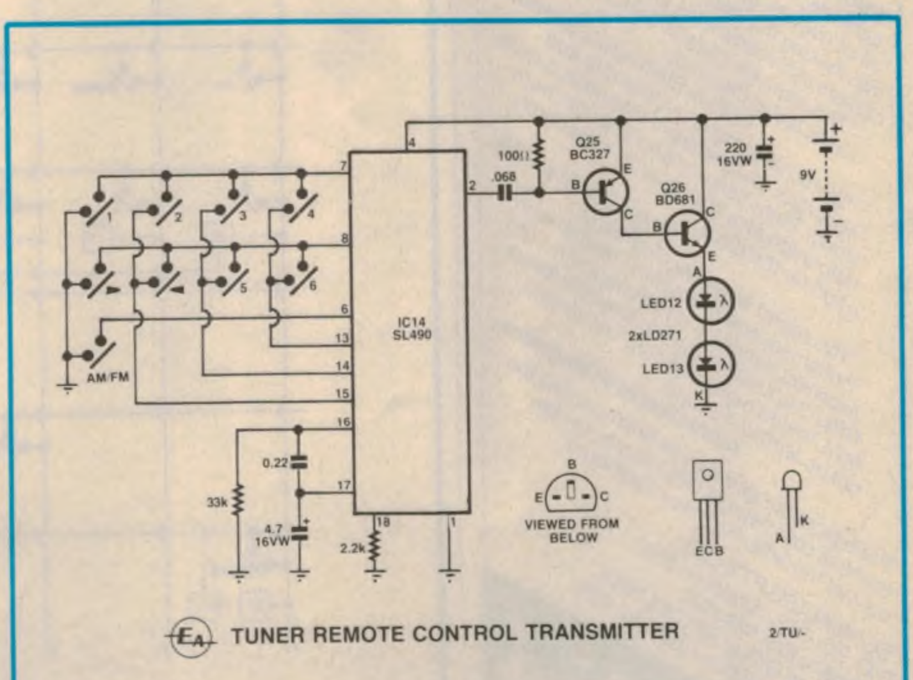
Up to 32 separate code commands are available with the SL490B. This is possible with 32 switches in an 8-row by 4-column switch matrix. Our remote control needs less than this and uses nine switches in a 4-column by 3-row matrix.

Switches for memories 1,2,3 and 4 have transmit codes from 01000 to 01011. The tune down, tune up and memories 5 and 6 have transmit codes from 01100 to 01111 and finally, the AM/FM switch sets transmission of 00100.

Transmit code output is at pin 2 of IC14. It is AC-coupled via the $.068\mu F$ capacitor to the base of transistor Q25 which produces a $15\mu s$ current pulse, each time pin 2 goes low. Thus Q26, which is driven by Q25, directly drives two IR LEDs with these very short current pulses.

The pulse position modulation frequency of transmission is set by the $33k\Omega$ resistor and $0.22\mu F$ capacitor.

Filtering for the internal 4.5V regulator of the SL490B is provided by the



The transmitter uses a Plessey SL490 IC to pulse code modulate two infrared LEDs.

Remote control

4.7μF capacitor connected between pin 17 and the 0V line.

The 9V battery powers the transmitter while a 220μF capacitor across the supply provides the high current surges required when the IR LEDs are pulsed on. Standby current of the circuit is less than 10μA.

Receiver circuitry

The remote control receiver comprises four ICs. Two of these are the above-mentioned SL486 preamplifier and the ML926 decoder. The remaining ICs are the 4052 and 4053 CMOS analog switches.

An IR photodiode, the BPW50, is the detector for the transmitted IR signal. It is connected across the differential inputs to the preamplifier, IC15, at pins 1 and 16. The differential input stage provides rejection of common mode noise from the diode and connecting leads.

Following this is a gyrator and four gain stages. Each of these has a low frequency roll-off below 2kHz, effectively rejecting any 100Hz signals (radiated by mains powered lights) picked up by the receiver diode. To provide these roll-offs, the 6.8μF, 47μF, .015μF, .033μF and finally the .0047μF capacitors (pins 2,3,15,5 and 6) respectively are used for decoupling.

An automatic gain decoupling 0.15μF capacitor at pin 8 filters the output from an internal peak detector which measures the final output at pin 9. The resulting signal controls the gain of the first three amplifier stages.

An internal regulator stabilises supply to the amplifiers and the input to this is at pin 12. Filtering for the supply input is with a 22μF capacitor while the 220Ω resistor reduces the overall supply voltage to the regulator. Supply decoupling between the sensitive input circuitry and the output circuit is via the 47Ω resistor and 0.33μF capacitor.

After amplification in IC15, the received signal is sent to decoder IC16. This demodulates the transmitted pulse position modulation code and waits for two consecutive and identical codes before providing a 4-bit binary output.

A reference oscillator input at pin 2 of IC16 sets the operating frequency with an RC network. In our case a .022μF capacitor and a 22kΩ resistor in series with a 50kΩ trimpot are used. Only when the transmission rate is cor-

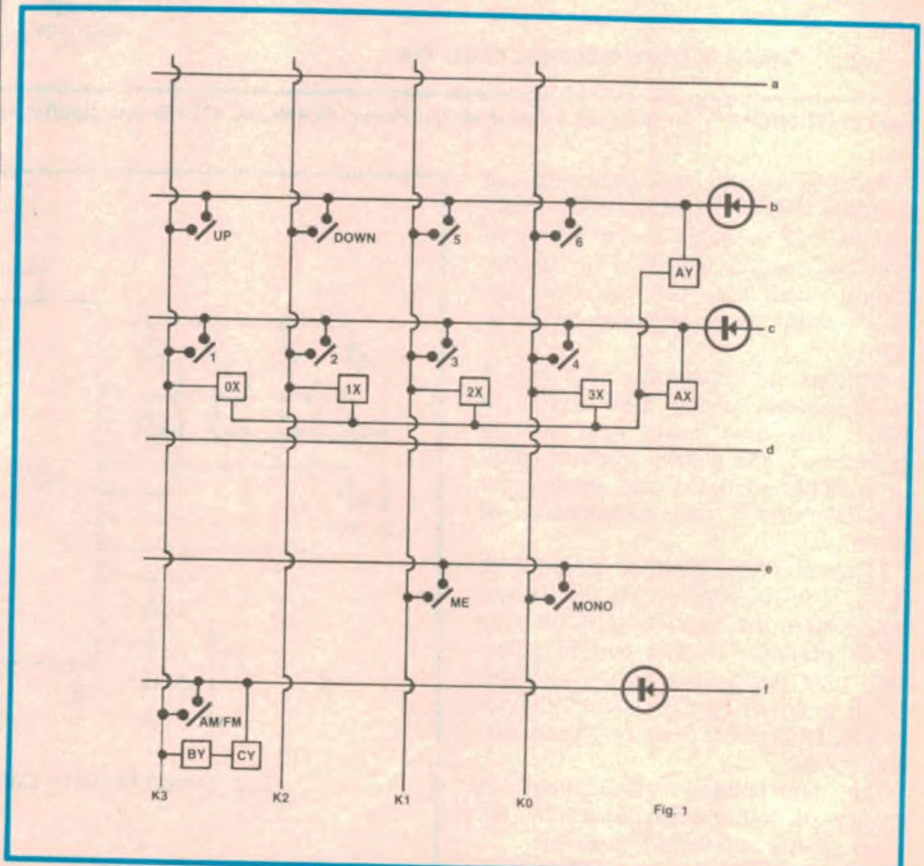
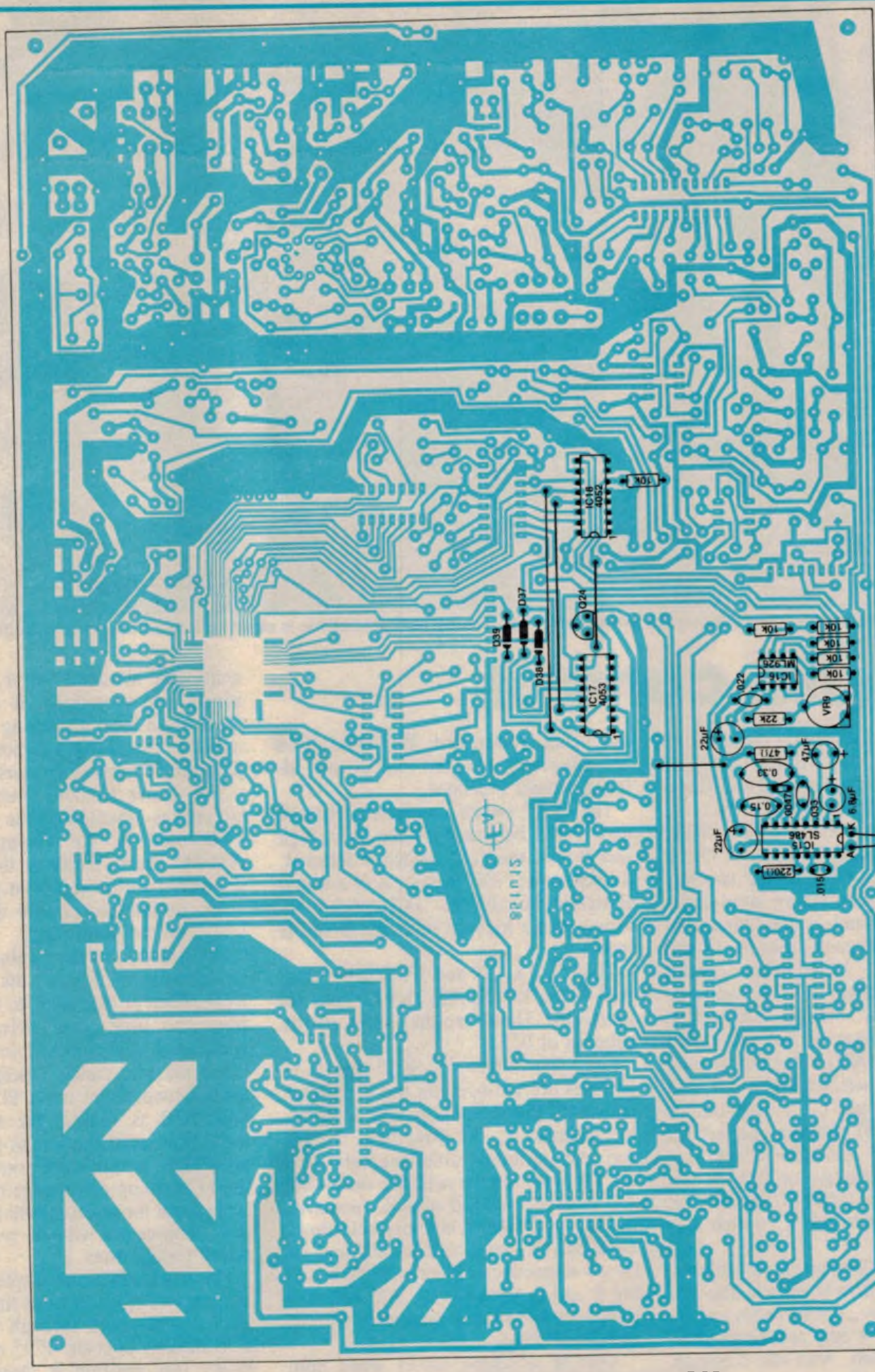


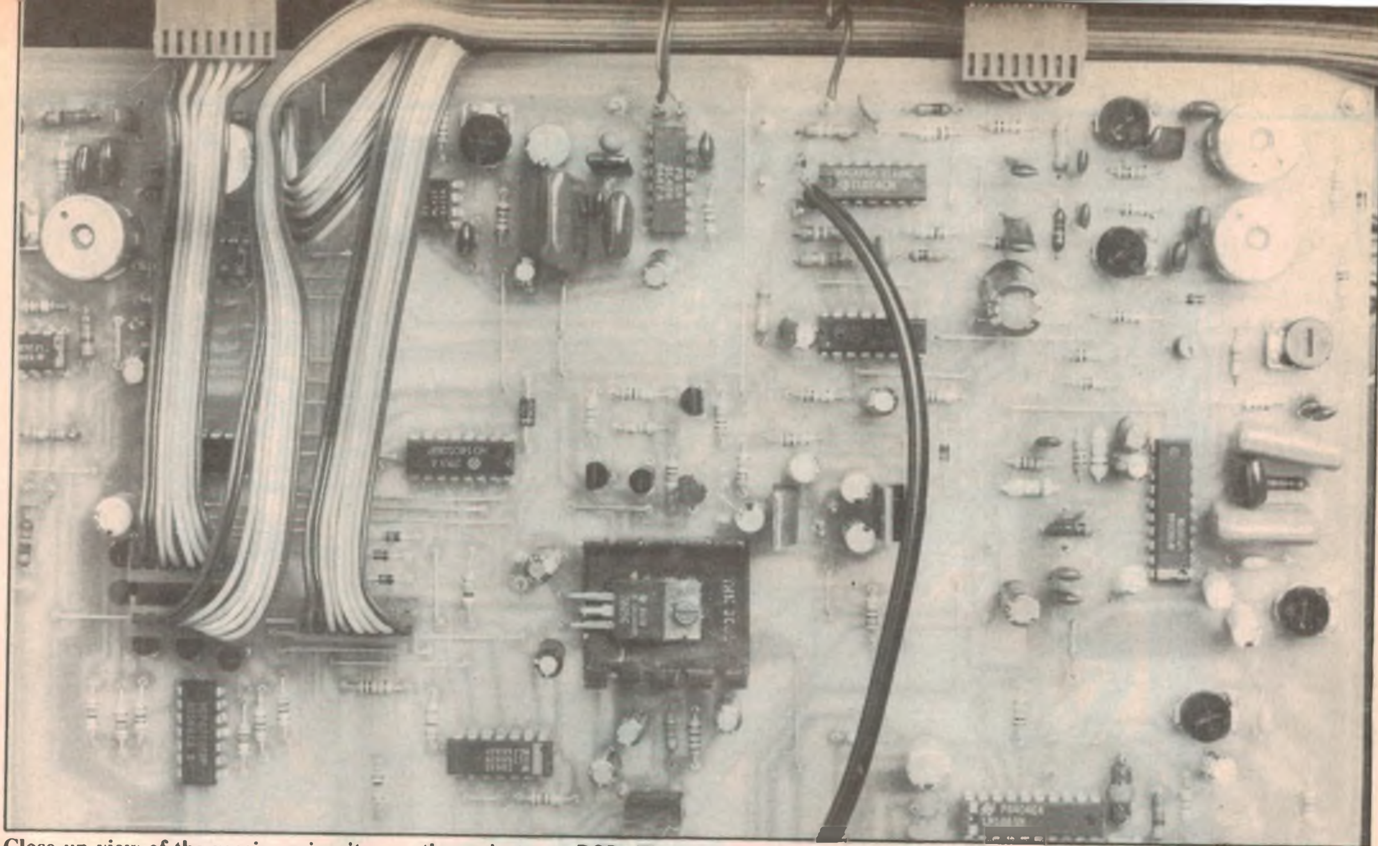
Fig.1: how the IC17 and IC18 CMOS switches are arranged on the IC1 switch matrix.



The receiver circuitry is accommodated on the main tuner PCB.

rect will IC16 provide a decoded output from the received signal.

Outputs at A,B,C and D are normally pulled low with 10kΩ resistors. When a correct code is received, outputs will go high. Note that the ML926 is designed only to receive 5-bit transmitter codes that have the most significant bit low, ie. it really only decodes 4-bit signals. (Another version of this IC is the Plessey ML927. This type responds to codes with the most significant bit high.)



Close-up view of the receiver circuitry on the main tuner PCB. The BPW50 photodiode is mounted behind the perspex front panel.

Remote control

The most significant (D) output from IC16 is inverted by transistor Q24. This D-complement plus the A, B and C signals are applied to IC17 and IC18.

These two ICs are CMOS binary decoders with analog switches. IC17 can be considered as a three-pole two-way switch responding to binary input codes fed to pins 9, 10 and 11. The binary inputs are the A, B and C pins (9, 10 and 11) which have independent control over their respective "a", "b" and "c" switch poles. For example, when A is high, the Y position of the "a" switch pole is selected (AY). When A is low, the X position is selected (AX).

The AX, AY and CY switch output (pins 12, 13 and 3) positions connect via diodes D37, D38 and D39 to the b, c and f segment outputs of IC1 in the Playmaster stereo AM/FM tuner. The BY pole connects to the K3 switch matrix input of IC1.

For its part, IC18 can be considered as a two-pole four-way switch also responding to binary control codes except that we are using it only as a single-pole four-position switch, with the common (wiper) being pin 13.

Note that the INHibit input at pin 6 is normally held high by virtue of the inversion of the D output from IC16. When pin 6 is low, IC18 is selected. This means that when no signal codes are being transmitted, IC17 and IC18 are effectively disabled and do not affect the tuner functions.

The "0X" switch is selected when A and B are both low. When A is high and B low, the "1X" switch is selected. To select the "2X" switch, A is low and B high and finally the "3X" switch is selected with a high on both the A and B inputs.

The 0X, 1X, 2X and 3X switches connect to the K3, K2, K1 and K0 lines respectively. These are the switch matrix columns of IC1.

Fig.1 shows how the IC17 and IC18 switches are arranged on the IC1 switch matrix on the main tuner board. To select memory 1, we close both the 0X and AX switches simultaneously. For the UP selection we need 0X closed but AY is closed instead of AX. Similarly, for the 2, 3 and 4 memory selections, we need AX closed and 1X, 2X and 3X closed respectively. For the DOWN and the 5 and 6 memory, the AY switch is closed along with the respective 1X, 2X and 3X switches.

AM/FM switching occurs when both the BY and CY switches are closed.

Construction

The Tuner Remote Control transmitter is housed in a small platic case measuring 112 x 62 x 31mm. All components are mounted on a PCB coded 85rc12 and measuring 56 x 74mm. A front panel label measuring 114 x 64mm indicates the switch functions as well as providing the finishing touch.

The Tuner Remote Control receiver circuitry is mounted on the main 85tu12 PCB used in the Playmaster stereo AM/FM tuner. Receiver diode BPW50 is secured to the sub-front panel of the tuner behind the neutral density filter screen on the front panel.

Construction of the remote receiver is straightforward. Firstly, the main tuner PCB (85tu12) will need to be removed from the tuner case. Disconnect the audio and AM antenna leads and remove the rear panel. Unclip the 8-way leads between the main PCB and display PCB as well as the short stereo lead. Now undo the screws securing the main PCB. It should be possible to have the PCB sitting up on edge to give sufficient room for inserting the remote control components without removing the power supply wires.

The front panel and display PCB will also require removal to fit the IR diode. Drill a 4mm hole through the display PCB directly opposite IC15 on the main PCB. This position is clearly marked with a copper pad just next to the "t" in the word "top" on the display side of the PCB.

Directly in front of this hole on the sub-front panel, drill another hole to expose the IR detector diode. The leads are bent back on the IR diode as shown on the circuit diagram. Note that the infrared active area is the flat face side of the diode.

Use epoxy resin to secure the IR diode to the sub-front panel. Note that it is important not to allow the leads to make contact with the metal panel and avoid placing glue on the active area of the diode.

Solder short leads to the diode and feed them through the hole in the display PCB. The front panel, sub-front panel and display PCB can now be reassembled.

When assembling components onto the main tuner PCB, follow the overlay diagram and do not forget the links. Note that the ICs, electrolytic capacitors and diodes must be oriented as shown.

After this PCB is completely assembled, it can be bolted back into the case. Replace the rear panel and resolder the audio plus AM antenna wiring. Reconnect the 8-way cables.

With the receiver complete, work can begin on the transmitter.

Insert the resistors, BC327 (Q25), and IC14 in position first. The capacitors and the BD681 (Q26) unconventionally lie sideways on the PCB. This is to leave sufficient room for the switches to protrude through the front panel.

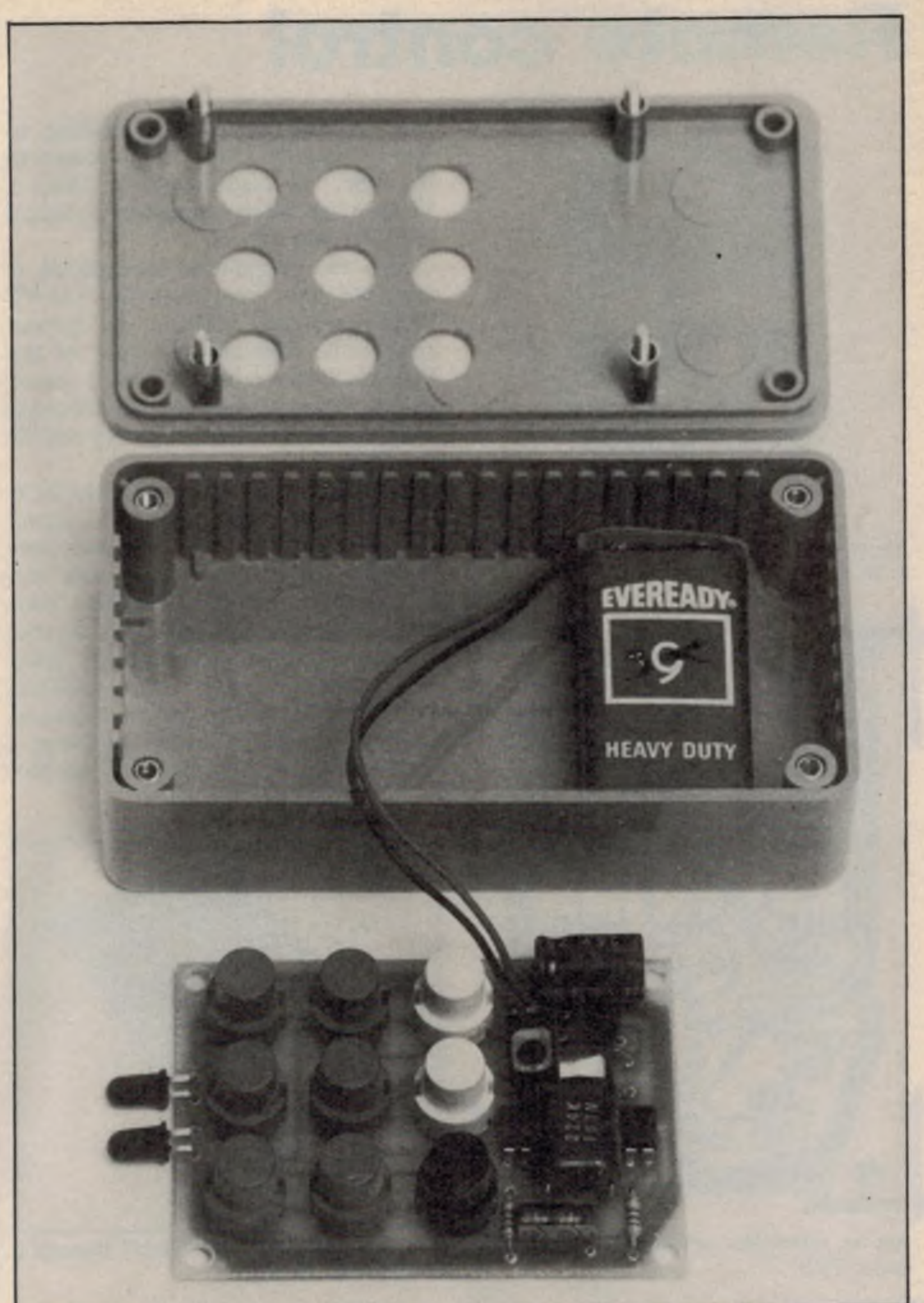
Lying flat on the PCB are the 4.7μF and 220μF capacitors. The 0.22μF capacitor lies across the IC, while the .068μF sits on top of the 100Ω resistor. Transistor Q26 straddles the .068μF capacitor.

All switches are mounted with the same orientation, ie, with the flat side to the right side of the PCB. Both IR LEDs are mounted close to the edge of the PCB and are bent over so that they point along the plane of the PCB. Wires for the 9V battery clip can also be soldered in place.

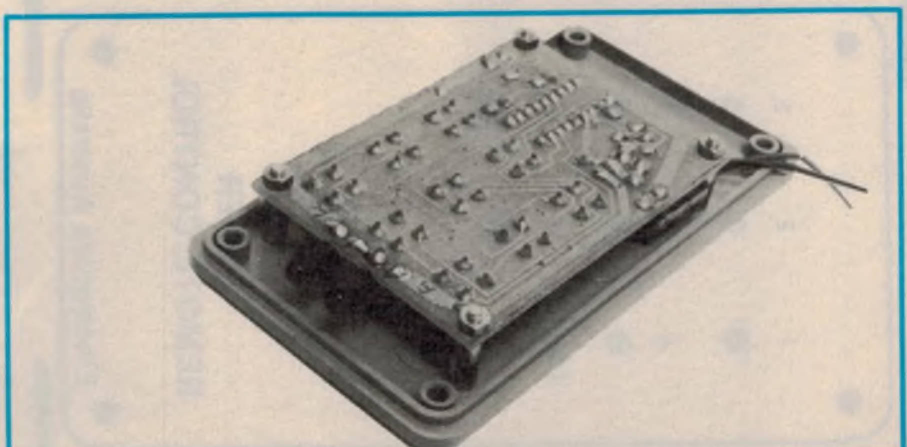
The PCB can be held within the box using one of two methods. We used screws, 12mm spacers and nuts to support the PCB at the four corners from the front panel. If you prefer not to see securing screws on the front panel, then the plastic clips that are supplied with the box can be used. These are designed to clip into the corrugations in the side of the box and hold the PCB at the correct height. Cut the clips to length so that the switch tops will just protude through the front panel.

Place the Scotchcal label on the lid of the box making sure it is lined up correctly before sticking it down. Drill holes for each switch and the PCB corner mountings if used.

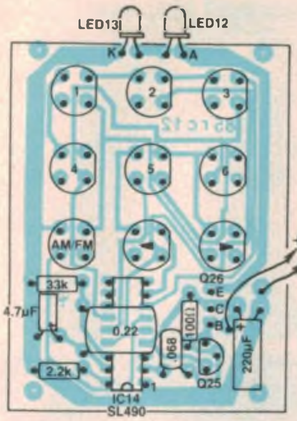
Make a rectangular cut-out at the



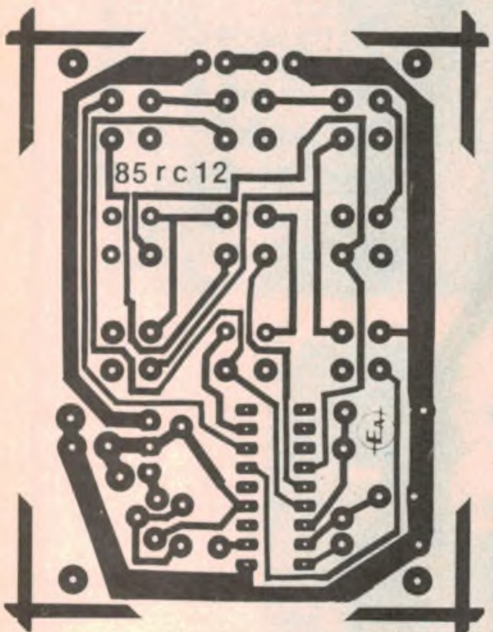
View showing the completed transmitter PCB, ready for assembly into the case.


The transmitter PCB is mounted on the lid of the case using four 6mm standoffs.

Remote control



Above: parts layout for the transmitter PCB.



Above: actual size artwork for the transmitter PCB.

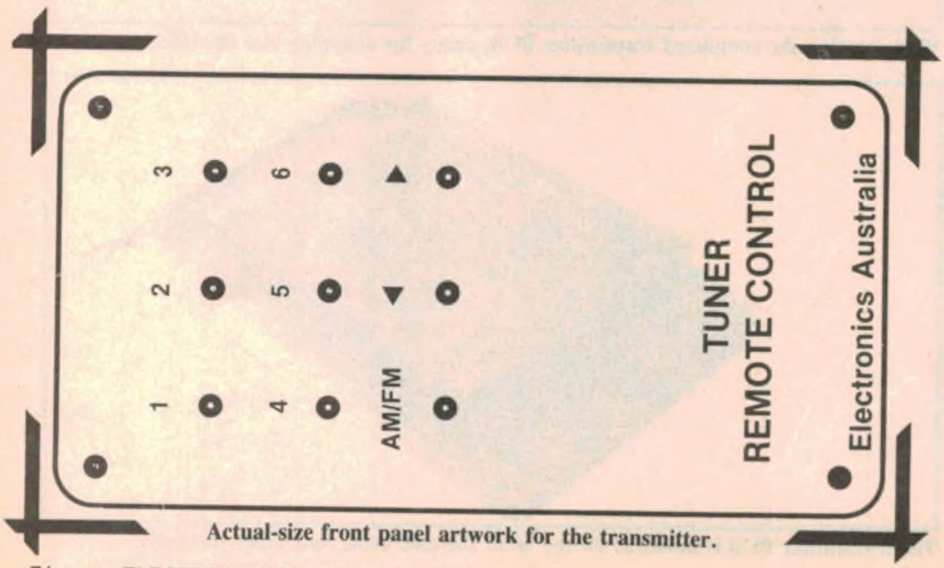
front end of the box in a position so that the two IR LEDs will be central to the hole. We made our hole 24mm x 12.5mm and fitted a circularly polarised red filter into this.

Now the transmitter construction is complete apart from assembly. The 9V battery squeezes between the bottom end of the case and the edge of the PCB. In some cases, the lower corner pillars within the case may need shaving with a knife so that the battery will fit correctly.

If screws are used to secure the PCB to the front panel, place a plastic washer under the nut at the top right mounting hole. This will insulate the PCB track from the electrically connected screws on the aluminium Scotchcal front panel. The remaining three corner mounting holes have adjacent PC tracks that are of the same ground potential and do not require insulating.

Assemble the transmitter into the box and it is ready for testing.

The two infrared diodes "look" through a red perspex window.



Actual-size front panel artwork for the transmitter.

Testing

Switch on the Playmaster stereo AM/FM tuner and aim the transmitter at the tuner. Push either the tune down or tune up remote control switches and adjust the VR9 trimpot in the receiver until the tuner responds correctly to the transmitter commands. Now check the remaining remote control functions and you are finally in business. EA

PARTS LIST

- 1 PC board, 56 x 74mm, code 85rc12
- 1 Scotchcal front panel, 114 x 64mm
- 1 plastic case, 112 x 62 x 31mm
- 1 red perspex sheet approx 24 x 12.5mm x 1-2mm
- 9 snap action keyboard switches, 6 green, 2 white, 1 black
- 1 216 9V battery
- 1 9V battery clip
- 4 6mm standoffs and screws and nuts

Semiconductors

- 1 SL490 remote control transmitter (Plessey)
- 1 SL486 IR remote control preamplifier (Plessey)
- 1 ML926 remote control receiver (Plessey)
- 1 4052 CMOS switch
- 1 4053 CMOS switch
- 1 BD681 NPN Darlington transistor
- 1 BC327 PNP transistor
- 1 BC547 NPN transistor
- 2 LD271 IR LEDs
- 1 BPW50 IR detector diode
- 3 1N4148, 1N914 small signal diodes

Capacitors

- 1 220μF 16VW PC electrolytic
- 1 47μF 16VW PC electrolytic
- 2 22μF 16VW PC electrolytics
- 1 6.8μF 16VW PC electrolytic
- 1 4.7μF 16VW PC electrolytic
- 1 0.33μF metallised polyester
- 1 0.22μF metallised polyester
- 1 .068μF metallised polyester
- 1 .033μF metallised polyester
- 1 .022μF metallised polyester
- 2 .015μF metallised polyester
- 1 .0047μF metallised polyester

Resistors

(0.25W, 5% unless stated)

1 x 33kΩ, 1 x 22kΩ, 6 x 10kΩ, 1 x 2.2kΩ, 1 x 220Ω 1/2W, 1 x 100Ω, 1 x 47Ω, 1 x 50kΩ horizontal cermet trimpot.

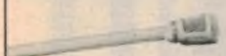
MICROPHONE OF THE MONTH

. . . A CLOSE LOOK AT ONE OF OUR 100

SM5B
UNI-DYNAMIC

SM83
OMNI-CONDENSER

SM7
UNI-DYNAMIC



SM82
LINE LEVEL CONDENSER

SM91
HALF-CARDIOID CONDENSER

SM81
UNI-CONDENSER

SM87
SUPER-CARDIOID CONDENSER

SM7
Studio cardioid dynamic

4 Mics in 1

Features two built-in frequency-tailoring switches that provide a choice of four different response curves to match the response to the individual voice and situation. Can be wide range flat, or with added presence, or roll off low end. Tight cardioid pattern cuts off-axis coloration.

SHURE

Sturdy, Silent

Integral foam windscreen covers a rugged steel cage that protects the cartridge. Patented air suspension shock mount for outstanding isolation from mechanical vibrations. Humbucking coil guards against electro magnetic interference. One of a kind. . . from Shure, of course.

For full details contact:
Audio Engineers
342 Kent St, Sydney 2000 (02)296731
Queensland (07) 44 8947
Western Aust. (09) 361 5954

Sound of the professionals

SHURE®

Glover & Assoc.

Eagle ELECTRONICS

ADELAIDE'S LEADING SHOP FOR KITS!

HASH HARRIER
SHORT FORM KITS
Circuit Board
& All Components
$44.50

*WE ARE SOLE STOCKISTS OF THESE TWO KITS!

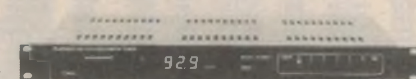
COMPLETE HARDWARE KIT
Includes Case,
GPO's, etc.
$57.50

ELECTROMYOGRAM KIT **$71.95**

THE BEST PLAYMASTER YET!
Single Board, Easy Construction. Full Kit.

ONLY **$199**

AM/FM SYNTHESIZED TUNER
This tuner will out-perform any other commercially available tuner.



$399 REMOTE CONTROL TO SUIT ONLY **$89.95**

ETI DIGITAL DELAY
Full Kit,
Amazing Value!
$119

JAYCAR CATALOGUE NOW HERE!

MAIL AND PHONE ORDERS WELCOME.
Eagle Electronics Pty. Ltd.
54 Unley Road, Unley, S.A. 5061
TELEPHONE:
(08) 271 2885 ALLOW $10 FREIGHT WITH ORDERS

MasterCard VISA

54 UNLEY ROAD, UNLEY

SUPER IC SPECIAL LM394CH
1-9 $6.95 · 10-99 $6.75 · 100+ $6.50

SUPER IC SPECIAL 8087
$299

SUPER IC SPECIAL 6264
1-9 $6.50 · 10-99 $5.50 · 100+ $5.25

SUPER IC SPECIAL 41256-15
1-9 $6.95 · 10-99 $6.50 · 100+ $5.50

SUPER IC SPECIAL 6802
1-9 $5.00 · 10-99 $4.75 · 100+ $4.50

SUPER IC SPECIAL AM 7910
WORLD MODEM CHIP
$29.50

SUPER IC SPECIAL 2N429
1-9 $7.95 · 10-99 $7.50 · 100+ $6.95

SUPER IC SPECIAL ADC0820
1-9 $24.95 · 10+ $22.95

SUPER IC SPECIAL 6116LP-3
1-9 $3.95 · 10-99 $3.75 · 100+ $3.50

SUPER IC SPECIAL 27128
1-9 $7.00 · 10-99 $6.50 · 100+ $6.25

SUPER IC SPECIAL 4164
1-9 $2.95 · 10-99 $2.75 · 100+ $2.50

SUPER IC SPECIAL 2732
1-9 $6.25 · 10-99 $5.95 · 100+ $5.50

rie

ROD IRVING ELECTRONICS
425 High Street NORTHCOTE 3070
VICTORIA AUSTRALIA
Phone (03) 489 8866

48 A'Beckett St MELBOURNE 3000
VICTORIA AUSTRALIA
Ph. (03) 663 6151

Mail Order and correspondance
P.O. Box 620 CLAYTON 3168
TELEX AA 151938

MAIL ORDER HOTLINE
(03) 543 7877
(2 lines)

POSTAGE RATES	
$1-$9.99	$2.00
$10-$24.99	$3.00
$25-$49.99	$4.00
$50-$99.99	$5.00
$100-199	$7.50
$200-$499	$10.00
$500 plus	$12.50

Errors and Omissions Excepted

Rod Irving Electronics No.1 for semiconductors!

ICL7106	19.50
ICL7116	19.50
ICL7117	21.50
ICL7611	6.95
ICL7660	5.90
ICM7211	12.50
ICM7216A	48.50
ICM7216B	44.50
ICM7224A	21.50
ICM7226A	48.50
ICM7227A	19.95
74S	
74S00	.60
74S02	1.00
74S03	1.00
74S04	1.00
74S05	1.50
74S08	1.00
74S09	1.50
74S10	1.00
74S11	1.00
74S15	1.60
74S20	1.20
74S22	1.50
74S30	1.00
74S32	1.70
74S37	1.70
74S38	1.70
74S40	1.20
74S51	1.20
74S64	1.20
74S65	1.20
74S74	1.30
74S86	1.60
74S109	1.30
74S112	1.30
74S113	1.30
74S133	1.20
74S134	1.40
74S135	1.30
74S138	3.30
74S139	3.30
74S140	1.90
74S151	3.10
74S153	3.10
74S157	3.10
74S158	3.10
74S161	5.90
74S162	5.90
74S163	7.90
74S168	11.50
74S169	11.50
74S174	4.50
74S175	4.50
74S181	8.50
74S182	3.40
74S189AN	4.10
74S188	8.50
74S194	3.30
74S195	2.90
74S196/82S90	
74S197/82S91	4.90
74S201	4.90
74S214AN	P.O.A.
74S225	10.90
74S226	7.90
74S240	6.90
74S241	6.90
74S244	6.90
74S251	3.90
74S252	4.90
74S253	4.90
74S257	3.30
74S258	3.30
74S260	2.90
74S274	POA
74S275	POA
74S280	5.90
74S281	POA
74S283	7.90
74S287	4.90
74S288	4.90
74S299	13.90
74S301	13.90
74S314	POA
74S330	POA
74S331	POA
74S373	9.90
74S374	9.90
74S381	9.90
74S387	3.30
74S412 8212	
74S428 8212	5.90
74S470	9.90
74S471	9.90
74S472	9.90
74S473	9.90
74S474	9.90
74S475	9.90
74S482	11.90
74S489	7.90
74H	
74H00	.60
74H01	.80
74H02	.80
74H03	.80
74H04	.80
74H05	.90
74H08	1.10
74H10	.80
74H11	.80
74H12	.80
74H15	.80

74H20	.80
74H21	.90
74H22	.90
74H30	.90
74H40	.90
74H50	.90
74H51	.90
74H52	.90
74H53	.90
74H54	.90
74H55	.90
74H60	.90
74H61	.90
74H62	.90
74H64	.90
74H65	.90
74H71	1.40
74H72	1.20
74H73	1.80
74H74	1.80
74H76	1.90
74H78	1.90
74H87	7.90
74H101	1.80
74H102	1.80
74H103	2.50
74H106	2.50
74H108	2.50
74H113	1.10
74H114	1.10
74H183	7.90
74C	
74C00	.50
74C02	.60
74C04	.80
74C08	.60
74C10	.80
74C14	1.40
74C20	.80
74C30	.80
74C32	.80
74C42	1.90
74C48	2.50
74C73	1.40
74C74	1.70
74C76	1.60
74C83	2.30
74C85	2.30
74C86	1.50
74C89	8.50
74C90	1.90
74C93	1.90
74C95	2.00
74C107	1.20
74C150	5.50
74C151	4.20
74C154	6.00
74C157	3.75
74C160	1.90
74C161	1.90
74C162	2.00
74C163	2.00
74C164	2.00
74C165	2.50
74C173	1.90
74C174	1.90
74C175	1.90
74C192	2.00
74C193	2.00
74C195	2.00
74C200	14.00
74C221	2.75
74C240	3.75
74C244	3.95
74C373	4.75
74C374	4.45
74C901	3.00
74C902	2.50
74C903	2.50
74C904	2.50
74C905	15.00
74C906	2.90
74C907	2.90
74C908	2.75
74C910	14.00
74C911	12.50
74C912	12.50
74C914	4.50
74C915	1.00
74C917	15.50
74C918	2.90
74C920	12.50
74C921	12.50
74C922	7.50
74C923	7.90
74C925	9.90
74C926	9.90
74C927	9.90
74C928	9.00
74C929	9.50
74C930	2.75
74C932	2.50
74C941	2.50
74C989	8.90
74LS	
74LS00	.35
74LS01	.40
74LS02	.40
74LS03	.40
74LS04	.60
74LS05	.50
74LS08	.40
74LS09	.40
74LS10	.40
74LS11	.40
74LS12	.60
74LS13	.80
74LS14	.90
74LS15	.60
74LS19	.50
74LS20	.50
74LS21	.90

74LS22	.90
74LS24	.90
74LS26	.90
74LS27	.90
74LS28	.90
74LS30	.40
74LS32	.70
74LS33	.70
74LS37	.70
74LS38	.80
74LS40	.80
74LS42	.90
74LS47	1.00
74LS48	1.00
74LS49	1.80
74LS51	.70
74LS54	.80
74LS55	.80
74LS63	2.80
74LS73	.60
74LS74	.60
74LS75	.60
74LS76	1.00
74LS77	1.00
74LS78	1.10
74LS83	.70
74LS85	.60
74LS86	.80
74LS90	.60
74LS91	.60
74LS92	.60
74LS93	.60
74LS95	1.20
74LS96	1.20
74LS107	.90
74LS109	.60
74LS112	.70
74LS113	.70
74LS114	.80
74LS122	1.30
74LS123	.90
74LS125	.80
74LS126	1.20
74LS132	1.50
74LS133	4.90
74LS136	1.50
74LS138	.80
74LS139	.80
74LS145	2.10
74LS147	2.50
74LS148	1.90
74LS151	1.20
74LS152	1.95
74LS153	1.00
74LS154	2.95
74LS155	1.00
74LS156	1.50
74LS157	1.10
74LS158	1.00
74LS160	1.00
74LS161	1.00
74LS162	1.50
74LS163	1.10
74LS164	.90
74LS165	1.00
74LS166	2.55
74LS169	2.45
74LS173	1.90
74LS174	.90
74LS175	.90
74LS181	4.00
74LS190	1.50
74LS191	1.50
74LS192	1.10
74LS193	1.20
74LS194	1.50
74LS195	.90
74LS196	.90
74LS197	1.75
74LS221	1.75
74LS224	1.90
74LS240	1.90
74LS241	1.90
74LS242	1.90
74LS243	1.90
74LS244	2.60
74LS245	2.60
74LS247	1.30
74LS248	1.50
74LS249	1.50
74LS251	1.30
74LS253	1.00
74LS257	.70
74LS258	1.30
74LS259	1.60
74LS261	2.50
74LS266	1.30
74LS273	1.95
74LS275	6.80
74LS279	.90
74LS280	2.60
74LS283	1.00
74LS290	1.50
74LS293	1.50
74LS295	1.75
74LS297	6.50
74LS298	1.20
74LS299	3.90
74LS320	3.90
74LS321	3.95
74LS322	6.75
74LS323	6.50
74LS324	2.20
74LS326	2.20
74LS327	2.20
74LS352	2.20
74LS353	2.20
74LS354	3.90
74LS365	1.00
74LS366	1.00
74LS367	.80
74LS368	.80
74LS373	1.90
74LS374	1.90
74LS375	1.90
74LS377	2.15

74LS378	1.20
74LS379	1.90
74LS386	1.00
74LS390	1.80
74LS393	1.80
74LS395	2.00
74LS396	2.50
74LS398	3.00
74LS399	1.90
74LS424	5.50
74LS440	5.50
74LS441	5.50
74LS442	5.50
74LS443	5.50
74LS445	2.20
74LS446	5.50
74LS447	5.50
74LS448	5.50
74LS449	5.50
74LS490	3.20
74LS540	5.95
74LS541	3.95
74LS621	2.75
74LS622	2.75
74LS623	5.95
74LS629	5.95
74LS640	3.95
74LS642	2.75
74LS643	2.75
74LS644	2.75
74LS645	2.75
74LS668	1.75
74LS669	1.75
74LS670	2.75
74LS673	12.55
74LS674	12.55
74LS690	3.95
74LS691	3.95
74LS692	3.95
74LS693	3.95
74LS696	3.95
74LS699	3.95
CDP	
CDP1802	10.50
CDP1864	17.50
CPU	
6502	15.00
6502A	15.00
6522	15.00
6522A	15.00
6532	14.00
6545	19.50
6551	12.90
6800	6.00
6802	7.00
6808	17.00
6809	10.00
6810	3.50
6821	5.50
6840	5.50
6845	12.50
6847	3.50
6850	7.90
6875	15.50
Z80CPU	5.00
Z80ACPU	5.00
Z80BCPU	12.00
Z80P10	4.50
Z80AP10	4.50
Z80CTC	5.50
Z80ACTC	5.50
Z80DMA	16.00
Z80ADMA	16.00
Z80S10	13.00
Z80AS10	13.00
AD570	69.50
AD590	9.50
AD7524	17.50
AY-3-8910	14.50
AY-3-2513	14.50
MSM5832	16.50
MM58174	19.50
MM5309	4.95
MM5369	4.95
LH0002	9.50
LH0042CH	9.50
LH0070	9.50
LH0071	9.50
TL061	1.50
TL062	2.90
TL064	4.90
TL071	1.50
TL072	2.90
TL073	3.20
TL074	4.90
TL081	1.00
TL082	2.50
TL083	2.90
TL084	3.45
TL494	4.90
TCA290	9.50
TCA280	4.50
TDA1024	2.80
TA7205P	3.90
TEA1002	17.50
UAA170	3.95
UAA180	3.95
LM10CH	7.50
LM301	.50
LM302H	6.50
LM305H	1.50
LM307CN	1.00
LM308	1.00
LM308H	1.80
LM309K	1.90
LM310N	3.20
LM310H	3.20
LM311	1.00
LM311H	1.30
LM317T	2.50
LM317K	4.50
LM318	4.90

LM324	1.00
LM325	4.50
LM326	4.50
LM329DZ	.90
LM344Z	1.90
LM335Z	2.20
LM336 2.5V	2.95
LM338K	12.50
LM339	1.20
LM348	1.80
LM349	1.60
LM350K	10.50
LM351N	1.80
LM353	2.50
LM356N	2.40
LM357	2.40
LM358	1.40
LM361	3.50
LM377	4.90
LM378	3.95
LM380 8 pin	1.80
LM380 14 pin	3.50
LM381	3.50
LM382	3.50
LM383	3.90
LM384	3.50
LM386	1.50
LM387A	3.95
LM387	2.20
LM390	2.95
LM391	2.90
LM392	1.90
LM394CH	5.95
LM395T	9.85
LM396K	22.50
LF398	5.90
NE544	6.50
NE555	.40
NE556	1.20
NE558	5.00
NE560	4.60
NE567	2.00
NE570	5.90
NE571	5.90
NE592	4.85
NE594	9.50
LM709-14	1.50
UA710CN	1.00
LM711	1.20
LM723	.75
LM723CH	1.50
LM725	4.75
LM733	1.50
LM739	2.75
LM741	.60
UA747	1.30
UA748	1.00
MC1310	9.50
MC1312	6.50
MC1314	5.50
MC1315	8.95
MC1327	7.95
MC1350	1.95
MC1408L8	7.95
MC1437	1.95
MC1445	5.95
MC1456	1.95
MC1458	1.20
MC1468L	21.50
MC1469R	6.90
MC1488	1.20
MC1489	1.20
MC1494	8.40
MC1495	8.40
MC1496	2.50
LM1596	3.00
MC1648	8.90
LM1812	10.50
LM1830	3.90
LM1889	3.90
LM2907	3.90
LM2917 8 PIN	4.90
LM2917 14 PIN	4.90
MN3001	17.50
CA3028	2.00
CA3046	1.90
CA3056	6.50
CA3059	5.95
CA3080	1.90
CA3086	1.90
CA3100E	2.75
CA3130E	2.20
CA3130T	2.95
CA3140E	2.20
CA3140T	2.95
CA3240E	11.95
CA3401	1.00
CA3900	1.20
CA3905	1.75
CA3909	2.95
LM3909	2.95
LM3911	2.95
LM3914	5.90
LM3915	5.90
LM3916	5.90
LM3999Z	4.90
RL4136	1.95
RC4145	20.90
RC4194	3.90
MM5369	4.95
SCR & TRIACS	
SC141D	1.90
SC141E	1.95
SC142E	2.95
SC146D	2.85
SC150D	4.95
SC151D	2.95
SC152D	6.90
C103YY	.90
C103B	.90
C106B	.90

C122D	2.50
C122E	2.95
C260D	8.50
C260E	8.90
2N2646	1.20
2N2647	2.50
2N6027	.90
TRANS.	
AC125	1.20
AC126	1.20
AC127	1.20
AC128	1.20
AC187	1.50
AC188	1.50
AC149	3.40
AD161	2.90
AD162	2.90
AF118	2.90
BC107	.50
BC108	.50
BC177	.60
BC178	.60
BC179	.60
BC182L	.40
BC212	.30
BC318	.30
BC320	.40
BC327	.30
BC328	.30
BC337	.40
BC338	.40
BC546	.20
BC547	.20
BC548	.20
BC549	.20
BC550	.40
BC556	.40
BC557	.20
BC558	.20
BC559	.20
BC639	.50
BC640	.50
BCY70	.90
BCY71	1.90
BD139	.60
BD140	.60
BD201	.90
BD232	.90
BD233	.90
BD235	.90
BD236	.90
BD237	.90
BD238	.90
BD262	1.20
BD263	1.20
BD437	1.50
BD488	1.50
BD647	1.80
BD648	1.80
BD677	1.80
BD681	2.00
BD682	2.00
BDV64B	3.90
BDV65B	3.90
BDX63	6.50
Y96 (BUX 80)	4.90
BDY97 (BUX 80)	4.90
BF115	1.50
BF167	1.20
BF173	1.20
BF177	1.20
BF180	1.20
BF182	.90
BF183	.60
BF184	.60
BF198	.60
BF199	.60
BF200	.90
BF245	1.50
BF337	1.50
BF338	1.90
BF458	1.00
BF459	1.00
BF469	1.20
BF470	1.20
BF494	.90
BF495	.90
BFW10	1.50
BFW11	1.50
BFW16	1.50
BFY50	1.20
BFY90	1.90
BFX90	1.50
BU126	2.90
BU208	4.90
BU326	3.90
BUX80	4.90
MFE131	2.90
MFE3001	9.90
MFE3003	6.95
MJ413	5.90
MJ802	7.90
MJ901	4.50
MJ1001	3.90
MJ11011	9.90
MJ11015	14.50
MJ11016	14.50
MJ15003	6.50
MJ15004	6.50
MJ15024	10.00
MJ2501	8.90
MJ2955	2.50
MJ3001	8.00
MJ4032	12.50
MJ4502	8.90
MJE340	1.50
MJE350	1.90
MJE371	2.90
MJE521	2.90
MJE700	2.90
MJE800	2.90
MJE2801	3.85

MJE2955	1.90
MJE3055	3.90
MJE13005	5.90
MJE13007	7.90
MJE13009	12.50
MPF121	2.50
MPF131	2.50
MPSA05	1.00
MPSA06	1.00
MPSA10	1.00
MPSA12	1.00
MPSA13	1.00
MPSA14	1.00
MPSA20	1.00
MPSA42	1.00
MPSA43	1.20
MPSA55	1.00
MPSA56	1.00
MPSA63	1.00
MPSA65	1.00
MPSA92	1.00
MPSA93	1.20
MPF102	.90
MPF103	.90
MPF105	.90
MPF106	.90
MPF109	.90
MPSL01	1.50
MPSL51	1.50
MPSU02	1.75
MPSU52	1.90
MPSU56	1.75
MRF131	
MRF221	19.50
MRF237	5.90
MRF238	29.50
MRF245	53.50
MRF455	37.00
MRF475	12.50
MRF603	19.50
MRF641	49.00
MRF646	53.00
MRF901	2.90
MPF131	1.90
TIP31A	.70
TIP31B	.70
TIP31C	.75
TIP32A	.70
TIP32B	.70
TIP32C	.75
TIP41C	1.50
TIP42A	1.40
TIP42C	1.50
TIP49	1.90
TIP50	2.20
TIP53	2.50
TIP111	1.50
TIP112	1.50
TIP116	1.50
TIP117	1.50
TIP120	1.50
TIP122	1.50
TIP125	1.50
TIP127	1.50
TIP145	3.40
TIP2955	1.50
TIP3055	1.50
2N301	4.00
2N429	$7.95
2N697	1.00
2N918	1.00
2N1304	1.00
2N1613	1.20
2N2102	1.90
2N2219	.80
2N2222A	1.00
2N2369	1.00
2N2484	1.00
2N2646	1.95
2N2647	3.95
2N2894	1.00
2N2904	1.00
2N2905	1.10
2N2906	1.10
2N2907	1.10
2N3019	1.90
2N3053	.80
2N3054	1.90
2N3055	1.00
2N3096	1.10
2N3109	1.90
2N3251	1.90
2N3302	1.90
2N3440	1.80
2N3441	2.50
2N3442	3.50
2N3563	.30
2N3564	.30
2N3565	.30
2N3566	.30
2N3567	.30
2N3569	.30
2N3638	.30
2N3640	.30
2N3641	.30
2N3642	.30
2N3643	.30
2N3644	.30
2N3645	.30
2N3646	.30
2N3702	1.20
2N3704	1.40
2N3739	5.50
2N3771	5.70
2N3772	5.70
2N3773	5.90
2N3792	6.00
2N3819	1.20
2N3866	2.95
2N3904	1.00
2N3906	1.00
2N4030	1.00
2N4032	2.20
2N4033	2.20

2N4036	2.50
2N4121	1.50
2N4123	1.50
2N4236	1.90
2N4237	1.90
2N4248	.40
2N4249	.40
2N4250	.40
2N4258	.50
2N4355	.50
2N4356	.50
2N4360	1.00
2N4401	.30
2N4402	.30
2N4403	.30
2N4416	1.90
2N4427	3.90
2N4919	2.90
2N5088	1.00
2N5089	1.00
2N5139	1.20
2N5179	1.20
2N5181	2.50
2N5191	3.30
2N5192	3.10
2N5193	2.50
2N5194	2.95
2N5195	3.30
2N5210	1.50
2N5245	1.50
2N5303	8.50
2N5401	1.50
2N5457	1.00
2N5458	.80
2N5459	.90
2N5461	.90
2N5462	.90
2N5485	.90
2N5486	.90
2N5489	14.50
2N5590	26.50
2N5591	29.50
2N5641	19.50
2N5656	2.50
2N5770	.30
2N5777	1.50
2N5830	.30
2N5831	.30
2N5873	1.40
2N5874	1.70
2N5944	15.50
2N5945	18.50
2N5946	19.50
2N5961	1.90
2N6027	1.00
2N6049	1.90
2N6080	21.50
2N6083	26.90
2N6084	37.90
2N6122	1.90
2N6125	1.90
2N6130	1.90
2N6133	1.90
2N6256	14.50
2N6259	13.50
2N6274	29.50
2N6378	4.90
2N6425	4.50
2N6578	4.90
3N201	1.50
2SA683	1.50
2SC2028	3.95
2SC2029	3.95
2SC2166	4.95
2SC1730	1.95
2SC1969	6.30
2SC1973	3.95
VN88AF	3.95
2SC372	1.95
2SC495	2.95
2SC710D	1.95
2SC73	1.95
2SC900F	1.95
2SC0454	1.95
2SC1014	2.50
2SC1017	4.95
2SC1018	1.95
2SC1061	2.95
2SC1096	2.95
2SC1226	2.95
2SC1306	6.30
2SC1419	2.95
2SC1449	1.95
2SC1674	1.95
2SC1307	6.90
2SD288	3.95
2SD325	2.95
2SD350A	4.90
2SD525	3.95
2SK45	3.95
2SJ49	7.95
2SJ56	12.50
2SK134	7.95
2SK176	12.50
1N4002	.15
1N4007	.20
1N5404	.30
1N5408	.40
OA47	.80
OA90	.50
OA95	.50
5082-2800	2.95
5082-2811	4.95
HLMP6620	5.95
BRIDGES	
1.5 AMP	
W005	.50
W02	.40
W04	.50
6AMP	
BPC602	2.90
KBPC604	3.50
KBPC608	4.50

10AMP	
KBPC1002	4.20
KBPC1004	4.90
35AMP	
KBPC3502	5.90
KBPC35014	MD
A3504	6.90
KBPC3510	MDA
3510	9.90
74	
7400	.35
7401	.45
7402	.45
7403	.45
7404	.60
7405	.80
7406	.80
7407	.80
7408	.60
7409	.60
7410	.60
7411	.70
7412	.70
7413	.70
7414	.80
7416	.80
7417	.80
7420	.60
7425	.90
7427	.80
7430	.70
7432	.70
7437	.80
7438	.90
7440	.90
7442	.90
7445	1.00
7446	1.20
7447	1.50
7449	1.20
7450	.90
7451	.90
7473	.90
7474	.70
7475	.70
7476	.80
7485	1.20
7486	1.20
7489	3.90
7490	1.00
7493	1.00
7495	1.00
7497	2.30
74100	1.65
74107	1.20
74109	.90
74110	1.50
74121	.90
74122	.90
74123	1.50
74125	1.00
74128	1.80
74132	1.00
74139	1.50
74145	1.45
74150	1.50
74151	1.20
74154	1.75
74155	1.20
74161	1.20
74163	1.40
74164	1.20
74165	1.20
74166	1.70
74174	1.45
74175	1.20
74180	1.20
74190	1.00
74191	1.45
74192	1.65
74193	.80
74194	1.10
74195	1.00
74197	1.10
74221	1.90
74367	1.50
74368	1.50
75107	2.50
75110	2.50
75150	2.50
75154	2.50
75450	1.50
75451	.90
75452	.90
75453	.90
75461	1.50
75462	1.50
75471	3.00
75472	3.00
75491	2.00
75492	2.00
75493	3.00
8121	5.00
8123	4.00
8130	6.95
8131	5.95
8136	6.95
8303	5.50
8304	6.95
82S23	5.95
82S123	6.95
8311	5.95
8641	5.95
8820	6.95
8830	6.95
8832	6.95
8833	6.95
8834	6.95
8835	5.95
1488	1.00
1489	1.00
81LS95	3.75
81LS96	3.75
81LS97	3.75

81LS98	3.75
8T26	3.00
8T28	3.00
8T30	3.00
8T96	1.80
8T97	1.80
8T13	2.95
8T14	2.95
8080	8.00
8085	9.50
8086	19.50
8088	29.00
8155	6.50
8156	11.50
8185	37.50
8202	52.50
8203	69.50
8212	2.90
8214	4.90
8224	3.50
8226	4.90
8228	5.50
8237	19.50
8238	9.50
8243	8.50
8251	6.90
8253	7.50
8255	5.50
8257	16.50
8259	6.50
8271	89.00
8272	33.00
8273	65.00
8274	42.50
8275	38.50
8276	28.50
8279	8.50
8282	6.90
8283	6.50
8284	8.50
8286	6.50
8287	6.50
8289	73.00
8741	57.50
8748	65.00
8749	58.50
8755	33.50
8035	6.90
8039	7.90
FD1771	19.00
FD1791 (8876)	39.00
FD1793 (8877)	39.00
FD1795	39.00
FD1797	39.00
WD1691	29.50
WD2143	14.50
WD1931	22.50
WD1933	34.00
WD1983	14.75
WD1993	59.00
WD2123	26.50
WD8250	16.50
TR1602 (S1883)	8.50
TR1863	8.90
COM8116	24.00
BR1941	23.00
CRT8002A	59.90
74HC	
74HC00	.60
74HC02	.60
74HC04	.60
74HC08	.60
74HC11	.60
74HC14	1.40
74HC27	.60
74HC30	.60
74HC32	.60
74HC74	1.10
74HC76	1.10
74HC85	1.40
74HC86	1.10
74HC123	1.40
74HC138	1.40
74HC139	1.40
74HC157	1.40
74HC165	2.50
74HC174	1.40
74HC221	3.60
74HC240	2.50
74HC244	2.50
74HC245	3.90
74HC367	1.40
74HC373	2.90
74F SERIES	
74F00	.79
74F02	.79
74F04	.92
74F08	.79
74F10	.79
74F11	.79
74F20	.79
74F32	.79
74F64	.79
74F74	.89
74F86	1.19
74F109	.99
74F138	1.79
74F139	1.79
74F151	1.79
74F153	1.79
74F157	1.79
74F158	1.79
74F175	2.78
74F181	5.98
74F182	2.73
74F189	7.44
74F190	4.86
74F191	4.86
74F194	2.41
74F241	3.72

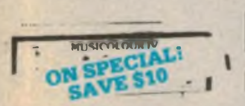
74F243	4.34
74F244	3.72
74F251	1.93
74F253	1.93
74F257	1.93
74F258	1.93
74F350	4.34
74F352	1.93
74F353	1.93
74F373	4.84
74F374	4.84
74F398	2.78
74F521	4.22
74F533	4.84
74F534	4.84
MEMORY	
2101	6.90
2102	2.50
2114	2.95
2708	8.90
2716	6.90
2732	7.00
2764	6.00
27128	8.00
4116	3.95
4164	3.50
6116	5.00
6264	8.00
58725 (6116)	4.00
2101 (5101) (8101)	7.90
5101	7.90
8101	7.90
2532	12.50
OPTO	
4N25	1.50
4N26	1.50
4N27	1.50
4N28	1.50
4N29	1.50
4N30	2.00
4N32	2.50
4N33	2.50
4N35	2.50
4N37	2.50
MCT6	2.50
MCT66	6.90
MCT2	1.50
1LD74	5.90
1LQ74	6.50
FND507	2.00
TIL31A	2.95
TIL81A	2.95
TIL306	22.50
MAN72 (DL702)	3.50
MAN74 (DL704)	3.50
BPW50	2.25
HP5082-2811	4.95
HLMP6620	3.95
LEDS	
3mm RED	.25
2mm YELL	.30
3mm GRN	.30
5mm RED	.15
5mm YELL	.30
5mm GRN	.30
5mm ONG	.30
RED RECT	.30
GRN RECT	.30
YEL RECT	.30
RED CHROME BEZEL	1.20
YELLOW CHME BEZEL	1.20
GRN CHRME BEZEL	1.20
VOLTAGE REGS	
7805C	.80
7805KC	2.50
7812UC	1.20
7812KC	2.50
7815UC	1.20
7815KC	2.50
7818UC	1.20
7818KC	2.50
7824UC	1.20
7824KC	2.50
7905UC	1.90
7905KC	3.00
7912UC	1.90
7912KC	2.50
7915UC	1.90
7915KC	2.50
7918UC	1.90
7924UC	1.90
78L05	.50
78L12	.50
78L15	.75
78L18	.75
78L24	.75
79L05	1.20
79L12	1.20
79L18	1.20
79L24	1.20
LM309K (7805KC)	1.90
LM317T	2.50
LM317K	4.50
LM317HV	9.50
LM323K	7.50
LM337T	2.90
LM338K	10.50
LM350T	6.50
LM350K	8.50
LM395K	22.50
LM396K	19.50

78H05KC	9.00
78H12KC	9.00
78HGKC	9.50
78P05KC	16.50
79HGKC	16.50
78S40	3.50
MC1496L	14.50
SPECIAL FUNCTION	
LM4250	2.45
NE5534N	3.95
NE5534AN	4.95
MC3340	2.90
MC3341	2.90
76477	8.95
76488	8.95
76489	9.95
8038	6.50
OM335	22.50
OM350	10.50
XR2206	7.95
XR2207	7.95
XR2208	6.90
XR2209	6.90
XR2211	7.45
XR2216	5.90
XR2240	6.95
XR2243	7.95
XR8038	7.50
95H90	8.50
11C90	16.50
LM7555	1.90
LM7556	3.50
MC10116L	1.50
LM13600	3.95
LF13741	.80
LF13741H	1.50
DM2502	22.50
DAC0800	4.50
DAC0808	4.50
SAK140	9.50
ZN414	1.95
2N	
4000	.50
4001	.50
4002	.50
4006	1.90
4007	.40
4008	1.20
4010	.90
4011	.40
4012	.40
4013	.60
4014	1.90
4015	1.90
4016	.75
4017	1.50
4018	1.90
4019	.90
4020	1.50
4021	1.50
4022	1.50
4023	.75
4024	1.20
4025	.80
4026	2.40
4027	1.20
4028	1.20
4029	1.50
4030	1.50
4031	2.95
4032	2.75
4033	2.75
4034	3.50
4035	1.95
4038	3.25
4040	1.20
4041	1.50
4042	1.00
4043	1.60
4044	1.20
4045	4.90
4046	2.50
4047	1.20
4048	1.20
4049	1.00
4050	1.00
4051	1.50
4052	1.50
4053	1.50
4054	3.90
4055	3.90
4056	4.20
4060	2.50
4063	2.00
4066	2.50
4067	9.90
4068	1.00
4069	1.00
4070	.90
4071	.40
4072	.90
4073	.90
4075	.90
4076	1.50
4077	.80
4078	.80
4081	.40
4082	.80
4085	2.20
4086	2.30
4093	.75
4094	3.35
4095	2.40
4096	2.40
4097	6.50
4098	2.90
4099	3.90
4175	1.60
4194	1.95
4433	2.75
MC14433	13.90
4510	1.50

4511	1.00
4512	1.10
4513	2.65
4514	2.90
4515	2.90
4516	1.45
4517	8.75
4518	2.50
4519	1.90
4520	1.20
4521	3.90
4522	1.90
4526	1.85
4527	2.65
4528	1.15
4529	1.80
4530	1.60
4531	1.65
4532	2.65
4534	8.90
4536	6.50
4539	1.65
4541	1.60
4543	2.50
4544	10.50
4549	7.25
4551	1.80
4553	5.50
4554	2.35
4555	1.10
4556	1.25
4557	7.85
4558	2.25
4559	7.25
4560	3.75
4561	1.80
4562	8.45
4566	3.00
4568	4.25
4569	2.50
4572	.75
4581	3.10
4582	2.25
4583	1.65
4584	.85
4585	2.10
ANALOG/DIGITAL	
ADC0800LCN	22.50
ADC0801LCN	23.95
ADC0803LCN	7.50
ADC0804LCN	6.50
ADC0808LCN	14.95
ADC0820	$24.95
DAC1220LCN	14.95
DAC1020LCN	13.95
DAC0832LCN	5.50
NEW ICS	
74LS169	2.50
MCS2400	4.90
AY31050	12.50
WD2791	59.00
WD2793	59.00
WD2795	59.00
WD2797	59.00
LM11CN	2.95
LM1871	5.95
LM1872	5.95
Z80ADART	13.50
CRYSTALS	
1MHz	11.50
1.832MHz	7.50
2MHz	6.90
2.3040MHz	6.50
2.4576MHz	6.50
2.7648MHz	4.90
3MHz	4.90
3.5795MHz	3.00
3.93216MHz	4.90
4MHz	4.90
4.194304MHz	3.90
4.433618MHz	4.90
4.44MHz	4.90
4.75MHz	4.90
4.915200MHz	6.90
4.9562MHz	4.90
5.00MHz	4.90
5.0688MHz	4.90
6MHz	4.90
6.14MHz	4.90
6.6670MHz	4.90
8MHz	4.90
8.867238MHz	4.90
10MHz	4.90
10.6445MHz	4.90
11MHz	4.90
12MHz	4.90
14.31818MHz	4.90
15MHz	4.90
16MHz	4.90
18MHz	4.90
18.432MHz	4.90
20MHz	4.90
24MHz	4.90
27MHz	4.90
32MHz	4.90
36MHz	4.90
32.768MHz	4.90

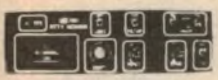
FUNCTION GENERATOR
This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160kHz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting.
(EA April '82, 82AO3A/B)
Cat. K82040
Cat. K82041 **$109**

COMPACT DISC PLAYER ATTENUATOR
If you have just purchased a compact disc player your amplifier could be in trouble! CD players seem to have standardised on a 2V output level where as most Hi-Fi amps have a 500mV sensitivity for full rated output.
In order to overcome this you may need a CD Antenuator. It does not distort the signal in any way. It is inexpensive and simple to construct making it an ideal beginners project.
(EA '86)
Cat. K **$7.95**



MUSICOLOR IV
Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety.
(EA Aug. '81) 81MC8
Cat. K81080 **$99**

VIDEO FADER CIRCUIT
Add a touch of professionalism to your video movies with this simple Video Fader Circuit. It enables you to fade a scene to black (and back again) without loss of picture lock (sync) or colour.
(EA Jan '86, 85ff10)
Cat K86010 **$19.95**



COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER
Here's what you've been asking for, a full trasmit-receive system for computer driven radio teletype station. The software provides all the latest "whizz-bangs" like split-screen operation, automatically repeating test message, printer output and more. The hardware uses tried and proven techniques. While designed to team with the popular Microbee, tips are avaialble on interfacing the unit to other computers. (ETI Nov. '84) ETI 755)
Cat. K47550 **$139**

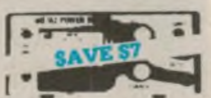
RADIOTELETYPE CONVERTER FOR THE MICROBEE
Have your computer print the latest news from the international shortwave news service. Just hook up this project between your short wave receivers audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too. (ETI Apr. '83)
Cat. K47330 **$19.95**

ELECTRIC FENCE
Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automotive ignition coil, it should prove an adequeate deterrent to all manner of livestock. Additionally, its operation comforms to the relevant clauses of Australian Stnd 3129. (EA Sept. '82) 82EF9
Cat. K82092 Normally $19.95
SPECIAL, ONLY $14.95

LISTENING POST
This device attaches between the audio output of a shortwave receiver and the input port of a computer. It allows decoding and printing out of morse code, radioteletype (RTTY) and facsimile (FAX) pictures using the computer. It has been designed from all readily available parts. Details for writing the software program are included.
(AEM 3500, July '85)
Cat. K93015 **$37.95**

AEM DUAL SPEED MODEM
The ultimate kit modem featuring 1200/300 baud, case etc. Exceptional value for money!
(AEM 4600 Dec '85)
$169

STROBE KIT
Includes perspex cover!
(AEM 9500)
Cat. K93018 **$59.95**



30 V/1 A FULLY PROTECTED POWER SUPPLY
The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current metering is provided. (ETI Dec '83) ETI 162
Cat. K41620 Normally $54.50
$47.50

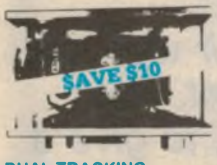
LAB SUPPLY
Fully variable 0-40V current limited 0-5A supply with both voltage and current metering (two ranges: 0-0.5A/0-5A). This employs a conventional series-pass regulator, not a switchmode type with its attendant problems, but dissipation is reduced by unique relay switching system switching between laps on the transformer secondary.
(ETI May '83) ETI 163
Cat. K41630 **$199**

15V DUAL POWER SUPPLY
This simple project is suitable for most projects requiring a dual voltage. (ETI 581 June '76)
Cat. K45810 **$19.50**

PHONE MINDER
Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb '84) 84TP2
Cat. K84021 **$27.50**

HUMIDITY METER
This project can be built to give a readout of relative humidity either on a LED dot-mode display or a conventional meter. In addition it can be used with another project as a controller to turn on and off a water mist spray in a hothouse, for example. (ETI May '81) ETI 256
(Includes humidity sensor $19.50)
Cat. K52460 **$29.50**

PH METER KIT
Build this pH meter for use with swimming pools to fish tanks to gardening, this pH meter has many applications around the home. This unit features a large 3 1/2 digit liquid crystal display and resolution to .01 pH units, making it suitable for use in the laboratory as well.
(EA Dec '82) 82PH12
Cat. K82123 **$135**



DUAL TRACKING POWER SUPPLY
Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages 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.
(EA March 82) 82PS2
Cat. K82030 **$109**

LOW OHMS METER
How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms.
(ETI Nov. 81) ETI 158
Cat. K41580 **$39.50**

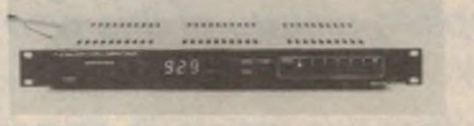
300 BAUD DIRECT CONNECT MODEM KIT
Think of the advantages of having your own modem!!
- Can't afford a floppy disc? Use your telephone to access one for the cost of a call.
- Bored with your old programs? Download hundreds of free programs.
- Want to get in touch with fellow computer enthusiasts? Use "electronic mail".
- Ever used a CP/M system? CP-DOS? UNIX? Well a modem will make a your computer a remote terminal on some of the most exciting systems around.

Save on ready built modems.
(ETI 699 May '85)
Cat. K46990 Normally $129
SPECIAL, ONLY $109
(Short form without phone)

TRANSISTOR TESTER
Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. '83) 83TT8
Cat. K83080 Normally $18.95
SPECIAL, ONLY $14.95

VOCAL CANCELLER
If you have ever imagined yourself as lead vocalist/musician with a famous band, here is your chance to "audition"! You can cancel out the lead vocal on almost any stereo record and substitute your own voice or musical instrument.
(EA April '82, 82vc3)
Cat. K82042 **$22.50**

AEM ULTRA FIDELITY PREAMP
The latest, definative preamp from David Tillbrook, the man who designed the famous Series 5000! Just as his Series 5000 were an enormous leap forward 5 years ago, so to is his latest AEM 6000 Series, especially in regard to Compact Disc signal processing.
"The input noise figures subsequently obtained are significantly better than the best op-amp designs and exceed the specifications of the best commercial amplifiers" -David Tillbrook, AEM October '85
Cat K **$289**



PLAYMASTER FM/AM STEREO TUNER
The new Playmaster FM/AM stereo tuner will out perform anything presently available on the market, regardless of price. As well as including a FM tuner section which is every bit as good as any other synthesised design, it is also the only unit featuring a genuine wideband, low distortion AM stereo tuner. Naturally, it has a digital readout, 12 station memory, automatic seek and an optional infrared remote control.

SPECIFICATIONS:

AM TUNER.....
Turning range: 522 to 1611kHz
Frequency Response: -3dB at 5.5kHz
Harmonic Distortion: Mono: 0.4% at 30% modulation
Stereo: ·1% at 30% modulation
Audio Output: 450mV RMS into 4.7 ohm load at 100% modulation
Stereo Separation: Typically 30dB
AGC Range: 40dB for a 6dB change in audio output
Signal to Noise Ratio: 70dB with respsect to full output for signal levels of 9 and 10 on bar graph display, better than 60dB with respect to full output for signal levels greater than 6
Usable Sensitivity: 350uV at -6dB audio level

FM TUNER.....
Tuning Range: 87.9 to 107.9 MHz
Frequency Response: -1dB at 20Hz, -0.5dB at 15kHz
Harmonic Distortion: Mono: 0.15% (100Hz); 0.15% (1kHz); 0.2% (6kHz)
Stereo: 0.4% (100Hz); 0.4% (1kHz); 0.4% (6kHz)
Audio Output: 450mV RMS into 4.7 ohm load at 100% modulation
Stereo Separation: 34dB (50Hz); 34dB (1kHz); 36dB (10kHz)
Subcarrier Product Rejection: 48dB
19kHz Rejection: 62dB
(EA Dec '85 Jan-Feb '86 85tu12)

Cat. K86020
only $499

FAST NICAD CHARGER
This project is specifically designed for modellers and photographers who make heavy demands on Nicad betteries quite routinely. Theres nothing more frustrating than having your remote control model run out of juice as it runs/flies out of sight, or your flash run out of flash at an inappropriate moment. If you use Nicads and need a quick charge then this project is a must for you.
(ETI 274, July '80)
Cat. K45630 **$79.95**

MODEL ENGINE IGNITION SYSTEM
Get sure starts every time, without glow plug burnouts on your model engines.
(ETI June'83) ETI 1516
Cat. K55160 **$49.50**

SOUND PRESSURE METER
Noise is one of the many pressures of todays often stressful lifestyle. To be able to comabt noise in its many forms, you must be able to measure it. This low cost Sound Pressure Meter will measure sound levels of less than 30dB to more than 120dB eith fast or slow response to the "A" weighting curve.
(EA May '81, 81sp5)
Cat. K81053 **$39.50**

ELECTRIC DUMMY LOAD
With this unit you can test power supplies at currents up to 15 Amps and voltage up to 60 Volts. It can "sink" up to 200 Watts on a static test and you can modulate the load to perform dynamic tests.
(ETI Oct '80) ETI 147
Cat. K41470 **$129**

PRINTED CIRCUIT BOARDS

ETI 044	$2.95
ETI 163	$7.95
ETI 164	$2.95
ETI 183	$6.95
ETI 256	$2.95
ETI 268	$1.95
ETI 278	$3.95
ETI 324	$4.95
ETI 412	$3.95
ETI 449	$2.80
ETI 453	$2.95
ETI 455	$3.95
ETI 458	$6.95
ETI 464	$3.95
ETI 466	$9.95
ETI 477	$9.95
ETI 478SA	$2.95
ETI 478SB	$1.95
ETI 478SC	$1.95
ETI 478SD	$1.95
ETI 480	$2.95
ETI 494	$3.95
ETI 496	$5.95
ETI 499	$7.95
ETI 581	$3.95
ETI 666	$3.95
ETI 668	$4.95
ETI 672	$2.95
ETI 688A	$4.95
ETI 688B	$2.95
ETI 699	$8.95
ETI 724	$2.95
ETI 733	$5.95
ETI 736A	$3.95
ETI 736B	$3.95
ETI 755A	$8.95
ETI 755B	$2.95
ETI 755C	$2.95
80pa6	$15.95
80pg6	$7.95
80bm10	$3.95
82ps2	$6.95
82eg2	$2.95
82vc3	$4.95
82pa7	$11.95
82pc10	$3.95
83ma11	$5.95
84au1	$2.95
84ma11	$2.95
85ef11	$7.95
AEM 4600	$21.95

rie

ROD IRVING ELECTRONICS
425 High Street, NORTHCOTE, 3070
VICTORIA, AUSTRALIA
Phone (03) 489 8866
48 A Beckett St, MELBOURNE, 3000
VICTORIA, AUSTRALIA
Ph. (03) 663 6151
Mail Order and correspondance
P.O. Box 620, CLAYTON 3168
TELEX: AA 151938

MAIL ORDER HOTLINE
(03) 543 7877
(2 lines)

POSTAGE RATES

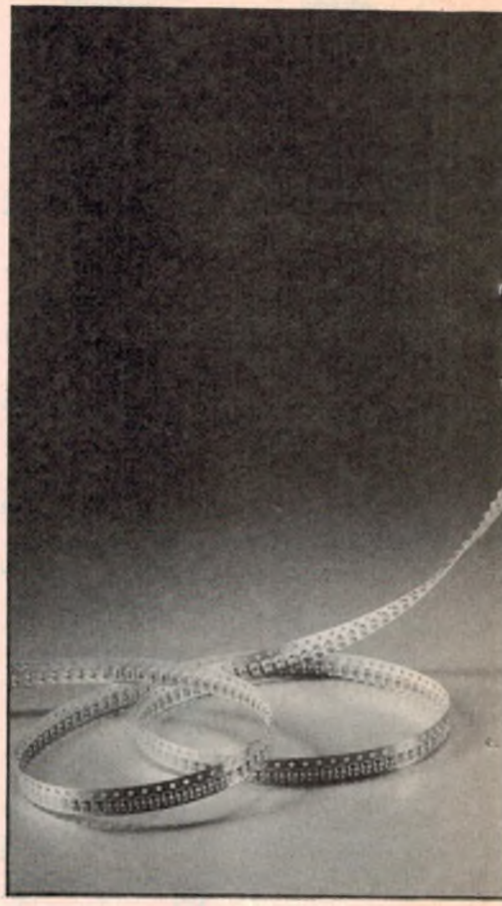
$1-$9.99	$2.00
$10-$24.99	$3.00
$25-$49.99	$4.00
$50-$99.99	$5.00
$100-199	$7.50
$200-$499	$10.00
$500 plus	$12.50

This is for basic postage only. Comet Road freight, bulky and fragile items will be charged at different rates.
Certified Post for orders over $100 included "free"!
Registered Post for orders over $200 included "free"!
All sales tax exempt orders and wholesale inquiries to RITRONICS WHOLESALE, 56 Renver Rd., Clayton Phone (03) 543 2166

Errors and Omissions Excepted.

One year ago, in the July issue, "Electronics Australia" featured a major article on the subject of surface mount components. We described the "quiet revolution" which has been gathering pace as these new ultra-miniature components find their way into more and more electronic equipment. Now we take a look at the subject again, to give a more complete picture of this new technology.

To ensure that this article is comprehensive, we have repeated some of the basic information from the first article. We also talk about the new machinery required for surface mount technology and detail some of the special servicing techniques which will be necessary for new electronic equipment.



Surface mount devices — the revolution continues

by TERRY AYSCOUGH

Evolution of surface mounting

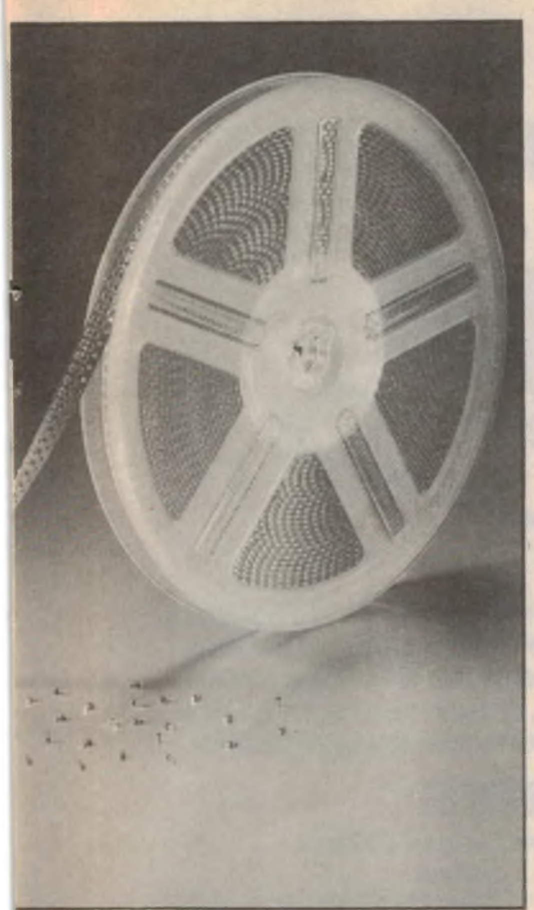
In the earliest days of radio, most components had screw terminals and were connected together using separate lengths of wire. The high cost and inconvenience of this system quickly became apparent and it was not long before small components such as resistors and capacitors had their connecting wires built in. As printed circuit board (PCB) technology developed, connecting leads provided a handy means of holding components in position on one side of the board, whilst providing electrical connections to the print tracks on the other. Now, after half a century of reduction in size, components are starting to change radically.

The development of thin and thick film hybrid circuits in the early 1970s created a demand for new types of components. Hybrid circuits are like miniature high-density PCBs, but often use ceramic substrates. It's not practical to drill multiple holes for connecting leads to pass through ceramic, so small components, such as resistors, capacitors, diodes and transistors were mounted on the same side as the print paths and soldered directly to them.

The first components to be 'surface mounted' in this way had ordinary wire ends, but it was not long before specially designed surface mount devices (SMDs, alternatively known as surface mount components, SMCs), became available. With SMDs, lead out wires were replaced by short tags, or metallised pads, which could lay flat on the print tracks before being soldered into place. Without the need to terminate and anchor connecting leads within the encapsulation, components could be drastically reduced in size.

The term 'chip' component was first adopted to describe very small leadless resistors and capacitors, but is now used to cover the whole range of smaller SMDs. In recent years more and more chip devices have become available and today, most component and semiconductor manufacturers offer most of their ranges in either conventional wire lead-out or surface-mount configurations.

A PCB can use surface mount technology in a variety of ways. The print



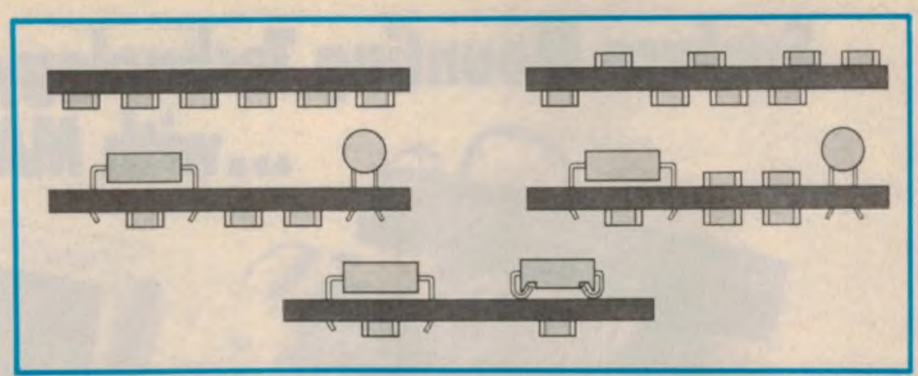


Fig.3: Surface mount devices can be used alone or mixed with other components and be mounted on or below PC boards. (Diagram by courtesy of Siemens.)

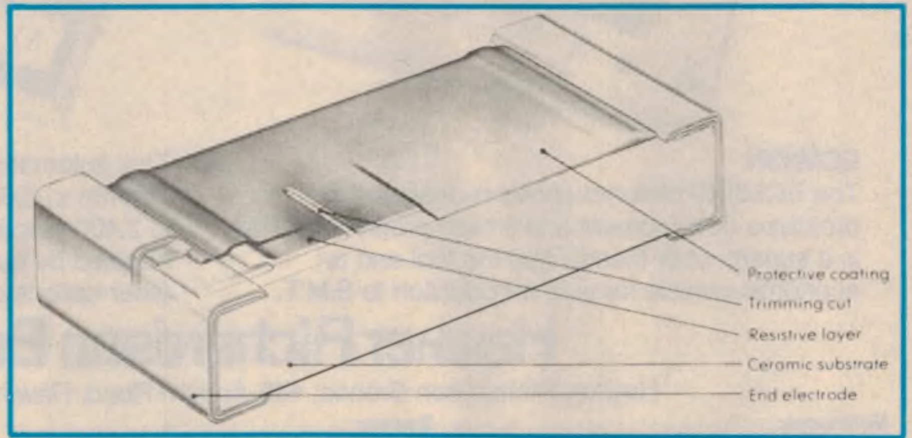


Fig.5: A typical chip resistor. Note the laser trimming cut which sets the resistance value precisely. (Diagram by courtesy of Philips.)

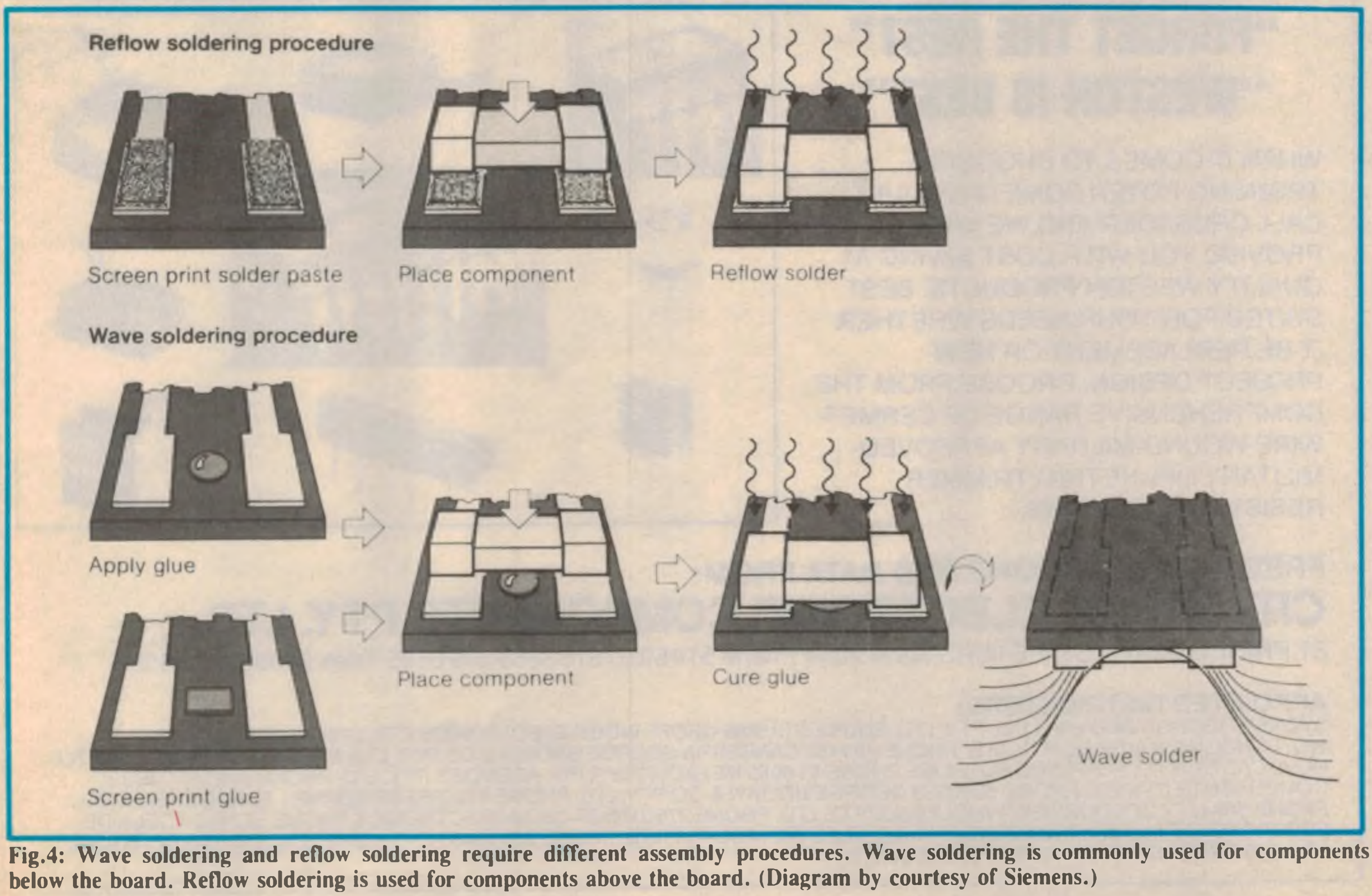


Fig.4: Wave soldering and reflow soldering require different assembly procedures. Wave soldering is commonly used for components below the board. Reflow soldering is used for components above the board. (Diagram by courtesy of Siemens.)

Surface Mounting Technology starts here ...with MAMIYA

ECM83N
The ECM83N pictured above is designed for prototype development and limited production. This is a superb, user friendly training tool and an economic vehicle for your introduction to S.M.T.

This automatic machine can handle boards up to 160mm x 150mm, with a cycle rate between 1,500 to 2,400 placements per hour. Chips can be handled by bulk, or tape feeder and numerous other options offer a high degree of flexibility.

Hawker Richardson Brenco

Hawker Richardson Brenco, 445 Auburn Road, Hawthorn, Victoria. 3122.

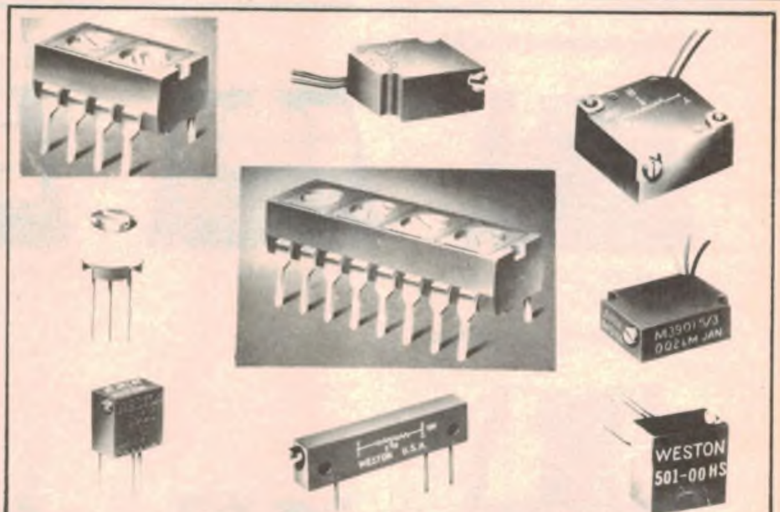
Melbourne:
Phone: (03) 20 2461. Telex: AA 30805.

Sydney:
Phone: (02) 648 4166. Telex: AA 20977.

Adelaide:
Phone: (08) 224 0883. Telex: AA 88385.

"FORGET THE REST" "WESTON IS BEST"

WHEN IT COMES TO CHOOSING TRIMMING POTENTIOMETERS, JUST CALL CRUSADER AND WE WILL PROVIDE YOU WITH COST SAVING A1 QUALITY WESTON PRODUCTS. BEST SUITED FOR YOUR NEEDS WHETHER IT BE REPLACEMENT OR NEW PROJECT DESIGN. CHOOSE FROM THE COMPREHENSIVE RANGE OF CERMET-WIRE WOUND-MILITARY APPROVED-MILITARY QPL-NETRIM TRIMMER RESISTOR NETWORKS.



FREE SPECIFICATIONS AND DATA FROM:

CRUSADER ELECTRONIC COMPONENTS PTY. LTD.

81 PRINCES HWY, ST. PETERS NSW 2044 Phone 519 5030 516 3855 519 6685 Telex 23993 or 123993

APPOINTED DISTRIBUTORS:
SYDNEY GEORGE BROWN & CO, PTY. LTD. PHONE 519 5855 GEOFF WOOD ELECTRONICS PTY. LTD. PHONE 810 6845 WOLLONGONG MACELEC PTY. LTD. PHONE 29 1455 CANBERRA GEORGE BROWN & CO PTY. LTD. PHONE 80 4355 NEWCASTLE NOVOCASTRIAN ELECTRONIC SUPPLIES PHONE 61 6055 MELBOURNE R.P.G. AGENCIES PTY. LTD. PHONE 439 5834 JESEC COMPONENTS PTY LTD PHONE 598 2333 GEORGE BROWN & CO PTY. LTD. PHONE 419 3355 BRISBANE L.E. BOUGHEN & CO. PHONE 369 1277 COLOURVIEW WHOLESALE PTY. LTD. PHONE 275 3188 ST LUCIA ELECTRONICS PHONE 52 7466 ADELAIDE PROTRONICS PTY. LTD. PHONE 212 3111 D.C. ELECTRONICS PTY. LTD. PHONE 233 6946 PERTH SIMON HOLMAN & CO PHONE 381 4155 PROTRONICS PTY. LTD. PHONE 362 1044

Surface mount devices

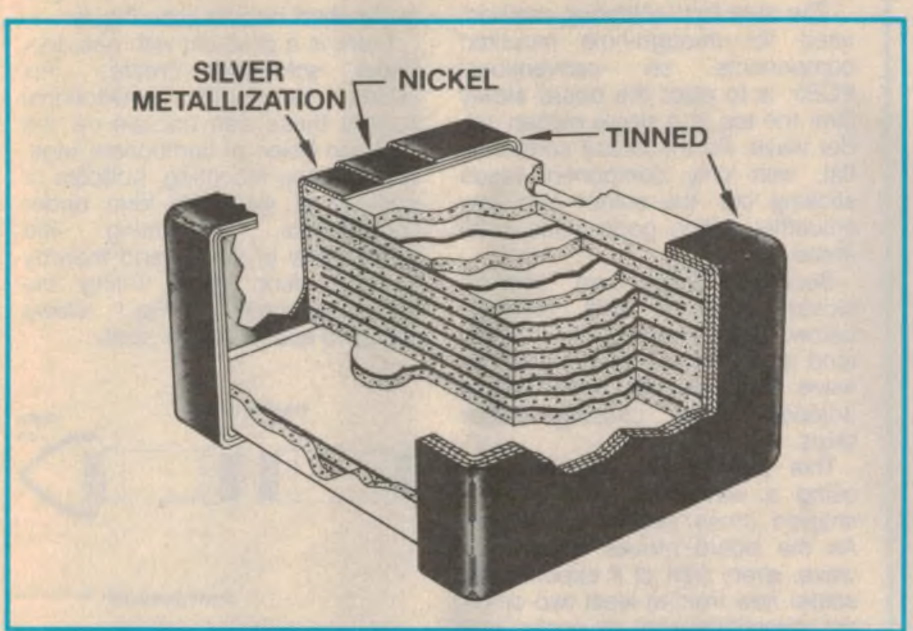


Fig.6: A typical chip capacitor with interleaved metallic plates and thin ceramic separators. (Diagram by courtesy of Crusader Electronics.)

path and SMDs may be on one side only (single sided PCB) or on both sides (double sided PCB). Wire ended components and SMDs can also be used together, giving 'mixed' boards of various types as shown in Fig.3.

Assembly methods

Because many SMDs are very small, it is not practical to manually assemble boards on a production line basis. In fact, the whole idea of surface mount technology (SMT) is to fully mechanise operations at every stage of production.

With present surface mount technology, a manufacturer can choose between wave soldering or one of several reflow methods. The choice affects how the boards are assembled.

Let's look at board assembly where reflow soldering is to be used.

A PCB designed for surface mount devices has metal tracks with rectangular contact pads, rather than the round pads with holes in the middle as on conventional PCBs. For reflow soldering, these pads have a sticky solder paste screen printed onto them as shown (see Fig.6).

When a board is fully assembled (or 'populated') with components, heat is applied which causes the solder in the paste to melt or "reflow", giving a solid metallic bond to the print. The heat may be supplied by gas flames, radiant infrared sources (including lasers) or hot vapour as described in the separate panel. In all cases, the components must be able to withstand heat well in excess of 200°C for many seconds without damage.

For wave soldering of SMDs, the board must be turned over after being populated, so each component needs to be firmly glued in place to prevent it falling off. The epoxy glue used must be quick-setting, strong and able to withstand high temperatures, otherwise the fast flowing solder wave might dislodge components or sweep them away completely. This method is very commonly used at present, especially where it is necessary to mix SMDs and wire ended components on the same board.

By contrast, the reflow method tends to be favoured for single-sided boards which have a high percentage of SMDs, and wire ended components are added later by semi-mechanised or hand soldering methods. Double-sided boards can use reflow soldering for surface mount components on top and wave soldering for mixed wire ended and SMDs on the underside.

Board Design

The introduction of surface mount technology will have major effects on some sections of the electronic industry and only minor ones on others.

Circuit design is not expected to change very much. There are a few components, such as large electrolytic capacitors and high wattage resistors, which will probably be designed out whenever possible.

But board layout and production engineering will be dramatically changed by SMT. The factory trouble-shooter or service technician will continue to use familiar tools and instruments with SMT, but he will need to learn new tricks on the practical side, as explained later.

Because chip components are smaller than their wire-ended counterparts, it is possible to pack more into a given board area. This allows single-sided surface mount boards to be reduced in size by up to 50% compared with conventional assemblies.

If a double-sided or multilayer board is used, SMT really comes into its own. Because lead out wires and pins from conventional components pass through the board, they take up space on both sides. This is especially true for ICs, which often take board space equal to twice their own area.

On the other hand, surface-mounted chip components and ICs only use space on their own side of the PCB, leaving the layout designer free to map out a completely independent layout on the other side. Because of this and the smaller size of SMDs generally, it is possible to increase effective component density by up to 300%.

SMDs can make it possible to replace

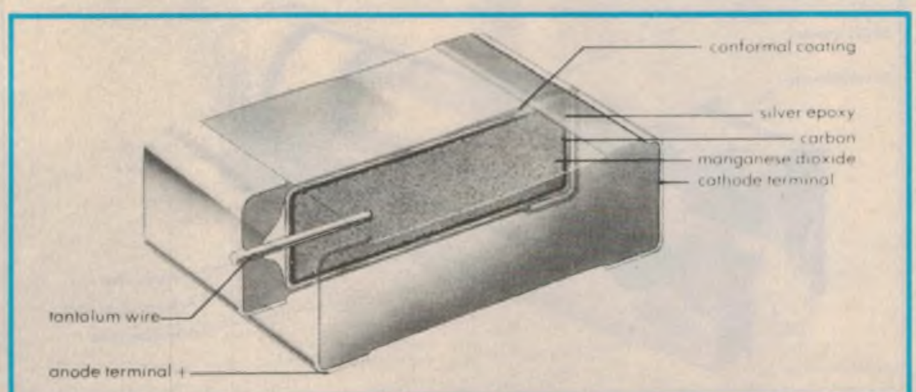


Fig.7: Surface-mounted tantalum capacitor, as made by Philips.

Fig.1b: This shows the turbulent soldering action of a dual wave soldering machine. (Photo by courtesy of Alfatron Pty Ltd.)

two or three separate boards with a single assembly. This can cut costs by eliminating connectors and wiring, simplify testing and improve reliability.

There are some limits, though, on just how closely components can be packed together. If a circuit is dissipating a lot of power, a small component version will get a lot hotter than one which is spread out and has good air flow.

Board design and layout can also be affected by the soldering system used. With the solder wave method, space must be provided for the blob of epoxy under each component. Printed tracks normally run under most larger components and their presence or absence will vary the amount of glue required to fill the gap.

As mentioned in the panel on wave soldering, the spacing and shape of components can also prevent the solder in the wave from flowing freely. If solder flow is obstructed, it can result in dry joints.

The small size of many SMDs and the closeness of connections on the latest ICs and chip carriers (well below 0.5mm) presents a particular challenge to PCB manufacturers. Improved masking and etching techniques will be needed to provide the fine, accurately positioned print paths and connecting pads required.

Wave Soldering

The standard soldering method, used for through-hole mounted components on conventional PCBs, is to pass the board slowly over the top of a single molten solder wave. As the board surface is flat, with only component leads sticking out, the solder can flow smoothly, giving good joints in all areas.

Because SMDs are packed closely together and protrude below the board surface, they tend to cause eddies in the solder wave. This prevents proper flow to adjacent joints, causing solder skips.

This problem is overcome by using a wave with a mushroom shaped cross section as shown. As the board moves across the wave, every part of it experiences solder flow from at least two different directions and all nooks and crannies are penetrated.

Dual wave soldering systems are often used. The first broad, turbulent wave is necessary to ensure good wetting of the contacts, but it can leave excessive amounts of solder behind, causing bridging of closely spaced leads on ICs, etc. The second, narrower wave has a gentle laminar flow, to remove excess solder and thereby avoid short circuits (see Fig.1).

There is a problem with gas, too. Wave soldering creates flux gases, but with conventional boards these can escape up the insertion holes of component tags. With surface mounting, bubbles or pockets of gas can form under components, preventing the proper flow of solder and thereby causing poor joints. Tilting the board as shown, in Fig.1, allows gases to escape more easily.

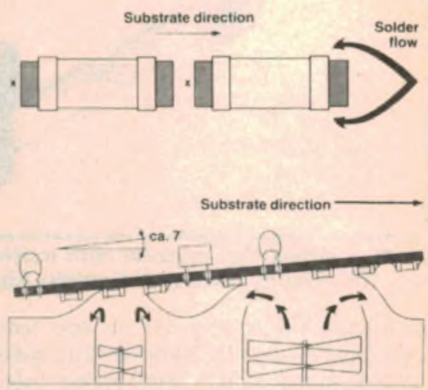


Fig.1a: SMD components close together tend to stop the flow of solder to individual connections. Tilting the board helps vent any gases produced during soldering. (Diagram by courtesy of Philips.)

Test points

Traditional PCB construction methods using wire ended components provide plenty of points for connecting probes or clipping on test leads. This does not occur with surface mounts so special test pads have to be included in the printed track layout.

Computer-aided design

Computer aided design (CAD) is often used to lay out large PCBs. Software programs originally written for designing boards using only conventional components will need lots of changes to take advantage of surface mount technology.

Component categories

As we have seen, SMDs are subjected to high levels of radiant or absorbed heat during reflow soldering processes or are completely immersed in molten metal if wave soldering is used. Imagine the effect of this on ordinary components and it's obvious that SMDs require very special survival characteristics.

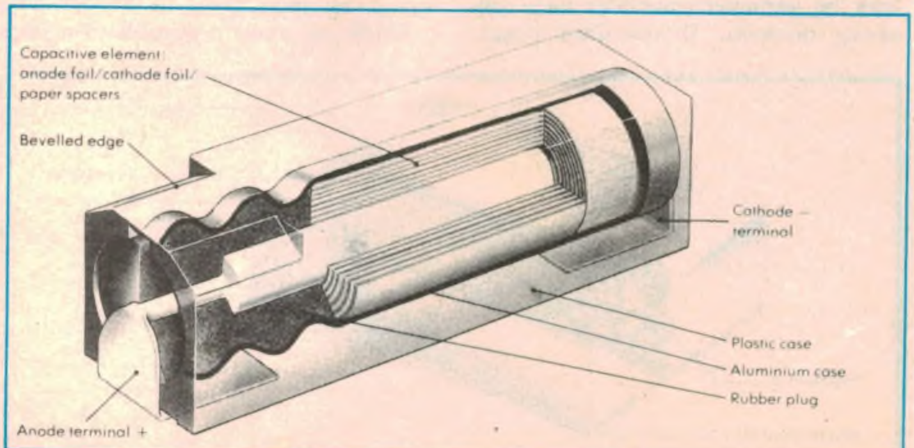
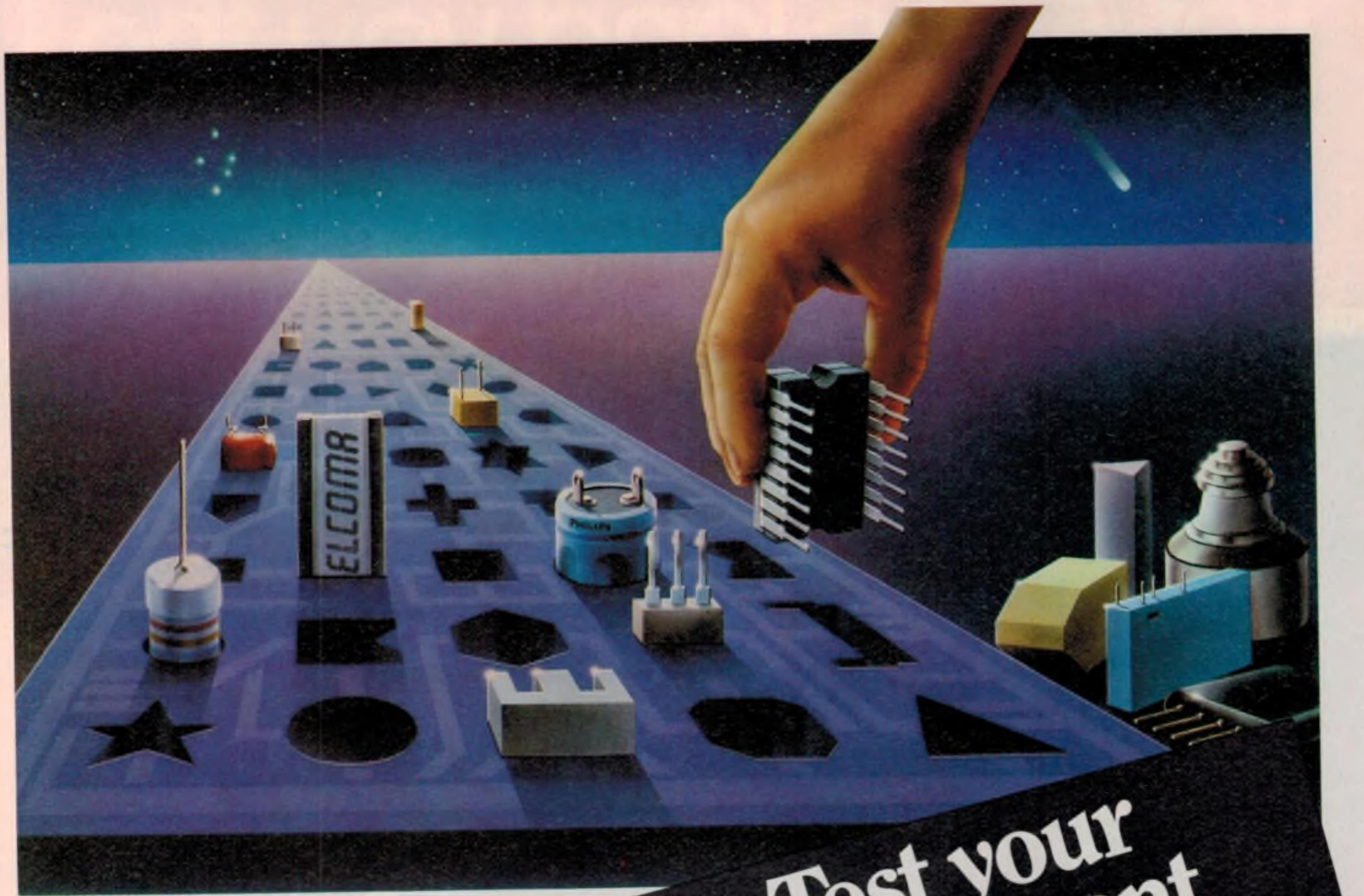


Fig.8: Surface-mounted aluminium wet electrolytic capacitor, as made by Philips.



Test your component IQ

For some companies and their products, today's market is very "testing" indeed. Firstly because more and more products are incorporating electronics for improved performance and reliability, so they fit a market hole precisely.

Secondly, the scope and range of functions they perform are leap-frogging each year with the introduction of intelligent features, via micro-processor based components.

The smart companies are learning that when they deal with Philips Elcoma in Australia, they can out perform their competitors by increasing their "marketing quotient."

Philips Elcoma (Electronic Components and Materials) encompasses some 200,000 different products to help you extend your products' IQ and improve sales. From micro-processors that can be built into computer assisted appliances – to a switch for a typewriter keyboard. From tiny resistors to integrated circuits of high complexity, or giant megawatt klystrons.

And the applications are almost limitless. For example, you can use Philips components in musical instruments, washing machines, cars, or security systems ...a wide, wide range of "thinking" products. The scope is only bounded by your ingenuity.

Additionally, Philips can design and manufacture a unique thick-film hybrid sub-assembly to satisfy a specific need you might have, or develop a dedicated IC for you.

Philips Elcoma serves the electronic industry around the world.

Call Philips Electronic Components and Materials for a solution to a market opening you can see.

Sydney	**(02) 439 3322**
Melbourne	**(03) 542 3333**
Adelaide	**(08) 243 0155**
Perth	**(09) 277 4199**
Brisbane	**(07) 44 0191**

We make electronics in Australia

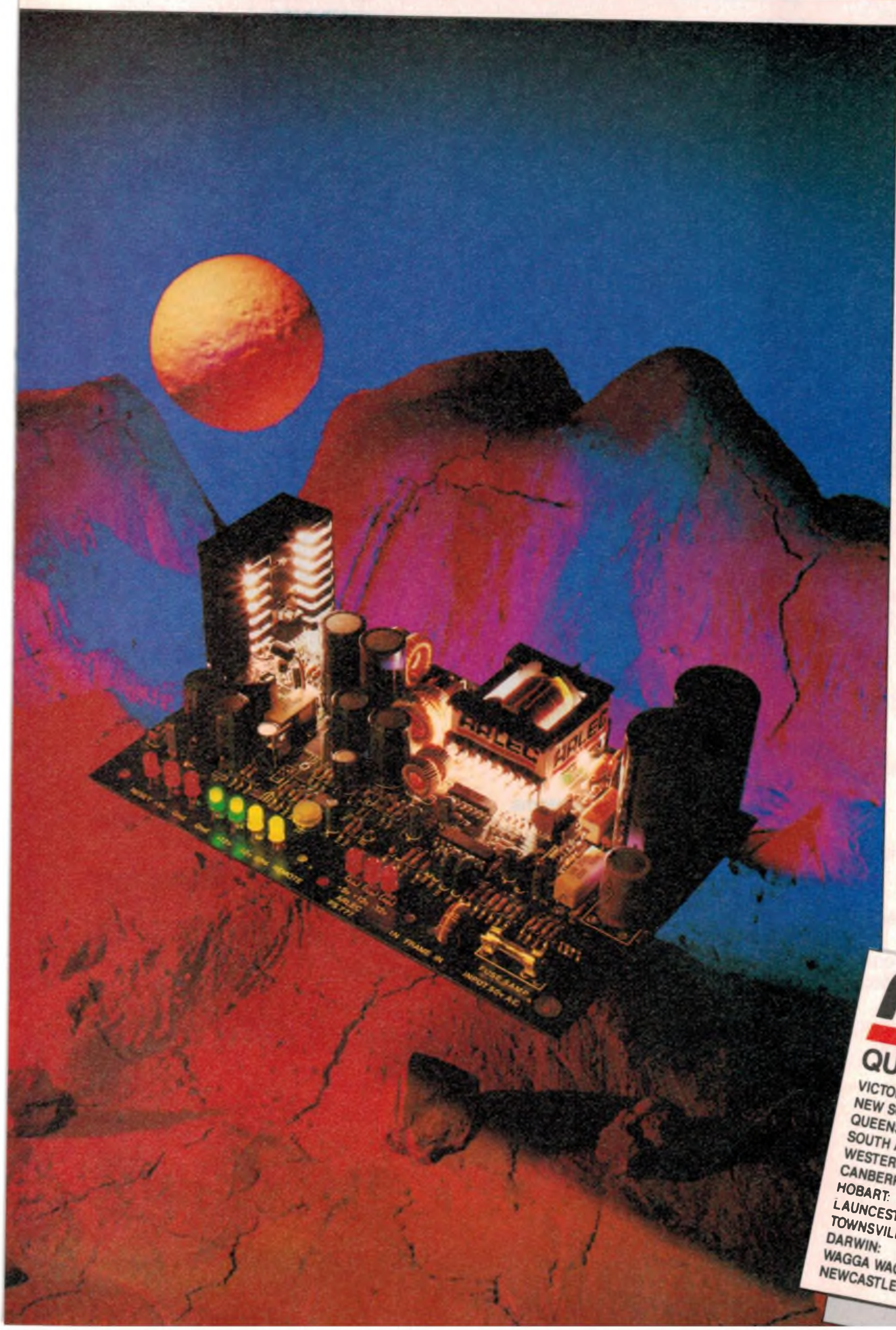
PHILIPS

Electronic Components and Materials

PHILIPS

the UN 109

Let Arlec land you the best price in town!



TRANSFORMERS: General purpose, specific application, P.C.B. mount, ferrite core and encapsulated.

POWER SUPPLIES: Specialised and switch mode.

PLUG PACK ADAPTORS: AC, DC and regulated outputs.

BATTERY CHARGERS: Specialised Nicad, Gel Cell and lead acid.

P.C.B. ASSEMBLY: Insertion and wave soldering Arlec or customer components.

WHAT ELSE? Light dimmers, speed controllers, electronic timers and component housing.

DESIGN: Computer assisted development facilities. Conforming to Australian standards with Electricity Authority and Telecom approval.

MANUFACTURER: Electronic assembly line features:
- laser guided insertion
- wave soldering machines

Modern Press Shop:
- computer controlled turret press and guillotines.

Local and Off Shore:
- Arlec has factories in Australia and Hong Kong.

40 YEARS IN THE BUSINESS: Arlec is the name you can trust for:
- customer satisfaction
- quality control
- after sales service
- guarantee on all work done.

ARLEC

QUALITY PRODUCTS

VICTORIA:	(03) 895 0222
NEW SOUTH WALES:	(02) 789 6733
QUEENSLAND:	(07) 852 1131
SOUTH AUST:	(08) 297 0766
WESTERN AUST.:	(09) 445 3611
CANBERRA:	(062) 80 5519
HOBART:	(002) 34 2233
LAUNCESTON:	(003) 31 6533
TOWNSVILLE:	(077) 79 4288
DARWIN:	(089) 84 4227
WAGGA WAGGA:	(069) 21 2735
NEWCASTLE:	(049) 25 896

Surface mount devices

Surface mount versions of almost all low power component types are now available, but resistors, capacitors, and discrete semiconductors make up about 80% of all SMDs used.

Resistors

Chip resistors are usually based on a tiny bar of high grade ceramic (aluminium oxide) material. Flat metal electrodes are fitted at either end for soldering to the PCB track. One side of the bar is coated with a resistive paste, formulated to give about the right resistance, and laser trimming can be used to bring this up to an exact value if close tolerance is required. Finally, the surface of the resistive layer is glazed to protect it from contamination or physical damage.

A typical chip resistor measures about 3.2 x 1.6mm and has a maximum dissipation of 0.125W at 70°C. Normal resistance ranges are from 1Ω to 10MΩ with tolerances from 1 to 10%.

Most manufacturers also supply jumper chips which are identical in appearance to resistors. These can be used in a similar way to wire links on a conventional PCB, but are more easily handled by automatic assembly equipment. For newcomers to SMD technology, it can be a surprise to find zero ohm resistors included in the parts list.

An alternative to the rectangular chip construction for resistors described above is the "metal electrode face" bonding (MELF) or mini-MELF format. These devices are cylindrical and resemble miniature cartridge fuses. They are generally a little larger than rectangular chip resistors and some have rated dissipation up to 0.25W at 70°C.

There is no agreed system for labelling surface mount resistors and some manufacturers simply leave the chip blank. Many Japanese suppliers use a three number system where the first two digits give resistance value and the last digit indicates the number of noughts. For example, 103 would indicate 10 followed by three noughts for a resistance of 10kΩ; 224 would indicate 22 and four noughts for 220kΩ. Some MELF resistors use the familiar colour band system found on wire ended types.

Most surface mount resistors are very rugged and can withstand heating to 250°C for up to one minute during soldering without damage.

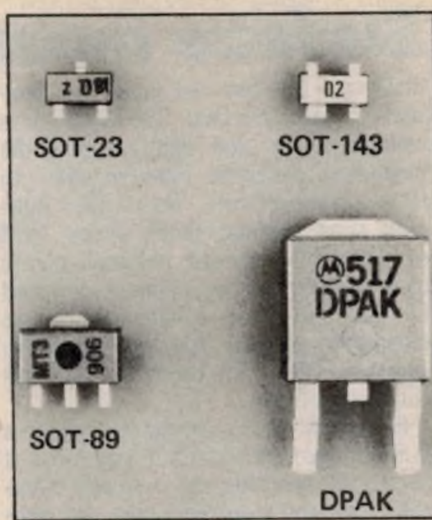


Fig.9: Surface mount transistors are available in several encapsulations, some of which are shown above. (Photo by courtesy of Motorola Semiconductor products.)

Capacitors

Like their wire ended cousins, surface mount capacitors come in a variety of types, to meet differing requirements.

The most popular chip capacitor at the moment is the ceramic multilayer type. A sandwich construction with interleaved metallic plates separated by very thin ceramic slices is used. These are stacked up, layer upon layer, until the required capacity is obtained. Each end of the capacitor is metallized to connect alternate plates together and a metal end cap is usually fitted to provide a good solderable connection to the PCB print.

Multilayer ceramic chips offer a very wide range of capacity extending from 1pF to 1.5μF. Typical working voltages are 63 or 100V but 200V units are available. Different formulations can be used for the ceramic dielectric, giving various capacity/temperature drift characteristics to suit particular applications.

Ceramic chip capacitors are generally rated to withstand 260°C for a maximum of 10 seconds during soldering. Most of the smaller chip capacitors are produced without any sort of labelling on the body. This makes life very difficult for service technicians, who will need a detailed layout diagram so chips can be identified by their position on the board.

Wire ended metallized plastic film capacitors, with their self-healing capability, are widely used in many types of electronic equipment. Chip versions of these components, suitable for surface mounting and wave soldering, have recently been developed.

Thin polyester film is used as the

Vapour Phase Soldering

Vapour phase soldering was initially developed in the USA about 15 years ago. It uses a sticky solder paste, with a consistency similar to Vegemite, which is screen printed on to the PCB connecting pads. This serves to hold the components in place during assembly and soldering.

A tray containing a special viscous liquid, which boils at 210 to 220°C, is heated to provide a saturated vapour cloud as shown. The PCB is placed in the cloud and hot vapour condenses on to it. Latent heat flows into the metal contacts on both components and board, causing the solder paste to melt or reflow. Bonding occurs over the full area between contact surfaces and there is no excessive solder to cause bridging problems.

The hot vapour penetrates even the most inaccessible gaps between densely packed components, ensuring uniform results regardless of board layout (see Fig.2).

The hot vapour cloud or zone is confined within a small area by using cooling pipes to form a 'lid' of colder, heavier vapour on top and at the sides. This prevents the expensive primary liquid from boiling away too rapidly while condensed liquid is returned to the heated tray for re-use.

Because the boiling point of a liquid can be closely defined, there is little danger of overheating SM components or boards with vapour phase soldering methods.

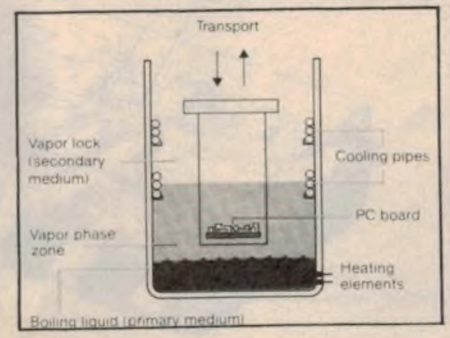


Fig.2: Vapour phase or reflows soldering uses a hot vapour to melt and make solder connections to surface mount devices. (Diagram by courtesy of Siemens.)

Surface mount devices

dielectric, but this can easily be damaged by excessive heat. The capacitor is constructed by first tightly rolling the metallised dielectric films together to form a compact core. This is then buffered from thermal shock during PCB soldering by a special moulded plastic case and lead out connections designed to minimise heat conduction. These techniques enable the capacitors to withstand 260°C for up to five seconds without problems.

Extremely stable polyester capacitors in the range 0.01 to 0.68μF and rated at about 50V working are currently available. As the moulded cases are generally larger than the bodies of ceramic chip capacitors, it is usual for the capacity and working voltage to be printed on them.

For applications requiring higher values of capacity, various types of polarised capacitors are available.

Surface mounted tantalums have been around for some time and are widely used. Capacities range from 0.1 to 100μF and working voltages from 4 to 50V. The smallest surface mount tantalums are about 2.5mm long and the largest about 7.5mm.

The capacitor body is coated with a heat resistant encapsulation to protect it from soldering temperatures. Typical tantalums are rated to withstand 260°C for 10 seconds or 300°C for 5 seconds. The small size and coatings used make it difficult to print any information on the component body, but polarity can sometimes be determined by identifying the small irregularity caused by the end of the tantalum rod, which provides the anode or positive connection.

Wet electrolytic capacitors for surface mounting are produced with values ranging from 0.1 to 22μF and working voltages from 6.3 to 63V. They are constructed by rolling etched aluminium foil electrodes and electrolyte impregnated paper separators together and mounting them inside a miniature aluminium case. A moulded plastic outer case provides insulation and protection from soldering heat.

Wet electrolytics are usually bigger than corresponding tantalum types and have overall lengths from about 8 to 12mm. Their larger size and the smooth surface provided by the plastic case make it possible for details of the capacity and voltage to be printed on them. The case sometimes also has a notch or bevelled edge to indicate the positive terminal.

Discrete semiconductors

Surface-mounted transistors and diodes, originally intended for use in miniature hybrid assemblies, have been available for some years. The first such standard plastic package to be introduced was the three terminal SOT-23 in the late 1960s. This was followed by the slightly larger SOT-89 in the mid 1970s and the four terminal SOT-143 in the early 1980s. SOT stands for 'small outline transistor' but the packages are used for all types of diodes and other semiconductors as well. A recent addition is the hermetically sealed SOD-80 two-terminal glass package, specifically intended for diodes of various types.

Transistors and single or double diodes of just about every type, except for power devices, are available in SOT-23 packaging. Because of their more recent introduction, SOT-89 and SOT-143 types are a little less common. Devices in SOT-23 and SOT-143 format can dissipate 200/350 mW and SOT-89 500/1000 mW. Motorola have recently announced a new DPAK range of surface mount power transistors. These are much larger than the standard SOT devices described above, but can dissipate 20W at 25°C (see Fig.9).

Readers may also come across several other commonly used package designations. These are TO-236 which equates to SOT-23, TO-243 which equates to SOT-89 and SOT-37 and SOT-103 which are used for RF transistors.

Red, yellow and green light emitting diodes are available in SOT-23 packaging. As there are three connections available, it is also possible to mount red and green LED chips in the same package and electrically select whichever is required. Alternatively, two chips of the same colour can be used together to double the light intensity.

As LEDs in this packaging measure a tiny 1.3 x 3mm and are only 1mm high, they can be grouped together on a PCB as elements in larger displays of numbers of characters, used as contact indicators under touch pads or mounted on PCBs to give visual indication of circuit status or fault conditions.

Soldering survival temperatures for transistors and diodes are typically 280°C for 10 seconds.

Because of their very small size, discrete semiconductors often have a two or three digit code stamped on them, rather than the full type number.

Integrated circuits

Small outline IC packages were originally introduced for use in subminiature applications, such as electronic watches, etc. They usually incorporate the same silicon chips as conventional ICs, but the encapsulation, together with pin size and spacing, has been 'squeezed' down to make the final device very much smaller. A smaller package will not radiate heat as effectively as a larger one and maximum permitted dissipation is typically reduced by up to one third compared to the same chip in a standard package.

A long and complicated list of "SO" numbers is used to cater for the various IC package sizes, numbers and spacing of pins, and we will not attempt to

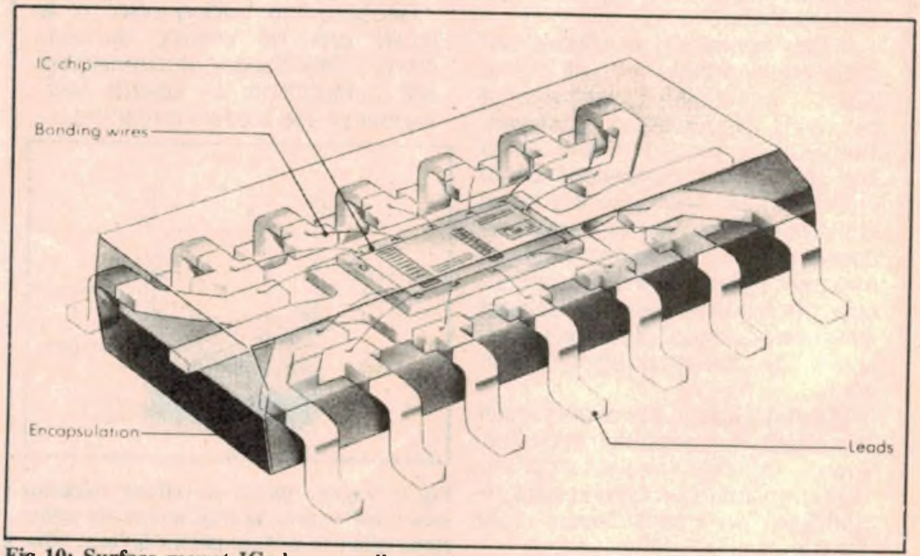


Fig.10: Surface mount ICs have smaller packages and much closer lead spacings. (Photo by courtesy of Philips.)

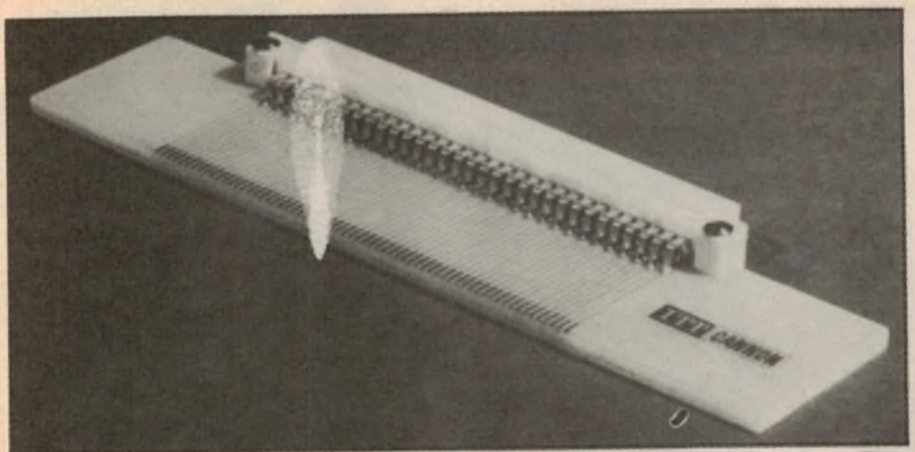


Fig.11: Board edge connectors are available in SM varieties too, as this photo from STC-Cannon shows.

rationalise them here.

Several different pin shapes and arrangements will be encountered on surface mount ICs. One of the most common is the outward facing L-shape. This makes the IC look rather bow legged and extends the board surface area required well beyond the encapsulation size (see Fig.10).

An alternative is to bend the pins back under the encapsulation to form an inward facing J-shape. This method saves space and also permits some flexing of leads to take up movement caused by thermal stresses during manufacture. One of its disadvantages is that soldered joints are out of sight below the IC and thus difficult to inspect.

Surface mount ICs often have a pin-spacing between centres of either 1.27 or 0.762mm. The smaller pitch calls for special PCB design and assembly methods. Reflow soldering techniques are preferred, because wave soldering can easily leave short circuits across closely spaced pins or associated print paths.

When ICs have more than about 40 connections, it is common practice to use square packages with leads emerging from all four sides. Chip carriers and special IC packaging for VLSI devices can now provide up to 400 connections to a surface mount PCB if required.

ICs are some of the more thermally sensitive components used in surface mounted assemblies. Many types can only take the 220/230°C temperatures required for good solder flow for about four or five seconds. Because of this and the bridging problems mentioned earlier, reflow soldering methods are preferred to wave systems for sensitive ICs. In some cases, device manufactur-

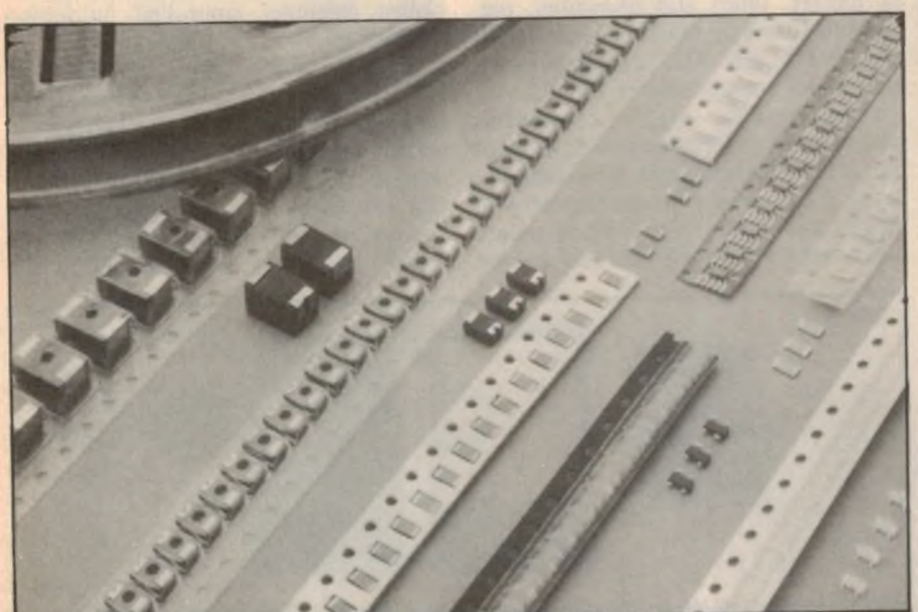


Fig.12: SMDs can be supplied in a wide variety of paper or blister tapes, as this photo from Siemens shows.

Surface mount devices

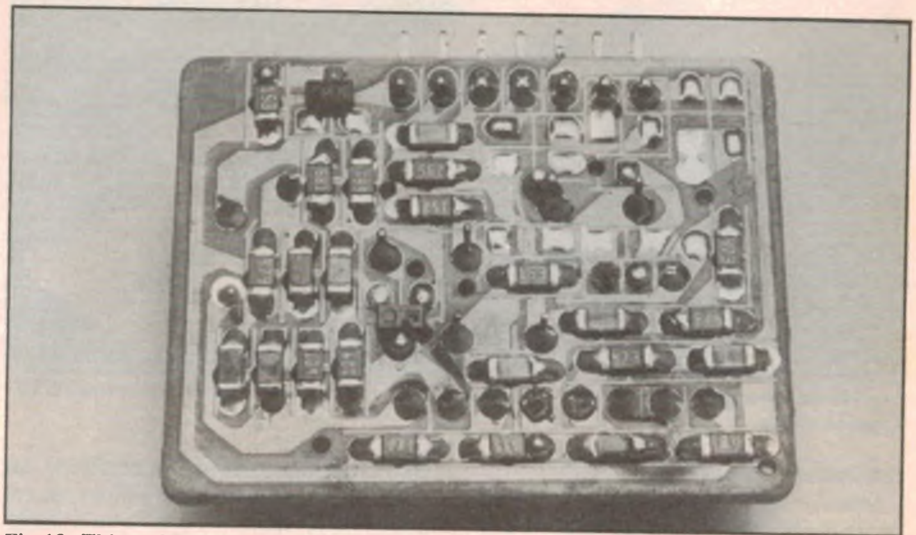


Fig.13: This small board, reproduced more than twice full size, is from a UHF transceiver marketed by Standard Communications Pty Ltd. It uses a mixture of conventional and surface mount devices.

ers recommend individual soldering of ICs using semi mechanical systems. These apply heat in short pulses directly to the joint areas between pin and board and avoid unnecessarily raising the package or silicon chip temperature.

Type number labelling on surface mount ICs is usually done in the same way as for through board devices.

Other components

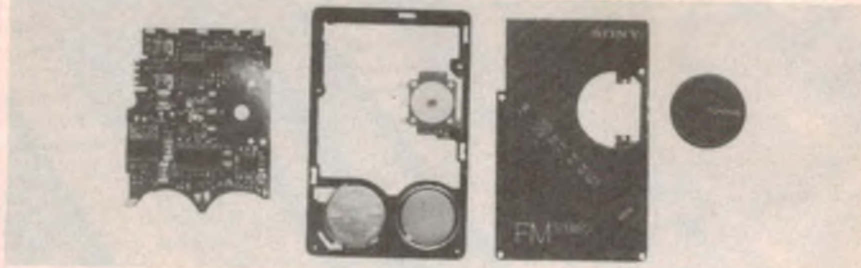
An interesting selection of other com ponent types, suitable for surface mounting, is now starting to appear. These include ferrite-cored inductors up to 100mH, filters and resonators, pre-settable (trimmer) resistors and capacitors, NTC and PTC thermistors and board edge connectors (see Fig.11).

Until recently, passive components and discrete semiconductors have been out of the limelight, with most attention being focussed on the development of bigger and better ICs. Surface mount technology is changing this and a great deal of work is now underway to adapt and upgrade existing component designs or develop new types which will be cheaper, smaller and more rugged than their predecessors. This should all lead to some interesting new components becoming available over the next few years.

Board production

In the preceding sections, we have taken a look at surface mount assembly/soldering methods, board design and the special components used. Now let's discuss how surface mount PCB assemblies are actually fabricated using the latest computer controlled production machinery.

Because of their small size and close pin spacings, it is essential that SMDs are positioned on the board with considerable accuracy. This requirement rules out the use of hand assembly methods for any sort of volume production and makes the use of precision 'pick and place' machinery essential. Once the



Sony's credit card stereo FM radio measures only 54 x 85 x 3mm thick! It is made possible by surface mount devices.

decision to use fully mechanised assembly has been made, the next step is to ensure that all components arrive in the factory packed in a way which is convenient for feeding the pick and place machinery without unnecessary handling.

Surface mount components are delivered to manufacturers packed in a variety of ways. The simplest form is bulk packaging, where devices are supplied without individual protection in boxes or bags. This method can only be used where there is no risk of bent pins or other damage and most MELF and mini MELF components are OK in this regard. Before assembly, the components are tipped into a hopper and from there go via an automatic sorter which assembles them into neat rows. In the case of polarised devices, such as diodes, it also makes sure they are the correct way round.

Devices such as ICs are supplied in various types of magazines which automatically feed the pick-and-place machine. These magazines may be in the form of long plastic sticks, with the ICs lined up end to end inside, special stack packages where removal of the bottom device causes all the others to drop down one place, or flat 'waffle' tray packs where the pick up system goes to a different compartment each time, until the tray is emptied.

By far the most popular packaging system is for components to be sealed into suitably sized pockets in a paper or plastic tape which is then wound, like movie film, on to a reel. Tape widths of 8, 12, 16 and 24mm are currently used to take different sizes of components. Sprocket holes in the tape allow components to be fed to the pick up system at the required rate (see Fig.12).

Each of the component pockets looks like a small bump or blister and so this form of packaging is known as blister tape. Examples of various width tapes, housing different size components, are shown. A typical 18cm (7-inch) reel of 8mm blister tape can carry between 3000 and 10,000 chip resistors or capacitors.

Pick and place machines vary enormously in size and capacity. A really big system might place 32 different devices simultaneously and have a capacity of 155,000 components per hour. At the other end of the scale is a range of smaller machines which handle devices one or two at a time and have a capacity between 3600 and 10,000 components per hour. The largest systems can handle several hundred different component feeds and the smallest ones about 30.

As mentioned earlier, the exact assembly process will vary according to the soldering method to be used. If components need to be glued into place for wave soldering, the pick and place machine will usually be depositing carefully controlled blobs of quick-setting epoxy with one application head, whilst simultaneously placing components on a previously prepared board with another.

If reflow soldering is to be used, the solder paste will already have been screen printed on to the boards and a placement machine with two heads can 'populate' both boards with components at the same time. Alternatively, a single head machine can be used.

An interesting bonus is obtained with the reflow soldering method. Surface tension in the molten solder and fluxes causes the connection areas of small components to 'swim' into exact position over their PCB pads. This provides a handy correction for any small discrepancies between the placement program and the PCB print pattern.

Each head on the pick and place machine contains a suction tube which initially lifts the required component from the blister tape or other feed system. Four tiny jaws then close against the sides of the component to give the exact orientation required. On some larger machines, components can even be automatically tested by contacts on the jaws. When the SMD has been correctly positioned on the PCB, an ejection pin holds it down while the suction grip is released.

All pick and place machines are controlled by built in computers which utilise software on floppy disk or tape. This makes it fairly easy to change the assembly sequence if a variety of different board types are being produced.

The precision of both the software and hardware is such that less than 20 placement errors per one million operations are normally expected.

At present, there is a lot of argument going on about the best method to use for fabricating both pure surface mount and mixed board assemblies. It may be several years before a clearly defined 'best way' of doing things becomes clear.

Electrical performance

Surface mount technology offers some very worthwhile improvements in electrical performance, particularly for RF and high speed digital applications.

The simple elimination of lengthy lead out wires means that unwanted resistance, inductance and stray capacity of connections between components and board can be greatly reduced. Big broad bonding areas on components such as chip capacitors also help to minimise lead inductance.

Active devices in SM packaging can give better gain and stability at VHF and UHF. Reduced lead inductance in capacitors improves RF bypass performance which also aids stability. In digital applications, reduced stray capacities and shorter signal paths result in improved pulse propagation times.

The accurate placement of SMDs eliminates variations which can occur with conventional PCBs where component and lead positions change slightly from board to board. This means that a proven RF design can be expected to give more consistent results, without the need for too much 'tweaking' on each individual board.

Manufacturers of TV tuners and VHF/UHF mobile radios adopted surface-mounting several years ago. In both cases, the improved RF characteristics, stability and ruggedness of SMT gave worthwhile improvements in performance without excessive increases in costs (see Fig.13).

Pros and cons

Like all new ways of doing things, surface mounting has some plus and some minus features. What do electronic equipment producers in Australia and overseas expect to gain by changing to surface mount technology? Current SM technology has evolved and matured over a 10/15 year period but recently it has started gaining momentum and is now being taken up by some of the world's biggest and most progressive manufacturers.

The worthwhile reduction in the size of single sided boards and the even more dramatic scaling down of double sided boards, made possible by SMT, has already been covered. Such miniaturisation not only leads to neater, more attractive products but can provide significant savings in material, handling, storage and shipping costs. In addition, the elimination of multiple drilled holes from boards which use 100% SMD gets rid of a costly and troublesome production operation.

Fig.14: This Dynapert NPS 500 pick-and-place machine can accept up to 120 different component feeds and place 6500 devices per hour. The machine is installed at Appliance Control Systems, Revesby, NSW.

Fabrication costs can also be reduced by adopting SMT. Initially, wire ended components were inserted into PCBs by lines of people sitting alongside slowly moving conveyor systems. Labour costs were high and mistakes, such as diodes and tantalums the wrong way round, were frequent.

A few years ago, larger consumer electronics manufacturers installed computer controlled automatic insertion equipment. This generally consisted of one machine for axial lead components, a second for radial lead components and a third for multipin devices, such as ICs and coil assemblies.

Now, a single pick-and-place machine can do all three jobs, selecting and mixing components as required. This helps explain why Japanese consumer electronics manufacturers have spearheaded the change to SMT.

In the digital equipment area, automatic assembly of boards consisting predominantly of ICs is already a single stage operation, so cost savings are less dramatic.

Until quite recently, most surface mount components were slightly more expensive than their wire ended equivalents. During the past few months however, many SMD prices have fallen and some now cost less than conventional types. This trend can be expected to accelerate as demand for SMDs increases, and many suppliers predict that by 1987, just about all SMDs will be cheaper than equivalent wire ended types.

Vibration resistance

In addition, SMDs also offer improved mechanical robustness, which can be a big advantage in certain situations.

Wire ended components, dangling on their leads, are easily damaged by shock and vibration. Lighter, smaller SMDs, bonded directly to the board by large, strong joints, are more likely to survive and remain in position when subjected to severe mechanical stresses.

This ruggedness has resulted in US aerospace and military equipment suppliers becoming heavily involved with SMT. Similar considerations, plus the favourable cost trends, have also persuaded some big car manufacturers to choose SMT for their growing electronic needs.

On the debit side, change over from existing technologies to SMT can be expensive and fraught with problems. During the present 'transition' phase, not all components are available in SM format. This means that mixed boards containing SMDs and wire ended components are often necessary. Some producers see advantage in this, as it enables them to gain SMT experience without requiring a total commitment to the new system.

Surface mount devices

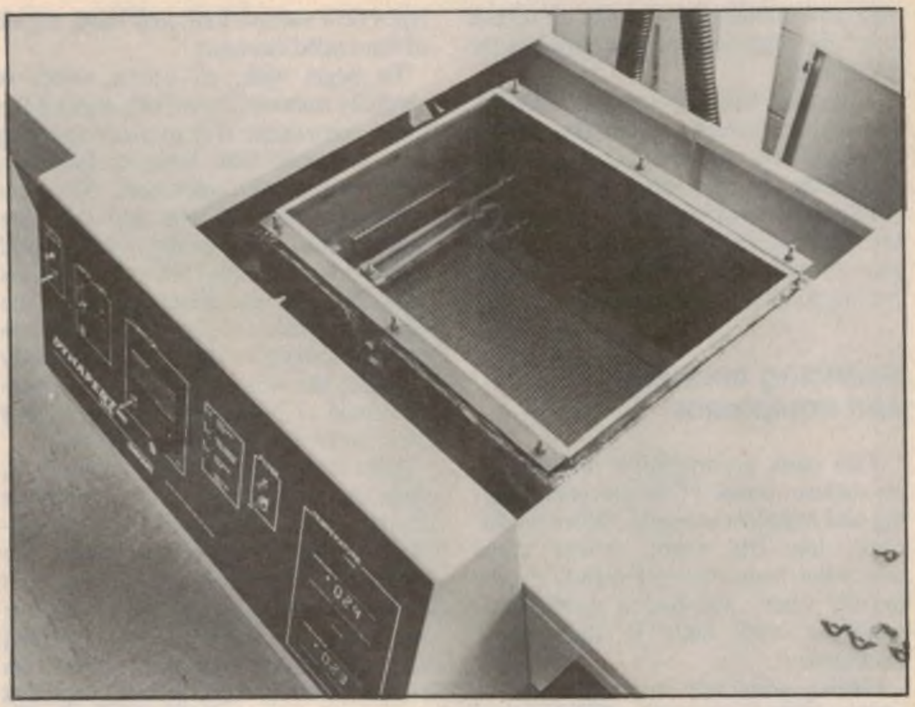


Fig.16: Inside the Dynapert vapour phase soldering machine installed by Yellow Light Car Alarms.

Because SMT is totally machine-oriented, the 'up front' investment in equipment is very high. Figures ranging from $A250,000 for the simplest placement machines up to $A1,000,000 for a small plant are typical, so SMT is definitely not a technology for the faint-hearted.

SMT in Australia

Some of the earliest activity with surface mount technology in Australia dates back to 1972/73 when the Philips plant at Hendon near Adelaide started using SMDs in hybrid assemblies. Philips remain one of the major suppliers and users of SMT in Australia along with other big companies, such as Siemens, NEC and Plessey.

Many engineers see the introduction of SMT, with its low labour costs, as a chance to re-invigorate electronic manufacturing in Australia. One company which thinks this way is Appliance Control Systems (ACS) in the Western Sydney suburb of Revesby.

ACS has recently completed installation of a DynaPert NPS 500 Pick and Place machine, together with a sophisticated wave-soldering system. The NPS 500 is manufactured in the UK. It can accept 120 different component feeds and place 6500 devices per hour (see Fig.14).

Three shifts run the plant for 20 hours a day to achieve maximum output. ACS's commitment to SMT was confirmed recently when they ordered a second placement machine to be delivered in August or September, 1986. This will enable factory throughput of boards to be doubled.

ACS say the new equipment allows two operators in the Sydney factory to control work previously done by 180 manual assembly workers overseas. This has enabled them to bring assembly work back from Singapore to Australia. In addition, the knowledge and expertise gained by ACS engineers, while setting up the Revesby plant, is now being used to expand activities into markets overseas.

Yellow Light Car Alarms have also chosen DynaPert equipment for their new SMT plant in the southern Sydney suburb of Caringbah. In this case, the smaller model 109 pick and place machine, which accepts 30 component feeds and handles 3600 devices per hour, is being used.

Yellow Light have also installed what they believe to be the first in-line vapour phase soldering system in Australia. Populated boards, with the components held in place by solder paste, are carried through a preheat tunnel on a conveyor belt, until they reach the vapour phase soldering area. Here a tray of fluorinated hydrocarbon liquid, with a specific gravity twice that of water, is heated to its boiling point of 217°C. Latent heat in the resulting vapour cloud melts the solder paste on each board as it passes through. Cooling pipes condense escaping vapour and return it to the heated tray for re-use.

Some photographs of Yellow Light's ultra modern plant accompany this article (see Figs.15-17).

Yellow Light are already active in several overseas markets, including PNG, NZ and the UK. Their next major objective is to crack the big US market for automotive protection systems.

Because of the limited home market, many Australian electronics manufacturers do not have sufficient throughput to effectively utilise even the smallest SMT plant. Others may wish to get involved, but lack the necessary technical or financial resources. In both cases, their needs can be met by sub-contracting de-

Fig.15: Yellow Light Car Alarms have installed a vapour phase soldering system as well as the Dynapert 109 pick-and-place machine capable of placing 3600 devices per hour.

Surface mount devices

sign and production to one of several specialist organisations now active in the SMT field.

The Allan Bradley company, based at Lidcombe in Sydney, offers the services of one of the United States major SMT specialists. In this case, most of the work would be carried out overseas. On the local scene, companies like Philips also provide full sub-contract design, prototyping and manufacturing services.

Servicing methods and equipment

Two basic pre-requisites for working on surface mount PCBs are good lighting and excellent eyesight. Older technicians, like the writer, whose visual acuity has been dimmed slightly by the passing years, will find a good bench magnifier with built in illumination invaluable.

Finding your way around a surface mount PCB is no more difficult than with a conventional board. In fact, because print paths and components are both on the same side, it can be a lot easier. One trap to watch out for however is the use of zero ohm chip resistors in place of links between tracks, as these are not often shown on the circuit diagram.

The lack of labelling on many chip capacitors, semiconductors and sometimes resistors, can cause difficulties. This makes it essential to have a really clear and detailed layout diagram of the PCB available. Suspect components can be identified by their physical position on the board and their circuit refererence numbers obtained from the layout diagram. Cross checking with a parts list should then enable full details of the component to be obtained.

Removing and replacing faulty SMDs need be no more difficult than changing their wire ended counterparts. The major difference with SMT is that any damage to the print is very difficult to repair and must be avoided at all costs. Damage to the component being removed is not important, as it is a golden rule that any desoldered SMD must always be discarded and never re-used.

Chip components can all be replaced using standard servicing tools. Three items are required: a fine tipped soldering iron which must be temperature-controlled so the bit never exceeds 280°C; second, a solder remover, which can be one of the capillary wire braid types or a suction tool; and third, a pair of flat-ended tweezers.

To begin with, all excess solder is carefully removed from both ends of the faulty component. Try to avoid applying heat for more than three or four seconds during this operation. Next re-apply heat, first to one end then the other, whilst very gently twisting and lifting the component with the tweezers until the ends are disconnected. If the device is glued in place, heat may be applied directly to the component body to soften the adhesive. Never use excessive force or prolonged heating, as this could cause the PCB track to lift off.

After removing the faulty component, clean up the pads and apply a thin layer of new solder. Inspect the new component to ensure its contact areas are clean and bright. If not, a very fine abrasive paper may be used to remove oxidisation or corrosion. Avoid tinning the replacement component unless this is considered to be essential to give a good joint.

Hold the new component in position with tweezers. Position the soldering tip so it contacts both PCB and component end. Feed solder to the joint until smooth flow occurs and the component sits firmly and squarely on its pad. Allow the SMD to cool before soldering the other end. Again, try to keep the time during which heat is applied down to about 3 or 4 seconds.

An alternative method of soldering and desoldering SMDs is provided by the Edsyn hot air system. This uses a hand-held tool which projects a thin stream of very hot air from its tip. Temperatures are adjustable over the range 205 to 425°C.

Because there is no need to press down onto the joint being heated when using hot air, it is possible to melt the solder and simultaneously pass a thin, non solderable shim, between the component and pad to separate them. This technique can be used to desolder multipin devices, such as ICs, by lifting pins one at a time. Alternatively, the shim

Fig.17: This Royel position table has a special hollow head to heat up the SMD to be removed and a vacuum feed to lift the device off the board.

Surface mount devices

can be replaced by a thin wire which is pulled through the just molten solder beneath each pin, like an old fashioned cheese-cutter.

Hot air systems are particularly effective for use on chip carriers and inward facing J-shaped pins, as these are almost inaccessible to normal conductive soldering tools. They also work well on non-glued chip components, where each end can be heated in quick succession from below until the device falls off.

A number of specialised tools for use in surface mount production and service situations are now available.

The Royel positioning table for SM components is illustrated. Various hollow heads or platens are available to suit different IC packages. To remove an IC, the arm is lowered and the platen presses down on either side of the device, providing heat to melt all the pin connections simultaneously. A vacuum system in the head allows the IC to be lifted off the board when the arm is raised (see Fig.17)

The storage and handling of SMDs at Service Department level will require special care. Chip components such as capacitors and semiconductors can be very difficult to identify once separated from their original packing. Stores personnel will have to be very careful to avoid accidentally mixing parts when topping up storage drawers, and technicians should only remove parts from packages or envelopes when they are required for immediate use. Tweezers will be necessary for handling some of the smaller SMDs.

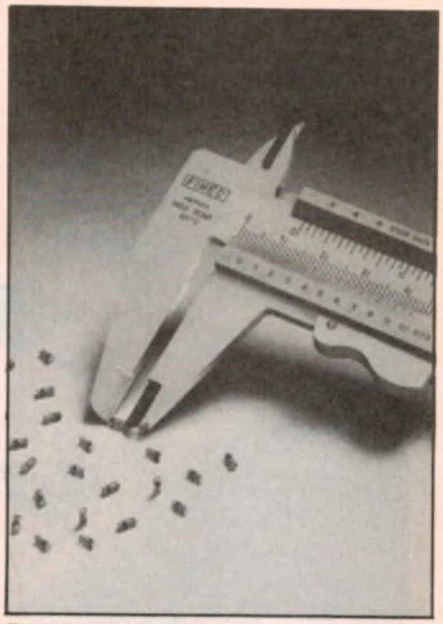


Fig.18: This photo shows the extremely small size of surface mount devices.

Predicted growth

Estimates of just how quickly SMT will be taken up by the world's electronics industry vary from manufacturer to manufacturer and country to country. Many engineers involved with the new technology see it becoming the standard way of manufacturing most PCBs by about 1995, whilst some of those still on the sidelines doubt that it will ever fully replace through board methods.

The figures below, which were kindly made available by Philips, give the percentage number of PCBs incorporating some SMDs in 1985 and similar predicted percentages from 1990. Separate figures are shown for each of the world's three major manufacturing regions. Japan is the clear leader in

Acknowledgements

The author would like to thank the following companies for their generous co-operation and provision of information and material during the preparation of this article.

Allen-Bradley Pty Ltd.
Appliance Control Systems Pty Ltd.
Crusader Electronic Components Pty Ltd. (Beyschlag, Kemet).
Heyden-Spike Co. Pty Ltd. (Edsyn).

adopting SMT with the USA in second place. It is interesting to note that Europe is expected to overtake the US in percentage terms and this may be due to economic factors favouring a return to 'local' rather than 'off shore' production as described earlier.

SMD Penetration

	1985	1990
Japan	30%	50%
U.S.	15%	30%
Europe	14%	35%

SMT proponents suggest that 60% of boards will use some SMDs by 1990 whilst doubters think the figure will be only about 30%. An average of these extreme views works out fairly close to the Philips estimates.

Component usage figures, set out below, also by courtesy of Philips, show that strong growth is expected for all types of devices. The total SMD figure rises from 28 billion units (18% of total) in 1985 to 80 billion units (41% of total) by 1990.

World Component Usage — Billion (10^9) units

	1985 ALL	1985 SMD	1990 ALL	1990 SMD
Diodes	17	2	20	6
Transistors	13	3	15	11
Capacitors	57	10	70	24
Resistors	53	12	65	30
ICs	15	1	25	9
	155	28	195	80

Whether one is an optimist or a pessimist, there seems little doubt that the expansion of SMT out of the Japanese consumer and US aerospace/military equipment areas is now underway. Perhaps by the end of the century, engineers will wonder why PCBs were ever made any other way.

IRH Components (MuRata).
Motorola Semiconductor Products.
Philips Electronics Components and Materials.
Promark Electronics (Telefunken, Thompson).
Royston Electronics (Royel).
Siemens Ltd.
Sony (Australia) Pty Ltd.
Standard Communications Pty Ltd.
STC-Cannon Components Pty Ltd. (ITT).
Yellow Light Car Alarms.

Fig.19: This photo shows the rapid action of a pick-and-place machine as it grabs components from the tapes and places them on the boards. (Yellow Light.)

Simple circuit is based on a quad op amp

Low-cost A-D converter for Apple & Microbee

If you want to connect your computer to the real world, you need an analog-to-digital (A-D) converter. This article describes a low-cost unit that can be plugged into the Apple games paddle port or the Microbee parallel port.

by RICHARD WALDING & PAUL PAVLUK

There are many applications for computers in instrumentation. With a little ingenuity, they can be put to work reading, storing, analysing, displaying and acting on data collected from external devices.

In this context, the computer's ability to process large amounts of data quickly, enables the progress of reactions and experiments, and operating variables such as temperature, light intensity, voltage and conductivity, etc, to be continuously monitored.

The most common output from a monitoring instrument is a varying analog voltage. In order for a computer to read and process this data, it has to be converted to a digital format. The device described here converts an analog voltage of between 0 and 5V to digital format and displays the value on the screen. It is up to the user to modify the software so that the measured voltage can be graphed against time, used to turn on switches, stored for later analysis or just left displayed on the screen.

About the Authors

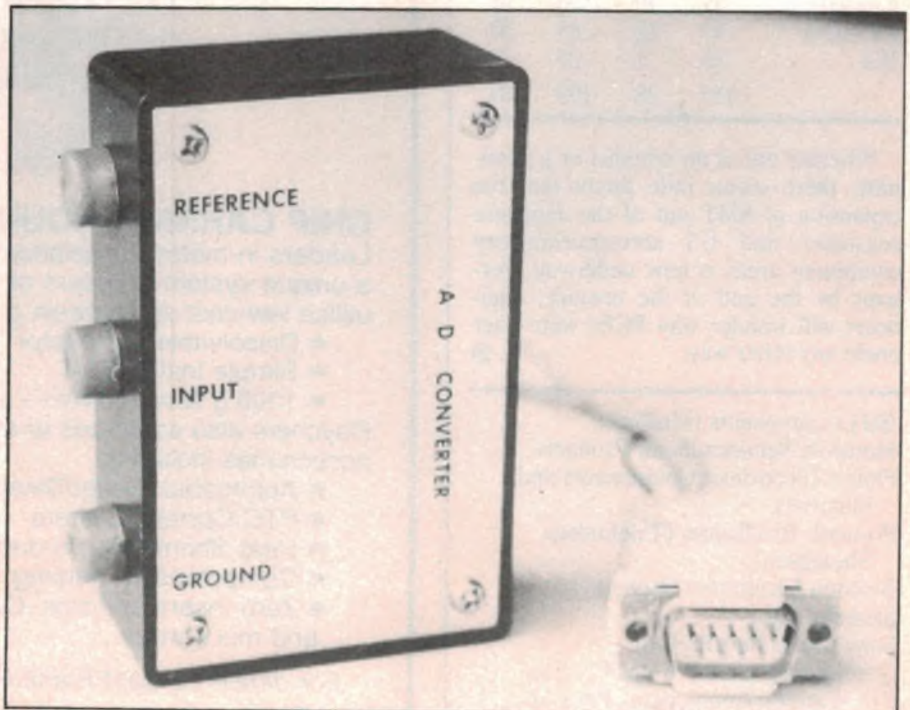
Richard Walding, B.App.Sc, Grad.Dip.Tch., M.Sc., M.Phil., is the Chemistry and Physics Master at Moreton Bay College in Brisbane. Prior to 10 years of teaching, he was an industrial chemist. He has been working on science interfaces under sponsorship of an Apple Education Foundation Grant.

Paul Pavluk, B.Sc. is a computer programmer with the South East Queensland Electricity Board and has been employed there for the past seven years. He has developed a number of interfaces and utilities for the Microbee.

Possible applications

This device was originally developed as an interface to a pH meter so that the progress of titrations could be monitored graphically. Most pH meters have a chart recorder output which can be used directly as the input for this interface, providing its output varies between 0V and 5V.

We've also used the A-D converter to measure the conductivity of solutions and the output of photomultiplier tubes in spectroscopy, but there are many other applications.



The A/D Converter uses the Input and Ground terminals to accept data and is connected to the computer by three wires to a 9 pin D plug for the Apple (shown here) or a 15 pin D plug for the Microbee.

In cases where some action is required when a preset potential is reached, the computer can be programmed to switch some external device on or off via the annunciator.

This article will describe how to use the converter, first with an Apple, then with Microbee.

The Apple IIe Games Port

The games port is a versatile and under-rated interface for the Apple. It is rarely used for more than a joystick control.

The 9-pin D connector on the rear of the IIe provides four analog inputs (PDL0-PDL3) and three switch inputs (SW0-SW1). These inputs are also available on an internal 16-pin socket which also provides four one-bit outputs and a data strobe, all of which can be accessed from a Basic program. Apple II+ users only have the 16-pin socket — it's not as handy, that's all.

The analog inputs read the resistance of a device between 0 and 150kΩ and return a number between 0 and 255. The relationship is linear. This has many applications, such as reading light intensity (using a light dependent resistor), temperature (with a temperature dependent resistor or a thermistor), and angular displacement (using a potentiometer).

The switch inputs can read the state of an external switch such as a pushbutton (eg. the open and closed Apple keys or joystick buttons), a photodiode, or some other electronic switch.

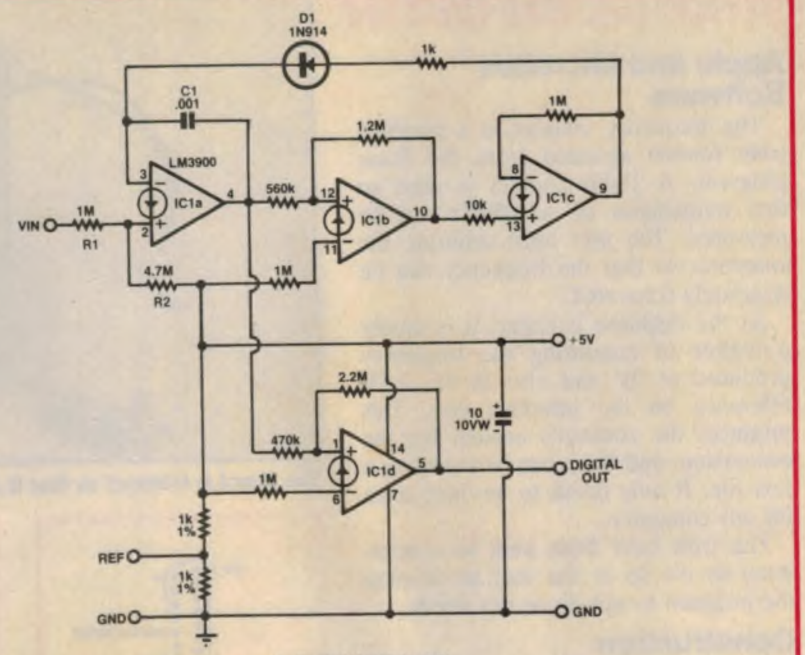
Voltage to Frequency Conversion

One variable the Apple can't measure directly is voltage. Many devices produce analog voltages or currents to which a meter responds. Usually, an analog/digital converter card is used in one of the Apple's expansion slots and even the cheapest home-made one can cost $100.

The unit described here converts a voltage to a square waveform (with frequency proportional to voltage) which is read via one of the switch inputs of the games port. The circuit details are described in the accompanying panel.

Microbee Parallel Port

All Microbees (even the cheapest) have a parallel port consisting of a 15-pin D connector providing eight lines which can be either input or output under program control. The port also contains a 5V power source and strobe lines.



A-D CONVERTER 2/CC/-

The circuit is based on a single LM3900 IC which contains four Norton op amps. These do much the same job as ordinary op amps but can be operated from a single supply and feature TTL-compatible outputs — ie, the outputs can go almost to the negative supply rail.

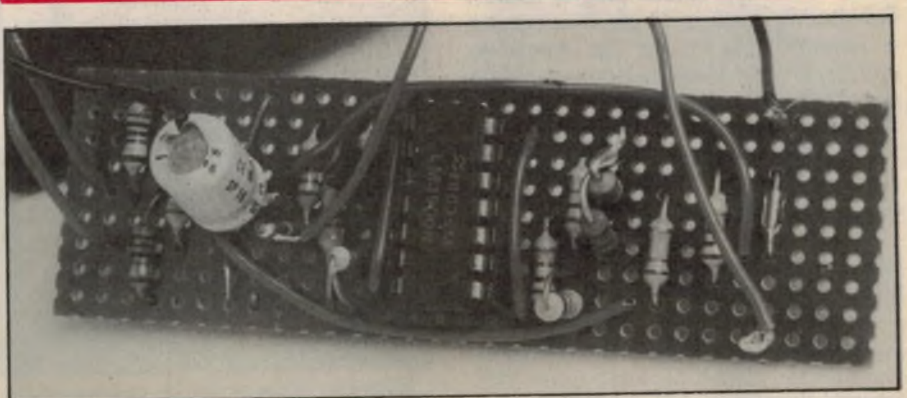
IC1a, IC1b and IC1c generate a sawtooth waveform, the frequency of which depends on the input voltage. The output frequency (at pin 4 of IC1a) is about 100Hz for 0V in and about 1kHz for 5V in.

Here's how it works:

IC1a is wired as an integrator whose output voltage increases at the rate Vin/R1C1 + 5/R2. This output voltage is applied, via a 560kΩ resistor, to the non-inverting input of IC1b which is connected as a Schmitt trigger. When the output of IC1a reaches 2.8V, the Schmitt trigger output (pin 10) switches high.

The output of IC1b is then fed to non-inverting amplifier IC1c which has a gain of 100. This stage is required because the LM3900 has poor gain for high frequency large voltage swings. The high output of IC1c forward biases D1 and forces the output of IC1a low. This, in turn, resets the Schmitt trigger and so the cycle repeats indefinitely.

IC1d forms another Schmitt trigger. It converts the 2.8V peak triangle wave at the output of IC1a to a 5V square wave which is then fed to the computer. The two 1kΩ 1% resistors across the supply rails provide an external 2.5V reference.



Above: close up view of the assembled board for the A-D converter. Take care with the orientation of the IC, diode and electrolytic capacitor.

A-D converter

Apple and Microbee Software

The frequency counter is a machine code routine accessed from the Basic program. A 16-bit counter is used so that frequencies up to 65kHz can be measured. The user must calibrate the computer so that the frequency can be accurately converted.

As the response is linear, it is simply a matter of measuring the frequency produced at 0V and also at the 2.5V reference on the interface box. This produces the constants needed for the conversion, and these can be stored as a text file. It only needs to be done once for any computer.

The frills have been kept to a minimum so it's up to the user to develop the program to suit his or her needs.

Construction

The circuit is built on a small piece of Veroboard and housed in a plastic utility case measuring 28 x 54 x 83mm.

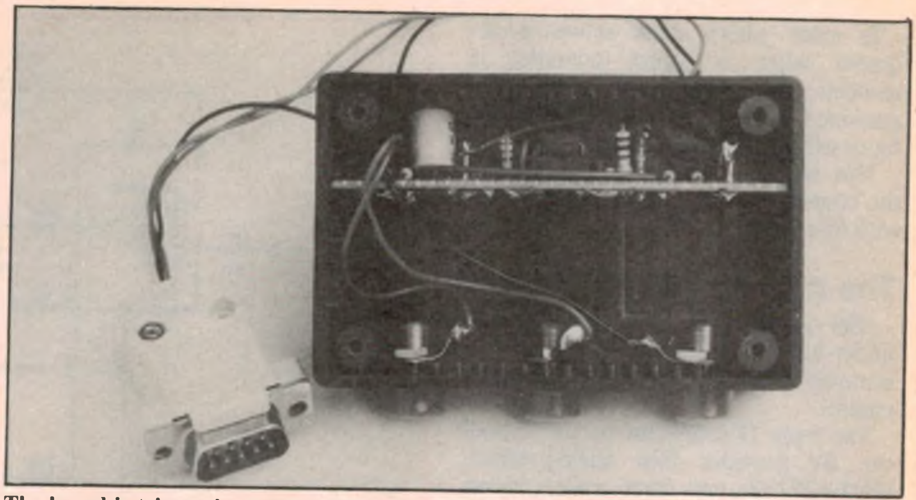
Begin construction by wiring up the Veroboard as shown in the wiring diagram. Take care with component orientation and make sure that each component is correctly positioned before soldering the leads. We mounted the IC in a socket but recommend that constructors save the cost of this item by soldering the IC directly to the board.

Check your work carefully as you proceed — it's very easy to make a mistake with Veroboard. An oversize drill can be used to make the necessary breaks in the copper tracks.

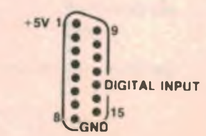
Once all the parts are in position, connect flying leads to all the external wiring points. This done, trim the Veroboard to a length of 78mm so that it can be slid into the ribbed slots at either end of the case.

Connections to the computer are made via an appropriate plug or socket. For the Microbee, a 15-pin D connector is required (Fig.1); for the Apple 2e and 2c, a 9-pin D connector is required (Fig.2); and for the Apple 2+, a 16-pin IC plug is required (Fig.2). Note that, for the Apples, the converter output is connected to one of the switch inputs, either SW0, SW1 or SW2.

Three banana sockets are used to accept the REF, VIN (input) and GND connections and these are mounted on one side of the plastic case as shown in the photographs. The leads to the computer plug (+5V, DIGITAL OUT and GND emerge through a hole drilled in the back of the case.



The board is trimmed so that it slots into the ribs of the plastic case.



DB15 PLUG CONNECTIONS FROM SOLDER SIDE

Fig. 1

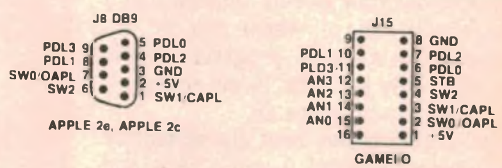


Fig. 2 APPLE PLUG CONNECTIONS

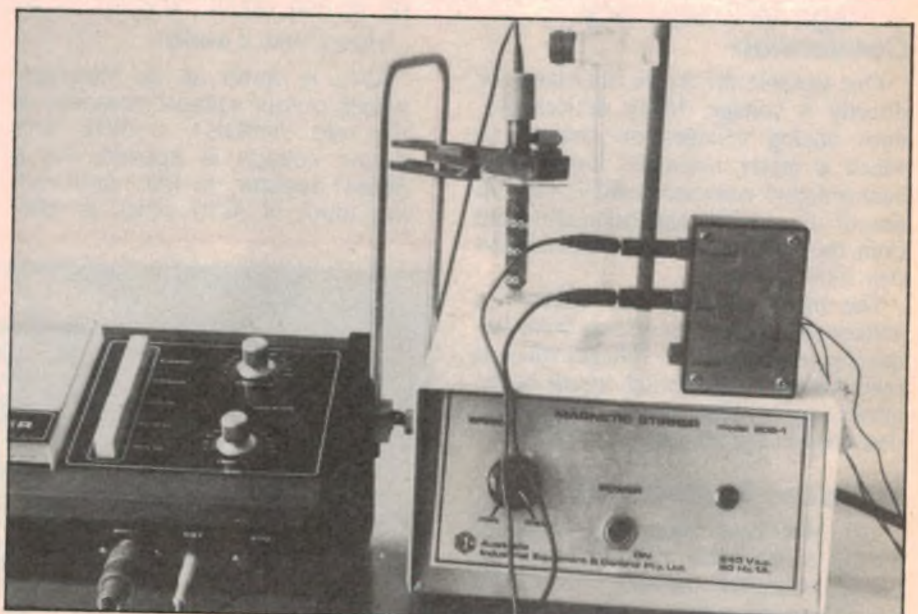
PARTS LIST

1 piece of Veroboard, 2.5 x 8cm
1 plug to suit computer
1 plastic utility case, 28 x 54 x 83mm
3 banana sockets, 1 red, 1 green, 1 black

Semiconductors
1 LM3900 quad op amp
1 1N914 diode

Capacitors
1 10μF 10VW electrolytic
1 .001μF polyester

Resistors (0.25 W, 5% unless noted)
1 x 4.7MΩ, 1 x 2.2MΩ, 1 x 1.2MΩ, 4 x 1MΩ, 1 x 560kΩ, 1 x 470kΩ, 1 x 10kΩ, 1 x 1kΩ, 2 x 1kΩ 1%.



Changes in voltages can be monitored with this converter. In this case the change in pH during an acid-base titration is being followed by connecting the A/D Converter to the chart recorder plug of a pH meter.

```
]LIST

5  GOSUB 10000
10  HOME
20  VTAB 2: HTAB 12: PRINT "ANALOG TO DIGITAL": VTAB 4: HTAB 12: PRINT "V
    OLTAGE CONVERTER"
30  VTAB 6: HTAB 7: PRINT "R.Walding & P.Pavluk 1986"
40  POKE 34,5
50 D$ =  CHR$ (4)
70  HOME
80  PRINT : PRINT : PRINT "DO YOU WANT TO:"
90  PRINT : PRINT  SPC( 5)"1. CALIBRATE CONVERTER": PRINT : PRINT  SPC( 5
    )"2. RUN": PRINT : PRINT "SELECT A NUMBER ";: GET Q: IF Q = 1 THEN  GOSUB
    260: GOTO 70
100  PRINT D$"OPENADCON.CAL": PRINT D$"READ ADCON.CAL"
110  INPUT G,S1
120  PRINT D$"CLOSE ADCON.CAL"
130  HOME
140  CALL 768:X =  PEEK (8):Y =  PEEK (9):CF =  PEEK (10):CS =  PEEK (11)

150 N = 12 * X + (256 * 12 + 1) * Y - 4
160 COUNT = CF + 256 * CS
170 N = N + 11 * (COUNT - 1) + 4 * CS
180 T = 1 / 1022714 * N / COUNT:FR = 1 / T
190  VTAB 10: HTAB 5
200  PRINT "FREQUENCY = "; INT (FR * 100 + .5) / 100;"
210 V = (FR - G) / S1
220  VTAB 12: HTAB 5: PRINT "VOLTAGE = "; INT (V * 100 + .5) / 100"
    "
230  IF  PEEK ( - 16384) < 127 THEN 70
240  GOTO 140
250  PRINT  CHR$ (4);"WRITE ADCON.CAL"
260  REM  CALIBRATION ROUTINE
900  HOME
910  VTAB 10: PRINT "CALIBRATION PROCEDURE"
920  PRINT : PRINT "1. Connect probes together"
930  PRINT : PRINT "PRESS RETURN WHEN READY ";: GET Q$
940  GOSUB 1080:G = FR: PRINT  INT (G)
950  PRINT : PRINT : PRINT "2. Connect INPUT probe to REFERENCE"
960  PRINT : PRINT "PRESS RETURN WHEN READY ";: GET Q$
970  GOSUB 1080:R = FR: PRINT  INT (R)
980 S1 = (R - G) / 2.5
990  PRINT : PRINT "CALIBRATION IS NOW COMPLETE"
1000  PRINT : PRINT "Voltage = (freq - "; INT (G);") / "; INT (S1)
1010  PRINT : PRINT "DO YOU WISH TO SAVE TO DISK (Y/N) ?";: GET Q$: IF Q$
     = "" THEN 1010
1020  IF Q$ <  > "Y" THEN  RETURN
1030  PRINT : PRINT  CHR$ (4);"OPEN ADCON.CAL"
1040  PRINT  CHR$ (4);"WRITE ADCON.CAL"
1050  PRINT G: PRINT S1: PRINT  CHR$ (4);"CLOSE ADCON.CAL"
1060  RETURN
1070  END
1080  CALL 768:X =  PEEK (8):Y =  PEEK (9):CF =  PEEK (10):CS =  PEEK (11
    )
1090 N = 12 * X + (256 * 12 + 1) * Y - 4
1100 COUNT = CF + 256 * CS
1110 N = N + 11 * (COUNT - 1) + 4 * CS
1120 T = 1 / 1022714 * N / COUNT:FR = 1 / T
1130  RETURN
10000  REM
10010  FOR J = 768 TO 826
10020  READ I
10030  POKE J,I
10040  NEXT J
10050  DATA 162,0,160,0,132,10,132,11,44,99,192,48,251,44,99,192,16,251,2
    32,208,1,200,44,99,192,48,247,232,208,1,200,44,99,192,16
10060  DATA 247,230,10,208,2,230,11,192,80,144,228,134,8,132,9,96,144,221
    ,134,8,132,9,96,0
10070  RETURN
```

Apple BASIC program for the A/D Converter.

```
ADDR   CODE     LINE   LABEL  MNEM    OPERAND      COMMENTS

                00100         ; Assembly Language Routine for the
                00102         ; Analog -> Digital converter for the
                00104         ; Mircobee using Bit 0 of the parallel port
2000            00110         DEFR 16
6000            00120         ORG 6000
                00130         ; GET COUNT INTO BC
6000 F5         00140         PUSH AF                   ; save the registers
6001 D5         00150         PUSH DE
6002 E5         00160         PUSH HL
6003 3EFF       00170         LD A,0FFH                 ; Set parallel port for input
6005 D301       00180         OUT (1),A
6007 D301       00190         OUT (1),A
6009 0600       00200         LD B,0                    ; Initialize flag
600B 110070     00220         LD DE,7000H               ; Set the number of times to loop
600E 210000     00230         LD HL,0                   ; Reset the count of positive changes
6011 DB00       00240  LOOP   IN A,(0)                  ; Input value of port
6013 E601       00250         AND 1                     ; Ignore unwanted bits
6015 B8         00260         CP B                      ; Compare with previous value from port
6016 010000     00270         LD BC,0                   ; Reset B and C
6019 CB11       00280         RL C                      ; Rotate carry bit into bit 0 of C
601B 09         00290         ADD HL,BC                 ; If the port value has changed add 1
601C 47         00300         LD B,A                    ; Save current  value of port
601D 1B         00310         DEC DE                    ; Decrement the counter
601E 7A         00320         LD A,D                    ; See if we are done
601F B3         00330         OR E                      ; See if D and E are both zero
6020 20EF       00340         JR NZ,LOOP                ; If we are not done then repeat
6022 44         00350         LD B,H                    ; save count into BC
6023 4D         00360         LD C,L
6024 E1         00370         POP HL                    ; restore registers
6025 D1         00380         POP DE
6026 F1         00390         POP AF
6027 C9         00400         RET
0000            00410         END
00000 Total errors

LOOP    6011
```

Microbee assembly language routine used in the A/D conversion.

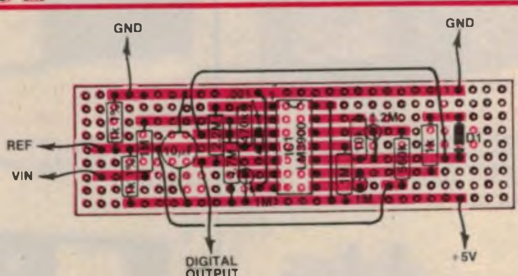
```
0300-   A2 00      LDX   #$00        031E-   C8         INY
0302-   A0 00      LDY   #$00        031F-   2C 63 C0   BIT   $C063
0304-   84 0A      STY   $0A         0322-   10 F7      BPL   $031B
0306-   84 0B      STY   $0B         0324-   E6 0A      INC   $0A
0308-   2C 63 C0   BIT   $C063       0326-   D0 02      BNE   $032A
030B-   30 FB      BMI   $0308       0328-   E6 0B      INC   $0B
030D-   2C 63 C0   BIT   $C063       032A-   C0 50      CPY   #$50
0310-   10 FB      BPL   $030D       032C-   90 E4      BCC   $0312
0312-   E8         INX               032E-   86 08      STX   $08
0313-   D0 01      BNE   $0316       0330-   84 09      STY   $09
0315-   C8         INY               0332-   60         RTS
0316-   2C 63 C0   BIT   $C063       0333-   90 DD      BCC   $0312
0319-   30 F7      BMI   $0312       0335-   86 08      STX   $08
031B-   E8         INX               0337-   84 09      STY   $09
031C-   D0 01      BNE   $031F       0339-   60         RTS
```

Apple machine code routine used by the BASIC program in the A/D conversion. This code is POKE'd in by the program in Listing 1 although it could be stored as a binary file (ADCON.OBJ) and called from BASIC in place of the pokes. The same is true of the Microbee listing.

```
00100 REM ANALOG TO DIGITAL CONVERTER PROGRAM
00120 REM For the Microbee
00140 REM Date         25-Nov-85
00160 ON ERROR GOTO 20000
00180 CLS : GOSUB 10000 : REM load in the machine code routine
00200 POKE 257,1
00220 CURS 10,2:PRINT "A n a l o g   t o   D i g i t a l"
00230 CURS 10,3 : PRINT" C o n v e r t e r   P r o g r a m"
00240 CURS 10,5 : PRINT "Written by Paul Pavluk"
00242 CURS 10,7: PRINT "PLEASE PRESS EITHER 1 OR 2"
00244 CURS 10,10 : PRINT 1. : INVERSE : PRINT"Calibrate Converter":NORMAL
00246 CURS 10,12 : PRINT 2. : INVERSE : PRINT"Run                 ":NORMAL
00260 A1$=KEY$ : IF A1$<>"1" AND A1$<>"2" THEN GOTO 260
00270 IF A1$="1" THEN GOSUB 9000 : GOTO 500
00280 IF A1$="2" THEN GOSUB 8000 : GOTO 500
00500 I=0
00510 CLS : PRINT "PRESS SPACE BAR TO STOP AND START"
00520  V=USR(A)
00540  V1=FLT(V-G)/S1
00550 I=I+1
00560 PRINT "Sample ";I;" = ";[F6.2 V1];" Volts"
00570 IF KEY$=" " THEN 800
00580 GOTO 520
00800 PLAY 0,8
00810 IF KEY$=" " THEN 520 ELSE 810
08000 REM       READ IN CALIBRATION VALUES
08020 OPEN "I",6,"ADCON.CAL"
08040 IN#6 : OUT#0 OFF
08060 INPUT G,S1
08080 IN#0 : OUT#0
08100 CLOSE 6
08120 RETURN
09000 REM  CALIBRATION ROUTINE
09020 CLS : INVERSE : CURS 10,2
09030  PRINT " C A L I B R A T I O N   P R O C E E D U R E " : NORMAL
09040 PRINT : INPUT"Connect probes together . press return when ready",Q2$
09060 G = USR(A)
09070 IF G=0 THEN PRINT "Device is not plugged in" :PLAY 1,24: GOTO 9000
09075 PRINT
09080 INPUT"Connect positive probe to reference, press return when ready",Q2$
09100 R = USR(A)
09120 S1 = (FLT(R)-FLT(G))/2.5
09140 REM
09160 PRINT : PRINT "Calibration is now complete" : PRINT
09180 PRINT "Voltage = (frequency - ";[I4 G];") / ";[F5.0 S1]
09200 INVERSE : PRINT " DO YOU WISH TO SAVE TO DISK (Y/N) ?";: NORMAL
09210 A1$=KEY$ : IF A1$="" THEN 9210
09212 IF A1$<>"Y" THEN RETURN
09240 OPEN "O",6,"ADCON.CAL" : OUTL#6 : LPRINT G,",",S1 : CLOSE 6
09300 RETURN
10000 REM a basic loader program
10010 RESTORE  10000
10030 READ A,B
10040 FOR Z=1 TO B : READ C : POKE A+Z-1,C : NEXT Z
10050 DATA      24576  ,          40
10060 DATA 245, 213, 229, 62, 255, 211, 1, 211, 1, 6
10070 DATA 0, 17, 0, 112, 33, 0, 0, 219, 0, 230
10080 DATA 1, 184, 1, 0, 0, 203, 17, 9, 71, 27
10090 DATA 122, 179, 32, 239, 68, 77, 225, 209, 241, 201
10100 RESTORE : RETURN
20000 REM ERROR ROUTINE
20020 IF ERRORC<>45 THEN PRINT : PRINT CHR$(7),"WHOOPS":STOP
20040 PRINT "THE DEVICE HAS NOT BEEN CALIBRATED"
20060 ON ERROR GOTO 20000
20080 A1$="1": GOTO 270

32767 END
```

Microbee BASIC listing for the A/D Converter.



Above: wiring diagram for the A-D Converter.

TOLLFREE TELEMAIL 008 022 888 FOR COST OF A LOCAL CALL

BASIC ALGERNON KIT
Cat. KJ-6100 $189.00

ALGERNON MANUAL
Cat. BI-8100 $25.00

MOTOR CONTROL BOARD
Cat. KJ-6110 $39.95

INTERFACE CARD
Cat. KJ-6120 $69.95

SOFTWARE
Cat. XS 7010 $29.95

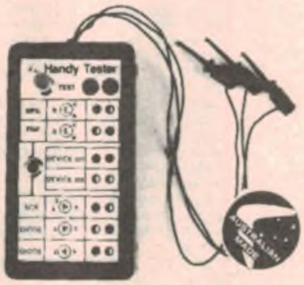
"ALGERNON" D.I.Y. 5 AXIS ROBOT KIT

UPGRADED DIGITAL CAPACITANCE METER
Ref: EA August 1985
Cat. KA-1595 $79.95

FUNCTION GENERATOR WITH DIGITAL READOUT
Ref: EA April 1982
Cat. KA-1428
$119.50

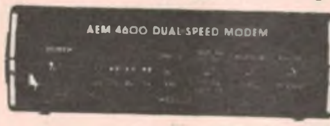
VIDEO FADER FOR HOME MOVIE BUFFS
Ref: EA January 1986
Add a touch of professionalism to your video movies with this simple video fader circuit. It enables you to fade a scene to black - and back again without loss of sync or colour.
Cat. KA-1626 $19.95

IN-CIRCUIT TRANSISTOR TESTER
Ref: EA Sept 1983
Cat. KA-1119 $19.95



UHF CONVERTER FOR CHANNEL 28
Ref: EA April 1986
Cat. KA-1650 $59.50

ETI 4600 DUAL SPEED MODEM
Ref: AEM December 1985
Cat. KM-3040 $169.00



SPEECH SYNTHESISER
LOW COST FOR YOUR COMPUTER
Ref: AEM Feb 1986
Cat. KM-3042 $39.95

ETI 675 RS-232 TO CENTRONICS ADAPTOR
Ref: ETI January 1984
This small project enables you to interface a printer to the RS-232 serial port on your computer. The kit consists of PCB and parts (including a special right angle Cannon DB25 plug) but not the Centronics plug or DIP switches, which are optional anyway.
Cat. KE-4666 $29.95

THE 'LISTENING POST'
Ref: AEM July 1985
Cat. KM-3015 $37.50

CONCORD "SHOWROOM" HAS BEEN EXPANDED FOR YOUR COMFORT

8 SECTOR BURGLAR ALARM
Ref: EA Jan/Feb 1985
Cat. KA-1582 $119.50

ETI 342 PULSE-SHAPED CDI
Ref: ETI Feb/March 1985
Cat. KE 4690 $79.50

HIGH POWER CAR STEREO BOOSTER AMP
50W RMS PER CHANNEL
Cat. KA-1600 $189.50

No.1 for KITS

50/500MHz DIGITAL FREQUENCY COUNTER
Ref: EA Dec '81 - Feb '82
Cat. KA-1390 $149.50
PRESCALER - A 500MHz prescaler kit (which fits straight on to the main circuit board) is available.
Cat. KA-1392 $35.00

"PEST OFF" ULTRASONIC PEST REPELLER
Ref: EA November 1985
Cat. KA-1620 $44.50

TOUCH LAMP DIMMER
To switch the light on and off all you need do is touch the plate anywhere. To dim the light you just hold your finger on the plate, the light will stay at whatever brightness it was when you remove your finger.
Cat. KA-1508 $27.95

NEW

RS-232 to COMMODORE
Without Commodore edge connector
Cat. KE-4722 $14.95

CIRCUIT PROTECTOR for AEM SERIES 6000 POWER AMPLIFIERS
Cat. KM 3045 $P.O.A.

300 WATT INVERTER
Ref: EA September 1985
BRAND NEW MODEL!
This compact and brand new design features a toroidal transformer and automatic regulation, current limiting and thermal overload protection. The Jaycar kit is absolutely complete including front panel. This kit is also available completely assembled with 90 day warranty (Cat. MI-5000) for $289.
Cat. KA-1610 KIT VERSION $229.00

30 VOLT - 1 AMP BENCHTOP POWER SUPPLY
Ref: EA Jan 1985
Cat. KA-1574 $74.50

DUAL TRACKING ±22V POWER SUPPLY
Ref: EA March 1982
Cat. KA-1410 $119.50

40 WATT 12/230V INVERTER
Ref: EA August 1985
Cat. KA-1598 $89.95

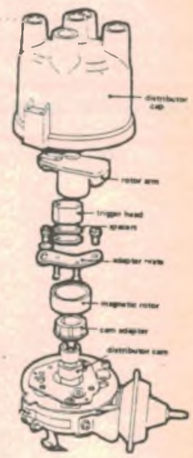
PULSE-POWER TRAIN CONTROLLER
Ref: EA Sept 1984
This is a state-of-the-art train controller offering tremendous features. ● Variable simulated inertia ● Full short circuit protection including audible and visual indicators ● Power and track monitor indicators ● Adequate power for double and triple heading locos ● Fixed 12V DC and 15V AC power for lighting and accessories ● Optional walk-around throttle.
Cat. KA-1560 $99.95
OPTIONAL WALK-AROUND THROTTLE
Cat. KA-1559 $11.95

DIESEL SOUND SIMULATOR
Ref: EA November 1984
Cat. KA-1561 $22.50

STEAM SOUND SIMULATOR
Ref: EA December 1984
Cat. KA-1562 $22.50

See EA December 1983
● Hall Effect Triggerhead ● Magnetic rotors for both 4 & 6 cylinder cars ● Over 6 cam lobe adaptors ● Over 12 different adaptor plates for your particular distributor ● Other hardware (i.e. screws, etc) ● You can remove this system and re-equip your car with the original breaker points when you sell the car! ● As easy to instal as a set of points ● Instructions (simple to follow) included.
Cat. KJ-6655
$34.50

CONTACTLESS HALL EFFECT "BREAKER POINTS"



T.A.I. HALL EFFECT 'BREAKERLESS" VERSION
Ref: EA December 1983
This kit is virtually identical to the KA-1506 except that it contains the interface electronics for the KJ-6655 Hall Effect Triggerhead.
Cat. KA-1505 $43.50

DON'T HAVE A 1986 JAYCAR ENGINEERING CATALOGUE YET? SEND $1 AND WE WILL POST YOU ONE

MAIL ORDER HOTLINE (02) 747 1888

A practical approach to Electronics PART 9

Pt.3

How to service cassette decks

Tape speed problems in cassette decks are generally due to worn or faulty parts. These parts include the motor, capstan, flywheel, idler wheels and brakes and clutches.

by KINGSLEY HOWE

Tape speed problems often arise when the motor becomes worn or faulty. Generally, the small DC motors suffer from brush and commutator wear. Arcing occurs at the brush/commutator interface, causing pits and scoring and the copper surface develops a high resistance. Uneven wear on the commutator may cause the brushes to bounce.

A miniature ferrite choke, together with several capacitors, filters out most of the electrical noise. These components are either built into the motor or may be externally mounted on the case. More elaborate filter circuits may be found some distance from the case, connected to it by shielded cable. Some of these boards may contain several transistors and a trimming pot. In this case, the board is a filter and speed control combination.

Note that motors with inbuilt electronic speed control use plain figure eight cable only.

The filter circuitry is used to prevent electrical noise from feeding into the amplifier via the motor power supply lines. A motor in a worn condition generates a buzz or crackling sound (or both) through the speakers. A reduction of this noise may be affected by fitting an electrolytic capacitor across the supply lines. Try a value of around 220μF.

A sudden rise in motor noise may indicate the loss of an earth connection from the motor case to ground. This should be checked, before making the following test:

Grasp the small motor pulley between the thumb and finger to apply a load to the motor. Any increase in noise level indicates that the motor requires replacement.

A worn motor may deliver poor torque, as well, and the motor may run slower than normal or stall completely.

The top bearing will usually wear out first, because of the tension from the drive belt. Run the motor with the belt removed, and listen for a rattling sound. This indicates a worn bearing. One or two drops of sewing machine oil may help, but this should be considered as a temporary measure only.

Sometimes the motor may be induced to vary speed, or rattle, by tapping the motor with the handle of a screwdriver. A sticking mechanical regulator will cause high speed running when it is locked into the closed position. Check that the motor pulley is firmly attached to the motor shaft and not slipping, when slow running is encountered.

Motor replacement

Where an exact replacement is not available, a substitute motor may generally be used. Many fixed speed motors may be replaced with an electronic speed controlled motor. There are standard sized versions of these readily available. Where space is very restricted, compact models may be fitted.

Note that the circle of screw holes on top of the motor may vary from the original. Where an exact match cannot be found, the motor mounting plate may have to be drilled to suit.

Thumping sounds

Thumping sounds may be heard from the motor area when the drive belt develops a kink. This can result if the deck is not used for some time. The section of belt 'parked' around the small motor pulley will develop a set shape, due to the relatively sharp bend, but this may disappear after several tapes have been run through. Note that, when the belt stops, it may 'park' itself in this position again.

Lumps of rubber from the belt may stick to the pulley grooves, causing a similar noise. In each case, a belt replacement is advisable, as running the motor under these conditions will damage the bearings. Make sure that the pulley and flywheel grooves are cleaned before fitting a new belt.

Capstan and flywheel

Another source of speed variation can arise from dry bearings on the capstan shaft. These bearings may be lubricated with sewing machine oil. To remove the flywheel and shaft, the support bracket must be unscrewed. Note that a small plastic washer is fitted to the shaft on the upper deck side, to prevent dust entering the bearing.

Withdraw the assembly from the deck and place one drop of oil on each bearing, and allow it to soak in. Insert the flywheel assembly and refit the plastic washer. Wipe any oil from the exposed end of the shaft to prevent contamination of the pinch roller or tape.

Replace the flywheel support bracket and, when all the screws are tightened, check that there is a clearance between the end of the shaft and the bracket (about 0.5 mm).

Flywheel damage

If a player has been dropped, the flywheel may jam or it may run out of true, causing wow. This should be rectified before any attempt is made to run the unit to avoid bearing damage. If a spare part cannot be obtained, note the following:

The flywheel/shaft assembly consists of a zinc diecast wheel, brass bush, and a spindle of hardened steel. The wheel is machined with a precision bore in order that the bush may be pressed into it and held tightly. The bush maintains its position purely through friction. In mechanical engineering terms, this is known as an interference fit.

The bush may be removed from the flywheel by placing the shaft through a hole in a block of wood (or in the vice), and carefully punching it out from the rear.

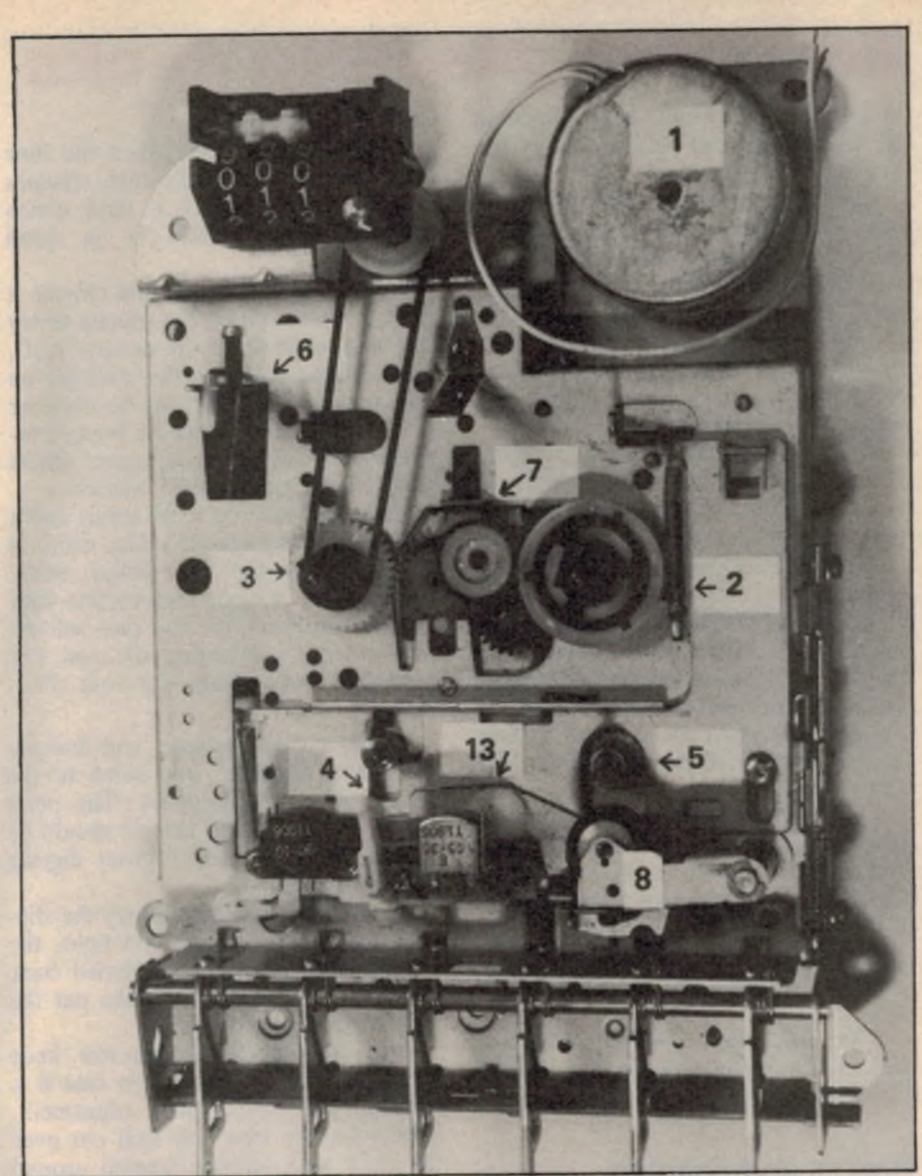
Many of these bushes are of a standard size, although the flywheels differ in diameter. Select another flywheel assembly (either from an old unit or a new part), and remove the bush. Check that the shafts are of the same length or longer. A longer shaft may be cut off with the hacksaw and the end filed smooth.

Before punching in the new bush, file a bevel or taper on the end of the bush, otherwise the flywheel bore may be scored. Once the edge of the bush digs into the soft metal, a burr will form, and the result will be a wobbly flywheel.

When exchanging a complete assembly, note that any pins or lugs moulded to the flywheel are used to drive the auto stop mechanism. Also, on some models, an extra belt groove may be found, or a gear or idler wheel drive may be moulded on.

Other flywheels are likely to be of an entirely different pattern, although the diameter may be the same. This is the reason for using the same flywheel and exchanging the bush and shaft.

Where the flywheel is plain, the diameter is not vital provided the deck is fitted with a variable speed motor and there is enough clearance from other parts.



Cassette player upper deck: 1 — Motor (note hole for speed adjustment); 2 — Takeup clutch; 3 — Supply spindle; 4 — Trip finger; 5 — Capstan spindle and bearing; 6 — Cassette case tab sensing finger (prevents recording if tab removed); 7 — Idler wheel with rubber tyre; 8 — Pinch wheel assembly; 13 — Record/play head.

General lubrication

Many of the deck linkages are not in contact with each other, and do not require lubrication. Where latching plates are used to lock the deck function buttons in position, they may become stiff or jammed. This may cause the auto stop to fail through overload.

Some have a light coat of grease applied during assembly, or a black substance may be found on them. The latter is graphite powder mixed with grease. Both of these lubricants dry out eventually, and cause the deck to either seize, or become stiff to operate.

Applying a few drops of sewing machine oil to the plates and working all the buttons will usually produce a satisfactory result.

Wipe off any excess to avoid contamination of the belts or idler wheels. Also, check that the auto stop operates correctly, before re-assembling the unit.

Worn idler wheels

The idler and drive wheels are constructed by fitting a rubber tyre to a plastic hub. These are subject to wear and subsequent slippage. Small particles of rubber may be found under these wheels, sticking to the deck. A small reduction in diameter can cause sluggish operation or complete failure of tape motion. Spare parts may not be available and, owing to constant design changes, parts from other decks may not fit.

Provided the outside of the tyre is not

Servicing cassette decks

lumpy or cracked with age, a build-up of the diameter can be achieved by use of the following method.

Remove the rubber tyre from the hub. If the groove in which it sat is square, trim some strips of masking tape to a width slightly smaller than the width of the groove. Build up the bottom of the groove with several turns of this and then insert the original tyre. Normally, two or three turns are enough to compensate for wear.

Now try the wheel in the deck. Some adjustment may have to be made with more or less tape. Some of these idlers perform two separate functions and both should be tried for satisfactory operation.

As an alternative to masking tape, self-adhesive black circuit board tape may be used. This is available in rolls of various widths and several rolls may be purchased to cover the range of groove sizes. Generally, these are from 1.5 to 3mm in width.

If the tyre is a little out of round after taping the hub, turn it around slowly and squeeze it down at the same time. This should seat the tyre correctly. If it is loose or some slippage on the hub is noticed, apply a few spots of contact adhesive to the hub and the edge of the tyre.

If the job is done correctly, the idler will run without trouble for several more years.

Brakes and clutches

Clutches are found mainly on the takeup side of the deck. They are deliberately designed to slip when running to allow for variations in the amount of tape on the takeup reel. At the beginning of the tape, the reel must turn fairly fast to take up the slack tape. As the diameter of the tape on the takeup reel increases, a smaller number of turns are required, and the clutch slips more and more.

At the beginning of the tape, it matters very little if the clutch has become tight. However, near the end of the tape, the load with a tight clutch becomes so high that the motor begins to slow down. This is quite noticeable, and may be wrongly attributed to a motor fault.

Some motors will behave in this manner when warm, say after an hours running. When cold, they will hold correct speed. To ascertain which condition is responsible, rewind the tape to the beginning and replay it.

If the motor is faulty, then the slow speed will persist. If the tape resumes normal speed, suspect a tight clutch (provided the cassette is in good condition).

To work on the clutch, first remove it from the deck. Grasp the spindle firmly (the part which turns the cassette reel), then turn the pulley or the turntable on the opposite end. This may be tight, or at least stiff. Most types are pressed together and may be pulled apart; others may be held with small 'C' washers.

Inside you will find a coil spring and a felt pad pressing against a disc, which is usually part of the drive pulley. Some types may be of open construction with a brass disc, and the felt pad will be clearly seen. Lubricating the pad has been tried, but this does not work effectively.

To lighten the pressure, and thus enable more slippage, snip some of the spring off with sidecutters. The point where the spring was cut off should be turned up to prevent it from digging into the clutch face.

Re-assemble the unit and try the slippage again. If it is still too tight, the spring may have to be trimmed back further. If it is too loose, take out the spring and stretch it a little.

When running the deck on test, keep a close eye on the takeup, in case it is slipping too much after adjustment. Otherwise, the tape may spill out over the deck and become tangled around the pinch roller.

Note that a clutch design fitted with three metal fingers on the top disc may be adjusted by lifting one finger and moving it either up or down on the steps moulded to the disc. These adjustments may be made without removing it from the deck.

Brake pads

These are one of the most important components on the deck. They are responsible for stopping the fast forward and rewind reels to avoid tape spillage. Incorrect adjustment or wear on the brake pads will cause a condition known as tape overrun. This occurs when the tape is stopped in the fast forward or rewind modes, and the supply reel of the tape runs on.

When the STOP button is pressed, the brake pads contact the sides of the reel turntable instantly, so that tension is kept on the tape. Even a centimetre of slack can cause a tangle.

The main cause of slippage with these appears to be that the surfaces of the small felt pads become polished. Constant rubbing on the plastic surface of the reel turntable eventually leaves the felt pad with insufficient grip.

Replacement of the pads has been tried, and is a very fiddly job at best. Roughening up the felt pad with emery paper is a temporary solution, but the polished surface soon returns again and the same problems arise.

After much experiment it was found that a lasting 'cure' could be effected by coating the clutch pads with contact adhesive. Apply a coat of adhesive with a toothpick. This will soak into the felt immediately. Let this coat dry for at least 15 minutes, then apply a second coat. When this coat is soft, but not tacky, place the brake arm in its usual position on the deck, and press it against the surface that it normally contacts. This will contour the surface of the pad to the correct shape. Now remove it and let the adhesive dry overnight.

This treatment will provide positive braking action, and the coating may well last for the life of the deck without further attention.

A special case

On the more expensive decks with two capstans and two pinch rollers, tape tension from the feed reel is critical. The tape is fed over a white plastic guide block before it reaches the first capstan. A fault which arises with this type of feed is severe mistracking, with the tape mounting the fingers at the sides of the block and becoming crushed or badly tangled.

Remove the decorator plate from the cassette compartment. This is attached to the main desk plate by means of small screws, and conceals the wheels and gears driving the two spindles (toothed).

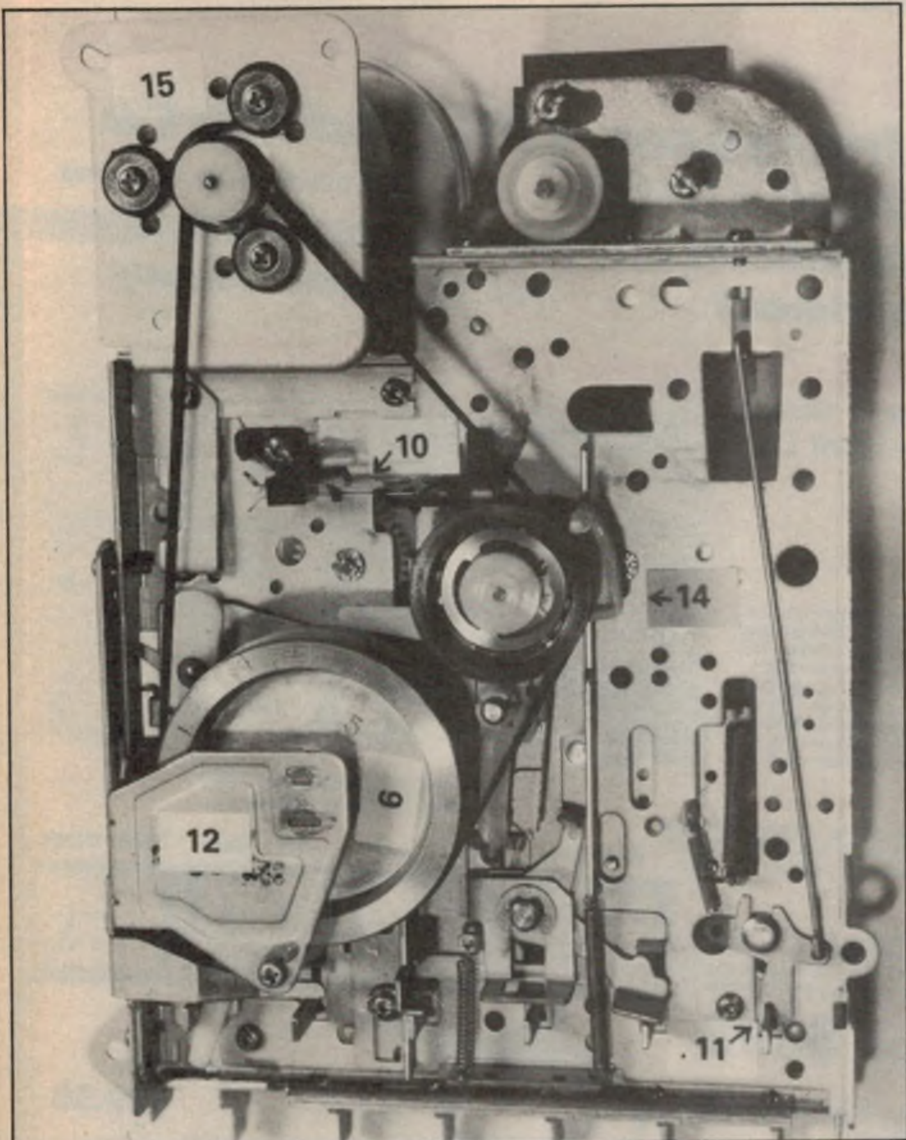
A braking system will be seen at the side of the feedout turntable. It consists of a spring loaded arm with a small felt pad. A series of holes punched in the deck permit adjustment of the spring tension.

In one case, careful observation revealed that the highest tension was insufficient. A slipping brake pad was suspected, and the above coating treatment applied. After testing for a full day, all tapes fed through without trouble.

This particular example illustrates just how finely a deck must be adjusted.

Misc. speed problems

Tapes playing at an excessively fast or



Cassette player lower deck; 9 — Flywheel; 10 — Leaf switch (motor power supply); 11 — Locking plate on record button (the wire link is attached to the trip finger (4) on the upper deck); 12 — Flywheel bracket; 14 — Main drive clutch; 15 — Motor mounting plate.

intermittent fast and slow speeds have a variety of causes.

A broken or weak spring on the pinch roller frame will allow the tape to slip between the roller and the capstan. Sometimes the frame tab will stick in the deck and not apply enough pressure to the capstan.

Where a tape has been torn, a portion may wind around the roller pin, either on top of the roller or below it. The only cure for this is to remove the complete frame and unwind the tape.

If tape is unwound from on top of the roller, and the roller is still stiff to turn, suspect more tape wrapped beneath it. Some pieces may have to be cut with a sharp knife and extracted a little at a time.

Head locking screws sometimes become loose or fall out. The head may then assume an angular position and will drag heavily on the tape. Occasionally, the head may fall right off.

Sudden stops and jumps by the tape may be due to a deep groove worn into the head. The edge of the tape is prone to catch and seize, then suddenly release. Both of the above conditions are usually accompanied by loud protests from the transport mechanism.

Cassettes

Binding or sticking cassette reels, tape in poor condition, or a warped case will cause speed problems.

If the tape transport is not operating properly, it may be because of one of

• PHONE YOUR ORDER — ALTRONICS TOLL FREE 008 999 007 •

Huge Import Duty Increases!!

(Next Shipment Increases 15% and that's $100 on the Labtech CRO)

Due to Import Duty Alterations from 1/7/86

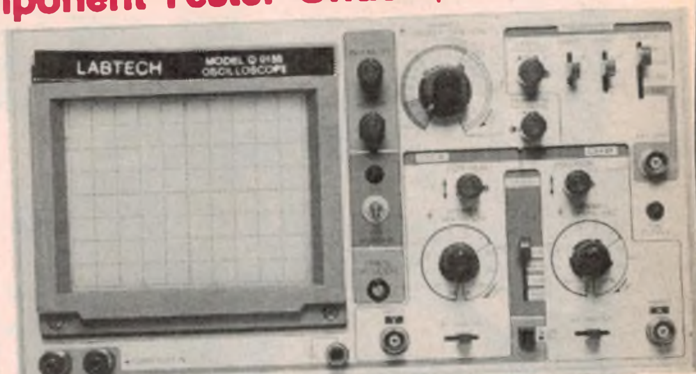
Full 12 Months Warranty

Sensational Labtech

Dual Trace 20MHz CRO With Component Tester Under $700!

Definitely Australia's Best Value in Quality Oscilloscope Test Equipment — Just Look at the Facilities

The Inbuilt Component Tester Alone Is Over $300 Value.



DESCRIPTION:

This model is a dual-trace 20MHz Oscilloscope using high brightness CRT The vertical amplifiers have high sensitivity of 5mV/Div and the frequency characteristic response with the smooth roll off exceeding 20MHz. The highest triggering sweep speed is 0.2 usec/Div. For component test, special circuit is designed, with whicn a single component or components in or out of actual circuit designed, with which a single component or components in or out of actual circuit board can be easily tested, requiring no power to drive the circuit. The display shows fault of components, size of a component value, characteristics of component, and half-dead components under dynamic test.

FEATURES:

• Component Tester • Wide bandwidth & high sensitivity • Very low power consumption • High sensitivity X-Y mode • Z axis (intensity modulation) • Front panel electrical trace Rotator • Regulated power supply circuit for Accuracy

TYPICAL COMPONENT TEST STATUS PATTERNS

Resistor | Digital Circuit | Capacitor | Zener Diode

ALTRONICS FAMOUS SATISFACTION GUARANTEE

We are delighted with our new Labtech Q 0155 Oscilloscope and Component Tester and naturally we are confident you will be too — However, if for any reason you are less than 100% satisfied with your new Labtech CRO you may of course return it to us (in original condition with all instructions, packaging etc.) within 14 days for a full refund less transport costs.

Q 0155 Value **$699**

1:1 or 10:1 Attenuation

Q 0175 **$39.50**

Highly Recommended For:
Service Workbench, Design Laboratory, Manufacturers, Universities and the dedicated Enthusiast.

Labtech *Test Equipment for Life*

Just Arrived - The Superb Micron Soldering Station

No more changing tips to obtain correct working temperature — simply select between 320 and 440 deg.C with the flick of a switch.

Excellent for Production Work | **Excellent for Delicate PCB Work** | **Quality Iron Clad Tips**

At last! A true temperature controlled temperature selectable soldering station with all the parameters one would expect from a professional soldering iron **without** the high price slug some of our competitors ask.

Temperature Selectable to 5 settings 320, 350, 380, 410 and 440 degrees C.

Temperature Readout via led baragraph instantly visable.

Temperature Stability to within 4% of selected mean temperature at normal ambient temperatures i.e. 20-25 deg. C.

Heat Capacity Full 48 watts of heat energy available for heavy duty work.

Earthed Tip/Element Tip is earthed as a protective measure for work on microprocessor circuitry etc.

Low Voltage Element 24V element for added safety especially with CMOS and microprocessor soldering in situ.

Silicon rubber iron lead used providing a comfortable, flexible connection to station and durability against accidental burn damage.

Chrome Plated Iron Plated Tips Regardless of the excellence of the station and iron element, it is absolutely imperative the iron tips be of a high standard, easily cleaned and long life. The Micron tips are "State of the Art" chrome plated, iron clad ultra long life, very resistive to over heating, clean easily and what's more are **very reasonably priced!**

* * * * * * * * * *

Free Bonus set of 3 tips **($12 value) this month**

Replacement Tips All $3.95

Micro Chisel	1mm Tip	T 2423
Mini Chisel	1.5mm Tip	T 2424
Standard Chisel	3mm Tip	T 2425

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008 999 007 FOR NEXT DAY JETSERVICE

BANCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008 999 007 FOR NEXT DAY JETSERVICE

• FOR DESPATCH P&P CHARGES AND ADDRESS DETAILS PLEASE REFER TO OUR AD. ON PAGE

• PHONE YOUR ORDER — ALTRONICS TOLL FREE 008 999 007 •

See Review Electronics Australia March '86

Brilliant New Digital Multimeter Q 1075

$89

Autoranging with Memory Function for Relative Measurements

SPECIFICATIONS:

DC VOLTAGE
Ranges 5 (200mV, 2V, 20V, 200V, 1000V)
DCV Accuracy 0.5% + 1DGT
AC VOLTAGE
Ranges 4 (2V, 20V,200V,750V)
ACV Accuracy 0.75%+5 DGTS
Input Impedance 10M Ohm Min
DC CURRENT
Accuracy 20mA—0.75%+1DGT
10A-1 50%+5DGTS

Free Select either a Carry Case or Holster this month with your Q 1075 at no charge

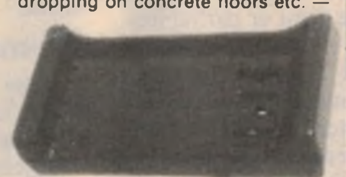
Carry Case

Keep your **Labtech** DMM looking like new for years!

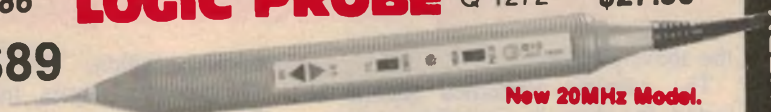
Q 1076 **$9.50**

Holster Q 1077 $9.50

What's this? For want of a better name we've named this thick rubber "Cliparound" protector a "Holster". Great protector for field use, dropping on concrete floors etc. —



LOGIC PROBE Q 1272 $27.50



New 20MHz Model.

Max. input frequency 20MHz **Input Impedance** 1meg Ohm. Operating supply range 4V minimum **TTL** Logic "1" Hi LED greater than 2-3V Logic "0" Lo LED less than -8V **CMOS** Logic "1" Hi LED greater than 70% Vcc Logic "0" Lo LED less than 30% Vcc **Minimum Detectable Pulse Width** 30 Nano seconds max signal input 220V AC/DC

ALTRONICS COMPONENTS

105 STIRLING STREET, PERTH

FOR INSTANT SERVICE PHONE ORDER TOLL FREE
008 999 007

PERTH METRO AND AFTER HOURS ORDERING SERVICE
(09) 328 1599

ALL MAIL ORDERS
Box 8280, Stirling St Perth W.A. 6000

PACKING AND DELIVERY CHARGES

$3.00 DELIVERY AUSTRALIA WIDE We process your order the day received and despatch via. Australia Post. Allow approx. 7 days from day you post order to when you receive goods. Weight limited 1Kg.

$6.00 OVERNIGHT JETSERVICE We process your order the day received and despatch via. overnight jetservice Courier for delivery next day. Country areas please allow additional 24-48 hours. Weight limti 3Kgs

$6.00 HEAVY MAIL SERVICE For deliveries exceeding 3Kgs and less than 10Kgs - allow 7 days for delivery

$10.00 HEAVY HEAVY SERVICE - All orders of 10Kgs. or more must travel Express Road - Please allow 7 days for delivery

INSURANCE — As with virtually every other Australian supplier, we send goods at consignees risk Should you require comprehensive insurance cover against loss or damage please add 1% order value (Minimum charge $1). When phone ordering please request "Insurance"

TOLL FREE PHONE ORDER - Bankcard Holders can phone order toll free up to 6pm Eastern Standard Time. Remember with our **Overnight Jetservice** we deliver next day

Altronics Resellers

Chances are there is an Altronics Reseller right near you — check this list or phone us for details of the nearest dealer.
Blue Ribbon Dealers are highlighted with a ■. These dealers, generally carry a comprehensive range of Altronic products and kits or will order any required item for you.
Don't forget our Express Mail and Phone Order Service—for the cost of a local call, Bankcard, Visa or Mastercard holders can phone order for same day despatch.
Please Note: Resellers have to pay the cost of freight and insurance and therefore the prices charged by individual dealers may vary slightly from this Catalogue — in many cases, however, Dealer prices will still represent a significant cost saving from prices charged by Altronics Competitors.

WA

COUNTRY
ALBANY
BP Electronics ■ . . . 41 2681
ESPERANCE
Esperance Communications 71 3344
GERALDTON
K B.Electronics & Marine 21 2176
KALGOORLIE
Todays Electronics ■ . . 21 2777
NEWMAN
Watronics 751734
WYALKATCHEM
D & J Pease 81 1132

NT

DARWIN
Ventronics 81 3491
ALICE SPRINGS
Ascom Electronics 52 1713
Farmer Electronics 52 2967

ACT

CITY
Bennett Commercial Electronics 80 5359
Scientronics 54 8334

NSW

CITY
David Reid Electronics ■ . . 267 1385
Jaycar 267 1614
SUBURBAN
CARINGHAH
Hicom Unitronics 5247878
CARLINGFORD
Jaycar 872 4444
CONCORD
Jaycar 745 3077
GORE HILL
Jaycar 439 4799
HURSTVILLE
Jaycar 570 7000
LEWISHAM
PrePak Electronics 569 9770
COUNTRY
ALBURY
Webb's Electronics ■ . . . 25 4066
BATHURST
The Electronics Shop 31 4421
BROKEN HILL
Crystal TV 4803
COFFS HARBOUR
Coffs Habour Electronics 52 5684
GOSFORD
Tomorrows Electronics ■ . . . 24 7246
KURRI KURRI
Kurri Electronics 37 2141
NEWCASTLE
D.G.E.Systems 69 1625
George Brown & Company 69 6399
Novacastrian Elect.Supplies . . . 616055
NOWRA
Southern Communications 21 4011
ORANGE
Fyfe Electronics 626 491
RAYMOND TERRACE
Alback Electronics 87 3419
RICHMOND
Vector Electronics 773 174
TENTERFIELD
Nathan Ross 36 2204
TOUKLEY
TES Electronics . 96 4144
WINDSOR
M & E Electronics ■ Communications 77 5935
WOLLONGONG
Newtek Electronics ■ . . . 27 1620
Madjenk Electronics 74 3061
Vimcom Electronics 28 4400

VICTORIA

CITY
Ellistronics ■ . . 602 3499
All Electronic Components . . 662 3506
MaGraths Electronics 347 1122
SUBURBAN
BENTLEIGH
Absolute Electronics 557 3971
BOX HILL SOUTH
Eastern Communications 288 3107
CHELTENHAM
Talking Electronics 550 2386
CROYDEN
Truscott Electronics ■ . . 723 3860
PRESTON
Preston Electronics 48 40191
SPRINGVALE
Ellistronics ■ . . 547 1046
COUNTRY
BENDIGO
KCJohnson ■ 41 1411
MORWELL
Morwell Electronics 34 6133
SALE
Gippstech ■ Communications 447402
SHEPPARTON
GV Electronics ■ 21 8866
SWAN HILL
Cornish Radio Services 32 1427

QUEENSLAND

CITY
Delsound P/L . . 2296155
Jaycar 393 0777
SUBURBAN
FORTITUDE VALLEY
McGraths Electronics . . . 832 3944
Economic Electronics 523 762
PADDINGTON
Jacques Electronics 369 8594
SLACKS CREEK
David Hall Electronics 2088808
TOOWONG
Techniparts 3710879
COUNTRY
CAIRNS
Thompson Instrument Services 512404
BUNDABERG
Bob Elkins Electronics 721 785
NAMBOUR
Nambour Electronics 411604
PALM BEACH
The Electronic Centre 341248
ROCKHAMPTON
Electron World 278 988
Purely Electronics (East St.) 21058
Purely Electronics (Shopping Fair) 280 100
TOOWOOMBA
Hunts Electronics ■ 329677
TOWNSVILLE
Solex ■ 722015

SA

CITY
Electronic Comp & Equip. 212 5999
Force Electronic ■ 212 2672
Protronics 2123111
SUBURBAN
BRIGHTON
Brighton Electronics ■ . . 296 3531
CHRISTIES BEACH
Force Electronics ■ . . 382 3366
PROSPECT
Jensen Electronics ■ . . 269 4744
REYNELLA
Force Electronics ■ . . 381 2824
COUNTRY
MT.GAMBIER
South East Electronics 250 034
PT.LINCOLN
West Coast Elect Supplies . . 82 5802
WHYALLA
Eyre Electronics ■ . . . 45 4764
TASMANIA
HOBART
D & I Electrical Electronics 34 8244
George Harvey ■ . 342233
LAUNCESTON
Advanced Electronics 315688
George Harvey ■ 31 6533
LEGANA
Frank Beech Electronics 301379

More Altronics Dealers Wanted

If you have a Retail Shop, you could increase your income significantly by becoming an Altronics Dealer. Phone Steve Wroblewski 09 381 7233 for Details.

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008 999 007 FOR NEXT DAY JETSERVICE DELIVERY

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008 999 007 FOR NEXT DAY JETSERVICE DELIVERY

the above problems.

The cassette concerned should be tested for drag by inserting a screwdriver blade or similar item into the cassette reel, and turning it by hand. The reels should turn freely, but any hard-to-turn sections should be examined for damage.

Part of the price of the more costly cassettes is involved in the choice of case material. A good quality case must meet tight specifications with regard to dimensional stability. This demands a more expensive plastic.

The cassette reels, although fairly loose in the case, will be moulded from a plastic which is self-lubricating. This ensures a long life for the cassette and ease of transport by the tape deck.

Cheap cases are moulded from plain styrene with no lubricating properties, and the reels are prone to jam. These low cost cassettes also generate a variety of mechanical noises when in use, ranging from knocking sounds to a persistent squeak.

Often the deck is blamed for these noises, but it may be the cassette itself. Try another cassette, before going further.

Note that on the rear of the cassette case, two tabs may be seen. When these are in place, recording can be carried out. To protect a recording from accidental erasure, remove the tabs. Should you wish to record something else on the same cassette, place some adhesive tape over the holes, otherwise the RECORD button cannot be depressed.

Play/record switch

These multipin slide switches are found on the main board. They are housed in a long rectangular metal case and may carry from 20 to 50 contacts. An internal spring holds the switch in the play position.

In compact players, the operation of the record button changes the contact arrangement in the switch by means of a metal pusher plate coupled directly to the button. Larger mains powered players may have the main board situated well away from the tape deck. In this case, linkage to the switch may be either by heavy dial cord and pulleys, or a strong wire with a direct pull.

When the record button is pushed, up to 10 separate circuits will change at the one time. Some larger units will exceed this.

Stereo players may carry a dual switch or two single switches side by side.

Switch problems

Grit, dust or sand (especially sea sand) may enter the housing through small gaps and cause total or partial loss of contact.

On stereo players, a fault in the slide switch may cause one channel to drop out or produce a very muffled sound. The needles of meters, where fitted, will swing wildly with no signal, or may rest hard against the stop pin. In some cases, recording will be impossible, depending on which contact is faulty.

Where a lot of dust is present in the switch, a pumping or motorboating sound will emanate from the speakers. In some cases, a loud shriek will be heard when the switch is operated.

Unless the condition of the switch is poor, it can be brought back to full operation by cleaning. Arrange the deck so that the switch is in a vertical position. It is now ready for treatment. Don't spray it with switch cleaner yet. Use a can of Component Cooler first.

Try to keep the can upright when spraying and use the tube fitted to the nozzle for maximum effect. Place the tube at the end of the switch where the plastic slider and bakelite base meet. This will blow out most of the dry and loose particles.

Now squirt in some CRC 5-56, a small amount at a time. Let it soak in, then apply more, until it starts to drip from the bottom of the switch. Work the plastic slider up and down. If any grinding noise is hard, use the component cooler again. This will carry out any particles mixed with the CRC liquid.

Note that this chemical gives good results when used on the above type of switch. Do not use it on slider pots, small slide switches or other switches.

Note: spray cans for cleaning electrical contacts and motors contain powerful degreasing agents, and are not suitable for the switches used in electronics. They are ideal for the removal of grease, oil and hard deposits on bare metal.

De-magnetising heads

Tape heads should be de-magnetised if an increase in noise level is heard. The head will acquire some residual magnetism from the tape or the field surrounding the inbuilt speaker. A lesser amount may be contributed by the ferrite magnet in the deck motor.

Hiss from the speakers on blank sections of the tape, and loss of treble on recorded sections, point to a magnetised condition.

De-magnetising cassettes are available to correct this. These are sold by hifi stores and are inserted into the deck in the same way as a standard cassette.

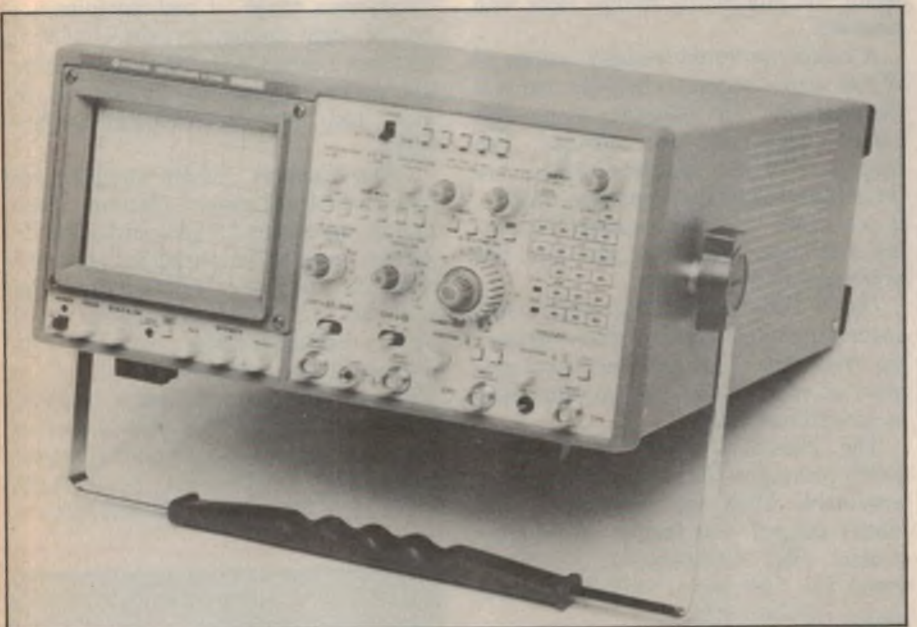
A pencil type demagnetising tool is the most effective on heads which are heavily affected. These may be bought in two versions. One type plugs directly into the 240 volt mains. Do not use them near TV sets or within one metre of recorded cassettes.

Switch off the tape player, and insert the tip of the tool into the deck play area. Move the tip slowly over the outside of the head case and then over the head face. About 10 to 15 seconds is adequate. Withdraw the tip very slowly from the head area. Keep moving it slowly until it is at arms length, well away from the deck, then switch off. These devices may only be used for a short period, as they heat up quickly and may burn out if left on (read directions on label before using).

A 12 volt type is sold for car cassette use. Try to obtain a long tip style, otherwise the head will be unreachable. These are used in the same manner as the mains version.

New Products...

Product reviews, releases & services

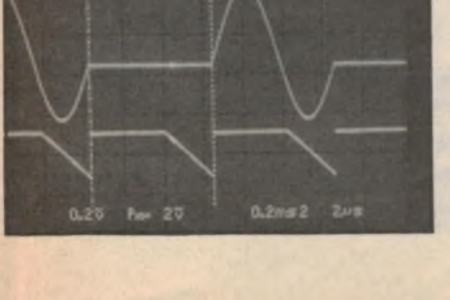


Hitachi 4-trace 100MHz oscilloscope

New from Hitachi, the V-1100A 4-trace 100MHz oscilloscope is an impressive instrument. In addition to all the functions of a conventional CRO, it also features on-screen display, a DMM and a frequency meter.

The first piece of equipment you'd choose for an electronics lab would have to be the CRO. But what type? Discharge and switching circuits can produce some really tricky waveforms, but not every expense account runs to a storage CRO. Hitachi's philosophy with the new V-1100A is to do the storage with a camera, and this CRO has many features especially suited to this application.

The big advantage of using a camera to 'store' waveform is that the equipment works out a lot cheaper. In fact, the V-1100A is less than half the price of a comparable storage CRO. For anyone who is not going to need storage facilities often, the $7000 or so saved would certainly compensate for the inconvenience of fitting the camera, etc.



Perhaps we should explain why the V-1100A is so well suited to off-screen photography. In addition to a one line, alphanumeric display which can be inserted by the operator, the timebase and volts per division settings (for both channels) can be displayed, as well as readings from an in-built DMM and frequency meter. Each photograph can thus be a complete record in itself.

This would be a real bonus for a consultant's lab where the work involves making comparisons or evaluations.

The one line message can have up to 30 characters, including upper case alphabet; lower case d, i, k, m, n, s, u, v, z; numerals; and 15 other symbols. The message might indicate the date of testing, model number, technician's name, client's name or many other details. This is an unusual feature, particularly for an under $10,000 CRO.

When setting up DMM and frequency meter measurements, two on screen cursors appear. The read out shows the values between the two cursors. One of these is considered the reference and is usually fixed in position. The other cursor can be positioned at any point on the waveform. This allows measurement of time or voltage between any two arbitrary points on the waveform.

A very clever variation of the cursor display, which Hitachi claims as unique, is a ground reference. In this mode, one cursor each for channels 1 and 2 indicates the true ground for the input signals. It's the same information you'd get by switching the input mode to GND, but is continually available. We thought this a most useful feature.

In addition to all the above, other on-screen information indicates whether the CRO is calibrated or not, whether AC or DC coupling is selected, and whether bandwidth limiting is selected. It also indicates plus or minus triggering and ADD mode.

Another very interesting on-screen display is the scale factor. When a 10:1 probe is selected, front panel controls can be adjusted to compensate for this. The read out for volts/div for the appropriate channel will automatically be scaled by a factor 0.1. Not only does this minimise the chances of a technician overlooking the 10:1 factor, it also prevents a subsequent photograph from being wrongly interpreted.

Whilst a reasonable impression of the Hitachi's more exotic features may have been gleaned by now, we should mention some of the conventional aspects. Basically, the V-1100A can be described as a four trace, 100MHz, dual time base CRO with digital mode selection.

Making normal measurements (ie, without referring to the on screen displays) is no more difficult than with any other CRO. The instruction manual only needs to be consulted for the 18 keys arranged in a small pad on the right side of the front panel. Although all of these keys have two functions, the primary function is always related to setting the triggering mode.

For example, this keypad is used to select positive or negative triggering, trigger source, and auto/normal/single trigger.

Pressing the A and B mode switches together puts the digital keypad into the "character" mode. This gives access to each of the secondary functions of the buttons, each of which is used to set some aspect of the display. There is a button for each number, but alphanumerics and other symbols can only be selected by a search procedure. Forward and reverse searching are possible and once the required symbol is reached, the "WR" (write) button enters the message.

Although the above description makes message insertion sound complicated, it is really not at all difficult in practice. The instructions outlined in the manual are quite clear, although we found that, in most instances, only every second or third instruction needs to be read.

Somewhat more difficult to use are the DMM and frequency meter functions. The instruction manual is indispensible here and some paragraphs are a little heavy, although the procedures become clear with practice.

Also available as part of the DMM — and also tricky to use — are relative measurements. These can be made for both percent or dB comparisons. Once again, the procedures become clear with practice.

A battery powered memory retains all of the digital settings when the mains is disconnected. The message, along with DMM ranges, are also retained. The brightness of the on-screen display can be adjusted separately from the trace — if you don't want the message distracting you from the trace, just turn the brightness down to zero.

The V-1100A is supplied with a soft cover for protection from dust and during transport. Test leads are not supplied as standard but can be purchased as an optional extra.

The Hitachi V-1100A is priced at $5300 plus sales tax, a price that is very reasonable when one considers the facilities offered. For further information contact IRH Components, 32 Parramatta Rd, Lidcombe, NSW 2141. Telephone (02) 648-5455.

Low-cost DMM from Dick Smith

Recently added to the Dick Smith Electronics range of test equipment is this 3½-digit multimeter, the Q-1520. It features a large, wide-viewing angle liquid crystal display and is suitable for most test and measurement applications.

Other features include compact size and pushbutton range selection. There are 14 measuring ranges, including 2A AC/DC current measuring ranges and a diode test facility. Overload protection is stated as 250VAC continuous on all of the resistance ranges, with 350VAC permissible for up to 30s.

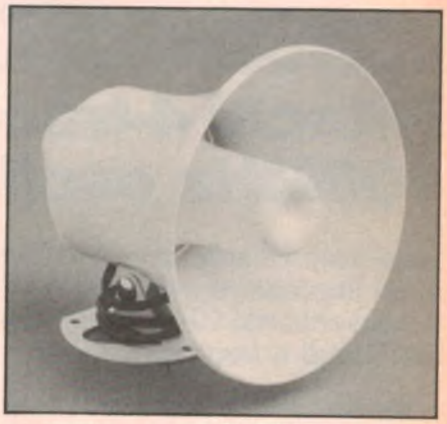
The Q-1520 costs $59 and is available from Dick Smith stores. For further information contact Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde, NSW 2113. Telephone (02) 888 3200.

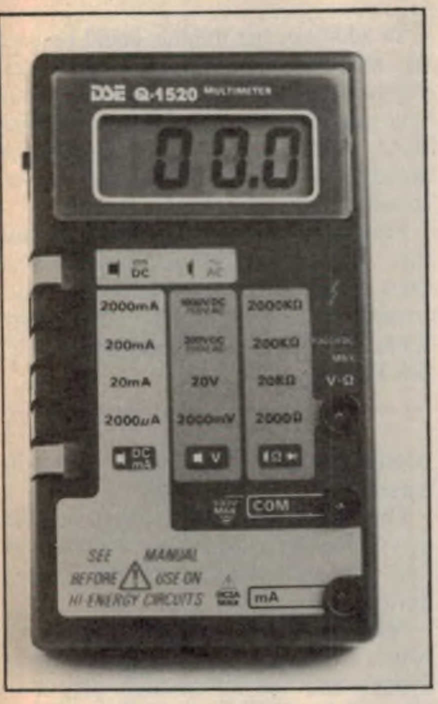
Laser tubes in stock

Helium-neon laser tubes are now available, ex stock from Laser Systems Pty Ltd. Sporting the NEC brand name, they operate at 632.8Nm and come in powers of 0.5, 1, 2 and 5mW.

The HeNe laser produces visible red light and is used widely for experiments in optics and holography. Matching power supplies for 240 VAC operation can also be purchased, along with injection moulded tube mounts which provide a secure means of mounting the laser tube in a compressed rubber ring mount.

For further information contact Laser Systems Pty Ltd, 4 Remont Court, Cheltenham, Vic 3192. Telephone (03) 584-8444.





Horn speaker for burglar alarms & PAs

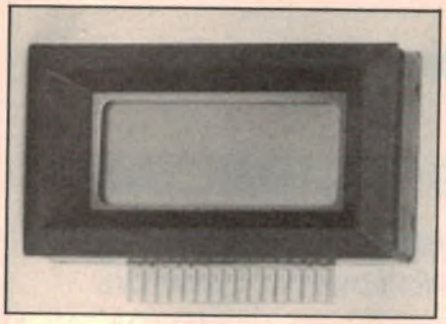
Recently released by Rod Irving Electronics, this new horn speaker is rated at 10W and is suitable for use with automotive and household alarms, as well as outdoor PAs. The material is white plastic, so it should be suitable for outdoor use. The unit (catalog number C12010) retails for $9.95. For further information contact Rod Irving Electronics, 425 High St, Northcote, Vic 3070. Telephone (03) 489-8866.

Program speeds disk access

Recently introduced by Computer Enhancements, ZAP comes on a single floppy and speeds disk access time, whether hard disk or floppy, by two to four times. It simply loads onto the DOS diskette where floppies are used, or into the DOS area of a hard disk.

In the case of Database programs and most Wordprocessors which load files to RAM and back to disk quite frequently, Zap can cut these times in half without suffering the loss of data disadvantages, to which the RAMDISK system is prone.

For further information contact Computer Enhancements Pty Ltd, 9th floor, 505 St Kilda Road, Melbourne, Vic 3004. Telephone (03) 267 7829.



3½ digit LC panel meter

This 3½ digit LCD panel meter is a complete voltmeter module which has many applications in test and measurement equipment. Similar modules are used in many DMMs. Only a few external components are needed to build a DC voltmeter or resistance meter.

In addition, the module could be used as the basis for an AC voltmeter, capacitance meter, or a pH meter, or in any one of a number of other applications. A two-part bezel is supplied as standard and makes the module easy to install.

Price of the module is $49.95. For further information contact your nearest Dick Smith store or Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde, NSW 2113. Telephone (02) 888 3200.

Reading the "unreadable" plastic card

National Business Systems Pty Ltd has introduced Australia's first independent service for analysing plastic cards that have been rejected by card-reading devices.

The new service will mean card-issuing organisations, such as banks, building societies, retailers and security firms need spend less time and effort isolating the cause of the error.

Cards can be rejected by a reading device for one of three reasons: they have not been manufactured to specifications; the data on the card's magnetic strip has been incorrectly encoded; or the reading device itself is in need of adjustment.

Because the production of the card and the supply of the reading device usually involves at least three companies, the issuing authority often has no choice but to approach each in turn to establish where the fault lies. This process of elimination is obviously time consuming, and often fails to reach an agreement on responsibility.

The Fima CA 7000 card analyser avoids this by establishing whether the fault lies with the card or the reading device.

All cards will be analysed at the company's security-controlled premises in Sydney and the information they contain will be treated as strictly confidential.

For further information contact National Business Systems Pty Ltd, 121 Alexander Street, Crows Nest, NSW 2065. Telephone (02) 438-4011.

Tunable antenna...from p.51

plumbing store, the largest of which was chosen to give an approximate fit with the outside diameter of the top of the pole (Fig.4). The "insulator" in the photos is a pipe fitting called a "½ inch BSP Riser". Two discs, cut to fit inside the 50mm coupling, must be made from 6mm thick PVC sheet or plywood. The coupling must have an internal ring, originally needed to ensure that each pipe can only be inserted in the coupling. This stop will keep the two discs apart.

The upper disc has a centre hole to take the bottom of the whip, which is held in place by a PK (self-tapping) screw passing through the disc edgewise, like a grub-screw. The screw hole should be counter-bored to keep the screw head from protruding above the edge of the disc. About 20mm from the bottom end of the whip, drill a hole to take a PK screw for the feedwire lug. Drill holes through the face of each disc to allow passage for the feedwire. The lower disc also requires two holes for shieldcan mounting screws. The heads of these screws **must not** touch the bottom of the whip when assembled.

Drill a hole in the PVC end cap to make a tight sliding fit for the whip. Use PVC glue when assembling the fittings, but fasten the coupling and 40/50 mm adaptor together with three PK screws as in Fig.4, so that these fittings may be taken apart for inspection. The writer used 6 PK screws to fasten the coupling to the top of the pole. In the prototype, the outside diameter of the pole was a little large for the coupling, so the pole diameter was reduced by cutting several slots in the top of the pole, then squeezing the diameter in a little. If the reverse applies, a shim made of aluminium (not gal. iron) can be inserted in the coupling.

The control box is held in place on top of the receiver by a mounting bracket fitted with rubber suction cups; if the receiver cabinet is steel, small ferrite magnets may be used instead. Inside the box, the trimpots were mounted on a scrap of circuit board, while the resistors and capacitors are mounted on a tagstrip. If an external DC supply is used, it will require an insulated socket in the back of the box, since each side of the supply is connected to earth alternatively. The writer used a 3.5 mm phone socket mounted in a rubber grommet. (It should be obvious that neither DC lead should be earthed at the power supply!) Keep the leads from this socket to R7, R8 and R9 as short as possible, to minimise stray RF from the power supply.

Three coax cables were taken out at the back of the box — one for the antenna feedline, and two for the receiver antenna terminals. The tuning dial was made from opal perspex, using fine tip brush pens for the scales. The calibration curves (Fig.2) do not utilise the full rotation of a normal potentiometer, but allow for some overlap on each range. Three LEDs, mounted behind the dial, shine through it to act as band indicators and pilot lights.

A calibrated dial is convenient but not essential. A simple numerical scale or just a large knob may be used, the antenna tuning being peaked on background noise or S-meter reading. Nor need the control circuit be as complex as the prototype. Fig.5 shows three simple arrangements, each of which was tried during testing.

References:

1. Two Solid-state Preamplifiers, by I. Pogson. Electronics Australia, July 1970.

2. Multiband Vertical Aerials, by I. Pogson. Electronics Australia, August 1972.

New Products...

No more dirty mains power

The new Exide Powerguard UPS (uninterruptible power supply) from the Chloride company conditions mains power and provides computers with up to one hour of standby power. It is a compact plug-in unit which is office and computer room compatible.

Error-generating mains spikes are eliminated by Powerguard. The computer is at all times presented with a clean sinewave of constant amplitude. In addition, an internal powerpack provides back-up in the event of mains power loss, thus preventing system crashes and possible loss of data.

Powerguard is available in three models with output powers of 1, 2 and 5kVA. The batteries used in the internal powerpack are fully sealed and require no maintenance.

For further information contact Chloride Industrial Division, 55 Bryant St, Padstow 2211. Telephone (02) 774-0500.

Force sensing resistors

A new type of thick film resistor which can sense force offers broad possibilities as a low cost control with no moving parts. Called simply a Force Sensing Resistor, the device conducts electricity as a function of the applied pressure. A system can thus be controlled by pressing harder or softer.

An FSR consists of a simple sandwich formed from an electrically conductive polymer and conductive surfaces. It can be customised for a wide range of sensitivities and resistivities. The components are screen printed on polyester film in virtually any shape and size.

The stand-off resistance when in contact, but under no load, is in the megohm range and can remain in the ready state indefinitely with essentially no power drain. Resistance drops as a progressive force is applied to the surface until a pre-determined saturation value is achieved. This can be tailored to occur from 100 to 100,000 ohms.

For further information contact Interlink Electronics, PO Box 40760 (535 E. Montecito Street), Santa Barbara, CA 93103, USA.

Microbee launches the Gamma

A powerful new 68000-based personal computer system has been developed by Microbee Systems. The outcome of over two years intensive R&D effort by Microbee engineers, the Gamma is a multi-tasking, multiprocessor machine featuring two Z-80 eight-bit processors in addition to the 16/32-bit 68000 running at 8MHz.

The Gamma runs 68000 software based on the CPM-68K and UNIX operating systems, using its own locally developed operating system with many UNIX-like features. In addition, it will also feature an optional 16-bit 80186 coprocessor card, which will provide the ability to run MS-DOS based software. And it has the ability to run most CP/M-80 8-bit software developed for existing Microbee computers.

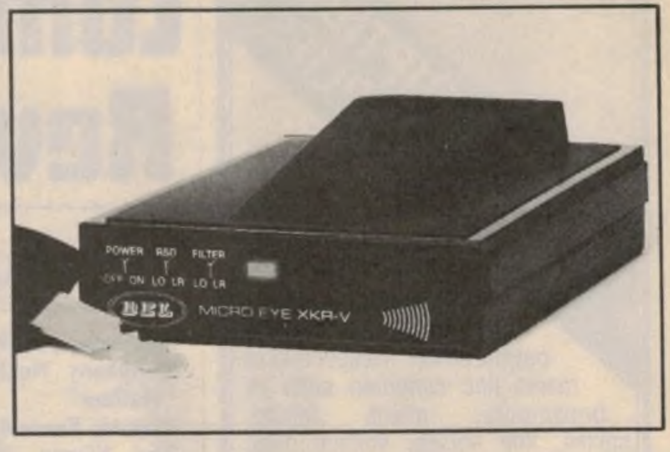
The Gamma comes with 1 megabyte of RAM, expandable to 4 megabytes on the main board and 8 megabytes total. It uses 3.5-inch double-sided 80-track microfloppy drives and features high speed 720 x 350 colour graphics. It also features two high speed serial communications channels capable of both asynchronous and synchronous operation at up to 1Mbps, together with a parallel printer port.

For further information contact Microbee Systems Ltd, Unit 2, Eden Park Estate, 31 Waterloo Road, North Ryde, NSW 2113. Telephone (02) 887 3723.

M I C R O E Y E VECTOR

Dash/Visor Model
Until now, **GaAs Diodes** have only been used in sophisticated military radar equipment. The MICRO EYE VECTOR is the first consumer electronics product equipped with this new technology.

MICRO EYE MODEL 860



Dash/Visor Model **XKR-V**
Powerful and precise, BEL's XKR-V was designed as the smallest, most compact **Superheterodyne** dash/visor detector in the world. Appealing, futuristic design, with our exclusive Horn-Microstrip hybrid circuitry, will enhance the interior of any vehicle.

MICRO EYE MODEL 864

Dash/Visor Model **XKR-IX**
Superheterodyne protection that fits in your pocket! Great performance and super value.

MICRO EYE MODEL 861

Dash/Visor Model **XKR-VI**
Similar to the 860, the XKR-VI incorporates our exclusive **Superheterodyne** Horn-Microstrip hybrid circuitry, but without the luxury features.

Compact Disc Review

BY RON COOPER

MOZART

Symphony No.29 in A major, K.201
Symphony No.35 in D major, K.385 "Haffner"
Masonic Funeral Music, K.477.
The Vienna Philharmonic Orchestra conducted by Karl Bohm.
Deutsche Grammophon CD 413734-2.
Playing time: 50 min 48 sec.

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

Of these three works, the Symphony No.29 exemplifies Mozart's "middle" symphonies while the so-called "Haffner" opens the group of the last six symphonies, most of which were composed in Vienna. For its part, the Masonic Funeral Music, K.477 is typical of Mozart's compositions for Masonic lodge ceremonies.

The No.29 is a delightful symphony and is the one predominant in the film "Amadeus" which will therefore give it even wider appeal. While Bohm does take it at a somewhat leisurely pace the music does not appear to drag. Overall balance is very good but the recording sounds dated. It has an edginess on the strings which sounds like a modulation noise and it needed some filtering to improve it.

The Haffner Symphony is an old favourite of mine and I hark back to my first experience of it with my father's first LP recording purchased in 1955 and there are numerous others, in particular the Neville Marriner version on Philips LP ten years ago. However, this latest version on CD, to be polite, is a bitter disappointment. The tempos generally are sluggish and the over-reverberant, edgy sound lacks detail, particularly when compared with the Marriner LP of ten years ago (still available on import). To be fair though, the No.29 and the Masonic Funeral Music are the better works on this disc and would be the main reason to buy it. (R.L.C.)

DVORAK

Symphony No.7 in D minor, op.70.
The Vienna Philharmonic Orchestra conducted by Lorin Maazel.
Deutsche Grammophon CD 410997-2.
Playing time: 39 min 17 sec.

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

The external stimulus for Dvorak's Seventh Symphony came from the London Philharmonic Society, which in June 1884 elected the composer an honorary member and invited him to write a new symphony. But there was another stimulus as well, from Dvorak's friend and early champion, Johannes Brahms.

The work was completed in March 1885 and its first performance in London on the 22nd April, with the composer conducting, was a triumphant success.

The sound from this disc is very pleasing and Maazel's skilful handling can only be described as exemplary for this seriously detailed work. The balance though, appears to favour the strings, with the brass somewhat subdued in comparison. Otherwise, the sound from this fully digital disc is clean and well-rounded with a good tympani attack.

At 39 minutes 17 seconds, DGG are not over-generous though. (R.L.C.)

FRENCH CLASSICS

Hector Berlioz
Hungarian March from the Damnation of Faust, op.24
Maurice Ravel
Pavane pour une infant defunte
Paul Dukas
The Sorcerer's Apprentice
Camille Saint-Saens
Danse macabre
Clause Debussy
Prelude a l'apres-midi d'un faune
Emmanuel Chabrier
Joyeuse marche.
Academy of St Martin-in-the-fields conducted by Neville Marriner. Philips CD 412131-2.
Playing time: 43 min 4 sec.

PERFORMANCE 1 2 3 4 5 6 7 8 9 10

SOUND QUALITY 1 2 3 4 5 6 7 8 9 10

The outstanding characteristics of French music are colour, rhythmic flexibility, melodic suppleness, and harmonic freedom. As compared with composers of Austro-German origins. French musicians have been less indebted to receiving traditions, far more eager to experiment, and less concerned about critical deprecation. French music has a national individuality, but it is none the less remarkable for the striking differences in artistic profile which can be observed as we scan the great names of French musical history.

When they lived, Berlioz and Debussy had no rivals across the Rhine with whom they could be compared. Each was true to a wholly individual vision.

Compact Disc Review

Though, in a subtle way, each carried in his art the imprint of an historic culture.

This delightful disc is, as usual, everything we have come to expect from Neville Marriner and Philips. Good sound balance, excellent playing with brisk tempos — possibly erring on the fast side but certainly not dull.

The sound quality is very good but not spectacular but any hesitancy here is outweighed by the excellent overall balance of the orchestra as a whole creating a wonderful illusion of contrasting and colourful sound which these evergreens are capable of.

Subtle harp sounds are clearly reproduced that are lacking on other recordings and there is an extremely quiet eerie atmosphere surrounding the solo violin in the Danse Macabre and in the opening of the Sorcerer's Apprentice.

Because of the tremendous dynamic range of the compact disc medium coupled with similar demands of this music I have though, a small criticism of noise intrusion on the extremely soft passages of the Danse Macabre and the Sorcerer's Apprentice. It sounds almost like Mr Marriner had squeaky boots! Trivial but it goes to show just how quiet the noise floor of the compact disc medium is. Particularly when the original tape is digitally recorded as with this one. Perhaps a more valid criticism is that the playing time of just 43 minutes is I feel a bit short. There is plenty of room for more of these French masterpieces.

ROSSINI OVERTURES

Tancredi, L'Italiana in Algeri, L'inganno felice, La scala di seta, Il Barbiere di Siviglia, Il Signor Bruschino, La cambiale di matrimonio, Il Turco in Italia.
Orpheus Chamber Orchestra recorded at the State University of New York. Deutsche Grammophon CD 415363-2. Playing time: 53 min 23 sec.

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

Although Rossini overtures have delighted audiences for generations, even when the operas they introduced passed out of the repertory, many of these masterpieces of wit and rhythmic vitality were performed in versions that the composer would hardly have recognised as his own. The basic structure and spirit were still Rossini's, but the musical details were often drastically transformed.

Sometimes this involved tampering with elements of style characteristic of the composer. Rossini loved the piccolo and how its piercing voice could cut through the orchestra. Recognising its potentially comic character, he frequently employed it with parodistic intent.

Having enjoyed Rossini Overtures for decades, expertly played by the traditional orchestras, there was a feeling of mild skepticism when I read about this small chamber orchestra co-operative of 26 musicians playing without a conductor.

It took me about five seconds to adjust to the sheer sonic brilliance of this recording as there was a freshness and clarity which I now realise is lacking from previous recordings.

The players, whilst very coherent, instantly recognise and yield to the particular soloist of the moment, encouraging each one's full virtuoso talent. You simply have never heard Rossini played like this before.

My only disappointment is that they could have possibly included 'Semiramide' and the 'Magpie' with these eight overtures.

The sound balance complements the performers and with little reverb, helps to maintain the overall clarity. (R.L.C.)

Information centre

Ignition Killer won't kill

I recently constructed the Ignition Killer (EA, September 1985) and installed it in my vehicle. Initially it did not work but I found that this was due to a dud resistor (220kΩ). This was replaced and the unit worked perfectly.

Subsequently, I built and installed your Transistor-assisted Ignition (TAI). This unit works satisfactorily but now the Ignition Killer does not.

When tested on the bench it does work OK although the run and cutout times are somewhat longer than those specified — I have not changed resistor values. However, when installed in the vehicle the cutout time is so short that the motor does not die. Instead, it falters as if there was a crook spark plug.

It would seem that the TAI is having some unwanted influence on the ignition killer. I have replaced all of the components except the relay. Help! (R.G., Canley Heights, NSW).

• Your Ignition Killer is failing to stop the motor because of the extra energy generated in the ignition coil due to the TAI. The cure is simple: reduce the 15Ω/5W resistor in series with the relay contacts until reliable engine cutout is obtained.

That said, we've had a recent call from a reader who maintains that the resistor is not necessary. To explain, when we first published the circuit in February 1984, no resistor was specified. The relay simply shorted the negative terminal of the coil to chassis which effectively stopped the engine cold.

Subsequently, in response to a warning from another (informed) reader, we published a note in the May 1984 issue specifying that a 33Ω/5W resistor be inserted in series with the relay contacts. This was designed to prevent damage to the coil in the case where the Ignition Killer had averted theft of the vehicle but where it had been left in the hot-wired state.

We subsequently republished the circuit in September 1985, but with a 15Ω series resistor because the 33Ω unit was too high to stop some vehicles with high energy ignition systems.

Our latest informant claims that when an engine stops, no cylinder will be left under compression and the points will always be closed. Therefore, if the engine has been left in the hot-wired condition, and is stalled, it is highly likely that the coil will be burnt out regardless of the presence of the Ignition Killer.

Thus, the vehicle will not be stolen, but the price could be a burnt-out coil. The same reasoning applies to vehicles with breakerless electronic ignition systems.

We are inclined to agree with this latest view that the 15Ω resistor is not necessary and can be replaced with a wire link. Can any reader offer any explanation as to why the foregoing would not be true?

Wrong part for video fader

I would appreciate your help regarding the Video Fader project (EA, January 1986) which I built using a Jaycar kit. The completed unit functions in a sort of a way.

The complaint is that the picture is too dark at switch on with the fader control set to zero. As the control is advanced, the picture brightens slightly, followed by evidence of vertical line distortion, then streaks and flashes. Control VR2 has no effect at all, regardless of adjustment of VR1.

Jaycar has substituted an SN74LS01N for the 7400 NAND gate (IC1). Is this OK? Finally, the 2.2kΩ resistor to control the LED current should, I believe, be 220Ω. (T.K., Rosewood, Qld).

● It seems that the solution to your problem may be very simple: the 7401 IC is not a substitute for the 7400. Although they are both quad NAND ICs, the pin-outs are not the same.

You are quite correct in pointing out that the LED current limiting resistor should be 220Ω instead of 2.2kΩ.

Problem with AM stereo decoder

I recently constructed the AM Stereo Decoder (EA, October 1984) and added it to my Playmaster AM/FM Stereo Tuner (EA, November 1978). I have replaced the 0.47μF electrolytics with tantalums as stated and adjusted the slug in L1 to get 4.1V on pin 19 of the MC13020P. Pin 10 reads 8.2V.

The problem is that the LED does not light up and I do not appear to be getting stereo.

My other problem is that the frequency readout is incorrect when the tuner is switched to FM. While it reads correctly for 92.1MHz, the reading when tuned to 96.1MHz is 95.1MHz and for 97.5MHz it reads 96.5MHz.

Control system for model trains

In your April information page you refer to your proposed command control system for model trains.

I have built the Model Railroader magazine CTC system designed by Keith Guttienez and found it very good, but a little expensive to construct. I would be very interested in your system also.

Regarding your Railmaster controller, I find that some locos tend to be a little "buzzy" with pulse power so I also use a pure DC throttle for such motors and this allows me to put sound effects through the rails.

The Railmaster does overheat the motor of highly geared locos such as the Shay type, whereas pure DC does not.

Have you thought of incorporating a memory system to your remote controllers. As it is now, when the remote is unplugged to move to a second location, the trains take off at full throttle. (P.F., Newtown, NSW).

• We haven't exactly been inundated with requests from readers for a command and control system for model trains. However, a certain person very high up on the EA staff is a rabid model train enthusiast, so it still might yet happen if more people write in and indicate interest.

As explained in the original article, the Railmaster will cause higher dissipation in the loco motor but we would not expect this to cause problems.

The reason that the locos take off at full throttle is that, when the remote control is unplugged, the pin 10 input of op amp IC1c is effectively open circuit

Can you help me?

● The voltages that you have measured on pins 19 and 10 are satisfactory and indicate that the decoder is in lock. However, to achieve stereo reception the input IF signal must have the correct amplitude.

We suggest that you monitor the voltage at pin 4 (the level detector output) and adjust the IF signal level to pin 3 by altering the series resistor until a reading of 2V is obtained. Note that the tuner must be tuned precisely to the station frequency in order to receive stereo.

That said, our experience with the Playmaster AM/FM Tuner indicates that it is not a good candidate for conversion. Its local oscillator is not stable enough.

Your problem with incorrect frequency readout may be due to insufficient signal level into the DS8629 prescaler chip. Try reducing the 220Ω resistor from Q14 to see if that cures the problem but do not reduce the resistor more than necessary otherwise multiplex hash will become evident.

Power line interference

I am having a lot of trouble with television interference. What is happening is that there are jagged lines moving across the screen, not in the herringbone pattern, but similar to dashes one after another. These move in bands slowly up and down the screen.

This interference is worst on Channel 2. As well as the jagged lines there are splashes of colour inside those lines and at times the interference on Channel 2 gets so bad that the picture on the screen is almost unwatchable. The same type of interference occurs on Channel 7 but it is not as bad.

There is no interference at all on channels 9, 10 and 28. We have a new VHF and UHF antenna under the roof. This reduced aircraft flutter and, because we live in a metropolitan area, the picture is still very clear and sharp with good colour.

From the antenna we have a high quality coaxial cable lead to the TV set. Everything seems to be OK but the interference is still there. At times it goes away but usually it is there. We have tried all kinds of RF filters but they seem to have little or no effect.

I hope you can help me with this annoying problem. (J.K., East Keilor, Vic).

● It sounds as though you are copping a first rate dose of power line interference. This normally takes the form of two bands of small dots which move slowly up and down the screen. The bands represent a high voltage discharge on each peak of the 50Hz mains (ie, 100Hz).

The source could be quite near to you on the insulators of a pole transformer or due to high-voltage lines some distance away.

Unfortunately, there is very little you can do about this apart from watching channels higher up the band or moving house. You might try contacting your local supply authority but don't hold your breath.

Movement detector false triggers

I have just completed constructing the Ultrasonic Movement Detector described in August 1984 as an addition to the Car Burglar Alarm (May 1984).

The unit functions OK and can be adjusted for sensitivity. However, when adjusted to lowest sensitivity so that it will not self-trigger, I find that after about half an hour in dormant state it does trigger itself. If I adjust the sensitivity any lower, it will not trigger at all.

I would appreciate it if you could provide an answer to this problem. (S.L., Albany, WA).

● You should be able to cure the false triggering problem by increasing the 0.1μF capacitor on pin 3 of IC2b to 4.7μF. Use an electrolytic capacitor with the positive polarity connected to pin 3. The higher value capacitor will delay the output trip time, thus making the circuitry less susceptible to false triggering.

---

and so the op amp output (pin 8) is pulled towards the positive supply rail. This represents the full throttle condition.

It's quite easy to incorporate a substantial degree of memory into the system, however. All you have to do is replace the 0.1μF capacitor on pin 10 of IC1c with a 47μF 16V electrolytic. The 47μF 16V electro connected to position 1 of S2a can be used for this job and need not be replaced.

Now, when the remote control is unplugged, the voltage across the 47μF capacitor will determine the output voltage of IC1c and thus the locos will continue at the set speed. This 'memory' will not last indefinitely but will be more than adequate to allow the controller to be unplugged and moved to a new location.

Infrared remote control switch

The April 1986 project for an infrared remote control switch may suit my requirements except for one glaring omission. As with previous designs of similar devices there is no provision to operate multiple controllers in the same room due to mutual interference between transmit and receive pairs.

I envisage an application for multiple units operating in close proximity, for physically impaired people.

Can the current project be modified to use a variety of frequency/coding combinations to provide immunity from other differently adjusted controllers? (P.S., Muswellbrook, NSW).

• Although we haven't tried it, it should be quite easy to modify the Infrared Remote Control Switch so that several units can operate independently in the same room. To do this, you can alter either the modulation frequency, the carrier frequency or both these frequencies.

To alter the modulation frequency, simply change the timing components on pins 6 and 7 for IC1 in the transmitter. Similarly to alter the carrier frequency, change the timing components for IC2.

At the receiver end, L1 and C3 on IC1 will have to be tuned to the new carrier frequency. At the same time, the tone decoder circuit (IC4) will have to be adjusted to suit any new modulation frequency. If this adjustment is outside the range of VR1, then either R7 or C10 will have to be altered.

Transistor ignition & sports coils

I have purchased an EA transistor ignition kit from Dick Smith Electronics and wish to know if it is capable of running, without modification, an "ACCEL" super coil which, at low revs, is capable of putting out between 60,000 and 85,000 volts.

Would any modifications to the circuit be necessary as this voltage is much higher than from a standard car ignition coil? I have already blown up a cheap commercial unit and require further advice so that the same does not happen with your unit. (G.A., Chermside, Qld.)

• We dunno. She might be right but she probably won't. The TAI was never designed for use with this type of coil and it's quite possible that the output transistors would fail.

Notes & Errata

PLAYMASTER STEREO AM/FM TUNER (December 1985, File 2/TU/55-57): the 30pF compensation capacitor which replaces the CSC500K7 50pF capacitor in the AM stereo decoder section has three terminal pins instead of two. It should be installed with the centre pin connected to ground and the outer pins both connected to pin 17 of IC4.

Readers should also note that a 1-metre length of wire is required to wind the 60 turns on coil L3, rather than the 755mm length specified in the article (page 61, Feb. 1986).

Finally, readers should note that L21 in the coil winding table (page 61, Feb.) should have been listed as L20. L21 is a standard off-the-shelf 22μH choke.

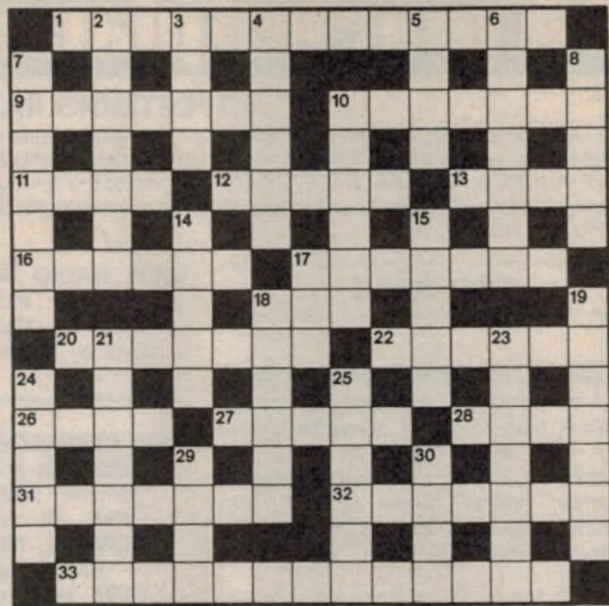
DIGITAL STROBE (March 1986, File 2/MS/64): further to our errata in the March issue, there are two more tracks missing from the PC board — between point C6 and pin 12 of IC3, and between the track running to point 13 and the bottom pad of the adjacent 1μF 250VAC capacitor. Also, the RPS and RPM labels on S3 on the main circuit diagram should be transposed.

INFRARED REMOTE CONTROL SWITCH (April 1986, File 2/LR/9): capacitor L6 (47μF) in the receiver is shown with reversed polarity on the parts layout diagram (page 42); the correct value for C7 is 0.1μF, not 1μF as shown on the overlay; and C12 (1μF) should be a tag tantalum type for low leakage.

The transistor base diagram on the circuit for the transmitter is also incorrect. The pins, from left to right, should be B, C, E. The layout diagram on page 44 is correct.

Finally, we recommend that the earth lead from the mains outlet socket be connected directly to the terminal block on the receiver PCB rather than to point 3. This is to guard against the possibility of the PCB track "fusing" if a fault develops in the external appliance.

JULY CROSSWORD



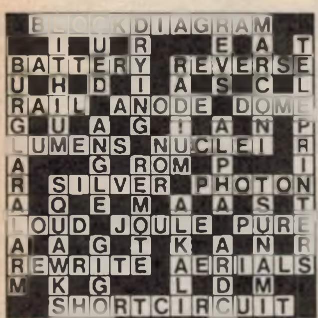
ACROSS

1. Having the most modern development. (5-2-3-3)
9. Remove ICs, etc. (7)
10. Type of trigger. (7)
11. Instrument, such as used in 9 across. (4)
12. Said of system processing signals for sound. (5)
13. What pressure mats do to burglars. (4)
16. Live antenna? (6)
17. Quality of hifi equipment. (7)
18. Brand of award-winning amplifier. (3)
20. Not the actor Marty, but the co-developer of the thin-film transistor. (7)
22. Pick up signal. (6)
26. Significant feature of magnetic hysteresis graph. (4)
27. Its sound can be duplicated by an electronic organ. (4)
28. Join components to operate in unison. (4)
31. Confusion of spurious signals. (7)
32. The pursuit of a hobby can be regarded as such. (7)
33. Said of circuitry responding to rhythm. (4-9)

DOWN

2. Kind of valve. (7)
3. Distort TV picture. (4)
4. Emergent signal. (6)
5. Fifth letter of phonetic alphabet. (4)
6. Form of radioactive debris. (7)
7. Convert current. (7)
8. Components of tonearms. (5)
10. Barrier to fields. (6)
14. Has advanced in phase. (5)
15. Sparked. (5)
17. ASCII code word. (3)
18. Inventor of logarithms. (6)
19. Arrange components out of alignment. (7)
21. Perform computer operation. (7)
23. The removal of data. (7)
24. Connect components. (5)
25. Type of representation of a variable. (6)
29. Electrical prefix. (4)
30. Fundamental physical quantity. (4)

SOLUTION FOR JUNE



50 and 25 years ago...

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

Wireless Weekly

July 1936

Berlin olympics: Some indication of the importance of the 1936 Olympic Games to be held in Berlin shortly as viewed by the German authorities is gleaned from the extraordinary technical arrangements for broadcasting being carried out.

It has been arranged for 30 direct transmissions and 38 recording installations to be in operation, and besides that to have in reserve 20 transmitting-cars with complete recording outfits.

Colourful cosmetics: (caption) This diagram shows the facial colourings necessary for satisfactory television work at the BBC. The young lady 'television hostesses' will have to make up their faces as shown above: black eyebrows, green eyelids, black eyelashes, brown lips, full red inside nostrils, dark yellow nose, light yellow cheeks.

Two-in-one: The Reliance-York, a combination phono-radio, has for some time been the show model of all the receivers made by this firm. The latest lives up to this reputation, and we are very much impressed with it. Apart from other features, we were most interested in the fact that it uses volume expansion as an adjunct to the gramophone end of the machine.

RADIO, TELEVISION and HOBBIES

July 1961

Screw-thread seal: a new sealing material for screw-threads is being made in Britain. It consists of a thin ribbon of PTFE. This synthetic material is fairly soft and, at the same time, has a very low co-efficient of friction.

The ribbon is wrapped around the thread of a pipe and when this is screwed home, the PTFE is soft enough to take up the contours of the thread without jamming it. PTFE is resistant to all chemicals and solvents and oils.

TV project: This article is the first of a series describing the construction of our new television receiver. Designed around the latest components, it is intended for use with the new 114-degree 19-inch or 23-inch "square-faced" picture tubes. Using panels to ensure systematic wiring, it is well suited to home constructors or as a project for tutorial classes.

EA marketplace EA marketplace

ADVERTISING RATES FOR THIS PAGE

SMALL ADS: The minimum acceptable size of 2 centimetres x one column costs only $40. Other sizes up to a maximum of 10 centimetres are rated at $20 a centimetre. CLASSIFIEDS: $4 for 40 letters. Just count the letters divide by 40 and multiply by $4, ROUND UP TO NEAREST WHOLE NUMBER. CLOSING DATE: Ads may be accepted up to the 18th of the month two months prior to issue date. PAYMENT: Please enclose payment with your advertisement. Address your letter to THE ADVERTISING MANAGER, ELECTRONICS AUSTRALIA, PO BOX 227, WATERLOO, NSW 2017.

FOR SALE

MY $39 8K TO 256K: Centronics parallel printer buffer kit now has an optional plug in serial converter board @ $18, which gives 75 to 19,200 baud in and/or out, and a plug to printer sharer board @ $12. For more info. Send SAE to Don McKenzie 29 Ellesmere Cres, Tullamarine 3043.

SOFTWARE: Over 900 Vol's public domain software for IBM and CPM systems. Free catalogues. Earom Electronics, 12 Florence St, Burwood 3125. (03) 288-3835.

KITS! We can supply most EA and ETI kits, FULLY BUILT AND TESTED. Also unassembled kits available. Please call for a quote. Ph 728 1674.

2N3055 80c ea, 10 for $7.50. BD139 30c ea, 10 for $2.50. BC 548, 549 15c ea. P & P free. Send for list. L.M.F. Products, PO Box 384, Cootamundra 2590.

EX-ABC AUDIO TAPES: ¼" wide on 10½" **Standard** metal spool $6.85 **Robust** metal spool $7.85. 7" spool $2.25. 5" spool $1.25. Post extra. Also in stock ½", 1" and 2" tapes. Waltham Dan, 96 Oxford St., Darlinghurst, Sydney. Phone (02) 331-3360.

AMIDON FERROMAGNETIC CORES: Large range for all receiver and transmitter applications. For data and price list and 105X220 SASE to: R.J. & U.S. Imports, P.O. Box 157, Mortdale, NSW 2223. Closed for business during July. NSW: Geoff Wood Electronics, ACT: Electronic Components, Fyshwick Plaza. Vic: Truscott Electronics, Croydon. WA: Willis Trading Co, Perth.

NEW RADIO VALVES: For entertainment or industrial use. Waltham Dan, 96 Oxford St,. Darlinghurst, Sydney. Phone (02) 331-3360.

IBM COMPATIBLE TURBO MOTHER BOARDS: 4.7 & 8 MHz can replace genuine IBM boards $280. RUN CPM IN YOUR IBM PC OR COMPAT. NEC V20 processor chip — 8088 plug in replacement and CPM boot disk $60. 8MHz $70. 256K RAM 41256 150ns $5. P & P $2. Earom Electronics, 12 Florence Street, Burwood 3125. (03) 288 3835.

HI FI SPEAKER KITS: Raw drivers, X-overs, plans, replacement speakers, custom wound coils, hard to get bi-polar capacitors and many other accessories from the world's finest manufacturers, Dynaudio, Scanspeak, Focal, Foster, KEF Constructor Series Drivers and Kits, Peerless Drivers and Kits, Scanspeak, VIFA Drivers and AEM 6102/6103 kits. We ship anywhere within Aust. and export to NZ and Pacific. Send $2 for latest catalogue. Audiocraft, PO Box 725, Toowong, Brisbane, Australia 4066.

FOR SALE: COMPLETE SET of EA and ETI back issues 1974-84 at $10 per year. Mr Baitch (02) 631 9202.

ARE YOU BUILDING AN EA KIT?

Kit suppliers often do not include all the information published on a particular project. We can supply photostat copies of any article we have published for a fee of $4, including postage. If the article was spread over more than one issue, the charge is $6.

Write to:
The Assistant Editor,
"Electronics Australia"
PO Box 227, Waterloo, NSW, 2017

WANTED

1960s 4 SPD AUTO RECORD: changer unit with scratch filter and pause levers. Make — "Dual", Model — 105. Working order preferred. I will pay for changer and packing/freight cost country/interstate. Phone (02) 92-6733 after 6 pm.

TMS1000 24-tune doorbell chip: as used in the EA Autochime Project. Please write to: S. lemma, 26 Wilding Street, Marsfield, NSW 2122.

MOVING OUT SALE BARGAINS GALORE

WE ARE MOVING SALE STOCK CLEARANCE

A.C.E. RADIO

136 VICTORIA RD, MARRICKVILLE, NSW 2204.
PHONE 51 3845.

PROUD TO BE AUSTRALIAN

ELECTRONICS CENTRE

50 WATT RMS SPEAKERS

★NEW MODEL★


ETONE FACTORY SCOOP
EVEN LOWER THAN FACTORY PRICE
A PAIR FOR $54.95 OR $31.95 EACH

RUGGED TOP QUALITY HI-FI WOOFER. 30cm 8 ohms ● 90 DAYS FACTORY WARRANTY ● FOAM POLY SURROUND ● STURDY SUSPENSION FOR RICH REPRODUCTION ● 3.5cm VOICE COIL ● FERRITE MAGNET ● FREQ. RESPONSE ... 35-4500Hz RESONANCE 35Hz

P-P NSW FOR ONE $4.50. INTERSTATE $6.90. P-P NSW FOR TWO $6.50 INTERSTATE $8.50.

JUMBO CABINETS

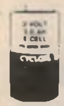
WAS $24.95
ONLY $15.95
P.P. NSW $4.50. V.SA Q.T. $6.50 WA. NT. $8.50

Heavy duty ABS plastic ● Detachable U-shape top and bottom, front and back panels ● Front panel has cut-outs, and will easily accept a blank. Dimensions 350mm (W) x 130mm (H) x 350mm (D). Excellent condition.

AEI BRIDGE RECTIFIER

150 piv. 10 amp.
10 FOR $14.50
P.P. NSW $2.50 INTERSTATE $3.50 OR $1.95ea. P.P. $1.35

GATES CYCLON RECHARGEABLE SEALED BATTERIES. 2 VOLT.



2.5AH D-CELL **$3.95**

CELLS ARE EX-NEW EQUIPMENT AND ARE GUARANTEED PERFECT WILL ACCEPT FAST CHARGE

NEW NICAN C-CELL $6.25

P-P $1.35
Interstate $3.25.

TUNING CAPACITOR

$6.75 EACH

P-P NSW $2.00
INTERSTATE $2.75

3 gang. 60PF. 200PF AND 415PF IDEAL for A.T.U., etc. Top quality. Ball bearings. 55×45×40mm.

HIGH GRADE POTTER AND BRUMFIELD RELAY

P-P $1.50 **$3.50**

KU series ● 240 VAC 50Hz operation ● 3 sets of 240V 10 amp change over contacts ● perspex cover and mounting base included ● size 50mm x 37mm x 35mm ● ex computer ● as new condition. At less than 1/3 of the normal price.

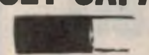
A AND R POWER TRANSFORMER

Primary Tapped from 200v to 250v 50Hz.
Secondary 0—20, 30,48v 2.5 Amps.
Size 95 × 80 × 85mm
$9.95 EACH

ALSO
V48. 30. 20. — CT — 20. 30. 48V 2A

P-P NSW $5.50
INTERSTATE $7.50
$14.95

PLESSEY CAPACITOR

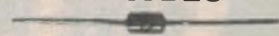


IDEAL FOR **CAPACITOR DISCHARGE IGNITION**
55×30 mm

1.5μF 440Vac 50Hz. 1200Vdc

P-P $1.35 **$3.95 EACH**

DIODES



650piv 3 AMP
50 FOR $9.50 P-P $1.35

MINI BRIDGE RECTIFIER W02

200 piv 1.5 AMP

10 FOR $3.95 P.P. $1.35

TRIAC

TYPE 225D **SENSITIVE GATE**
400V. 10AMP
10 FOR $17.50
OR $1.95 EA. P-P $1.50

TRANSISTORS

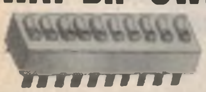
MJE 350
PNP. 300V 1/2A
10 FOR **$2.95**
BD140. 10 FOR **$5.95**
BC337. 25 FOR **$3.85**
25A473. 25A 634
10 FOR **$3.95**
MJE 3055 10 FOR **$14.00**
BC547. BC548. BC549.
BC327. 2N4248. 2N4250
50 MIXED FOR $4.85

P-P NSW $1.35
INTERSTATE $2.00

BOSCH RELAY

12 VOLT 30 AMP
FOR HORN OR HEADLAMPS
$4.25 P-P $1.35

10 WAY DIP SWITCH



10 FOR $6.75 P-P $1.50

PLANETARY DRIVE

PROFESSIONAL QUALITY
30:1 REDUCTION
WITH FINE TUNER
1/4" SHAFT
1/4" COUPLING
LIMITED STOCK
$12.95 P-P $1.50

GOLD PLATED RN 16 PIN IDC HEADER

10 FOR $6.95 P-P $1.50

26 WAY IDC COMPUTER CABLE

5 MTRS FOR $9 P-P $1.65

EMITAPE 5" 1200 FT RECORDING TAPE

TYPE HDP12 HI-DYNAMIC DOUBLE PLAY HIGH OUTPUT LOW NOISE
$5.75 EACH OR 4 FOR $21
P-P $1.50
P-P NSW $3.00
INTERSTATE $5.00

CONTROL UNIT S338 FOR COMMANDER N308 TELEPHONE SYSTEM $285.00

P/P NSW $6.50

N.B. THE CONTROL UNIT IS THE COMPUTER SYSTEM FOR THE N308 TELEPHONE. THE HANDSET AND THE POWER SUPPLY IS NOT INCLUDED. THE UNIT OPERATES OFF 18DVC POS. AND NEG. RAIL. THE UNITS ARE IN NEAR NEW CONDITION.

INTERSTATE $10.50

26 WAY BLUE MACS

IDC CONECTOR 1A, 150V P.C.B. MOUNTING
10 FOR $9.50 P-P $1.50

CANNON PLUG

3 PIN MALE

$3.50 EACH P-P $1.50

JUMBO SIZE FIBREGLASS

$4.45 EACH

PRINTED CIRCUIT BOARD
A1 QUALITY 365 x 330mm
NSW $2 P-P INTERSTATE $3.50

MINIATURE LICON SWITCH

10 FOR $2.95
Push-on — Push-off
10 x 10 x 20mm High
P-P $1.50

INTEGRATED CIRCUITS

MC 14541. 74L500. 74L'5367. MC1488. 4017. 4049. 4066. 7406. 7441. 74157. LM3301. LM3401N = LM3900.
10 MIXED TYPES $3.95
P-P $1.50.

ROTATING FLASHING RED DISTRESS BEACON

12 VOLT 2A

Ideal for Car, Truck, Boat. Also Disco.

$12.95
P-P NSW $2.50
INTERSTATE $3.50

★ POWER TRANSFORMER SALE ★

No. 1. 12-0-12V .5A	$2.50
No. 2. 0-18V 1.8A	$4.95
No. 3. 0-24V 1A	$4.95
No. 4. 0-38V 2A	$4.50
No. 5. 34-0-34V 1.5A	$4.95
No. 6. 0-12V. 250MA	$2.50
No. 7. 0-15V 1.5A 6.3V	$3.50
No. 8. 0-34V 1.5A 6.3V 1A	$4.95
No. 9. 7V-0-7V 10 amp	$25.00
No. 10. 0-14V. 5 amp	$25.00
No. 11. Ferguson Lo Profile. 23V-10-CT-10-23V. 40VA	$9.95

Pack & Post. NSW $2.50. Interstate $3.50. P-P. Nos 9, 10. NSW $5 Interstate $8.50.

AUTO DIODES

$2.25 EACH
BY X21L 100
100 PIV. 80 AMP PRESS FIT
10 FOR $17.50 P-P $2
FORWARD AND REV. AVAILABLE

WATCH OUR NEXT ADVT. FOR NEW ADDRESS

Protect your copies of Electronics Australia in these binders

MAGAZINE BINDERS $7.50

Ready to use binders with easy, clip-in fastener, covered in soft, decorator brown vinyl. Holds 12 issues of electronics Australia.

Postage and packaging additional: Please refer to reply card for charges.

6 Binders — only **$39.95**

SAVE WITH SIX

ORDER TODAY — Simply return The Freepost reply card to:

Tel: (02) 663-9999
Tlx: AA74488

The Federal Publishing Company
PO Box 227, Waterloo, NSW 2017

Electronics Australia Reader Service

"Electronics Australia" provides the following services:

BACK ISSUES: available only until stocks are exhausted. Price: $4 (includes post and packing where necessary).

PHOTOSTAT COPIES: when back issues are exhausted, photocopies of articles can be supplied. Price: $4 per project or $8 where a project spreads over multiple issues (price includes postage).

PCB PATTERNS: high contrast, actual size transparencies for printed circuit boards and front panels are available for $3 each, including postage. Please specify positive or negative.

ADDRESS: send all correspondence to The Secretary, "Electronics Australia", PO Box 227, Waterloo, NSW 2017.

PROJECT QUERIES: advice on projects is limited to postal correspondence only, and to projects less than five years old. Price: $3. Please note that we cannot undertake special research or advice on project modifications. Members of our technical staff are not available to discuss technical problems by telephone.

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.

PAYMENT: must be negotiable in Australia and made payable to "Electronics Australia". Send cheque, money order or credit card number (American Express, Bankcard, Visa Card or Master Card), name and address (see form).

Back Issues ....
....
....

Photostat copies ....
....
....

Total price of magazines/photocopies, including postage and handling.

No off issues reg .... x $4 = $..................

Cheque*/Money Order ☐ Please tick box to indicate method of payment:
**Please make payable to the Federal Publishing Company Pty Ltd*

Mastercard ☐ American Express ☐ Visa ☐ Bankcard ☐ Tick ☑

Card Expiry Date ....

☐☐☐☐ ☐☐☐ ☐☐☐☐ ☐☐☐☐☐☐☐☐

Credit Card No

Signature ....
(Unsigned Orders cannot be accepted)

NAME: ....

ADDRESS: ....

.... POSTCODE..............................

ADVERTISING INDEX


Introducing
the handlers
TM
UNIDIRECTIONAL DYNAMIC MICROPHONES
La linea Italiana
paso
M 601
paso
M 701
paso
M 800
paso
M 501
paso
SOUND PRODUCTS
For information & literature contact
Conference Technology PTY LTD
ct
100 Gladstone St,
Sth Melbourne, 3205
Ph: (03) 690 9988
Trade Enquires Welcome