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New series: Understanding colour television

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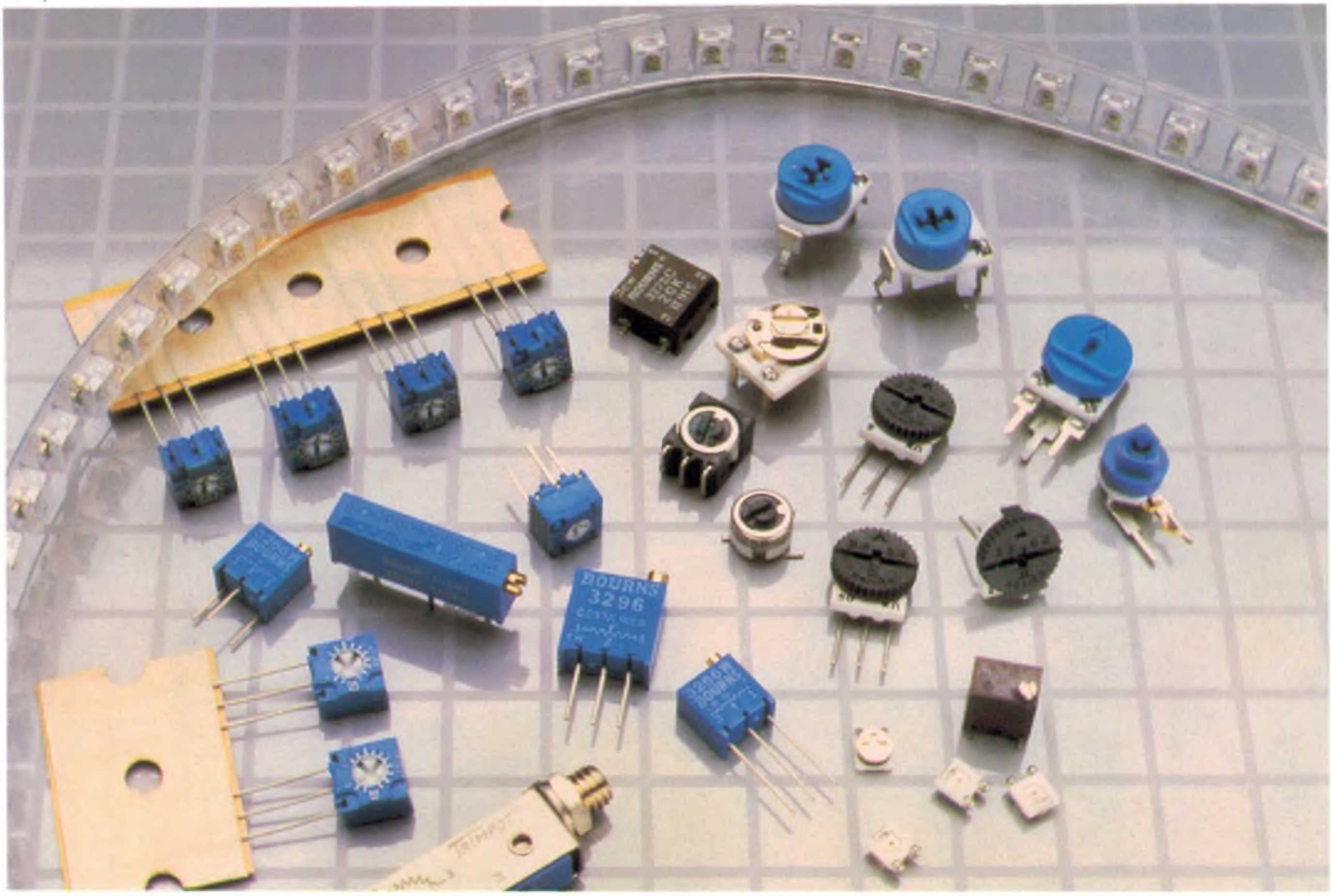

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Volume 49, No.1

Electronics Australia

January 1987

THIS MONTH'S COVER

You don't need a crystal ball to build our new shortwave radio. Just follow the project article starting on page 52.

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News and Comment

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Remote switch for burglar alarms

Forget about entry and exit delays on burglar alarms. This handy radio-controlled switch lets you turn the alarm on and off from outside your car or house.

What's coming

Next month, we really do promise to publish the digital sound recorder which has been held over twice now due to space problems. We'll also publish a dual tracking power supply and take you for a ride on the Bond airship.

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Letters to the editor

Switching mains appliances

I refer to a letter from J. Parry, in the August 1986 issue of EA, concerning switching of mains appliances. I would agree that the device as shown in the circuit would not comply with Australian Standards, but not for the reasons given. The relevant Standard is AS 3100 — Definitions and General Requirements for Electrical Materials and Equipment and covers "... fittings, accessories, appliances and apparatus".

According to clause 3.8 of the Standard, there is no mandatory requirement for a regulating switch on the device in question. However, I believe it would be good practice to have one included. Clause 3.8.5 of the Standard would then require that the switch shall open all live conductors — that is, active and neutral.

The Standard, AS3000, to which Mr Parry refers covers Electrical Installations in Buildings, Structures and Premises and therefore is not appropriate to appliances. One should be careful to apply the correct Standards because sometimes if the wrong one is used one can obtain the wrong result. I can thoroughly recommend RS3100 as an essential book for every electronics hobbyist who builds equipment to be operated from the mains supply.

R.V. Barringer,
Mt. Colah, NSW.

Utopia — it's here now

Over the years I have learned, as no doubt many readers have, to respect the writings of Neville Williams, a father figure of *Electronics Australia* and eminent in the field of electronic journalism.

Nevertheless, after reading Utopiatronics (Forum, May 1986) I consider the article not only misaptly named, but also less than positive in its approach to N.M.'s letter.

There are still a lot out there who will never buy kits for various reasons, but still build plenty of equipment. If we are a dying breed why are there so many retailers still in existence whose greater percentage of turnover is centred around the sale of component parts?

Youngsters with ambitions for a career in electronics should be encouraged to build this way as part of a learning process. (Try using a kit for a college assignment and see how far you get with your instructor.)

Building from scratch allows the constructor to upgrade or vary component quality, modify at will and take advantage of components already on hand, 'bog-standard' or otherwise.

I have been building electronic gear since 1950 and find it hard to appreciate the first two paragraphs of the Utopiatronic article.

What utopian period?

It always has been and always will be difficult to get out of stock components. Looking back on the past 36 years, I really cannot see much change in component supply situations. I guess people will always scrounge, swap and pinch the housekeeping money to pursue their hobby. But surely this sort of behaviour cannot be pin-pointed as part of halcyon days long gone.

Surely, if ever a utopian period existed in the field of electronics, it must be now. At what stage in our past have we ever had the choice of such a magnificent multitude of componentry, integrated and otherwise.

Ninety-nine percent of componentry for projects is readily available off the shelf and it is still perfectly safe to undertake projects published five years ago. Take for instance your own Function Generator. This was first published in April 1982.

A digital frequency meter was offered as an addition to the instrument two years later. If this unit was to be built now, every part would be available off the retailer's shelves. The same could be said for your 50V/5A Laboratory Power Supply (1983) and many, many others.

Also, if printed circuit boards, front panels, cabinets etc. are required for published projects, there are retailers who specialise in stocking these items. However, if magazine design engineers create projects using componentry not readily available or in common use within the industry, then problems in project construction will arise.

In my opinion, it is the duty of any reasonable magazine to ensure that such components will be available to readers. If retailers will not stock the parts and they are unobtainable through any other source, then the magazine should undertake the supply of such parts.

If kit suppliers as general electronic retailers are able to procure such special parts, but will not sell them over the counter as separate items, then it is pretty obvious from information you already have in hand that they may be cutting off their noses to spite their faces.

If they are unable to see the advantages of selling special parts individually as well as in kits, then it is possible they will be left playing in their own small backyards.

What the electronic retailing industry needs is a little more entrepreneurial action dealing with situations such as occurred when the Playmaster Stereo AM/FM Tuner was offered as a kit only project. Some enterprising retailer/s could have taken up the challenge to supply EA readers with the special parts, even if it meant obtaining firm orders first, if minimum order requirements were involved.

Believe me, the special parts are not as difficult to obtain as some would have us believe.

It is still not too late to assist those who wish to build this fine piece of equipment and it will be interesting to see what transpires with respect to the project. Perhaps *Electronics Australia* will really become the 'Good Guys'.

J. S. Douglas,
Elmore, Vic.

Editorial Viewpoint

A new chairman for the CSIRO

The news that the CSIRO will have Neville Wran as its new chairman will no doubt displease many in the scientific community. Mr Wran has a reputation as a consummate politician and a brilliant lawyer but he would probably be the first to admit that he knows nothing about science or technology. To anyone who has been at an official function concerning science or technology, that lack of knowledge has been cleverly covered by Mr Wran's skills as an orator. That was OK when Mr Wran was a practising politician but as CSIRO chairman it may not be sufficient.

Among the other people considered for the post were Sir Roderick Carnegie, ex-chairman of CRA, and Sir Gustav Nossal who is perhaps the doyen of Australian science. Neither of these men were able to find time for the post but will be on the new board of directors. The present chairman, Dr Keith Boardman, is expected to be appointed as full-time chief executive by the new board which will have mix of scientific and business acumen.

Now consider the importance of the job of the CSIRO chairman. If the main task is to be a highly visible lobbyist on behalf of the CSIRO, maximising the funds available to it, then Wran must be regarded as a top choice. With his silver tongue and demonstrated ability to get at funds squirrelled away in "hollow logs", he could be a winner. And after all, past chairmen, notably qualified scientists though they may have been, have not played a star role.

But if the task of chairman is to be the leader and motivator of a large body of highly qualified scientists and engineers, he will have to speak with authority. He will not simply be a mouthpiece but someone who fully understands the importance of the CSIRO to the Nation.

As far as the staff of the CSIRO are concerned, they would probably have preferred a more traditional appointee in Sir Gustav Nossal. By constrast, the choice of Mr Wran will surely be criticised as being another case of "jobs for the boys". Mr Wran may yet turn out to be the ideal person for the post but until he demonstrates a close affinity for our most important scientific and research organisation he will be very much on trial.

Leo Simpson

Kits are far cheaper

The July Forum brought up some interesting topics.

First, unlike some readers, I know that a "kit" bought complete is a lot cheaper than buying individual components. Consider the cost of travel, mail orders, phone calls etc and you would be naive to say you could save money by buying individual parts.

If one store could supply individual parts, would it be economically viable? Hardly, if a lot of specialised parts were used. Another store, or stores, would soon jump on the bandwagon and depending on locality a lot of retailers would soon have excess stock. This is a big country with a relatively small population or have readers forgotten that.

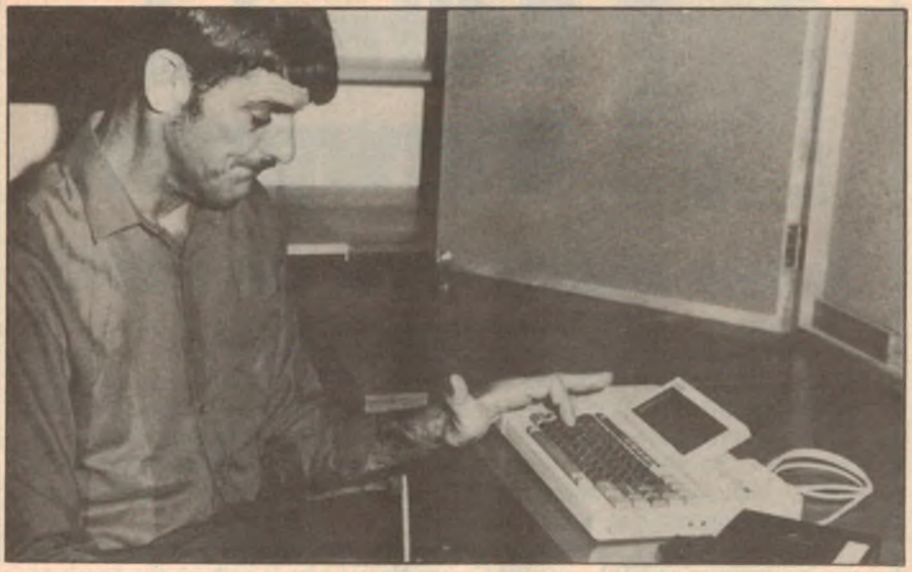
Another point is the method of kit building. If readers spent at the rate some have stated, they would be involved with the same project for at least a year. What about all the other projects that passed by in the meantime? And how many are there that would build kits this way. Not me! I simply don't have the time.

I.G. of Myrtleford — how much did you spend on your Heathkit kit? Too much, I reckon. The extra money isn't worth the shiny brochure and packing. You throw the packing away and don't use the "professionally printed" construction guide after the kit is built.

I think I.G.'s view of local kits is very unreasonable. They are very good value, all the bits are included and all you need is common sense to construct one.

G. D'Abrera, VK3DOD/M,
Amberley, Qld.

News Highlights



Talking computer for the disabled

Brisbane has recently established a Communications Aid Centre which they hope will allow handicapped people, especially those with speech disabilities, to find solutions to their problems through technology.

Epson computers has developed a software package on their PX-4 compact personal computer, which produces conversation for speechless people in printed form. An artificial voice produced by coupling a speech synthesiser and amplifier to the device is under development.

The process would be a long and tedious one if each word had to be typed into the terminal, so a code has been developed which allows the user to type in a short mnemonic defined beforehand to stand for a certain phrase.

The speech synthesiser gives a clear and understandable output which is an important consideration if the message is used over the phone or in an emergency.

Electronic mail — the introverts strike back

In the "good old days", before the invention of the telephone, or the jet airplane, or the automobile, the success of a businessman or diplomat depended greatly upon his ability to communicate in writing.

Extroverts may have done well in face-to-face negotiations, but often it was the introverts, with their carefully honed prose, who got the edge in business dealings.

With the invention of the telephone, that situation changed and it was the extroverts who got the upper hand. But now, according to a recent report by International Resource Development Inc., a US-based market research company, electronic mail services are rescuing the introvert once more.

Just as in the early days of the photostat machine, when sneaky executives learned to bombard their managers and colleagues with copies of their memos, today's executives are using electronic mailing systems to blanket their organisations in electronic "bumf".

In fact, some organisations are even having problems with electronic "junk mail" (unsolicited advertising) finding its way into their electronic mailboxes.

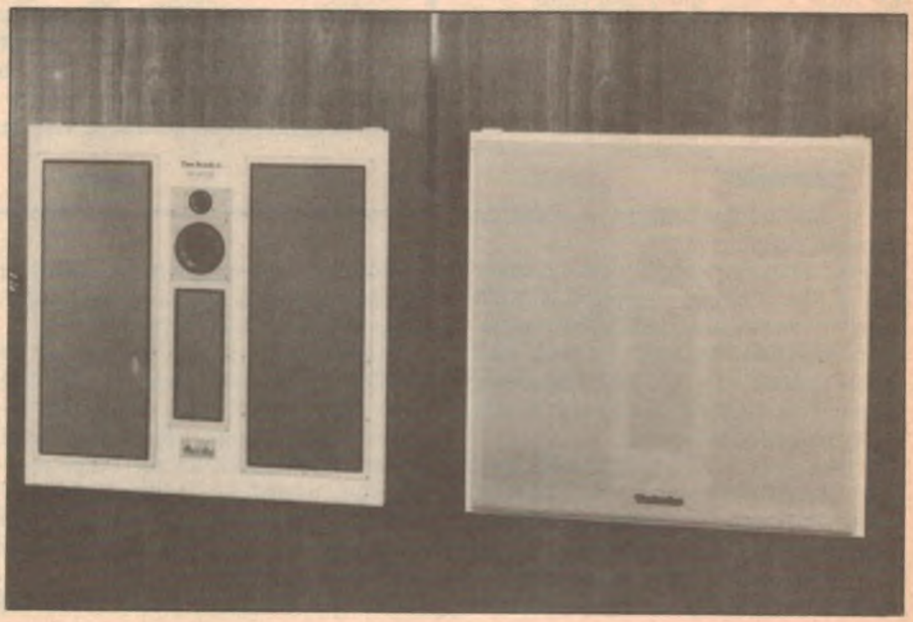
IRD believes that most of this electronic mail is originated by introverts and sees several years of growth for the technology, ahead, "perhaps until the extroverts strike back with new video conferencing technologies".

Matsushita's new flat panel speakers

Matsushita has developed an "ultra-flat" panel loudspeaker that is ideal for wall mounting and for use with digital audio systems. It has been developed mainly for use at home but it may also have some professional applications.

The new loudspeaker, which is about 6cm deep and has a front panel of one square metre, features the worlds first "twin cabinet" construction. The loudspeaker has four voice coils and drives a flat diaphragm of woofers and mid-low-drivers, each in its own sub-cabinet.

The enclosure features a frequency response of 35Hz to 40kHz and is claimed to offer particularly accurate reproduction of the low range. The music power rating is 350W and the efficiency is 88dB/W/m.



Australia's new Parliament House will be among several prominent Canberra sites being initially observed by seismograph recorders running off Webster's Spectrum minicomputer.

Order for local earthquake system

The Bureau of Mineral Resources (BMR) has selected an Australian-designed and developed earthquake monitoring system to help it assess earthquake risk throughout the Australian continent.

The information collected will be used to upgrade the current Seismic Zoning Map in an attempt to ensure that large buildings throughout the country will have similar safety margins against damage from earthquakes.

The seismograph recorders were designed and constructed by the Seismology Research Centre of the Phillip Institute of Technology (PIT) in Melbourne, a company that is rapidly gaining an international reputation for its expertise in this area. The minicomputer is an Australian Spectrum Mark 2 from the Webster Computer Company, around which the software has been developed.

Some of the structures to be instrumented initially are in the ACT and include Australia's new Parliament House, the Telecom Tower and the Googong and Corin Dams which supply water to Canberra.

Living computers – the eighth generation

Although there are not yet any viable fifth generation computers, scientists are already planning subsequent generations. Fifth generation computers will take only seconds for tasks presently requiring days, but Britain's ICL thinks that the sixth generation will be even faster, relying on optical circuits.

ICL believes that some of us will live long enough to see the eighth generation of computers. The seventh, suggests an ICL spokesman, will be based on organic circuits which use proteins to store information. This will begin to approximate the cognitive processes of living organisms, which begs the question of when 'artificial intelligence' stops becoming artificial.

Speculation at ICL suggests that the eighth generation of computers will be living devices. We wonder whether technology might not have come full circle by that time, producing a computer which suffers headaches, takes sickies and goes on strike!

Strong market for electronic dashboards

Flat panel electronic displays, currently installed in some 15% of US passenger cars, are set to record impressive growth levels. At present, this type of display is used as an expensive option in some sports and luxury models. However, it is likely that flat panel displays will eventually replace mechanical instruments in this field.

As has happened in many other areas (watches and multimeters, to name two), the price of mass produced electronics panels will be much cheaper than present-day mechanical assemblies.

International Resource Developments of the US cite a recent report which predicts a 55% penetration for flat panel displays by 1996. In addition to the usual engine, chassis and cabin information, forthcoming systems are likely to present navigation and communications data. The big advantage of electronic displays is that they can be easily adapted to switch from one mode to another, presenting the most appropriate information at any given time.

News Highlights

Electronics courses at Box Hill College of TAFE

In response to the article by Jim Lawler in EA, August 1986, the TAFE in Victoria has advised that they have several vocationally oriented courses in the School of Electronics Technology.

There are three main reasons why there is a shortage of trained technicians in the industry: (1) employers can not charge for repairs at a rate which will permit the employment of trainees; (2) most self employed servicemen do not earn enough to cover the wages of relatively unproductive trainees; and (3) at least half of the domestic electronics servicemen employed in 1974 had left the industry by 1976.

In Victoria, these problems have been recognised for a number of years and several options have been developed to remedy the situation.

In 1983, a common core of electronics was developed for a Certificate of Technology in Electronics and Industrial Electronics. This course consists of some 500 hours study and was registered as the Basic Electronics Certificate (BEC), although the end product is anything but basic.

At Box Hill College, students attend the college for 26 hours per week to study for the Basic Electronics Certificate. This course covers the concepts of DC, AC, components, amplifiers, power supplies, digital and logic applications and microprocessor fundamentals.

A complementary package of maths, communications skills, and electronic drafting is also included.

The students then have four choices available: exit to semi-skilled occupation; continue studies to technician level; seek work experience as Certificate of Technology Cadets; or seek employment and training as an apprentice.

For further information, contact Box Hill College of TAFE, School of Electronics and Technology, 991 Whitehorse Rd, Box Hill, Vic. 3128. Telephone (03) 895 1321.

Go-ahead for Jindalee OTH radar system

Following a recent Cabinet decision, a network of Jindalee over-the-horizon radars are to be incorporated as a basic element of Australia's national air and sea surveillance equipment.

Jindalee was conceived in the mid 1970's after some years of earlier ionospheric investigations. Even with a high priority endorsement, it will not be introduced to service before the mid 1990's, due to the size of the undertaking.

Jindalee uses HF radio transmissions which are reflected from the ionosphere to overcome line of sight limitations of conventional microwave radars. By this means, surface and airborne targets can be tracked at ranges of up to 3,000km.

The success of the project is largely due to the development of complex algorithms to achieve the necessary high performance and automatic detection and tracking capabilities. This makes use of a novel signal processing technique and requires the use of high speed computers which were developed locally for the purpose.

Survey shows stereo AM sales growing

Increasing consumer interest in stereo AM radio receivers and strong sales have been reported by Stereo AM Australia in its September review of the Australian market.

In its latest review of the stereo AM receiver market, Stereo AM Australia (which represents AM stereo broadcasters) reports that there are now some 67 different models currently available in Australia which provide stereo on both the AM and FM bands.

The latest release is Yamaha's T420A Tuner which has a recommended retail price of $394.

Some 25 companies are now marketing stereo AM receivers and most report strong sales, with some unable to satisfy consumer demand. In fact, some companies are now moving to make AM stereo a standard feature in their receiver products.

The swing to AM stereo has been further strengthened by a recent decision by the ABC to convert its most popular stations in each capital city to broadcast in stereo.

New LSI chips for multistandard TV

Toshiba has developed two types of advanced LSI chips to be used for multistandard colour televisions.

There are currently 11 major television standards in use around the world and a conventional TV is compatible with only one of these. The multistandard TVs can receive and decode signals from a variety of transmission standards.

Such multistandard TVs are particularly useful in Europe and the Middle East where different transmission standards (PAL and SECAM) operate in close proximity. The increasing availability of VCR and video disc players has also spurred demand for multistandard colour TV sets.

At present, a multistandard TV might use seven ICs and about 500 peripheral components. Toshiba's two new chips can reduce the number of components to 250. One of the chips — the TA8616N (video-chroma-deflection) — is the world's largest integration of a bipolar device, having some 3,800 elements crammed into a 64-pin package.

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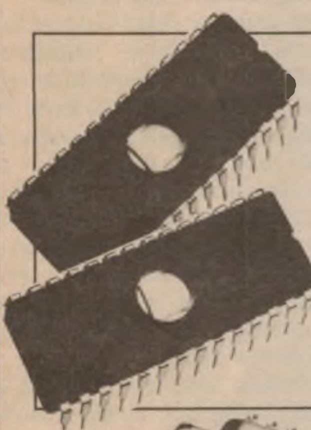

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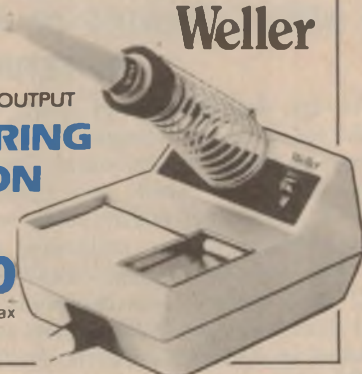

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The big screen at the big match

A colour television screen that's as bright as day and as big as a three storey house. Sounds impressive? Yes, it certainly is but where would you go to see one in action? Easy, just watch one of the Test matches between England and Australia this summer in either Sydney or Melbourne.

by TERRY AYSCOUGH

As any dyed-in-the-wool sports fan could tell you, the whopper television screens at Sydney or Melbourne Cricket Grounds are not exactly new although there is still a great novelty about such a large brilliant display. Melbourne was the first, with their system installed in 1982 while Sydney's was delivered just over three years ago. Both systems were installed by Mitsubishi Electric Australia Pty Ltd.

Mitsubishi call their large screen technology "Diamond Vision", which ties in with their familiar three diamond corporate symbol. By the middle of last year, they had installed more than 50 major systems at sports stadiums and advertising sites around the world.

The largest single screen, which measures 7.3 metres high and 19.6 metres long, is at the Jockey Club racecourse in Hong Kong. More than half the systems sold have gone to the USA, for use in world-famous venues like the Houston Astrodome, the Yankee Stadium in New York and the Dodger Stadium in Los Angeles.

Primary colours

Nearly all the methods used to produce coloured pictures, ranging from an artist with his palette to printing, photography and colour television, are based on the use of a few carefully selected primary colours. These colours, when mixed in just the right proportions, can give our eyes the impression of seeing thousands of subtle shades and hues.

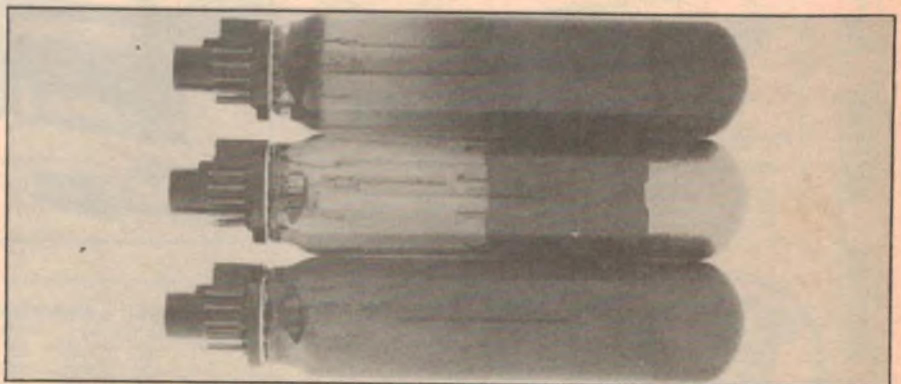
Painting, printing and photography all depend on a subtractive process, where the dyes or pigments absorb the unwanted colours present in white light, leaving only the wanted colours to be reflected. Colour TV sets on the other hand, actually generate very pure red, green and blue light. These colours add together to convince our eye and brain that we are really seeing all the range and variety of colour which is part of our daily experience.

Mitsubishi's Diamond Vision technology, like the domestic colour TV set, also uses red, green and blue primary colours as the building blocks to generate a full colour video display.

Each primary colour is generated by thousands of small, torpedo-shaped cathode ray tubes, as shown in our illustration. The tubes have a fairly normal-looking electron gun and base assembly at one end and a phosphor screen, about the size of a 20-cent piece at the other. Tubes for each of the three different primary colours look very similar when not in operation and it is necessary to check the type number to find out whether they will produce red, green or blue light.

The tubes have no focussing or deflection system and the electron beam is allowed to fan out so it activates the whole phosphor area.

Each tube is about 130mm long from base spigot to screen and the glass envelopes may be either 28 or 35mm in



38,400 of these green, blue and red CRTs are used in the Melbourne and Sydney Cricket Ground TV screens. The tubes are similar to conventional TV picture tubes but do not have focussing electrodes or deflection circuitry.

diameter. The Melbourne screen uses 28mm tubes which operate with 8.5kV DC on the final anode and the Sydney screen uses 35mm tubes which run at 10kV. In both cases, the power consumed is about 2W per tube.

Picture elements

If a part of the picture is to appear bright white, the eye needs light containing all three primary colours, with brightness ratios of about 60% green, 30% red and 10% blue. This means that if the green tubes were running flat out to produce the brightest possible picture, the red tubes would be operating at only half power and the blue tubes would be loafing along at about one sixth full power.

This unequal work load is balanced up by fitting two green tubes for every one red and blue tube. Each picture element or pixel thus consists of two green, one red and one blue primary coloured dot. So each pixel is produced by four tubes.

In the additive colour mixing process, non primary colours such as yellows and golds, result from mixtures of green and red. Maroon or purplish colours are produced by combining red and blue etc. If the weaker pastel shades are needed, white is added to water down or desaturate the colour. A pale blue sky would be reproduced by using some red, green and blue light to make white, but also having some extra light output from the blue tubes, to give the predominant hue required.

To create the illusion of a smooth, detailed image, rather than a screen full of coloured dots, two things are needed. Firstly, there should be as many four-tube elements or pixels as cost and size will allow and secondly, the screen has to be viewed from a minimum distance, which for Diamond Vision is about 50 metres. (Although that does not stop cricket-fans who are near the screen from running down to the boundary fence to have a look at the action replay).

The Sydney and Melbourne video screens are both 7.25 metres high and 10.85 metres wide. Each contains 38400 individual CRTs, which means there are 9600 four-tube pixels.

Creating the image

With a conventional colour TV display, there is only one set of electron beams, so each pixel has to wait its turn to be lit up as the picture is scanned line by line. Pixels in a Diamond Vision display on the other hand, can be turned on to give continuous light output for as long as required. This means they appear to be much brighter, which makes the system ideal for strong sunlight conditions.

The scoreboard in action at the SCG during a match between NSW and Pakistan.

In the video mode, the display drive circuits accept a normal PAL-B colour TV signal. Analog to digital converters are used to provide a 5-bit drive signal for each CRT. This gives 32 different brightness levels in each primary colour, enabling a wide range of hue, saturation and contrast to be reproduced. Latch circuits are used to store the required drive levels and keep the CRTs operating between updates.

The control or address lines for each set of pixel latches can be thought of as a grid of vertical (Y) and horizontal (X) connections. The X lines contain 7 wires, 5 for the 32 level brightness signal and 2 to select the tube combination required. Simultaneous application of signals to the X and Y lines allow individual pixels to be addressed via their latches, just like cells in a ROM or RAM memory chip.

Although the pixels remain lit for as long as necessary, they must also be capable of turning on or off very quickly to reproduce rapid movement across the screen. With Diamond Vision, the maximum pixel address rate is 60 per second and this is more than adequate to avoid any problems with blurring or smear behind fast moving objects in the picture.

Message Board

In addition to the main 7.25 by 10.85 metre video screen, the Sydney installation also has 7.25 metre high by 2.9 metre wide electronic "message board" screens on either side. These are intended for displaying alpha numerical characters and use only green CRTs. Each board has a further 10240 tubes in

The Big Screen

a 160 by 64 matrix and can display 13 rows with 8 characters in each row.

Although the main role of the large centre screen is to display video, it can also act as a multicolour score board and, in conjunction with the message boards, gives a spectacular display almost 19 metres wide.

Melbourne also has message boards at both sides of the main screen, but these are of the more traditional manually operated score board type.

Advertising Panels

The video screen and message boards are flanked on both sides by big Trivision advertising screens. Most people would be familiar with these mechanical systems which are made up of 26 vertical columns, each with an equilateral triangular cross section. Each column is placed close to its neighbour, so the triangle sides all line up to give a large flat surface on which an advertising message is painted.

All 26 columns can be rotated through steps of 120 degrees (one third of a revolution), causing the other two sets of sides to line up and provide additional surfaces for advertisements. When a sporting event is in progress, the columns are rotated periodically, allowing all three advertisements to be viewed. Timing of this rotation is linked in with the other display control software, as we will see later.

Supplementary score board

Those spectators sitting in front of the main screen and message boards risk a dislocated neck if they turn around to check the score, so a small supplementary electro-mechanical board is placed on the opposite side of the ground for their benefit. These boards are locally manufactured by Questec in Sydney and are driven from the main board software via their own small computers.

Why CRTs are used

Some readers may be intrigued by Mitsubishi's decision to use individual colour CRTs for the video screen rather than a simpler alternative, such as incandescent lamps with suitably coloured glass. The main disadvantage of using incandescent lamps is their high power consumption.

To produce the equivalent light output of a 2W colour phosphor CRT, a filament lamp and filter combination could dissipate an average power of nearly 20W. This means that a video screen and message board system like Sydney's, with a total of 58,880 tubes, could have a peak power consumption of over one million watts. If such a system was ever built, the heat generated would certainly make it a candidate for the title of World's Largest Toaster.

The slow response times of incandescent lamps as they turn on and off would also cause serious smearing problems in a video display, whenever rapid movement occurred on the screen.

Structural details

The complete Diamond Vision main screen and message board system is manufactured in Japan. It breaks down into 6 units, each about the size of a cargo container for shipping. On site, these units are re-assembled, three high and two wide, giving a structure measuring 9.3 metres high, 19 metres wide, 2.5 metres deep and weighing 60 tonnes. Hence, our earlier comparison to a three storey house.

Behind the screen there are fully enclosed galleries at three levels, plus internal inter-connecting ladders to provide full access for service. Twelve cooling fans draw in air from outside to keep operating temperatures down.

The video and message board screens are both made up from sub-assemblies, each about the size of two copies of EA laid side by side. Each assembly carries 32 CRTs in an 8-by-4 arrangement, plus control circuitry and two EHT generators (for the high voltage supplies). Connectors provide 24V DC, 40V AC and the XY and brightness drives men-

Part of the control room at the SCG showing the producer's desk.

tioned earlier.

Display contrast in bright sunlight is maximised by using a matt black background and by providing each CRT with an individual hood, rather like the shields used on traffic lights.

Operating power of up to 200KVA comes from a 415V, 3-phase mains supply. An automatic alarm system keeps watch on display performance plus power supply currents, and temperatures. If a problem develops, a warning flashes on a VDU screen in the control room.

Production facilities

Program material for the large video screen and message boards is provided by a mixture of data input and video production facilities.

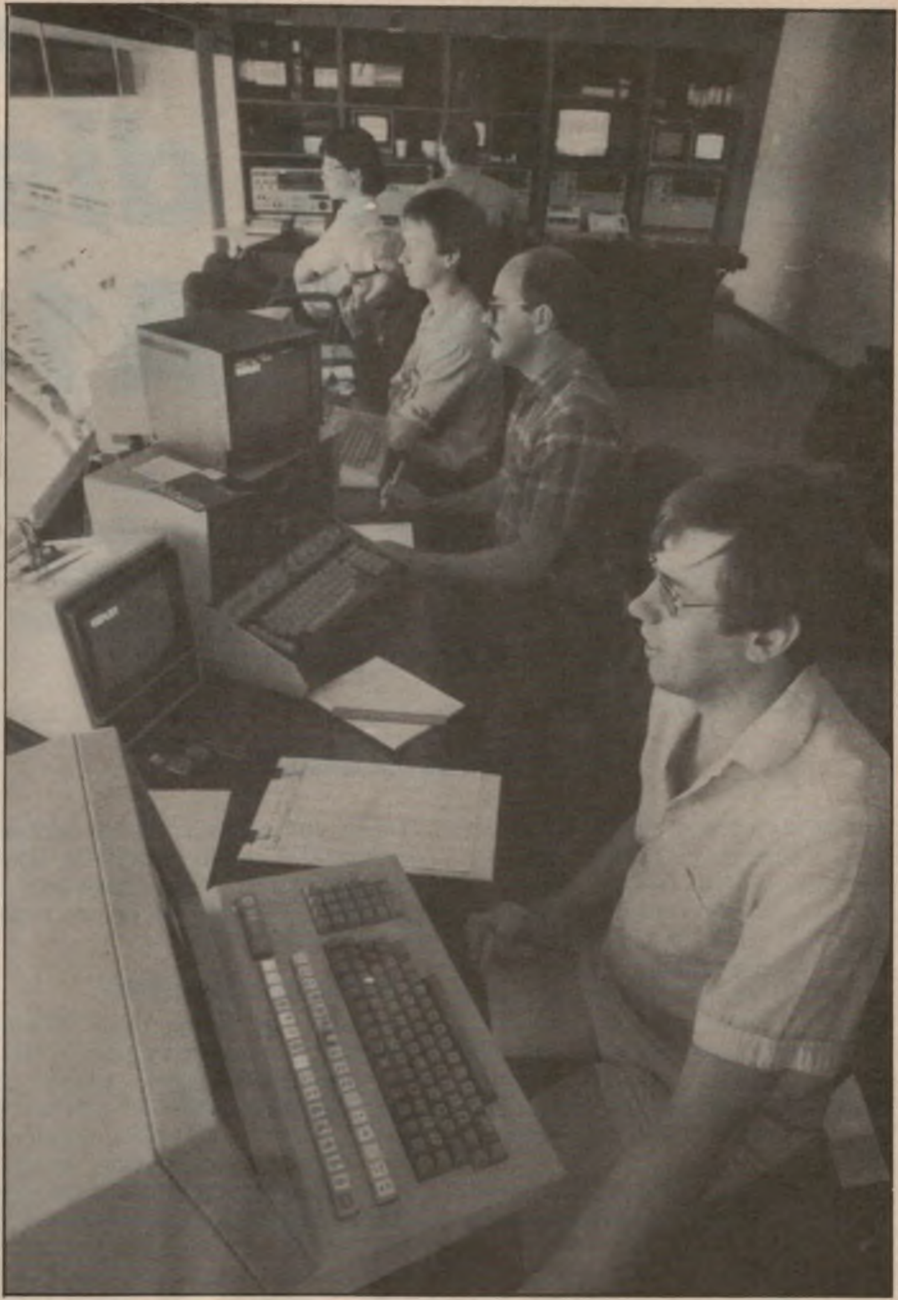
On the video side, the Sydney operation has quite an impressive list of equipment. This includes four 3/4-inch Sony videotape recorders, two of which incorporate special slow motion facilities. Action on the field is captured by two Thompson CSF colour cameras and there is a Quantafont video character generator to provide graphics and on-screen messages. Interestingly, many of the graphics, like the little duck so dreaded by batsmen, are video rather than computer-generated.

Highlights and incidents in the game can be replayed on the main video screen in slow-motion or freeze-frame almost immediately after they have occurred. This facility has occasionally resulted in the crowd advising umpires or referees that a visit to their opticians may be needed.

A crew of six comprising director, cameraman, statistician, scorer, tape operator and technician are employed for most events, but an extra cameraman is sometimes added for bigger events such as grand finals.

The video screen, message boards and supplementary score-board are all controlled via Mitsubishi Melmus-11 computers. There are two VDU/keyboard terminals in the control room which are used to operate and provide alphanumeric inputs for the board.

In the scoreboard mode, the video screen can handle three sizes of characters, whch may be fixed or scrolling. As well as standard scoreboard formats for cricket and the various football codes, interesting match statistics and results from outside sporting events, such as horse racing, can be shown.



Another view of the control room at the SCG showing the graphics production facilities and, in the background, the video tape recorders.

Software

In addition to providing full control and alarm facilities, the system's software also takes care of scoring for Test and one-day cricket matches plus Australian Rules Football, Rugby League and Union matches. The original software was written in Japan and Mitsubishi Australia had the difficult task of explaining the intricacies of cricket and Aussie Rules to a programmer who had probably never seen either game played.

Nevertheless, the software incorporates lots of subtleties. For example, the Trivision advertising boards mentioned earlier, cycle continuously during football matches, but for cricket they are only activated when the operator inputs a change of bowler at the end of each over.

Running Repairs

Mitsubishi say the expected life of each CRT is 6000 to 8000 hours, which is the equivalent of 330 days continuous operation. Unfortunately, one of the main reasons for tube failure is breakage, caused by vandals throwing stones at the screens. When CRTs fail, a complete 4-by-8 tube module is pulled out and replaced from the back. This operation only takes about two minutes, so the display can be kept "up and running" throughout an important event.

Managing the information overload . . .

Cockpit displays in the F/A18

Flying Australia's new F/A18 fighter is like operating a personal computer at twice the speed of sound. To help the pilot, the cockpit features high-tech electronic displays based on a surprisingly old-fashioned technology — cathode ray tubes.

by TERRY AYSCOUGH

Most readers will either have visited or seen pictures of the flight deck of a modern commercial aircraft. Directly in front of the pilots there is usually a group of large, circular instruments which give basic flying information such as airspeed, altitude, height, etc. A long control console between the pilots' seats, plus panels on either side and overhead, contain a vast array of instruments, lights and switches which monitor and control the hundreds of onboard systems.

In a commercial aircraft there is usually a crew of two or three people to monitor and interpret all the information provided and to manage the many systems. Even so, at busy times such as take off and landing, it can be a demanding task.

Information overload

Imagine how much more difficult everything must be for the pilot of modern multi-mission fighter aircraft. A fighter has many additional systems for locating targets, controlling weapons and detecting and evading threats. There will be frequent and sometimes unplanned changes to height, direction and speed. Usually there is only one person to handle the entire workload and when over hostile territory, the outside world will be doing all it can to prevent, rather than help, the pilot complete his mission.

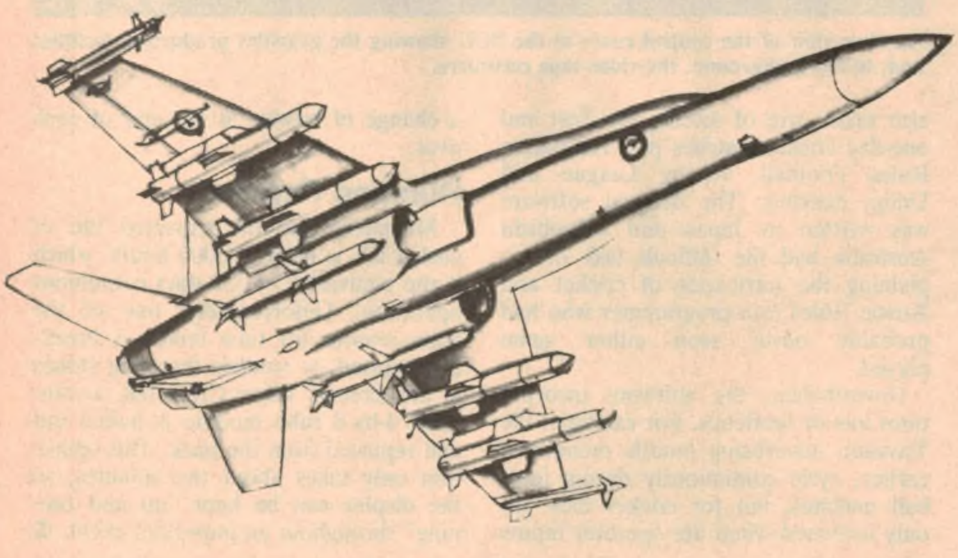
Obviously, the hard-pressed fighter pilot needs as much help as he can get from advanced avionic systems. In addition, it is not going to be possible to cram a vast amount of instrumentation into a small cockpit and an easily read, multi-purpose display system is required.

The answer is provided not by some super hi-tech device just out of the laboratory, but by using good old-fashioned cathode ray tubes (CRTs) in conjunction with powerful microprocessor systems.

CRT displays

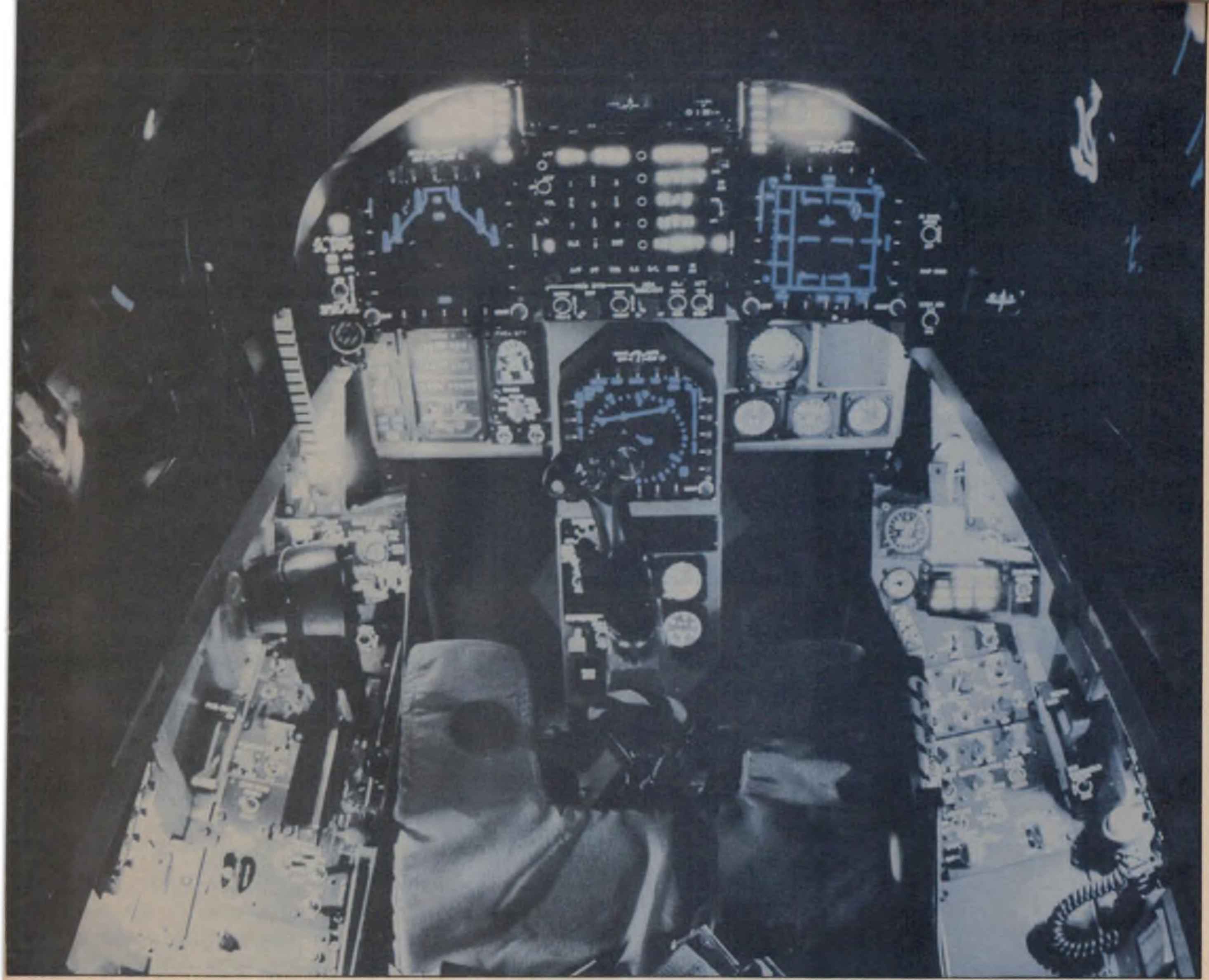
Normally, three or four separate CRTs are used in fighter aircraft to provide a mixture of directly viewed and projected displays. Each CRT can replace different data as required. Alternatively, a composite display can be generated, which shows several pieces of information in an easily assimilated form at the same time.

Systems of this type have great flexibility. Television type scanning can be used to present high-definition visual images from infrared sensors, etc. Modifications to cater for different mission requirements or new weapons and equipment can be made without the need for extensive changes to cockpit hardware and the CRTs act as back-ups for each other in case of failure or damage.



The F/A18 Hornet

Fig.1 shows part of the cockpit, or 'advanced digital crew station' as it is officially called, in Australia's new F/A18 Hornet fighter. The instrument



panel in front of the pilot is dominated by four CRT displays.

At the top and forming part of the canopy through which the pilot looks forward, is the head-up display (HUD). It is given this name because visual images are projected from below and appear superimposed on the view ahead of the aircraft, so the pilot need not look down to read the information. The HUD is the primary display system for flight information and visual air-to-air and air-to-surface weapons delivery.

Below the HUD to left and right are two similar head-down 'multifunction display generator' (MDG) screens. These use small directly viewed CRTs, with square faces.

The fourth and lowest screen is called the horizontal situation display. It can show maps projected from 35mm film or high resolution radar images of the ground below, for navigation or attack purposes.

A few conventional round instruments are tucked away on the lower right hand side of the panel. These provide a get-home capability if the electronics system should be put out of action by severe battle damage.

Now let us have a more detailed look at each display system in turn.

Head-up display

The principle of the F/A18 HUD is shown in Fig.2.

Very bright yellow-green images are

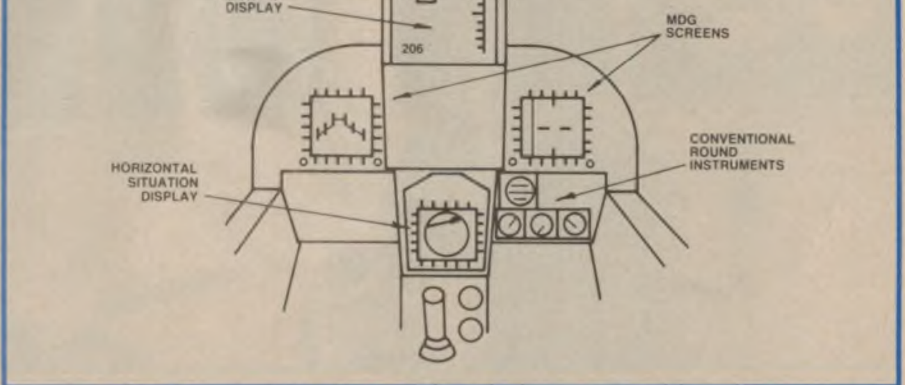


Fig.1: CRT displays in the F/A18 Hornet's cockpit.

F/A18 cockpit displays

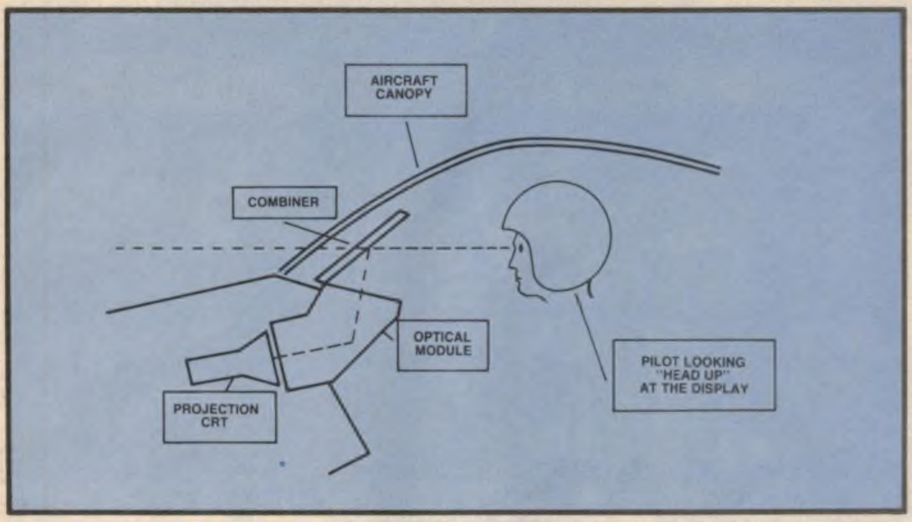


Fig.2: main components in a head-up display (HUD).

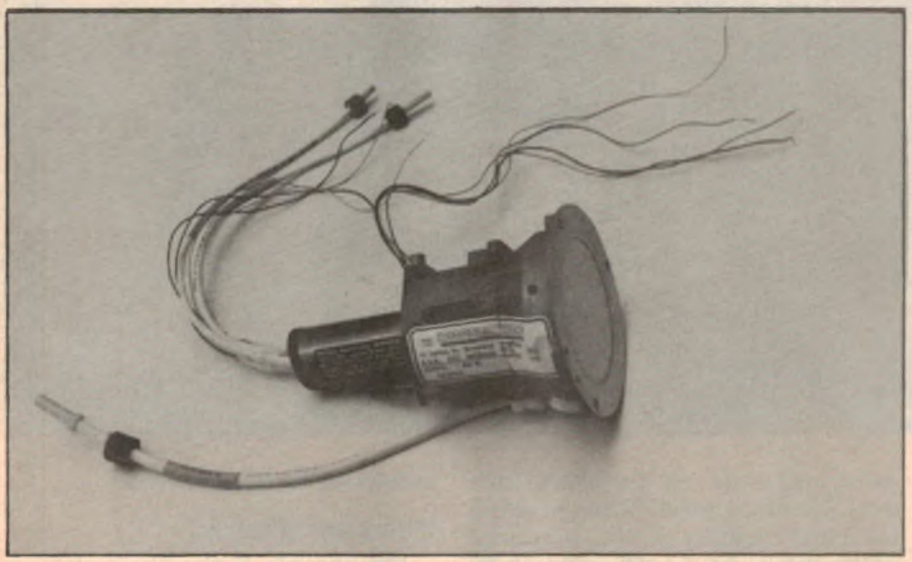


Fig.3: a HUD projection CRT manufactured in Australia. (Courtesy Thomas Electronics).

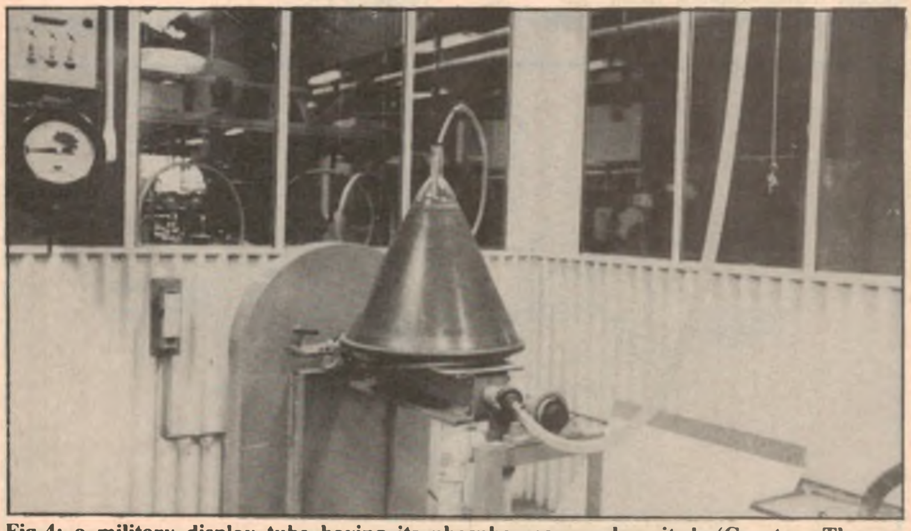


Fig.4: a military display tube having its phosphor screen deposited. (Courtesy Thomas Electronics).

produced by a special projection CRT. Light from the CRT screen passes through a set of fairly complex collimating lenses which make the rays parallel to each other so they appear to be focussed at infinity. When he looks through the windshield, the pilot's vision will normally be concentrated on objects some distance ahead of the aircraft, so his eyes will also be focussed close to infinity.

After passing through the optical system, the collimated images fall onto a combiner as shown in Fig.2. This is a very special optical device which, at first sight, appears to be an ordinary transparent piece of glass. In fact, it acts as a selective mirror and reflects light with wavelengths corresponding to yellow/green (approx 5250 Angstroms) so that the image from the CRT is directed towards the pilot's eyes. All other wavelengths of visible light pass straight through the combiner without much reflection or attenuation, so when the pilot looks ahead he sees a fairly normal view of the world outside, with green diagrams and data superimposed on it.

While avionic CRTs work on the same principles as those used in TV sets and VDUs, the tough operational environment in a modern high performance military aircraft obviously requires them to have many special electrical and mechanical characteristics.

The projection CRT used in the F/A18 HUD, is magnetically deflected, has a 22mm diameter neck, an 80mm (3.1-inch) circular screen and operates with a final anode voltage of 20kV. It has a medium persistence P1 phosphor similar to those used in many oscilloscope tubes.

High CRT screen brightness levels of around 13,000 foot-Lamberts are required, as a lot of light is lost in the complex optical system and the final image seen by the pilot must remain clearly visible, even when the aircraft is operating in bright sunlight. Phosphors loose their efficiency as they heat up due to heavy beam current being concentrated in small areas of the screen, and projection tubes often have liquid or air cooled face plates to keep temperatures down. In this case, however, the system is kept as simple as possible and cooling relies on normal conduction through the faceplate glass and surrounding metalwork.

HUD tubes use specially designed gun assemblies and envelopes to increase their mechanical ruggedness. Before being approved for service, they must survive severe vibration testing and shocks to 15g.

F/A18 cockpit displays

Multipurpose displays

The two F/A18 MDG head-down displays also use magnetically deflected 22mm neck CRTs operated at 20kV. Because these are directly viewed, rather than projection tubes, they have 130mm (5-inch) square screens. A green P43 medium persistence phosphor is used and each tube gives a peak brightness of 3000 foot-Lamberts. Mechanical vibration and shock requirements are the same as for HUD tubes.

Each MDG screen is viewed through a bandpass optical filter. Light emitted from the P43 phosphor closely matches the filter passband and only has to pass through once on its way to the pilot's eyes, so its brightness is only slightly reduced. Ambient light from outside must pass through the filter, be reflected from the CRT face and then pass back out through the filter again.

Colours outside the filter passband are almost completely absorbed by this double journey, while green in the ambient light is considerably attenuated. As a result, contrast between illuminated and unlit screen areas is greatly enhanced, giving good display visibility, even when intense sunlight is shining through the cockpit canopy.

As well as displaying data and graphics, the MDG system has a video capability and can handle 511, 525, 675 and 875-line raster-scanned pictures. This allows images from infrared sensors for nightime target identification or TV guided weapons to be viewed.

Horizontal situation display

The fourth and lowest screen shown in Fig.1 takes the place of the map board which, in more leisurely days, used to rest on the pilot's knees. As well as back-projected maps, it can also display high definition images from an 80mm (3-inch) CRT similar to the one used in the HUD.

A Hughes APG675 multimode pulse Doppler radar, mounted in the nose, gives a high resolution ground map which can be sharpened to pinpoint any small areas of special interest. The APG65 also provides terrain advoidance information during low flying, as well as precision speed measurements which are necessary for accurate weapons delivery.

Other avionics

A few other details about the F/A18's avionics may be of interest.

A quadruplex digital control system is used to fly the aircraft. This has two independent computer systems which monitor and control all basic flight parameters. McDonnell Douglas, the aircraft manufacturers, claim the system improves aircraft handling qualities and offers better redundancy and safety. If all else fails, however, there is a mechanical back-up.

We have already mentioned the major contribution to navigation made by the APG65 radar. In addition, it can be used to track moving targets in the air and on land or sea, to track and scan at the same time, to provide automatic acquisition and lock on for air to air combat, or to illuminate targets for radar guided missiles. Its range enables targets or threats which are beyond visual range to be engaged in all weather conditions.

Whenever an external radar system illuminates the aircraft the pilot is alerted and its location is shown on one of the displays. Built in active electronic counter measures and devices deployed from dispensers can distract or jam threats from air or ground.

The capabilities of a standard aircraft can be extended by fitting external pods carrying special sensors and other instrumentation below the fuselage. These include a Forward Looking Infra Red sensor (FLIR) package which works in conjunction with the MDG to provide detailed nightime images of the ground below the aircraft or visual identification of objects such as ships at sea. Another pod contains a Laser Detector Tracker (LDT) system which enables the aircraft to lock on to and home in on laser illuminated targets.

With such complex systems, reliability is obviously of great importance. Particular attention has been paid to keeping component counts down and, as an example, the APG65 radar has 8000 less parts than a similar system used in the F4 fighter. When things do need checking, adjusting or fixing, there are 307 access doors and over 90% of these can be reached from ground level.

Local involvement

The complete HUD, MDG and horizontal situation indicator system for the F/A18 are supplied to McDonnell Douglas by Kaiser Electronics, of San Jose, California. Thomas Electronics of Wayne, New Jersey supply the specialised CRTs to Kaiser.

Thomas Electronics of Australia has been well known as a supplier of new and rebuilt CRTs for both industrial and domestic applications since the mid 1950s. Although they are fully Australian owned, Thomas has a long standing association with its American counterpart and this has enabled them to become involved in offset arrangements which were part of the F/A18 deal. They were also assisted by the Industry Development Branch of our own Department of Defence.

As a result, HUD projection tubes and MDG direct view tubes have been manufactured at the Thomas factory in Riverwood, NSW. Samples of both types were recently sent to the USA for rigorous testing and the MDG tubes have already received full approval. This means they can be fitted in new aircraft sold anywhere in the world, including the USA, or used as service replacements. A Thomas HUD tube, complete with its robust shield, is shown in Fig.3.

One of the trickiest operations necessary to meet the tough performance specifications set for military CRTs is the laying of a very uniform layer of screen phosphor. Thomas has been building radar and other display tubes for the RAAF and RAN for some years however and now has plenty of experience in this area. Fig.4 shows a metal cone radar tube going through part of the screen laying process at Riverwood.

With the present emphasis on reviving our manufacturing industry, it is good to know that key components for one of the worlds most advanced avionics systems are being produced by an all-Australian company.

Acknowledgement

This article was based on information kindly supplied by Thomas Electronics of Australia Ltd.

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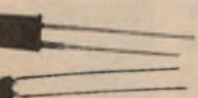

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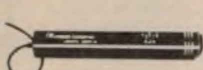

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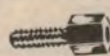

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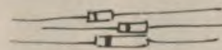

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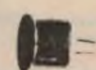


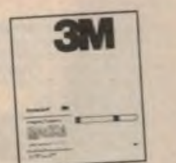
ELECTRET MIC INSERTS
With pins for easy board insertion.
Cat. C10170

1-9	10+	100+
$2.50	$2.25	$2.00

CRYSTAL LOCKED WIRELESS MICROPHONE AND RECIEVER
MICROPHONE SPECIFICATIONS:
Transmitting Frequency: 37.1MHz
Transmitting System: crystal oscillation
Microphone: Electret condenser
Power Supply: 9V battery
Range: 300 feet in open field
Dimensions: 185 x 27 x 38mm
Weight: 160 grams
RECIEVER SPECIFICATIONS:
Recieving Freq: 37.1MHz
Output Level: 30mV (maximum)
Recieving System: Super heterodyne crystal oscillation
Power Supply: 9V Battery or 9V DC power adapter
Volume control
Tuning LED
Dimensions: 115 x 32 x 44mm
Weight: 220 grams
Cat. A10452 R.R.P. $113
Our price, $99

DIGITAL SPEEDO/ DIGITAL TACHO/ SPEED ALERT
- Digital readout (LED) for both tacho and speedo
- Alarm with sound at variable preset speed
- Audible beeper and visual indicator
- In built light indicator for night illumination
- Designed for 12 volt negative earth electrical systems
- Speedo: 0 - 199kph
- Tachometer: 0 - 9900kph
- Speed alert: 40 - 120kph
- Complete with mounting hardware

Cat. A15064 R.R.P. $89.95
OUR PRICE $74.95



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8016 BLUE/WHITE	
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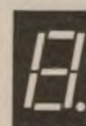
300 x 600mm	$74.95
8018 GREEN/WHITE	
250 x 300mm	$64.95
300 x 600mm	$74.95



½" HIGH INTENSITY RED LED DISPLAYS
(Available in Common Cathode and Common Anode)
Dimensions:
Overall: 12.7mm across, 19mm high
Display: 12.7mm(H) x 7.3mm(W)
Segment Width: 1.2mm
Brightness: 3400 ucd. I_F = 10mA

COMMON CATHODE:
Pin 1 Segment E — Pin 6 Segment B
Pin 2 Segment D — Pin 7 Segment A
Pin 3 CC — Pin 8 CC
Pin 4 Segment C — Pin 9 Segment F
Pin 5 Segment Dp — Pin 10 Segment G

Cat No.	1-9	10+
Z10190	$1.95	$1.75

COMMON ANODE:
Pin 1 Segment E — Pin 6 Segment B
Pin 2 Segment D — Pin 7 Segment A
Pin 3 CA — Pin 8 CA
Pin 4 Segment C — Pin 9 Segment F
Pin 5 Segment Dp — Pin 10 Segment G

Cat No.	1-9	10+
Z10191	$1.95	$1.75

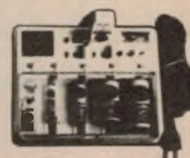
HIGH INTENSITY RED LED BAR GRAPH
Dimensions:
Overall: 63mm across, 5mm high
LEDs: 10 x 5mm x 1mm

Cat No.	1-9	10+
Z10180	$2.95	$2.75

HIGH INTENSITY ALPHANUMERIC RED DISPLAY
Interlockable 2" display module with 35 high intensity 5mm pixels per module allowing vast scope for custom displays.
Brightness: 3000 ucd. I_F = 10mA

PIN 1 Row 5A — PIN 8 Row 3A
PIN 2 Row 7A — PIN 9 Row 1A
PIN 3 Col. 2C — PIN 10 Col. 4C
PIN 4 Col. 3C — PIN 11 Col. 3C
PIN 5 Row 4A — PIN 12 Row 4A
PIN 6 Col. 5C — PIN 13 Col. 1C
PIN 7 Row 6A — PIN 14 Row 2A

Cat No.	1-9	10+
Z10196	$7.95	$6.95



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 **$29.95**

RECHARGEABLE 12V GELL BATTERIES
Leakproof and in 3 convenient sizes, these long service life batteries are ideal for burgular systems, emergency lighting or as a computer backup power supply. Ideal for many power needs.

Cat. S15029 12V 1.2 AH	$17.50
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Errors and omissions excepted

*Apple and IBM are registered trade names

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HUNG CHANG (RITRON) 20 MHz DUAL TRACE OSCILLOSCOPE

- Wide bandwidth and high sensitivity
- Internal graticule rectangular bright CRT
- Built in component tester
- Front panel trace rotater
- TV video sync filter
- Z axis (Intensity modulation)
- High sensitivity X-Y mode
- Very low power consumption
- Regulated power supply circuit

COMPONENT TESTER is the special circuit with which a single component or components in circuit can be easily tested. The display shows faults of components, size of a component value, and characteristics of components. This feature is ideal to troubleshoot solid state circuits and components with no circuit power. Testing signal (AC Max 2 mA) is supplied from the COMPONENT TEST IN terminal and the result of the test is fed back to the scope through the same test lead wire at the same time.

CRT
CRT: 6" (150mm) Flat-faced high brightness CRT with Internal Graticule
Effective display area: 8 x 10 div (1 div = 10 mm)
Acceleration potential: 2KV

VERTICAL
Operating Modes: CH-A, CH-B, DUAL, ADD (CH-B can be inverted.)
Dual modes: Alter; 0.2uls - 0.5ms/div Chop; 1ms - 0.5s/div
CHOP frequency 200KHz approximately
Deflection factor: 5mV/div 20V/div +/−3%, 12 ranges in 1-2-5 step with fine control
Bandwidth: DC: DC - 20MHz (−3dB) AC: 10Hz - 20MHz −3dB)
Rise Time: Less than 17ns
Overshoot: Less than 3%
Input Impedance: 1M ohm +/−5%, 20pF +/−3pF
Maximum Input Voltage: 600Vp-p or 300V (DC+AC Peak)
Channel Isolation: Better than 60 dB at 1KHz

HORIZONTAL
Sweep Modes: NORMAL, and AUTO
Time Base: 0.2ufs - 0.5s/div +/−3% 20 ranges in 1-2-5 step with fine control
Sweep Magnifier: 5 times (5X MAG)
Linearity: 3%

TRIGGERING
Sensitivity: INTERNAL: 1 div or better for 20Hz - 20MHz (Triggerable to more than 30MHz) EXTERNAL: 1Vp-p or better for DC - 20MHz (Triggerable to more than 30MHz)
Source: INT, CH-A, CH-B, LINE and EXT
Slope: Positive and Negative, continuosly variable with level control PULL AUTO for free-run
Coupling: AC, HF-REJ and TV. TV SYNC Vertical and Horizontal Sync Separator Circuitry allows any portion of complex TV video waveform to be synchronized and expanded for viewing TV-H (Line) and TV-V (Frame) are switched automatically by SWEEP TIME/DIV switch
TV-V:0.5s/div to 0.1ms/div TV-H 50ufs/div to 0.2ufs/div

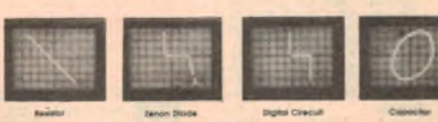
X-Y OPERATIONS
X-Y Operations: CH-A: Y axis. CH-B: X axis Highest Sensitivity 5mV/div

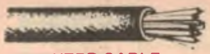
COMPONENT TESTER
Component Tester: Max AC 9V at the terminal with no load. Max current 2mA when the terminal is shorted. (Internal resistance is 4.7K ohm)

OTHER SPECIFICATIONS
Intensity Modulation: TTL LEVEL (3Vp-p), Positive ... brighter
BANDWIDTH: DC - 1MHz MAXIMUM INPUT VOLTAGE: 50V (DC+AC Peak)
Calibration Voltage: 0.5Vp-p +/−5%, 1KHz +/−5% Square wave
Trace Rotation: Electrically adjustable on the front panel
Power Requirements: AC; 100, 120, 220, 240V 20W
Weight: 7kg approximately
Size: 162(H) x 294(W) x 352(D)mm

Cat. Q12105 .... **only $849**
(tax exempt only *$695*)

Bulk orders, schools, please phone (03) 543 2166 for special low pricing



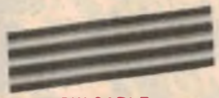


COMPUTER CABLE
CIC6 6 conductor computer interface cable. Colour coded with braided shield (to IE422 specifications) Copper conductor 6 x 7/0.16mm
1-9 metres **$1.90/m** 10+ metres **$1.70/m**

CIC9 100 9 conductor computer interface cable. Colour coded with mylar shielding. 9 x 7/0.16mm
1-9 metres **$2.50/m** 10+ metres **$1.95/m**

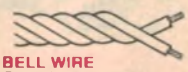
CIC12 12 conductor computer interface cable. Colour coded with mylar shielding. 12 x 7/0.16mm
1-9 metres **$2.70/m** 10+ metres **$2.50/m**

CIC16 16 conductor computer interface cable. Colour coded with mylar shielding. 16 x 7/0.16mm
1-9 metres **$3.90/m** 10+ metres **$3.40/m**



RAINBOW CABLE
Suitable for IDC connectors

Cat.No.	Description	$/metre
W12714	28AWG 14W	$1.80
W12716	28AWG 16W	$1.80
W12720	28AWG 20W	$2.20
W12726	28AWG 26W	$2.90
W12734	28AWG 34W	$3.60
W12740	28AWG 40W	$4.40



BELL WIRE
Red and white twisted
Conductors: 2 x 1 strand 0.17mm
Sheath O.D. 2 x 1.35mm
Cat. W
1-9 rolls **$19.00/m** 10+ rolls **$17.50/m**

BULK CABLE 100M ROLLS

Cat. W11222 3C2V 75 OHM	$22
Cat. W11224 5C2V 75 OHM	$35
Cat. W11219 4 Core Shielded	$49

PORTABLE MINI P.A. AMPLIFIER
A completely portable system, sets up anywhere in seconds. Inputs for microphone, electronic organ and cassette players. Variable echo makes this an ideal unit for buskers and budding singers.
SPECIFICATIONS:
Output power: 1W RMS, 2W max.
Frequency Response: 100-15kHz
Speaker: 5" full range, 4 ohms
Echo Time: Variable 5-52m/sec
Power Source: 6 x "D" size batteries (position for power adaptor also)
Size: 280(H) x 120(W) x 180(D)mm
Weight: 1.3kg
Cat. A12022 **$89.95**

MINI HAND HELD MEGAPHONE
Suitable for schools, sports meetings, boats, etc. Portable, lightweight and effective with anti howling dynamic microphone. High power output, low power consumption.
SPECIFICATIONS
Size: 150mm diameter
Power output: 2/4 watt maximum
Effective Distance: 120 metres
Power source: 6 x "AA" batteries
Power duration: 6 hours
Weight: 0.6kg
Cat. A ????? **$69.95**

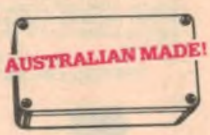
SCOPE 60W SOLDERING SYSTEM
- Infinitely adjustable temp. 200 C to 470 C. Sliding control selects desired tip temperature (LED readout monitors tip temp.)
- Safety holder features ceramic burn-proof bush and can be converted to left-hand-side
- Soft and cool hand grip in pliable rubber
- Screw type connector 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

RITRON 19" RACK CASE
Tremendous Value! Dimensions 480(W) x 134(H) x 250(D)mm
Cat. H10415 ...... **Normally $47.95**
SPECIAL, ONLY $42.95

CORDLESS RECHARGEABLE SOLDERING IRON
- Built in solder point illumination
- Easy replacement of solder tip
- Protective stand which also functions as charging unit
- Sponge pad attach to stand
- Plug pack power adaptor
- Includes Nicad battery
- Instruction manual
- 12 months warranty

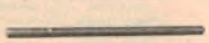
Cat. T12480 ...... Normally $79.95
SPECIAL, $69.95



DIECAST BOXES
Diecast boxes are excellent for RF shielding, and strength
Screws are provided with each box.

H11451 100 x 50 x 25mm	$ 5.95
H11452 110 x 60 x 30mm	$ 6.50
H11453 120 x 65 x 40mm	$ 6.95
H11461 120 x 94 x 53mm	$11.50
H11462 188 x 120 x 78mm	$13.50
H11464 188 x 188 x 64mm	$29.50

ECONOMY MINI STEREO HEADPHONE
Light and comfortable, low budget stereo sound with 3.5mm plug!
Cat. C14000 ...... **$5.95**



FERRITE AERIAL ROD
200mm x 9mm
Cat. L11401 ...... **Normally $2.75**
SPECIAL, ONLY $1.50

POT CORES

FX2242 Assembly 2 halves, 36mm diameter L12100	$9.95
Former to suit FX2242 L12101	$0.95
FX2243 Assembly 2 halves, 24mm diameter L12110	$9.95
Former to suit FX2243 L12111	$1.00
E Core, 2 halves L12115	$8.95
Former to suit E Core L12116	$4.95
Complete E Core assembly (including and plates and bolts) L12117	$16.95

UNPROTECTED HEADERS
Dual in Line 2.54mm

	1-9	10+
10 Way Cat. P12240	$1.95	$1.75
16 Way Cat. P12246	$2.95	$2.65
20 Way Cat. P12250	$3.25	$2.95
26 Way Cat. P12256	$3.75	$3.40
30 Way Cat. P12260	$3.95	$3.55
34 Way Cat. P12264	$4.95	$4.50
40 Way Cat. P12270	$5.25	$4.75
50 Way Cat. P12275	$5.95	$5.35

RELAY AND BASE
Can carry 10A at 28V DC or 5A at 240V AC. Supplies with Chassis Mounting Socket with screw terminals. Great for school projects and demonstrations, switching DC power supplies, central circuits and with contacts parallel up to 20A can be switched.
Cat. S14074 ...... **$8.95**

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**

DB CONNECTORS

Cat. No.	Description	Price
P10880	DE9P Male	$1.95
P10881	DE9S Female	$2.25
P10882	DE9C Cover	$1.20
P10884	DE9P R.A. Plug	$3.65
P10885	DE9S R.A. Skt	$4.25
P10890	DA15P Male	$2.10
P10891	DA15S Female	$2.25
P10892	DA15C Cover	$1.25
P10894	DA15P R.A. Plug	$4.25
P10895	DA15S R.A. Skt	$5.00
P10900	DB25P Male	$2.75
P10901	DB25S Female	$2.95
P10902	DB25C Cover	$1.25
P10904	DB25P R.A. Plug	$4.50
P10905	DB25S R.A. Skt	$5.95

3½ DIGIT ECONOMY LCD DPM 50
- **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 - 50-C
Supply Voltage: 5 - 15V DC
Supply Current: 200uA typical
Max DC Input Voltage: + −20V
Cat. Q15513 ...... **$79.95**

ECONOMY 4 CHANNEL MICROPHONE MIXER (MM1)
Its size and simplicity makes this mixer very portable and easy to operate.
SPECIFICATIONS:
- 4 low impedance 600 ohm microphone inputs
- Individual gain control for each microphone
- Master volume control
- Power on LED
- Inputs/Outputs - 6.3mm mono sockets
- DC operated (9V battery only)
- Input impedance 600 ohm
- Output impedance 1.5kohm
- Signal/noise ratio 55dB
- Frequency response 20Hz to 20kHz plus or minus 2dB
- Weight 320 grams
- Dimension 148 x 46 x 86mm
- Torque variable range 1-22dB
- Input sensitivity 1mV
- Output level 90mV (at input 5mV)
- T.H.D. 0.01%

Cat. A12001 ...... **$44.95**

MAGNETIC BULK ERASER
The best and by far the quickest way to erase tapes, cassettes and computer disks! Reduces noise levels below recorders own erase head level. On/Off switch located in handle 240V AC operation.
Cat. C14950 ...... **Normally $34.95**
SPECIAL, ONLY $29.95

ULTRASONIC TRANSDUCERS
Designed to transmit at 40kHz (L19990) and receive at 40kHz (L19991) with up to 20V I/P on the transmitter. These units can't be heard and so are ideal for TV remote controls, water level detectors, burglar alarms, motion detectors and information carriers as they can be either pulsed or used in the continuous wave mode.
Full specifications below for design purposes.
Maximum Input Voltage: 20V rms
Centre Frequency (kHz): 40 + −1.0
Sound Pressure Level 10V RMS: 110dB min.
Sensitivity (dB/v/ubar) min.: −65 min.
Bandwidth (kHz):
Transmit 4.0 (at 100dB)
Receiver 5.0 (at −73dB)
Impedance:
Transmit 500
Receiver 5000
Cat. L19990 (Transmitter) **$4.75**
Cat. L19991 (Receiver) **$4.75**

UHF remote switch for burglar alarms

Fancy a remote-controlled burglar alarm? It can be done. This handy remote control lets you switch your car burglar alarm on and off by simply pressing the button on a handheld UHF transmitter unit. You can also use the device to eliminate the wiring between a house alarm and its sensors.

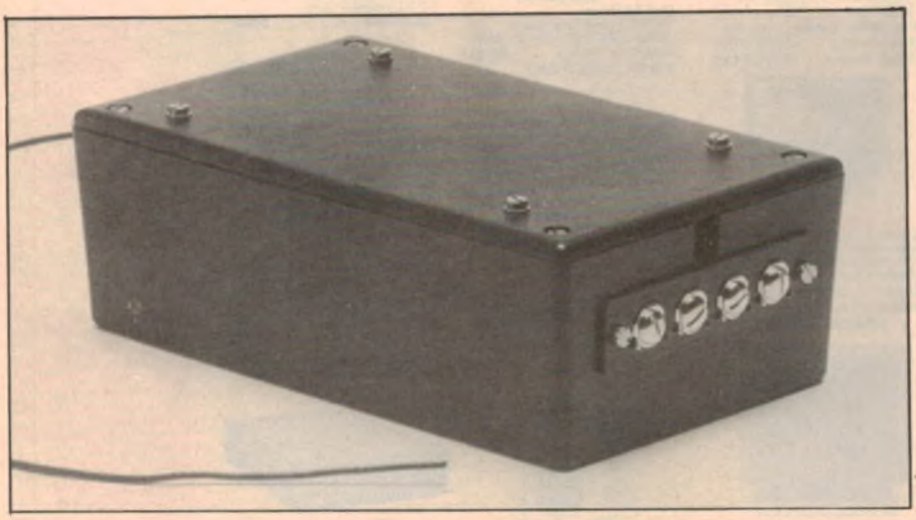
by BRANCO JUSTIC

This easy-to-build unit provides remote control of your car alarm, house alarm and other emergency electronic aids. It operates in the ultra high frequency (UHF) portion of the spectrum and you can select your own "key" combination from about 13,000 possible codes.

That's a lot more than from existing mechanical locks!

The unit is relatively simple to construct because there are no specialised RF coils to be wound. They are all included in the PCB pattern. Furthermore, the unit is easy to install since in its simplest form only three connections are necessary to wire it into an existing system.

Basically, this device lets you switch your car's burglar alarm on and off from outside the vehicle. No longer do you have to fumble about for the key, or worry about such things as hidden switches or exit and entry delays. Complete external control means that all sensors can now be wired to instant-trip inputs, a factor that will greatly improve security.



The receiver is housed in a plastic utility case and fitted with a short antenna.

The transmitter is virtually the same as those used with expensive commercial car alarm outfits. It fits into a small pocket-size plastic case. There is only one control — a pushbutton switch. Press the button once and the alarm switches on; press it again and the alarm switches off.

At the receiver end, the transmitted signal is decoded and used to drive a number of outputs. As well as switching the alarm on or off, these outputs also drive audible indicators and optional external relays.

Audible indicator

Many commercial units require extensive wiring in order to connect them to the vehicle's electrical system. The blinker, horn and hazard light circuits are usually wired to these units. This is often just too much of a hassle for the average hobbyist.

To simplify installation, this unit features an integral on/off audible indicator output. When connected to a loudspeaker or piezo transducer, this will give a short beep at switch on and a longer beep at switch off. This replaces the hazard flasher and horn function frequently used for on/off indication in commercial units.

However, you can wire up the horn or hazard flashers if you wish. This involves adding an external relay board to the circuit. More on this later.

House alarms

In addition to its obvious application in car burglar alarms, you can also use the UHF remote switch to control your house alarm. Another option is to use it to eliminate the extensive wiring normally required between the control box and the various sensors.

The result: a wireless alarm system just like those fancy commercial systems. All you have to do is build multiple transmitter units and connect them

Press the button once and the alarm turns on; press it again and the alarm turns off. You can buy the transmitter case from Dick Smith Electronics.

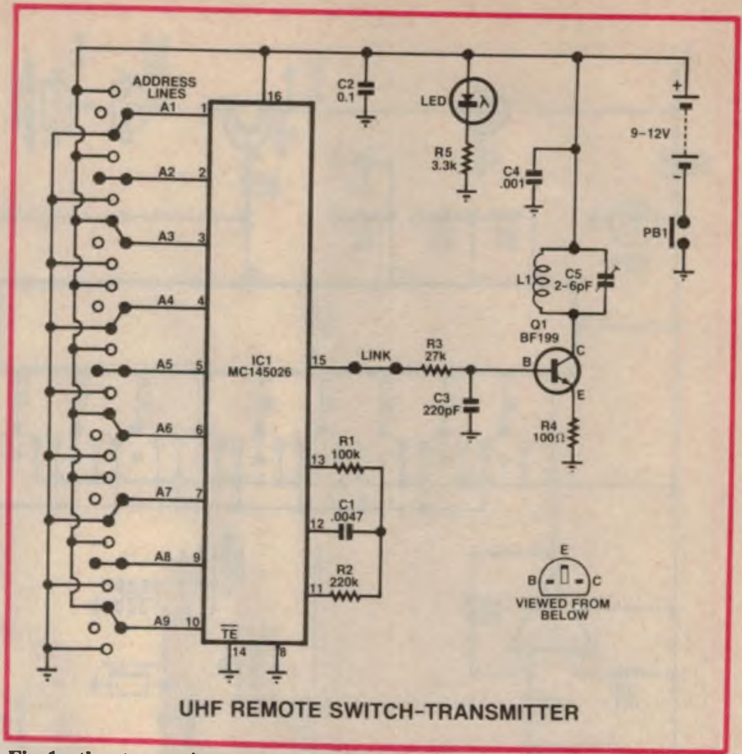
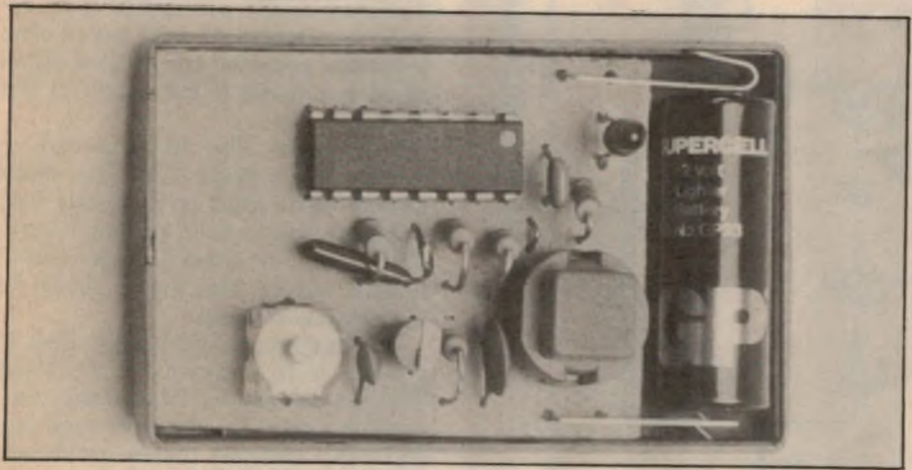


Fig.1: the transmitter consists of an MC145026 trinary encoder and UHF oscillator stage Q1.

Below: view inside the transmitter case.



so that they are switched by the sensor outputs instead of by the pushbutton switch.

The receiver circuit can be hidden away, close to the control box, and connected directly to an instant trip input.

Of course, we now have the problem of turning the alarm on and off. Answer: just build another receiver and matching hand-held transmitter unit and program them to a different code.

Why UHF?

UHF (ultra high frequency) transmission was chosen in preference to other possible systems for the following reasons:

(1). At UHF, better penetration is obtained into remote, partially shielded areas. This means that a good range can be obtained even with the receiver placed under the bonnet, under the dashboard, or in the boot.

Thus, the receiver and its associated short antenna can be completely hidden.

(2). Antennas required at UHF are very short. In fact, no external antenna is required for the transmitter — it's etched into the PC board. The effective radiated power is only a few microwatts.

(3). The circuitry can be kept simple while still conforming to Department of Communications standards for security radio alarm systems. The operating frequency is 304MHz while bandwidth is less than 100kHz.

Transmitter circuit

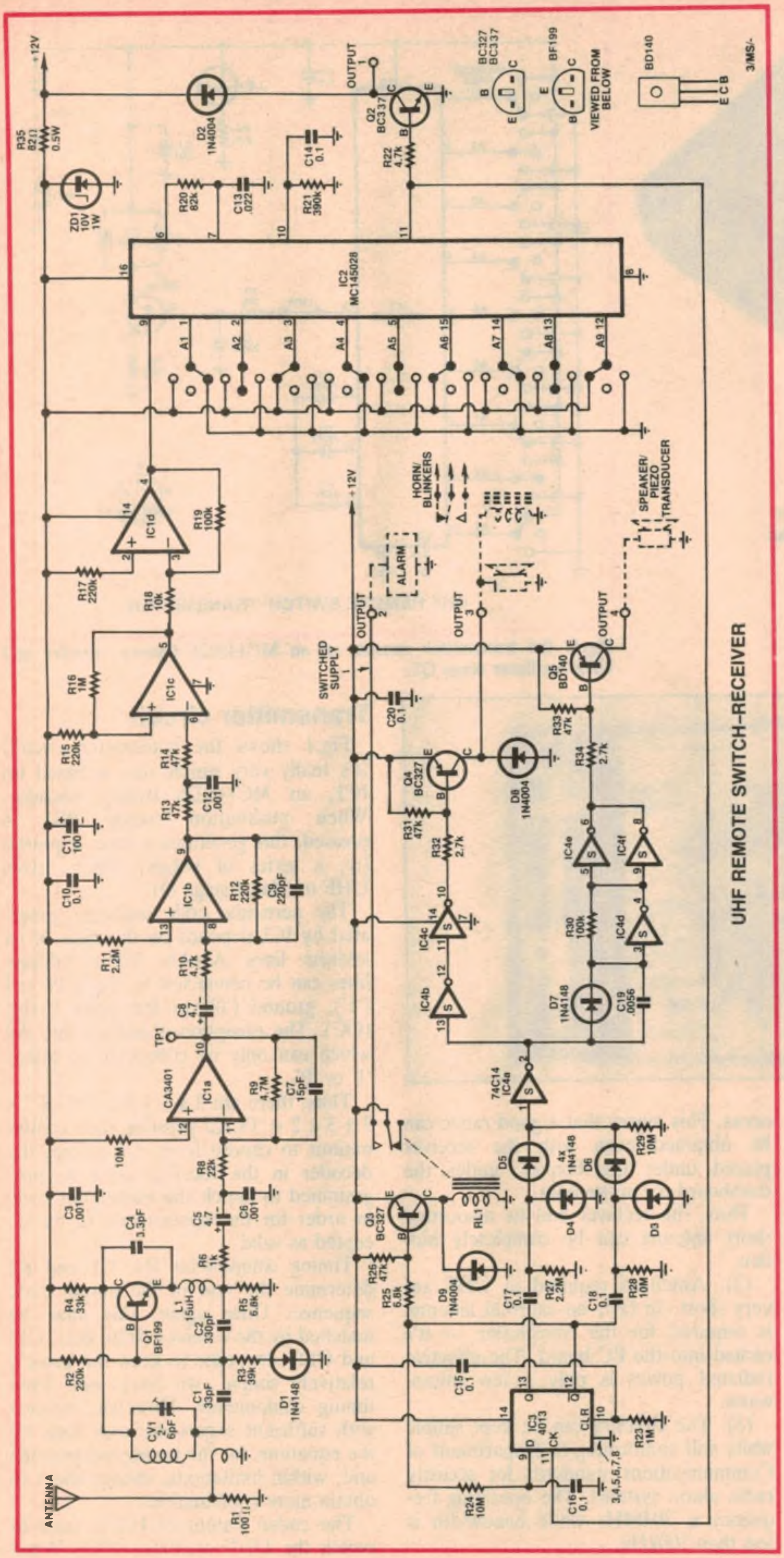
Fig.1 shows the transmitter circuit. It's really very simple and is based on IC1, an MC145026 trinary encoder. When pushbutton switch PB1 is pressed, this generates a code sequence (ie, a series of pulses) which drives UHF oscillator stage Q1.

The particular code sequence generated by IC1 depends on the state of its address lines A1-A9. These address lines can be connected to the +9V rail ('1'), ground ('0') or left open circuit (OC). The exception is address line A9 which can only be connected to either '1' or '0'.

Thus, there are 3 x 3 x 3 x 3 x 3 x 3 x 3 x 3 x 2 = 13,122 possible code combinations to choose from. Of course, the decoder in the receiver must be programmed to match the transmitter code in order for the transmission to be accepted as valid.

Timing components R1, C1 and R2 determine the rate of the output code sequence. Once again, this must be matched by the receiver (R20, R21, C13 and C14). In order to keep the project relatively simple, we have used fixed timing components. However, readers with sufficient experience may look up the equations for the timing components and, within limitations, change them to obtain more combinations.

The coded output of IC1 is used to switch the UHF oscillator (Q1). When



UHF Remote

pin 15 of IC1 is high, the oscillator switches on. When pin 15 is low, the oscillator switches off (see Fig.2).

Q1 is connected in common-base configuration and forms an oscillator by virtue of its tuned collector load and the stray capacitance between its collector and emitter terminals. The operating frequency is set by paralleled tuned circuit L1 and C5 and must be accurately adjusted to 304MHz (see adjustment procedure).

Receiver circuit

The stage associated with Q1 forms a regenerative self-detecting UHF receiver. The resonant frequency of this stage is determined by the parallel tuned circuit L (printed inductor) and trimmer capacitor CV1.

The detected output is AC-coupled via R6, C5 and R8 to the inverting input of high gain amplifier stage IC1a. A test point is provided at the output of this stage for tuning purposes. IC1b also forms an inverting amplifier and, because its output is normally biased close to ground potential, the original digital signal is restored at the output of this stage.

From there, the signal is fed to Schmitt trigger stage IC3c. This cleans up the digital signal and prevents false triggering due to noise or interference. IC1d inverts the Schmitt trigger output to give a pulse train that is similar to the transmitted signal.

The recovered digital pulse train is now fed to IC2 which is an MC145028 Tri-state decoder IC. This device compares the code sequence at its input (pin 9) to the addresses present on its address pins 1-9. If these are matched to the encoder address pins, and the rate of code transmission is similar, the output of the decoder (pin 11) will go high for the duration of the transmission.

Thus, Q1 will be turned on and its output can be used to trigger the input of a house alarm, either directly or via an external relay.

Alternate presses of the transmitter key will also clock IC3. IC3 is a 'D' type flipflop connected to operate as a toggle ('T') type. The addition of R24 and C16 on pin 9 prevents IC3 from changing its output state at less than one second intervals. This prevents any unpredictable operation due to breaks in transmission.

C15 and R23 clear the flipflop (ie, Q = 0, Q-bar = 1) when power is first applied to the circuit. This is equivalent to the alarm off condition.

When pin 11 of IC2 subsequently switches high (ie, when a valid transmission is received), the flipflop is set and the Q output switches high and the Q-bar output low. Q3 is now forward biased and activates relay RL1 which switches the +12V rail to output 4.

Audible indicators

The Q and Q-bar outputs of IC3 also drive separate time constant networks. C17, R27 and R29 set the time constant on the Q output to approximately 0.2s, while C18, R28 and R29 set the time constant on the Q-bar output to around 0.5s. The outputs from these time constants are fed to pin 1 of Schmitt inverter IC4a via D5 and D6.

Thus, each time the flipflop toggles, pin 2 of IC4a briefly switches low for either 0.2s or 0.5s, depending upon which time constant is involved. When this happens, pin 10 of IC4c also switches low and Q4 switches the +12V rail to output 2 for the duration of the time constant. The output of IC4a also controls Schmitt trigger oscillator IC4d. Normally, the output of IC4a holds pin 3 of IC4d high via D7 and the oscillator is disabled. However, when pin 2 of IC4a switches low, the oscillator is enabled and drives Q5 and the loudspeaker via parallel inverter stages IC4e and IC4f. Note that the loudspeaker could be replaced by a piezo alarm transducer and parallel 1k resistor for lower current consumption and possibly louder sound output.

The result of all this jiggery-pokery is that the loudspeaker sounds for approximately 0.2 seconds when the alarm is switched on and for approximately 0.5 seconds when the alarm is switched off.

Construction

Construction is quite easy and mainly involves the assembly of two printed circuit boards and then installing them in their respective cases. The transmitter board is very small and measures only 44 x 32mm. The receiver board is also fairly small and measures 115 x 77mm.

Before installing any of the parts or doing any soldering, you must first set

How to Use the Receiver Outputs

The receiver has four separate outputs and these should be used as follows:

Output 1 - this output is normally high and switches low during transmission. If you want to trip a house alarm, this is the output to use. It can either be used to trigger the alarm via an external relay (see Fig.5) or connected direct to one of the alarm inputs.

Output 2 - provides a switched +12V output via on-board relay contacts. This output can be used to switch a car burglar alarm on and off. It can also be used to drive an external relay to switch the EA Home Burglar Alarm on and off (see Fig. 6).

Output 3 - provides relay drive during on and off transitions. The relay can be used to activate the car's blinkers or the horn to provide on/off indication.

Output 4 - similar to output 3. This output is used to directly drive a loudspeaker via a 10 ohm 5W series resistor or drive a piezoelectric transducer with a parallel 1k resistor, for audible on/off indication.

Coding the Transmitter & Receiver

With this project, you have 13,122 possible codes to choose from. The selected code is programmed into the transmitter and receiver by cutting the thin tracks joining the address pins (A1-A9) to the high ('1') and low ('0') logic lines.

Thus, each individual pin can either be connected to logic 1 or to logic 0, or left open circuit (OC). The exception is pin A9 which must either be connected to logic '1' or logic '0' (ie, it cannot be left open circuit). Table 1 shows an example code while Figs.3a and 3b show how this code is programmed.

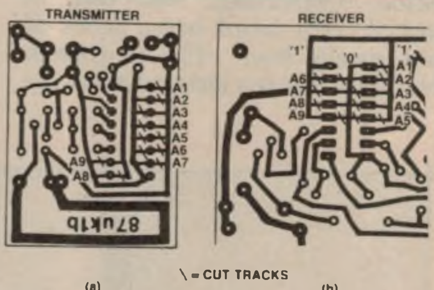


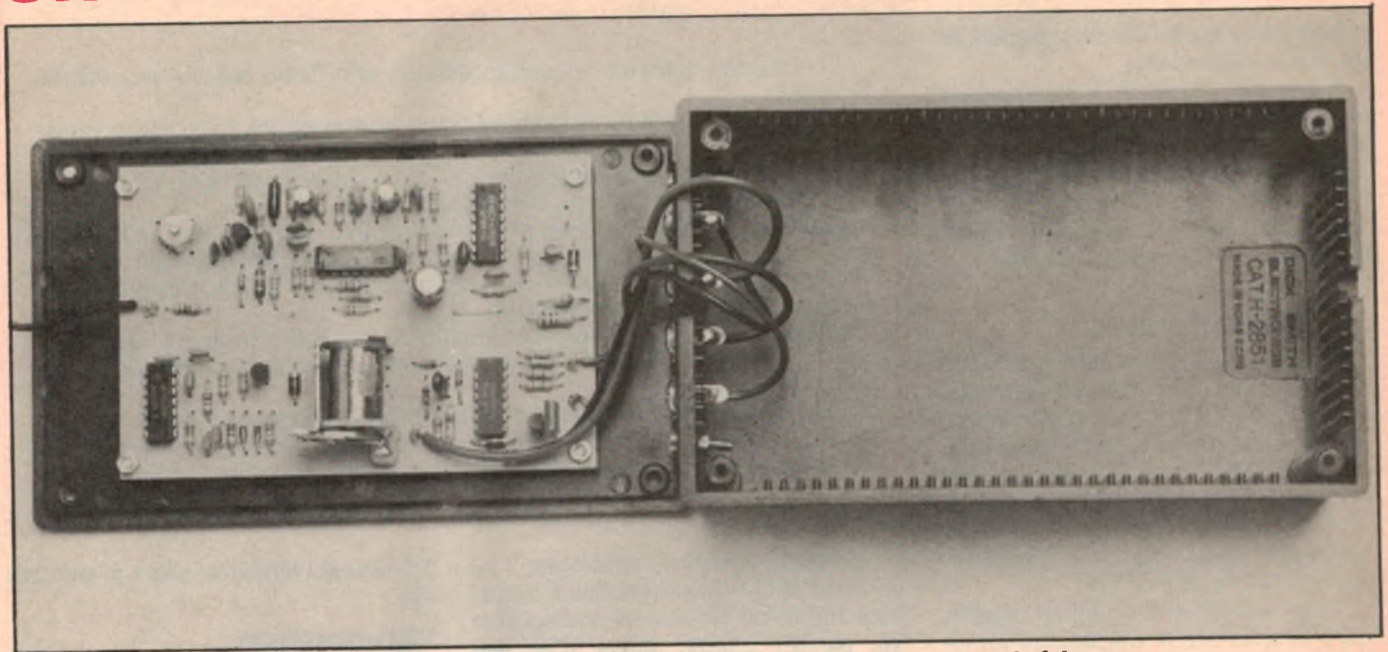
Fig.3: how to program the transmitter and receiver (example only).

Address Line	A1	A2	A3	A4	A5	A6	A7	A8	A9
Choice of Address	0, OC, 1	0, OC, 1	0, OC, 1	0, OC, 1	0, OC, 1	0,OC,1	0,OC,1	0,OC,1	0,1
Our Example Code	0	0	1	1	OC	OC	0	0	1
Your Choice									

Table 1: the example code programmed in Figs.3a and 3b.

Thus, to program logic '0' on address lines A1, A2, A7 and A8, you must cut the thin track which joins these pins to the logic '1' line. Similarly, to program logic '1' on to pins A3, A4 and A9, you cut the thin track between these pins and logic '0'. Finally, to program OC on to pins A5 and A6, you cut the tracks leading to both logic '1' and logic '0' lines.

Follow the above example through and, when you understand the procedure, enter your own code into the space provided in Table 1. You can then program your own transmitter and receiver units by cutting the appropriate tracks with a sharp knife.



View inside the receiver. We connected our selected outputs to a 4-terminal strip mounted on one end of the case.

up the address lines for the encoder and decoder ICs (IC1 in the transmitter and IC2 in the receiver). This is done by making cuts in the thin copper tracks joining the address pins to the logic '1' (+12V) and logic '0' (ground) lines.

Figs.3(a) and 3(b) in the accompanying panel show just one of the 13,122 possible combinations. Note that, as supplied, each board has a series of short circuits from +12V to ground. This means that you must cut either the track to logic '1' or the track to logic '0' (or both) for each pin, otherwise the supply rails will be short circuit.

You should also take care to ensure that the transmitter addresses match those of the receiver, otherwise the unit will never work.

Once the address lines have been set up, the assembly work can begin.

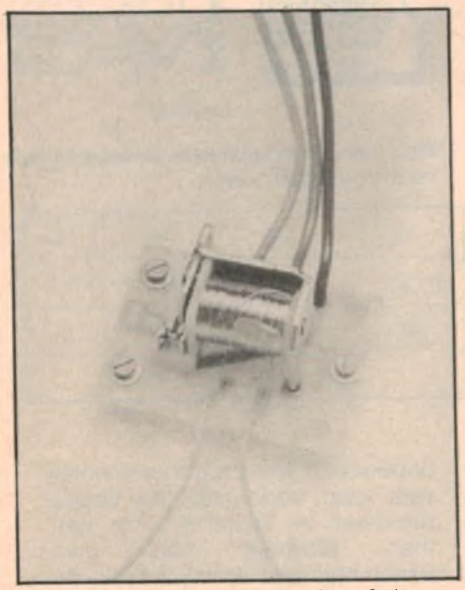
The small transmitter PCB (coded 87uk1b) should only take a few minutes to assemble. Make sure that you install the switch, IC and transistor correctly but don't install the wire link (adjacent to pin 16 of IC1) at this stage. Note that some of the resistors are mounted 'end on' to save space.

Take care when installing the LED — the anode is the longer of the two leads and is installed next to the positive battery terminal. Note that the top of the LED should be about 11mm proud of the PCB so that it will fit into the hole in the lid of the case.

Adding an External Relay Board

Some readers will want to use their receiver to drive external relays. No problem — just add this handy relay board. The assembly includes a PCB, a low-cost SPDT 12V relay, three mounting screws and has provision for diode isolation for blinker flashing (on/off indication).

Fig.7 shows the circuit of the external relay board, while Fig.8 shows the parts layout. Note that the two diodes are only necessary if you're hooking up the car's blinkers. For most other applications, they can be left out of circuit.



The optional external relay board (note: does not include diodes for blinker circuit).

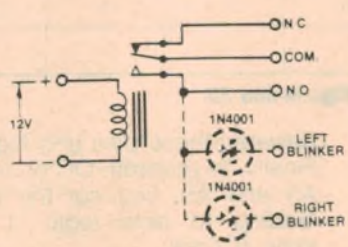


Fig.7: the external relay circuit.

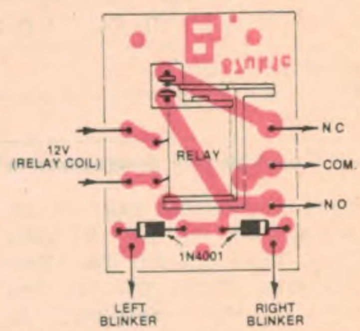


Fig.8: parts layout for relay PCB.

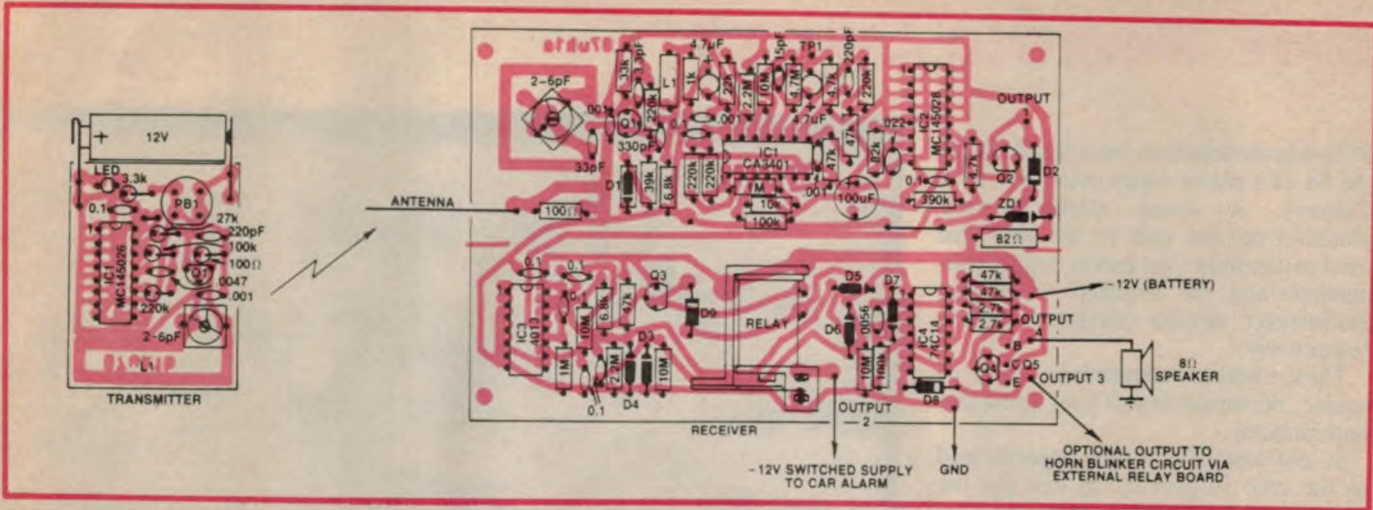


Fig.4: how to use the UHF Remote Switch to switch your car alarm on and off. L1 in the transmitter and the inductors in the parallel tuned input circuit of the receiver are etched into the PCB patterns.

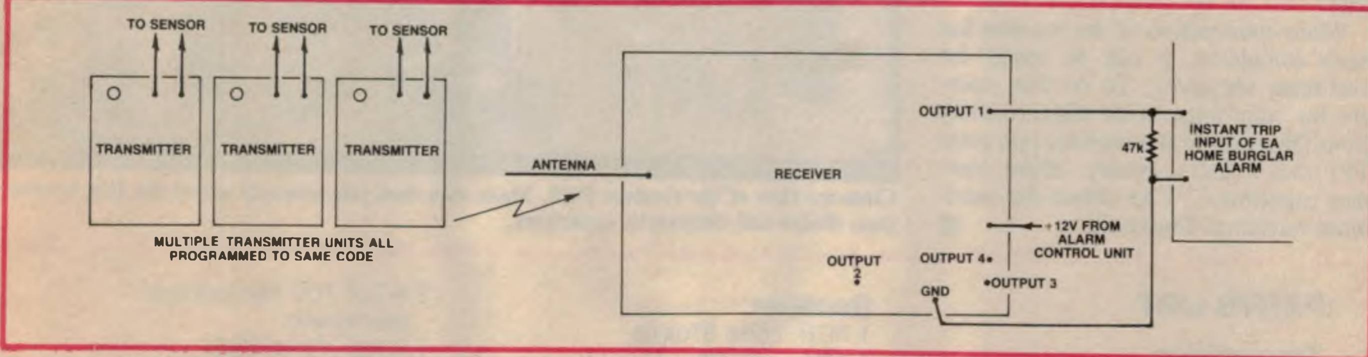


Fig.5: how to use UHF Remote Switch to trigger the EA Home Burglar Alarm. Some alarm systems may require triggering via the external relay board.

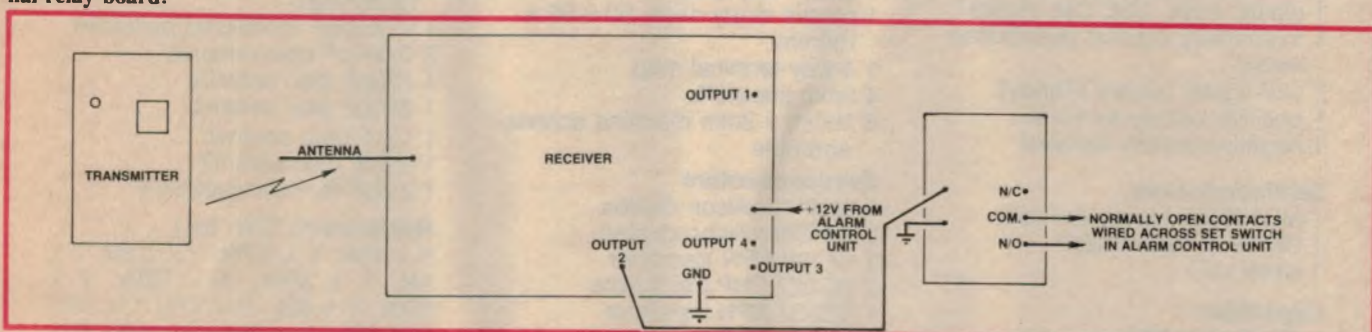


Fig.6: a separate transmitter and receiver are required to switch the EA Home Burglar Alarm on and off. They must be programmed to a different code than those in Fig.5

At this stage, all the parts should be installed except for the wire link. You are now ready to adjust the transmitter to its correct operating frequency.

To do this, temporarily connect the link side of R3 (27k) to the positive supply rail and install the battery. The oscillator will now run continuously when the button is pressed and its output frequency must accurately set to 304MHz using a frequency counter. The counter input should be loosely coupled to the printed inductor on the transmitter.

In most cases, it will be sufficient to simply hold the transmitter adjacent to the counter input and press the button. If this doesn't do the trick try winding a few turns of insulated wire around the transmitter to act as a pick-up probe.

The output can now be set to 304MHz by adjusting C5 (use a plastic alignment tool). Don't touch any of the parts or the PCB tracks during this procedure otherwise you'll get a wrong reading. In fact, it's best to sit the transmitter in the bottom half of the case while adjustments are carried out.

Once the adjustments have been completed, disconnect the link to the positive supply and install the link on the PCB between R3 and pin 15 of IC1. Assembly of the transmitter can now be completed by installing the PCB in the lower half of the case and clipping the two halves of the case together.

Building the receiver

Fig.4 shows the assembly details for the receiver PCB (87uk1a). Use PC stakes for all external connections and for TP1, and take care to ensure that all polarised components are correctly installed. These include the ICs, transistors, diodes and electrolytic capacitors.

Inductor L1 (15uH) can be installed either way round. The inductors in the parallel tuned input circuit form part of the PCB pattern, so you don't have to worry about these.

For the prototype, the completed

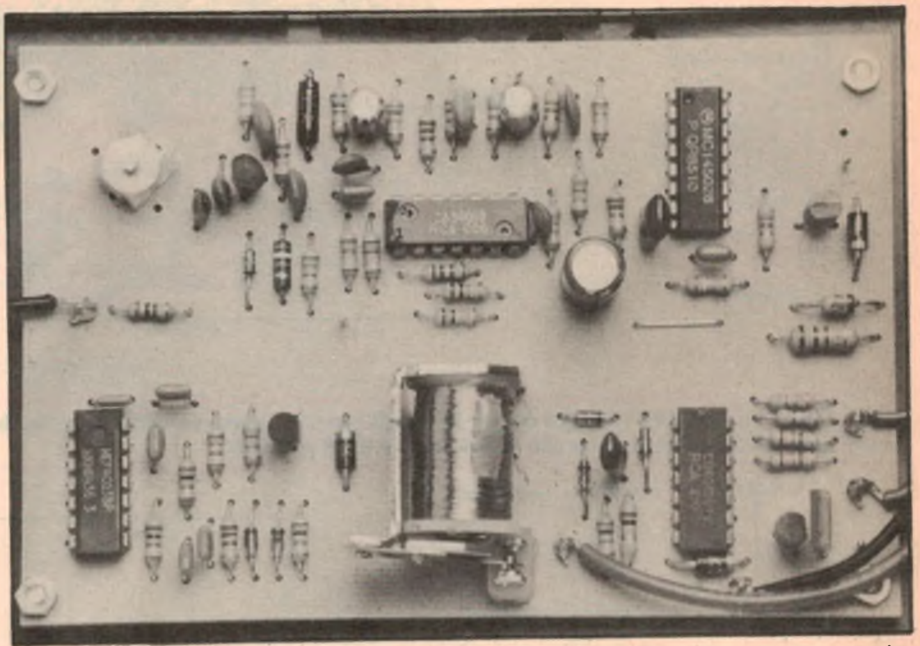
UHF Remote Switch

PCB was mounted on 5mm standoffs on the lid of a plastic zippy case (50 x 90 x 150mm). A 4-way terminal strip mounted on one end of the case was used to terminate the power supply connections and the switched +12V and loudspeaker outputs (outputs 4 and 3 respectively).

These output connections can, of course, be varied to suit your particular requirements.

A slot was filed in the opposite end of the case to provide an exit for the antenna lead. This lead simply consists of a 25cm length of insulated hookup wire.

When construction of the receiver has been completed, it can be tuned for maximum sensitivity. To do this, operate the transmitter some distance away from the receiver and monitor test point TP1 with a CRO. Finally, adjust trimmer capacitor CV1 to obtain the maximum waveform amplitude. EA



Close-up view of the receiver PCB. Make sure that you correctly orient the ICs, transistors, diodes and electrolytic capacitors.

PARTS LIST

Transmitter
1 PCB, code 87uk1b
1 plastic case, DSE Cat. H-2497
1 momentary contact pushbutton switch
1 12V lighter battery (Tandy)
1 positive battery terminal
1 negative battery terminal

Semiconductors
1 MC145026 trinary encoder
1 BF199 NPN transistor
1 small LED

Capacitors
1 0.1uF monolithic
1 0.0047uF polyester
1 0.001uF disc ceramic
1 220pF disc ceramic
1 2-6pF trimmer

Resistors (0.25W, 5%)
1 x 220k, 1 x 100k, 1 x 27k, 1 x 3.3k, 1 x 100 ohms

Receiver
1 PCB, code 87uk1a
1 15uH inductor
1 SPDT 12V relay
1 plastic zippy case, 50 x 90 x 150mm
1 4-way terminal strip
4 5mm standoffs
6 15mm x 2mm machine screws and nuts

Semiconductors
6 1N4148 silicon diodes
2 1N4004 silicon diodes
1 BF199 NPN transistor
2 BC327 PNP transistors
1 BC337 NPN transistor
1 BD140 NPN transistor
1 RCA3401 op amp
1 MC145028 trinary decoder
1 4013 D-type flipflop
1 74C14, 40106 Schmitt trigger
1 10V 1W zener diode

Capacitors
1 100uF 16V electrolytic
2 4.7uF 10V low leakage electrolytic
7 0.1uF monolithics
1 0.0056uF metallised polyester (greencap)
1 0.0022uF metallised polyester
3 0.001uF disc ceramic
1 330pF disc ceramic
1 220pF disc ceramic
1 15pF disc ceramic
1 3.3pF disc ceramic
1 2-6pF trimmer capacitor

Resistors (0.25W, 5%)
4 x 10M, 1 x 4.7M, 2 x 2.2M, 2 x 1M, 1 x 390k, 4 x 220k, 2 x 100k, 1 x 82k, 5 x 47k, 1 x 39k, 1 x 33k, 1 x 22k, 1 x 10k, 2 x 6.8k, 2 x 4.7k, 2 x 2.7k, 1 x 1k, 1 x 100 ohms, 1 x 82 ohms 0.5W

Relay assembly
1 relay PCB
1 SPDT 12V relay
3 mounting screws
2 1N4004 diodes (optional)

Where to buy the parts: parts for this project are available from Oatley Electronics, 5 Lansdowne Pde (PO Box 89), Oatley, NSW 2223. Telephone 579 4985 (Thursday & Friday only). Prices are as follows:
Transmitter kit (minus battery, case and pushbutton switch) .... $11.90.
Receiver PCB kit .... $29.90.
Receiver plastic case, terminal strip, screws and wire kit .... $5.90.
Relay kit (does not include diodes) $3.20
All prices include packaging and postage (minimum purchase $10 only).
The transmitter case (Cat. H-2497), pushbutton switch (Cat. S-1200), and 12V lighter battery (Cat. S-3335) are available from Dick Smith Electronics. The 12V lighter battery (No. GP23) is also available from Tandy.

Note: PC artworks for this project are copyright Oatley Electronics.

Video RoomMate — loudspeakers for your stereo VCR

Here's a really innovative idea for home entertainment from Bose. It's the Video RoomMate powered stereo loudspeaker system. The new loudspeakers are ideally suited for use with stereo VCRs and TVs, and are just the shot where portability is a prime requirement.

There's no doubt that the added realism of stereo greatly enhances the appeal of TVs and VCRs. But there are still a few problems — especially if you wish to maximise the stereo effect by using external speakers.

Normally, this involves wiring up your stereo system to accept the video sound track. Often, however, this can be inconvenient, because it means that the VCR must be positioned close to the stereo amplifier. There are many situations where you may want to use the VCR in a separate room or where portability of the equipment is important.

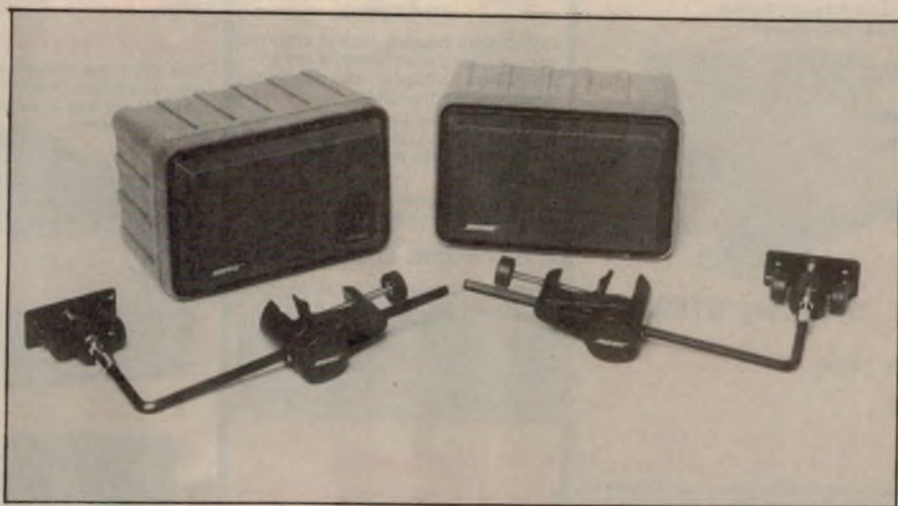
Bose has neatly sidestepped these handicaps with its new Video RoomMate loudspeaker system. They are compact, portable and do not require a separate amplifier.

The big advantage of the Video RoomMate is that it is a powered system — that is, a stereo amplifier is built into one of the enclosures. You simply plug this enclosure into the mains and it's ready to go. The only control is for volume and this is located on the front panel.

The other cabinet of the pair can be considered as a satellite loudspeaker and is driven by one of the amplifier outputs on the back of the powered unit. Despite the extra complexity of the latter, both cabinets are exactly the same size with dimensions of just 150 x 150 x 230mm.

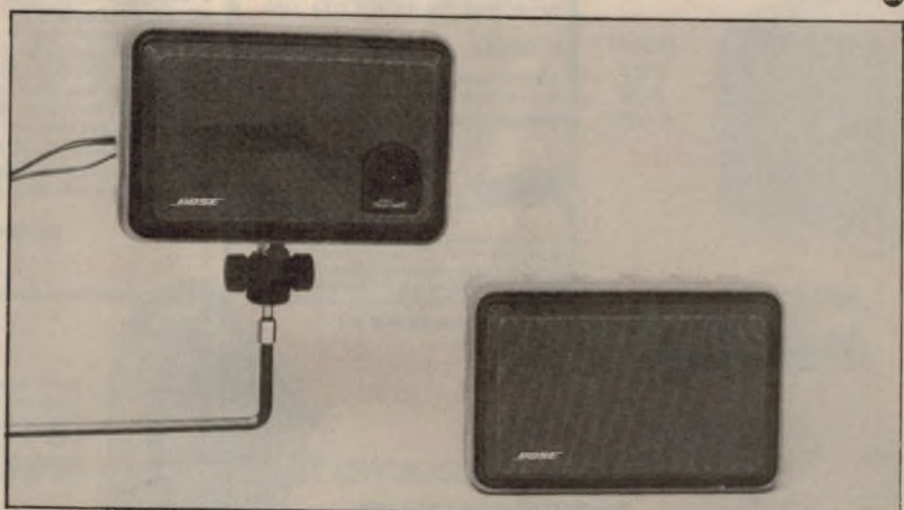
One interesting aspect of the construction is the unusual cabinet material. Each box is moulded from thick copolymer styrene which makes for rugged construction and light weight. The cabinets are finished in an attractive mottled grey/black charcoal colour.

Standard accessories include a mains cord, shielded stereo input leads (terminated with RCA connectors), and several metres of wire to interconnect the two loudspeakers. Optional extras include a convenient carry bag and "monkey arm" mounting brackets which allow the speakers to be attached to any convenient surface, shelf or railing (see photo).



The recommended retail price for the Video RoomMates is $507 per pair. The optional monkey arms are $100 per pair while the carry bag retails for $69.

For further information, contact Bose Australia Inc., 11 Muriel Avenue, Rydalmere, NSW 2116. Telephone (02) 684 1255. (C.R.D.)



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Jack O'Donnell & Staff ***Altronics***

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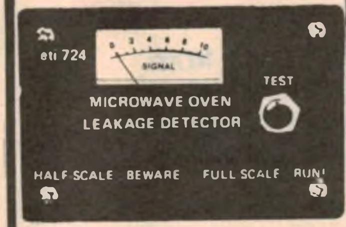

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- Output waveforms — sine and square.
- Sinewave harmonic distortion (typical)
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  - 10KHz less than .002%
  - 100Kz less than .02%
- Square wave rise and fall times 50nS

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Build These Fantastic New Playmaster HiFi Loudspeakers

See Electronics Australia Sept '86

$449 full kit K 5090

If your budget won't run to the $600 to $800 needed for a fully imported pair of equivalent speakers, these are the ones to go for.

Some extracts from Electronics Australia Magazine — Each woofer has a foam roll surround and a doped paper cone with an effective (piston) diameter of about 155mm. **The Tweeters** "the Tweeters are exotic little beasties" (Editor EA Magazine) each is a 19mm soft dome unit with a ferro-fluid damped voice coil for high power handling and a very smooth frequency response. Its resonant frequency is around 1.7kHz.

Power Handling (60 watts plus RMS!) In an average sized lounge room and driven by the Playmaster Sixty-Sixty or an equivalently rated amplifier, these speakers will deliver enough sound volume to satisfy the most power crazed enthusiast.

Construction Only the most basic of tools are required to assemble these loudspeakers. Even if you are a rank amateur at carpentry you will have no problems putting them together. You don't need special clamps or jiggs and all timberwork has been precisely machined. You do have to be able to use a soldering iron though, to connect the loudspeakers to the crossover network.

The reproductive purity of these speakers simply amazed us. The secret, of course is the DANISH VIFA Drivers. VIFA drivers are used in many top selling imported systems such as Bang & Olufsen, Rogers, Mission, Jamo DCM Timewindow etc.

'Sixty-Sixty' Integrated Amplifier Kit

(EA May,June,July '86)

Features:
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Performance Specification

Power Output — 8 ohms 62W **Distortion** - Less than .0% at 1kHz **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 1kHz -4.3mV • Line Level - 270mV **Hum & Noise** - Phono - 89db • High Level Inputs - 103db **Tone Control** - **Bass** - + -12db at 50Hz **Treble** - +-12db at 10kHz. **Damping factor** - At 1kHz and 30Hz - greater than 80 **Stability** — Unconditional.

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"This New Amplifier offers a standard of performance far ahead of anything we have previously published and ahead of most commercial integrated Stereo Amplifiers".
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Controls the temperature of your standard soldering iron. Suitable for irons rated from 20W—75W—Standard soldering iron plugs straight in no need for modification.
The Altronics Kit comes complete—pre-punched and silk screened **Cat.K6400**

Prescision time your Processing with this low cost Project

Digital Photo Timer K 1850

This classy digital timber allows prescision timing for photographic processing from 1 second up to 9 minutes 59 seconds in 1 second increments.
Features:-Large easy to read LED displays. Hold switch which interups timing and focus switch which bypasses the timer settings.
The Altronics kit is housed in an attractive instrument case which is fully pre-punched and screen printed.

See EA Aug '86

New

Great Value

$79.50

Bench Top Power Supply

$79.00

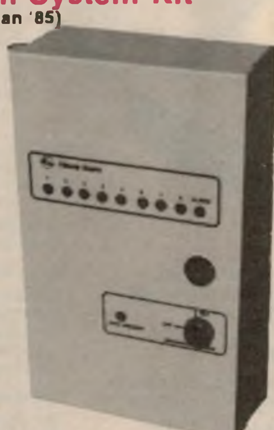
FEATURES:
* Output 3 to 30V at 1A * Short circuit protected * Load switching * Current limiting. Dual scale meter * Housed in our Deluxe "ABS" instrument case

SPECIFICATIONS:
* Output Voltage - 3 to 30V * Output Current - 0 to 1 amp (fully variable) * Load Regulation - Better than 0.2% from 0 to full load * Output Ripple-Less than 2mV RMS. Cat. **K 3210**

Super Low Price on Famous EA 8 Sector Alarm System Kit

(See EA Mag.Jan '85)

Features:
- Alarm has 8 separate input circuits - 8 sectors can be monitored independently.
- Each input circuit is provided with an indicator LED and a sector On/Off switch.
- Individual sector isolation allows the user to have some areas of the premises habited while others remain protected e.g. Inside Off/Outside On.
- Inputs accept both normally closed and normally open sensors.
- Two inputs provided with an entry delay between 10-75 seconds).
- Internal trip warning buzzer—alerts owner/occupant of pending alarm operation—great for the "forgetful" amoungst us. This buzzer is pre-settable between 5 and 55 seconds prior to Alarm.
- Unique circuit detects automatically when any N/O or N/C loops are either open circuit or dead short. **e.g. someone trying to bridge reed switches etc.**
- Switched output can be used to send a silent alarm through an auto-dialler circuit or similar.



K 1900 (without Back Up Battery) **$139.50**
S 5065 (12V 1.2AH Backup Battery) **$22.95**

240V Mains Power From Your 12V Battery

300 Watt Inverter with Auto Start

(See EA Sept.'85)

Just think how handy is would be to have 240 Volt AC Mains Power when camping or for your boat or Caraven.
Auto Start draws power from your battery only when appliance is plugged in and "turned on" i.e. battery can be left permanently connected if desired.
Thermal Over Load. Current Regulated. Current Overload.

K 6752 Complete Kit **$229**
K 6754 Fully built & tested **$325**

Transistor Tester

For In Circuit Testing

$17.50

Have you ever de-soldered a suspect transistor only to find that it checks OK? Trouble shooting excercises 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 • Test Diodes and SCRS as well • No need to switch between NPN and PNP — it's automatic. Two LED indicators are used to show condition of device being tested.
Altronics Kit Features - "ABS" jiffy box and test leads supplied. **Cat.K 2530**

FOR NEXT DAY JETSERVICE DELIVERY

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008 999 007

INPHONE Go Anywhere Cordless Phone Sensation

The Fabulous Portable Telephone that you can take anywhere around the House, Garden or Swimming Pool.
Altronics Inphone is Microprocessor controlled with a range of up to 250 metres and absolute clarity.
No other cordless phone has the quality, security and the features at anywhere near the affordable price of ***INPHONE***

Tired of being tied to the phone when you have better things to do? Wouldn t it be wonderful if you could take the phone to where you want to be around your Home, Office or Factory. You could be getting on with other things instead of worrying about missing a call! Now you can with the new generation cordless phone ***INPHONE.***

FEATURES:

* Simple to use and easy to install—just plug it in.
* Operating range up to 250 metres (800 ft).
* Security Code System with 16,348 combinations.
* Call function at base unit to alert handset.
* Pulse dialling with audible tone feedback at the touch of a key.

Inphone Is Now $100 Less Than Our Competitors

Yes its true, Inphone the fantastic performer with good looks is up to $100 less cost than our Competitors, Just Phone Telecom for a quote on theirs!

Fantastic Range
Up to 250M from Base Unit

Why Pay $385?

$ 269

A 0338

Exclusive Guarantee

Should you be less than totally satisified with your purchase you may return it within 7 days for a full refund less transport costs. Returned product must be in ***as sold*** condition with all packaging & invoices.

Telecom Permitted

THE ALTRONIC INPHONE SECURITY CODING SYSTEM IS FULLY AUTOMATIC — that's right, after the initial code setting of base unit to handset there are no more buttons to push. The base automatically cross checks with the handset whenever the handset is selected **"ON"**.
Beware of other Cordless Phones which require you to dial in a 4 digit code prior to dialing the number and those with software operated security (these need reprogramming each time you lose Base Power!!!) **In our view both types are an operators nightmare.**

Specifications:
Handset Power DC 4.8V rechargeable.
Base Unit 12V Ac (Adaptor supplied).

Base Unit:	Channel 3	Channel 2
RX Sens:	luV	luV
RX Freq:	39.875 MHz	39.825 MHz
S/Noise:	50db	50db
TX Power:	Max Permitted	Max Permitted
TX Freq:	30.175 MHz	30.125 MHz
Handset:		
RX Sens:	luV	luV
RX Freq:	30.175 MHz	30.125 MHz
S/Noise:	45db	45db
TX Power:	Max Permitted	Max Permitted
TX Freq:	39.875 MHz	39.825 MHz

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

Altronics Deliver Next Day With Jetservice
Phone Your Order Now

Protect Your Home for Just $99
New Ultra Sonic Home/Office Alarm System

Fantastic system for this price. Frankly we were amazed at the performance of this very compact system.
Very simple to connect and operate — New Technology has enabled very compact overall dimensions (master unit only 180 x 100 x 65) hence ideal for concealing among book shelves etc.

Look At The Features:
Exit Delay 30 - 35 secs.
Entry Delay 10 secs
DC Source.
Battery Backup 9V Nicad rechargeable (additional Cost S 5024 $14.50)
Auto Reset 3 minute operate cycle and auto reset.
Range Reliable to 30ft. (9M) Included.
Low Battery Indicator
Accessories Included for the one Low Price
4 Sets Reed Switches for Window/Doors
1 Roll fig "8" cable
1 External Type Horn Speaker
1 AC/DC plug pack adaptor
Now there is no excuse for not Protecting yourself, your family and all your hard earned possessions!

S 5310 Only **$99.00**

Out performs our main competitors system which, incidently sells at around $50 more for the comparable system and accessories.

Strobe Signal Lamp

Uses Xenon Strobe tube for High energy strobe flash output at a rate approx. 1 per second.Fantastic light energy output for the DC power used. DC Input 12V 320mA Dimensions 97 dia.90H

Two Colours Available

S 5455 Blue
S 5450 Red

$24.50

Reed Switch and Magnet Sets

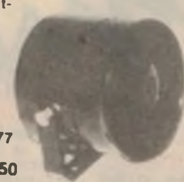
3 Types (Surface Mount)

S 5153	SPDT	$3.98	3.40
Changeover Type			
S 5155	N/C SW	$3.98	3.40
S 5156	N/O SW	$4.50	4.10

High Energy Siren with Swivel Bracket

(As Illustrated except white colour)

Absolutely ear splitting SPL 120db
Handy Bracket for wall mounting etc.
12V 300Ma.
Dimensions 100mm
Diam 125mm L.



Cat. S 5177
$22.50

Universal Monitor Stand

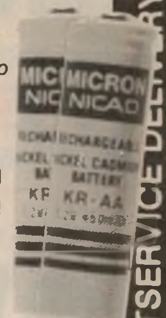
With Pan & Tilt Adjustment

This brilliant monitor stand enables you to swivel left/right and tilt up/down i.e. to position monitor to any desired position. Hence viewing position is enhanced and screen glare eliminated. **Cat.D 1100**

Why Pay $50

Last chance to stock up

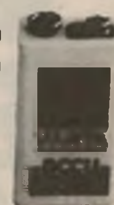
MICRON NICADS



1-9	**$2.95 ea**
10-99	**$2.45 ea**
100up	**$1.99 ea**

Why Pay $4 ?

9V Nicads



150maH

The finest 9V Nicad on the market Genuine 9V (many others are actually 7.2V)

S 5024 **$15.95 ea**

Why Pay over $20?

Desk Mounted Lamp Magnifier

$189 NEXT MONTH

Only **$169**

If you have trouble with fine PCB work or component identification but still want both hands free, this is for you. We thoroughly recommend this quality Australian made product.

TECHNICAL INFORMATION Illumination: 22W Fluorescent **Weight:** 8.16kg **Lateral Extension:** 254mm **Vertical Extension:** 254mm **Fixing:** Heavy table base (grey & Ivory) with two chrome plated flexible arms. Cat A 0980

Toroidal Power Transformers

Great Savings Over Conventional E.I. Transformers

Why a Toriod?

• Smaller size and weight to meet modern "slimline" requirements • Low electrically induced noise demanded by compact equipment • High efficiency enabling conservative rating whilst maintaining size advantages. • Lower operating temperature • Simple, quick single bolt mounting.

Dimensions and Weight

160 VA Models 110 Diam. 45mm H. 1.8Kgs Leads 200mm
300 VA Models 125 Diam. 45mm H. 25Kgs Leads 200mm

160 Watt Models

Cat.No.	SEC.V
M 3050	12 + 12
M 3055	18 + 18
M 3060	25 + 25
M 3065	30 + 30
M 3070	35 + 35
M 3075	40 + 40
M 3080	45 + 45

$49.95 10 Up **$46.00 ea**

300 Watt Models

Cat.No.	SEC.V
M 3085	12 + 12
M 3086	18 + 18
M 3088	25 + 25
M 3090	30 + 30
M 3092	35 + 35
M 3100	40 + 40
M 3105	45 + 45

$59.95 10 Up **$56.00 ea**

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	1.75
P 3010	Female 9 Pin	3.25	1.60•
P 3020	Male PCB Rt/L	3.75	2.40
P 3030	Fmale PCB Rt/L	4.50	2.20•
P 3040	Male PCB mnt	2.95	2.00
P 3050	Fmale PCB mnt	3.95	3.00
P 3090	Backshell cover	1.95	.95•
DB15			
P 3100	Male 15 Pin	3.25	1.60•
P 3110	Female 15 Pin	3.85	2.40
P 3120	Male PCB Rt/L	4.35	2.15•
P 3130	Fmale PCB Rt/L	5.50	2.75•
P 3140	Male PCB mnt	3.85	2.75
P 3150	Female PCB	4.85	2.95
P 3190	Backshell cover	2.20	.95•
DB25			
P 3200	Male 25 Pin	4.95	2.45•
P 3210	Female 25 Pin	5.50	3.95
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	3.95
P 3250	Fmale PCB mnt	6.25	5.25
P 3290	Backshall cover	2.20	.95

100 Amp Jumper Leads

Superb Quality

A 3011 **$17.50**

Up to Incredible 1KM Range

Professional Megaphone PA

A 1990
$109.50

SPECIFICATIONS:

Power Output	20 Watts max.
Effective Range	Approx. 400M (up to 1KM in ideal conditions)
Power	8 Pcs Cell (not included)
Dimensions	230 Diam. 360 Length
Weight	1.5K (less batteries)
Shoulder Strap	Supplied

The Superb Micron T 2440 Soldering Station

No more changing tips to obtain the correct working temperature — simply select any one of 5 temperature settings between 320 and 440 deg C
Temperature Readout via LED bargraph
Temperature Stability to within 4% of selected mean temperature
Heat Capacity full 48 watts available for H/D work.
★ Low Voltage Element ★ Silicon rubber burn resistant lead ★ Chrome plated iron clad tips.

Excellent For Production Soldering

Excellent for Delicate PCB Work

T 2440
$99.50

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

Save Up To 30% With These Prices

A RARE OPPORTUNITY

NATIONAL SEMICONDUCTOR DATA MANUALS

EXCLUSIVE OFFER FROM ALTRONICS

Sold Separately or by the set

BONUS OFFER

THE ENTIRE SET FOR JUST **$75**

PLUS $10 EXPRESS DELIVERY ANYWHERE IN AUSTRALIA

ATTENTION: UNIVERSITIES, COLLEGES, SCHOOLS, DESIGNERS & ENTHUSIASTS.

An Outstanding chance to purchase the entire set of 10 books at a significant saving.

SAVE OVER $21

COMPLETE SET ORDER NO **B9996**

INTERFACE

This data book provides complete specifications for a variety of transmission line drivers/receivers, peripheral/power drivers and level translators/buffers. Product selection guides list applications information and operating features. Memory, dynamic memory, microprocessor, data communications and disk support products are also covered in the data book. The interface appendics section contains cross reference guides, the programmable logic section describes the technology, design and gives application suggestions.

Pages: 1520 **Year 1983**

B 1005 . . . $13.50

DATA CONVERSION ACQUISITION DATA BOOK

The 1984 edition of the Data Conversion/Acquisition Data book is one the the most comprehensive in the industry. It contains specifications for high technology conversion products in the analog signal path, both preceeding and following the conversion process. Combining high volume production capability with leading edge technology such as thin film resistors, laser trimming and advanced micro CMOS and bipolar processing, has helped develop products best suited to your design needs.

Pages: 1232 **Year 1984**

B 1007 . . . $13.50

HYBRID PRODUCTS DATA BOOK

The Hybrid Products Data book is the only National Semiconductor publication that contains complete information on all our hybrid semicondutor products.
Included are precision thin film and thick film products which provide the user with standard functions from operational amplifiers to converters with capabilities beyond those of current monolithic technology. Product selection guides and an application section are also included.

Pages: 792 **Year: 1982**

B 1045 . . . . . $9.95

LINEAR DATA BOOK

The 1982 edition of the National Semiconductor Linear Data book is the most comprehensive available. It presents approximately 2000 pages of specifications for our high-technology linear products. Applications, descriptions, features and diagrammes in this data book include detailed sections for Voltage Regulators, Op Amps, Voltage Comparators, A to D, D to A Converters, Industrial Blocks and Audio and TV Circuits. The data book also features advanced telecommunications devices and speech synthesis (DIGITALKER). Plus other non state-of-the-art linear products offering performance, economy, quality and reliability.

Pages: 1952 **Year:1982**

B 1010 . . . $21.50

LINEAR APPLICATIONS HANDBOOK

Provides an indexed & cross reference collection of linear integrated circuit applications using both monolithic & hybrid circuits. Individual application notes written to explain the operation & use of one particular device or to detail various methods of accomplishing a given function. Each section includes, applications, descriptions, features, diagrams & specifications.

B 1012 . . . $15.00

LINEAR SUPPLEMENT

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

Pages: 566 **Year: 1984**

B 1011 . . . . . $7.50

MOS MEMORY DATA BOOK

The 1984 MOS Memory Data book is a comprehensive collection of information advanced, high-density memory products covering the spectrum of this mainstream semiconductor component category.
National Semiconductor has an array of advanced technology processes to apply to memory design and development. These range from high-density triplepoly process used in the most advanced RAMs, the small-geometry, silicon oate, oxide-isolated micro-CMOS technology which is now being applied to high performance memory devices for the first time.

Page: 256 **Year: 1984**

B 1025 . . . . . $7.50

TRANSISTOR DATA BOOK

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

Pages: 558 **Year: 1982**

B 1050 . . . . . $9.95

The first 30 customers also receive NATIONAL'S BRILLIANT VOLT—AGE REGULATOR HANDBOOK absolutely free - that's a further $10 value

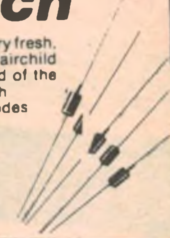
Free Bonus offer for the first 30 Customers Phone order reserve yours now!

VOLTAGE REGULATOR HANDBOOK

The 336 page Voltage Regulator Handbook becomes a must for the selection of three terminal and dual tracking components that meet the system requirements while utilizing the most cost effective approach. Beginning with product selection procedure and a data sheet summary, the text continues with easily accessible information about booster circuitry, power transformer and filter specifications, test methods, manufacturers' cross reference and extended use applications for National's regulators. **B 1055**

Million Diode Sellout! From 1.5¢ each

Altronics have just purchased around 1 Million (yes million) factory fresh, premium quality IN914/IN4148 diodes. These became surplus to Fairchild Australia as the factory supplied bulk, loose pack diodes instead of the tape/reel diodes ordered. So unless you are a manufacturer with automatic component insertion equipment, these fine quality diodes represent the diode bargain of all time!! **Cat. Z 0101**

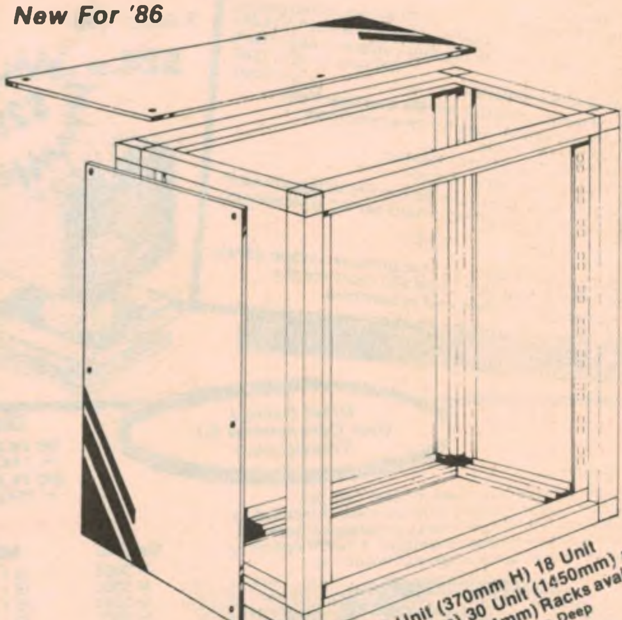


1-99	**3¢ ea**
100-499	**2.5¢ ea**
500 plus	**1.5¢ ea**

RACKS

Rack Frames for the Home Stereo System
Rack Cabinets for Equipment Manufacturers

New For '86



Supplied In Flat Pack Format
Easily Assembled In Minutes

6 Unit (370mm H) 18 Unit (907mm) 30 Unit (1450mm) and 38 Unit (1804mm) Racks available
All 450mm Deep

The all new Altronics racking system is available in 2 formats.

1. **Racking Frame Only** Fantastic for neatly housing your home HiFi system. Looks fine as is with your various sound system modules bolted in place, however, should the little woman disagree, then it is dead simple to obtain some low cost timber panels from your local cabinet shop to fill the side and top recesses. Edging of the timber is not required due to the 15mm recesses.

2. **Complete Equipmment Cabinet** with the simple addition of the panel sets you now have a series of professional equipment cabinets of appearance and ruggedness second to none - and just look at the savings!

Assembly Each Frame System is supplied complete with 12 Custom extruded Natural Anodised Aluminium sections., 8 ABS corner connector pieces, 6 clip in MM6 captive nuts and 6 M6 mounting screws. The sections and corner pieces simply push-fit together. A rubber or wooden mallet is recommended to fit together the self aligning pieces. Further strength can be obtained by pop rivetting the various overlapping extruded sections if desired, although we hardly feel this is necessary.

Side and Top Panels Tough powder coat medium grey gives a pleasing contrast with the natural anodised frame. The resultant product is extremely professional in appearance and well and truly strong enough for the heaviest of electronic equipment.

H 0365 Rack 6 unit (370mm)	**89.50**
H 0367 Panel Set for H 0365	**49.00**
H 0370 Rack 18 unit (907mm)	119.50
H 0372 Panel Set for H 0370	**89.00**
H 0375 Rack 30 unit (1450mm)	**149.50**
H 0377 Panel Set for H 0375	**129.00**
H 0380 Rack 38 unit (180mm)	**189.50**
H 0382 Panel set for H 0380	**149.00**
H 0385 Rack screw M6 PK 12 Nat.	**2.95**
H 0386 Rack " M6 PK 100 Nat.	**19.95**
H 0390 Rack " M6 PK 12 black	**2.95**
H 0391 Rack " M6 PK 100 black	**19.95**
H 0395 captive nuts M6 PK 12	**3.95**
H 0396 captive nuts M6 PK 100	**25.00**

Rack Panel Screws

Low, Low prices on Nickel Plated and Black finish Rack Screws
Dome Head. M6 Thread. 25mm overall length

Going Boating? Well Here Is Safety For You, Mum & The Kids For Just $199

Uniden Sea Wasp Marine 2 Way Radio

10 Channels 27 Meg. Marine Band Transmit and Receive. Plus Seaphone FM Channels 16 (emergency) and 67 (continuous weather and sea conditions reports) Receive facility.

C 5012 Only **$199** **(Be Quick Next Shipment $279)**

Designed for Australia our fantastic new Uniden Sea Wasp Transceiver includes allocated 27Meg Marine channels for normal boat to boat and boat to shore communication and emergency calls **The Big Bonus** is the inclusion of the Seaphone FM channels 16 (emergency 156 8Mhz) and 67 (weather/sea reports 156 375Mhz) receive channels Now you can listen out for other craft in distress or get up to the minute sea and weather reports whilst fishing or relaxing in that bay 30KM from home **Another Fantastic Feature** of this Radio is the simple "One Touch" emergency switch i.e. a person totally unfamiliar with 2 way radio operation can, in an emergency, i.e. boat fire, capsize etc simply select the "88" (or 27.88Mhz) override button and make that life saving call

FACILITIES

• **In-built Signal Meter** indicates level of both incoming and outgoing transmissions • **CB/PA Switch** with external horn speaker (C 2010) fitted, you now have a handy little Boat PA System • WX1 (CH16) and WX2 (CH67) Selector switch independent of Main Channel Selector • **Noise Limiter** • **RF Gain Control** • **Mic Gain Control** • **Digital Channel readout.**

SPECIFICATION:

Channels RX/TX	10.27 680-27 980Mhz	**Accessories**	DC power cable with fuse, microphone and mic clip
Channels RX (WX)	2.CH16 156 8Mhz.CH67 156 375Mhz	**Transmitter RF Power**	4 Watt
Speaker	In-built plus external speaker Jack	**Receiver Sensitivity**	5uV/12db SNR
Size/Weight	160W x 55H x 217D.1 2KG	**Squelch Range**	1—1000uV
		Audio O/P	5W
		PA Facility	Included 5W O/P

Deluxe 9' Whip with Multiway Base Mount

Superb pretuned 27Mhz Marine Antenna with sturdy multiway mount. With mount on horizontal, vertical or angled surfaces— **Very Efficient. Cat.C 5110**

$79.50

Helical Whip Antenna with Ground Plane Eliminator.

1.4m length suitable for horizontal mounting surfaces-angle bushing supplied allows mounting to sloping surfaces Complete with lead and PL259 plug. Pretuned for 27Mhz Marine Band. **Cat. C5100**

$49.50

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 limit 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
Ewing Electronics 218412
Southern Communications 21 4011
EAST MAITLAND
East Maitland Electronics 337327
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
Active Electronics ■ .. 602 3499
All Electronic Components .. 662 3506
Ellistronics■ 6023499
MaGraths Electronics 347 1122
SUBURBAN
ASPENDALE
Giltronics 5809839
BENTLEIGH
Absolute Electronics 557 3971
BOX HILL SOUTH
Eastern Communications 288 3107
CHELTENHAM
Talking Electronics 550 2386
CROYDEN
Truscott Electronics ■ .. 723 3860
MULGRAVE
Ellistronics■ 5615844
PRESTON
Preston Electronics 48 40191
SPRINGVALE
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JVC's stylish W77CD midi hifi system

The W77CD is JVC's top of the range midi system with all the facilities that users expect from full size systems plus the luxury of full infrared remote control and a programmable automatic timer for recording material off-air.

Believe it or not, most hifi systems sold today are complete systems all from one manufacturer. While many of these are fairly low priced, there is a solid trend to more expensive and more compact "midi" systems which give a very good performance. In view of this trend, we decided to have a look at the JVC W77CD midi system which has full remote control.

These midi hifi systems are not to be confused with the new "musical instrument digital interface" which is now becoming so popular with musicians. Rather "midi" refers to the compact size of the new hifi equipment coming from Japan. All the electronic components of midi systems are 340mm wide but of varying depth and height. This applies even to turntables which makes them not much wider than a normal LP record.

The JVC W77CD system comprises the AX-E77 amplifier which includes a 7-band graphic equaliser, the FX-77 synthesised AM/FM stereo tuner, the TD-W33 dual cassette deck which includes Dolby B noise reduction, the AL-E77 linear tracking turntable, a pair of SP-E77 3-way loudspeaker systems, the RM-E77 remote controller (receiver) and matching handheld remote control (transmitter), and the optional XL-V22 compact disc player. All of this equipment is pictured in the photo on this page.

All of it can be controlled by the handheld remote control. This has no less than 30 membrane switches to control functions on the amplifier, tuner, turntable, CD player and cassette deck.

As well, it switches the whole system from standby to fully on and also provides a "sleep" timer if the system is being used as an (expensive) alarm clock, as it can be.

In detail, the functions selected by the remote control are as follows: on the tuner, it can be used to select any of the stored AM or FM stations; on the CD player, it gives Play, Stop, Skip Forward and Skip Reverse; on the turntable, Play and Stop; and on the amplifier, Mute and Volume Up or Down. And as might be expected, it gives most of the functions for the dual cassette deck: Record, Play, Pause, Rec Mute, Rewind and Fast Forward.

So effectively, the user can control the most-used functions of all the equipment without moving from the listening chair.

The heart of the whole system, as far as the listening quality is concerned, is the AX-E77 stereo amplifier which features a seven-band graphic equaliser instead of conventional tone controls. Nor does it have any conventional knobs for that matter, since even the volume control is in the form of a horizontal slider. Input facilities are fairly basic and essentially provide for the program sources in the system (ie, phono, CD, tuner and tape) plus an external tape deck or VCR.

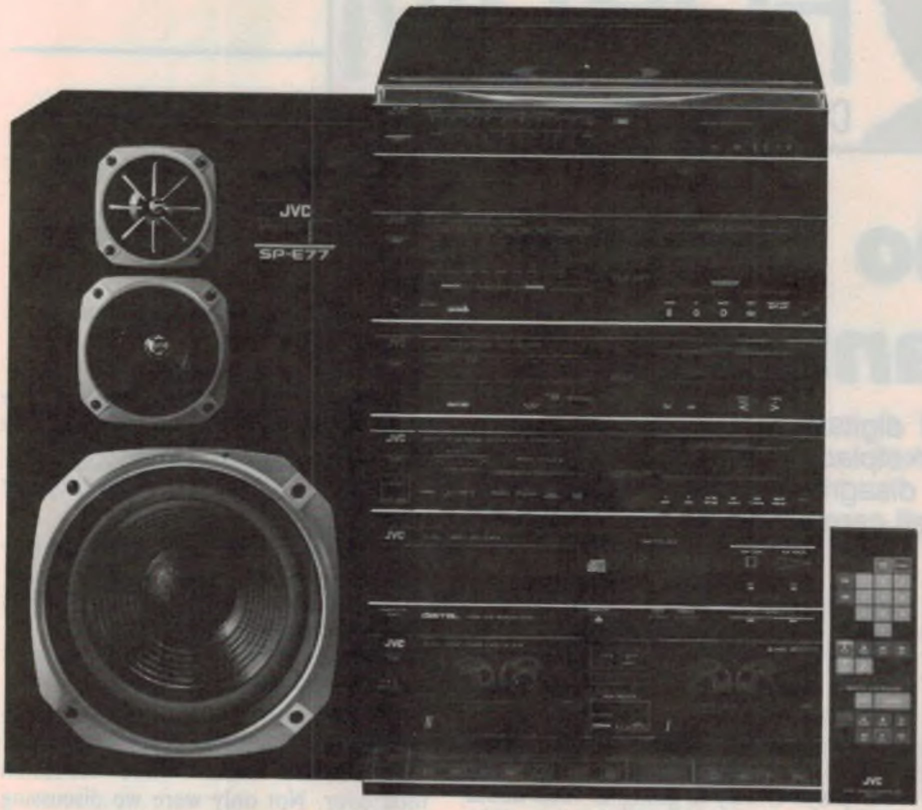
Only one pair of loudspeakers is provided for and they are switched off when a pair of headphones is connected. This means that the designers have avoided any need for speaker switching and the additional cabling and connectors involved with it.

While you might expect the interior of such a compact amplifier to be crammed to the eyeballs, it is not particularly crowded. It uses a large toroidal power transformer, which gives a lot of power from a small volume and keeps external hum fields to an absolute minimum. The transformer feeds a couple of 8700uF 50V filter capacitors (via the rectifier diodes) to give a power supply which is reasonably hefty.

The four output transistors for the two power amplifiers use the new large plastic encapsulation which is becoming more common in Japanese amplifiers and these are mounted on a generously sized extruded aluminium heatsink, inside the well-ventilated chassis.

The amplifier and all the other program sources carry the double-insulation symbol, by the way, and are all fitted with a sheathed two-core power cords and three-pin plugs.

Incidentally, we should again express a reservation about whether most Japanese "double insulated" equipment



Pictured at left is the complete JVC W77CD system with one of its loudspeaker cabinets.

would in fact meet the Australian standards. The particular area in which consumer equipment tends to fall down is not in the power supply components but in the mains wiring itself within the chassis. To be designated "double insulated" it needs to to have two separate layers of insulation, as does the sheathed power cord.

Cassette deck

The TD-W33 dual cassette deck is a fairly conventional unit with automatic selection of tape type (via the cassette) and with Dolby B noise reduction. The two tape mechanisms make it possible to dub from one cassette to another at normal or high speed. The layout of the transport controls on the separate sloping panel is a nice feature for easy use.

On the negative side though, we're not too keen on the touch switches used on this deck, and on the tuner and amplifier. For a system in this price range, they should be a little more substantial.

Perhaps the most interesting component in the system is the AL-E77 turntable. This has a linear tracking arm which first scans the record surface to detect the number of tracks. It is then possible to program the turntable to play up to eight tracks for up to 15 plays. It also has an "index scan" feature which lets you hear the first 15 seconds of each track, which is handy when you are programming the system. It can thus be used in a similar way to a compact disc player.

Test results

Our sample system did not include the optional XL-V22 CD player and to simplify the testing procedure, we decided to test only the amplifier and tuner components. We found both of these to give a good middle-of-the-range performance.

The amplifier is rated at 70 watts per channel according to the DIN 45500 spec but we have never regarded this as a hifi specification. Our measurements show the amplifier can deliver 46 watts per channel with both channels driven into 8-ohm loads. With 4-ohm loads, this figure rises to 68 watts per channel.

For single channel operation, the figures are 54 watts into 8 ohms and 84 watts into 4 ohms. At these powers the harmonic distortion is in the region of .04% to .08%, for the whole audible spectrum, which is quite a good result. The amplifier does have very good dynamic power performance, ranging up to 128 watts into a 4-ohm load under the IHF pulse power conditions.

We also checked all the claimed sensitivity figures, the boost and cut for the equaliser, and figures for frequency response and found them all within spec. A check on signal-to-noise ratios shows the amplifier to be modestly but not spectacularly quiet with a figure of 65dB for the phono inputs and 76dB for the high level (150mV) line inputs.

The tuner is a fully synthesised model with the usual scan up and down tuning buttons and the ability to store 16 AM and 16 FM stations. Its overall performance is about on a par with middle-of-the-road tuners. Sensitivity for 50dB quieting was 3uV (microvolts) in mono and 50uV in stereo.

Ultimate quieting figures were 72dB for mono mode, achieved for an antenna input of 150uV. In the stereo mode, ultimate quieting was 58dB which is not a good figure, although it is acheived with an input of only 200uV.

On the other hand, FM distortion is quite low, with figures of 0.06% in mono and 0.08% in stereo. Our sample tuner was a pre-production model with a low wave AM section so we did not measure its parameters. JVC do not quote bandwidth or distortion specs though, so it is reasonable to assume that it is only average in this regard.

In summary, the W77CD midi system is a compact and comprehensive music system with the luxury of remote control. It will appeal to many buyers who have small living rooms but still want reasonable performance. However, we think that it is very expensive for what it offers.

Recommended retail price of the complete system, including the three-way loudspeakers but without the CD player, is $3799. The optional CD player is $529.00. For more information, contact your JVC dealer. (L.D.S.)

FORUM

Conducted by Neville Williams

There's no antics like semantics!

Argument about the fidelity of digitally recorded sound may well have subsided in the marketplace but there's still plenty of scope for uncertainty and disagreement in the technical area — especially if one is at all careless in the choice of terminology.

The above heading and introduction was prompted by a recent telephone conversation with EA's managing editor, Leo Simpson, which began as a routine exchange of ideas and ended up in quite an argument — until it became evident that we were talking at cross purposes.

At the time, I had completed parts 8 and 9 of the series "An Introduction to Hifi", to do with digital technology, and was about to make a start on the first of two instalments dealing with compact disc players. By way of orientation, I had been looking through various articles on the subject, along with consumer level explanatory literature from the major hifi manufacturers.

Pleasantries and generalities having been disposed of, the conversation with Leo — in summary — went something like this:

WNW: With the benefit of hindsight, I'm not too happy with the routine explanation of digital audio processing. It tends to be fragmented . . . doesn't hang together as a whole.

LDS: How do you mean?

WNW: Well, to start with, the reader is often presented with a waveform referenced to an incremental ladder marked "0" in the middle, "+" above and "-" below. It communicates the basic idea well enough but, in the process, can sow the seeds of confusion.

LDS: Because it isn't the kind of waveform mapping they'll encounter later on?

WNW: That's right. Once fed the plus/minus concept, the reader may later conclude that a 16-bit reference ladder is really two 8-bit ladders end-to-end, one plus, one minus, with "0" in the middle!

LDS: That wouldn't make sense, because two symmetrical 8-bit ladders end-to-end would provide only the same number of increments as a 9-bit ladder — 512 instead of 65,000-odd!

WNW: For sure but, in the context of CD players, they're going to read about 16-bit numbers being divided into 8-bit numbers, and that could further reinforce the idea.

LDS: That's done for an entirely different reason . . .

WNW: Yes, but there's more to come. When reading about quantising small signals, they're likely to be faced with a diagram showing a very small waveform and an increment of about the same magnitude, referred to as the LSB or "least significant bit". The way they're drawn, some of those diagrams can create the impression that it's happening at the bottom of the ladder!

LDS: I guess that part of the problem is that signal and offset levels inside proprietary A/D chips aren't publicised. The chips tend to be seen only as boxes, with analog signals going in and binary numbers coming out.

WNW: Maybe the time has come to work out a whole new explanatory routine, starting with a modified Philips/Marantz style quantising diagram, which assumes that analog waveforms are normally mapped from a reference beyond one extreme of the peak to peak swing. It could serve, not only to illustrate quantising but as the basis for general statements about mapping.

LDS: What are you waiting for?

WNW: In the context of quantising very small signals, it might involve mention of two possible LSBs — one either side of the zero signal level — which could turn the alternate half-cycles of critically small signals into rectangular pulses.

LDS: Hold on! You can only have one LSB in a digital system — by definition. The other bits are all going to be progressively larger.

WNW: We're talking about a linear system, remember?

LDS: Of course we are but the bits increment as the power of two!

And that's about where confusion took over. Not only were we discussing potentially misleading word pictures but we were also getting hung up on terminology, for which I must accept most of the blame.

Because I'd been poring over digital audio literature, I was tending to take quantum jumps in logic and to be less than precise in my choice of words. Bits, LSBs, increments — what's the difference when your brain's in a hurry?

Fortunately, we were able to get back on to the same wavelength (or clock frequency?) with Leo agreeing that there were conceptual difficulties and volunteering the further suggestion that few readers would realise that the first quantising bit to toggle was always the MSB — the most significant bit — not the LSB.

Sorting it out

Had this conversation taken place a few weeks earlier, I may well have explored the new approach in the October '86 issue (An Introduction to Hifi Pt. 8) although new diagrams and more detailed explanations could well have posed a space problem.

For purposes of the present discussion, we reproduce herewith a quantising diagram of the kind we have in mind, along with a table of 16-bit binary numbers.

As you will note, the centre column is in binary format, with the equivalent decimal value on the right, incrementing by powers of 2 as binary 1 is moved progressively from right to left. Intermediate numbers can be represented by substituting "ls" for particular "0s" in the case of binary, or by simply changing digits in the case of decimal.

The extreme right-hand binary digit is referred to as the LSB (least significant bit) because it indicates the presence (1) or absence (0) of a single unit — in this case a single (voltage) increment in the reference ladder.

As Leo quite rightly insisted, a binary number, as such, can only have one LSB. Digits to its left indicate values increasing progressively by the power of 2, with the 16th, and most significant digit (MSB) indicating the presence (1) or the absence (0) of decimal 32,768 increments.

In the conversation referred to earlier, I upset (toggled?) Leo Simpson's equanimity by using the expression "one LSB", admittedly loosely, when I really meant one increment. I venture to suggest that, in digital talk, it may be a fairly common verbal transgression!

The point I was trying to make was that, with the analog input referenced to the centre of the voltage stack, a critically small signal in an otherwise silent channel might conceivably toggle the binary reading to register one increment either way, on alternate half-cycles, thereby specifying an ostensibly rectangular signal.

Looking at the numbers

Let's look at the numbers in the Table — and here I might indulge in what may well be the ultimate nitpick: including zero (0) a 16-bit binary number can convey 65,536 distinct values or levels but only 65,535 increments!

Taking up the point made in conversation by Leo Simpson, you will note that an 8-bit binary number can indeed accommodate only 128 increments and that two such "ladders" would add up to 256 — the same figure as for a 9-bit number.

Thinking in terms of a reference voltage stack, we could suggest, as a hypothetical — but not unlikely figure — that each increment might be equal to 100uV or 0.1mV. The total voltage across the stack would therefore be 6.5535V.

For purposes of quantisation, an input signal would need an effective DC offset or bias of half that voltage, such that a peak swing of just over 3V up and down the ladder would be possible, before running into digital overload.

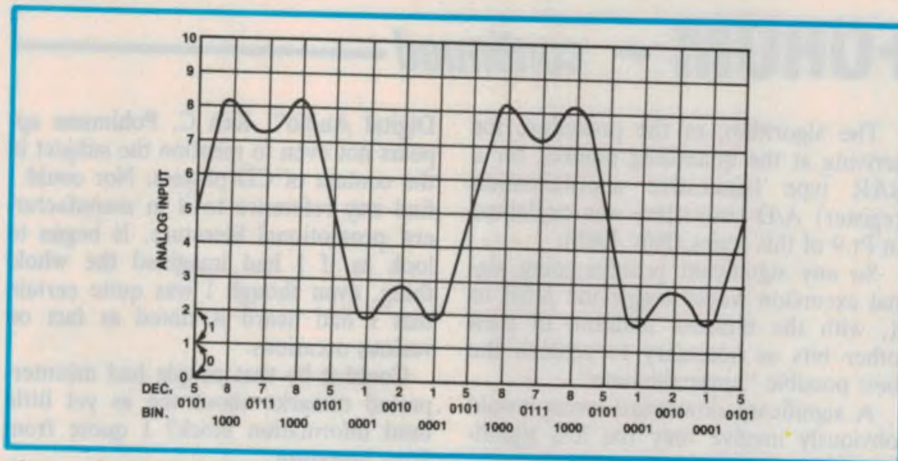


Fig.1: this diagram is similar to the diagram on page 110 of the October issue but mapped from beyond the peak-to-peak swing. Increment 0 extends from 0 to just below 1, &c. Quantised levels are indicated along the bottom in both decimal and binary numbers.

Let's assume, by way of illustration, that the offset was precisely 3.27V. With no signal and a completely noise-free channel, the binary output would be a 1 — MSB — followed by fifteen 0s.

Now let's imagine that a small signal appears in the otherwise noise-free channel of something over one increment in amplitude. On the positive swing, it could have the ultimate effect of adding the LSB to the MSB: 1 followed by fourteen 0s and a final 1, or decimal 3.2769V. On the negative swing, the MSB would toggle to 0, with all others resetting to 1, or decimal 3.2767V.

It has been pointed out in other articles that the combination of offset and signal amplitude can cause a critically small signal to cycle within a single increment, thereby producing no audio output. Or it may cycle above and below a single reference voltage, producing a rectangular wave equal to one increment.

In practice, things don't happen in such a clinical fashion. In the presence of noise energy, ranging from ambient or system noise to deliberately added "dither" (see Hifi Pt.9) bits in the binary output from the A/D converter tend to toggle continuously, in response to the instantaneous sum of the signal plus noise.

In fact, as explained in Hifi Pt.9, it is this very noise which randomises what might otherwise emerge as small but identifiable quantising artefacts, transforming them into a quite negligible white noise component.

Toggle, toggle binary bits,
Bewildering to this writer's wits;
Shuffling numbers hither, thither,
In response to noise and dither!

It will be apparent from the foregoing that the randomising effect of dither is present at all signal levels. It is potentially important, however, only for very small signals, where quantising error might otherwise translate into significant distortion.

"RUNGS" IN A 16-BIT REFERENCE LADDER

Bit Number	Binary Notation	Number of Increments
1 LSB	0000000000000001	1
2	0000000000000010	2
3	0000000000000100	4
4	0000000000001000	8
5	0000000000010000	16
6	0000000000100000	32
7	0000000001000000	64
8	0000000010000000	128
9	0000000100000000	256
10	0000001000000000	512
11	0000010000000000	1024
12	0000100000000000	2048
13	0001000000000000	4096
14	0010000000000000	8192
15	0100000000000000	16384
16 MSB	1000000000000000	32768
	Total number of increments:	65535
	Levels, including zero (0):	65536

Table 1: a table of 16-bit binary numbers showing the decimal value of all "1s" ranging from the LSB to the MSB. Levels can be represented ranging from 0 to 65535.

The algorithm, or the procedure for arriving at the quantising number for a SAR type (successive approximation register) A/D converter, was explained in Pt.9 of this series (Nov 1986).

So any significant positive-going signal excursion would toggle the MSB to 1, with the ultimate addition of such other bits as necessary to achieve the best possible "approximation".

A significant downward swing would obviously involve only the less significant bits.

It also follows that, to use the digital system to best advantage, the level of the incoming program signal should be preset so that the peak-to-peak swing will approach but never exceed the reference voltage range represented by the stack or ladder.

4-Channel Recording

By way of relief from all this number talk, I ran into a hassle of a quite different kind when preparing the first article on compact discs (Pt.10). I'm still not sure of the answer.

Early in the article, while discussing the potential of the format, I casually stated that, if and when the need arose, compact disc would be able to accommodate 4-channel "discrete" sound; in other words, "surround" sound involving four separate channels.

Later, however, when explaining the various data bit rates, I had reason to question the statement.

With 16-bit sampling at 44.1kHz, the basic data bit rate for two discrete audio channels works out at 1.4112MHz. By the time synchronising, error correction and other information is added, the figure has risen to 2.0338MHz. EFM (eight-to-fourteen) processing, to format the data for laser-optical recording and playback, extends the recording channel bit rate to 4.3218MHz!

One doesn't need to be a genius to appreciate the seeming impossibility of adding two extra symmetrical discrete channels, while still conforming to existing standards. Simply doubling the basic data rate of 1.4112MHz would carry it well beyond 2.0338MHz, even without the essential, supplementary information.

So I began to backtrack in an effort to determine where I had picked up the information, or misinformation, about 4-channel sound in the first place — but without much success.

In his excellent book "Principles of Digital Audio", Ken C. Pohlmann appears not even to mention the subject in the context of CD players. Nor could I find any reference to it in manufacturers' promotional literature. It began to look as if I had imagined the whole thing, even though I was quite certain that I had heard it stated as fact on various occasions.

Could it be that people had misinterpreted remarks about the as yet little used information block? I quote from Sony literature:

" . . . only one fourth of the control bits are utilised and six bits still remain unused".

In due course, I rang a contact in the audio-hifi division of National Panasonic (Technics). He knew nothing of any provision for 4-channel sound but promised to telex his principals in Osaka, Japan.

A contact at Philips also professed ignorance but promised to make further enquiries.

A spokesman for Sony said that, like me, he had the impression that provision had been made for 4-channel but, after looking at the figures, agreed that there seemed little prospect of them accommodating double the amount of audio data.

He rang back later to say that he could find no reference whatever to the matter in the literature available to him but he vaguely remembered some talk of running the discs at double speed. We agreed that this would be commercially unacceptable, since it would necessitate a special double-mode player, and half the playing time into the bargain!

About this same time, a telex arrived from Osaka stating that Technics in Japan had no plans for 4-channel CD "long-term, short-term or mid-term". They were apparently intrigued as to who had even raised the subject!

Just when it seemed that I had led myself completely up the garden path, information came through from Philips engineering in Melbourne confirming that long-term CD planning did apparently envisage four audio channels, "sampled simultaneously". That was all; no information was forthcoming as to how it would be achieved.

It was then that I "struck oil" myself, in the form of a note regarding the PQ code in the Service Manual for Sony's first commercial CD player, model DEP-101. On page 15, it says:

CONTROL: Indicates channel number and pre-emphasis ON/OFF

Output from MSB:

0000 — 2CH, no pre-emphasis
1000 — 4CH, no pre-emphasis
0001 — 2CH, pre-emphasis
1001 — 4CH, pre-emphasis

On CDP-101, data processing is done only for mode ADR=0001

A circuit in page 69 of the manual shows the de-emphasis circuit which activates when the control code signals a pre-emphasised recording. And that's where the matter ends at the time of writing. If the information has been published, or is otherwise available, it will have to be unearthed, rather than simply requested!

It could be that some reader has already come across it.

Why 4-Channel?

Why am I getting up-tight about 4-channel recording and playback? Primarily because it turned up as a technical problem, to which, to date, no adequate answer has been forthcoming.

However, while appreciating the difficulties of operating more than two loudspeakers in the average listening room, I remain personally partial to surround sound, when appropriate and where it can be accommodated.

If it can be offered as an ultimate and compatible option on compact discs, that would be fine, especially in a 4-channel discrete form.

If it has to be of the multiplexed or encoded variety, we should be well ahead of the situation, last time around, if only because we could be assured of a uniform system — maybe a version of the Ambisonic approach.

With compact disc, there would also be the possibility of using information bits to control the gain of the ambience channels — something that was not practical with analog encoding.

No less to the point, decoding circuitry could be included in CD players, probably at negligible extra cost. There would simply be two extra output circuits on the back which you would use or ignore, as desired.

Come to think of it: there's no special reason why existing CD players could not include a modern chip version of one of the surround sound synthesisers that we used in the 70's. They were very successful with selected standard stereo recordings; they could be even more so with noise-free, distortion-free compact discs.

Now where did I put that synthesiser board from the old 4-channel Playmaster?

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The Serviceman

Don't pass the salt please

What must rate as one of the most frustrating jobs I have encountered in recent months involved a colour set with a particularly stubborn intermittent fault. But that was not its only claim to notoriety. Even when the fault was finally tracked down, there remained the mystery as to what caused it in the first place. And from a reader there is a story about a particularly nasty appliance fault.

But to start at the beginning. The set, a Philips KL9A-2, belonged to two ladies — long standing customers — who live very close to the ocean in a nearby beachside suburb. I had installed the set for them when they bought it about four years ago, and it had given little trouble until now. But their location is not a very favourable one in terms of TV sets. They face north-east across the water and during the humid summer months when the wind often blows from that quarter, the salt laden air will penetrate almost everywhere.

Nevertheless, I didn't think along these lines when they first called me to report their problem. They described the trouble as "brief bursts of lines across the screen", which had suddenly appeared the previous evening. Now it so happened that the previous evening had been one of those rare occasions when we experience a breakthrough from interstate stations, particularly on channel 2, which was the one they were watching.

I explained this to the lady and suggested that she would probably have no more trouble, but added that, if it persisted, to give me a call. I heard nothing more for several days, and had more or less written off the incident, when I found myself making another service call in the same street. So I took the opportunity to make an unofficial call and confirm that all was well. And apparently it was, because there had been no recurrence of the trouble and the set was behaving perfectly. So that seemed to be that.

Except that a phone call to the workshop the next morning brought news that the fault had shown up again the previous evening. Now I knew it was a real fault, because there had been no further breakthroughs. This was further confirmed by additional description of the fault which, while still vague, hinted at a sync problem.

No horizontal sync

So, later that day I faced up to the offending set. I switched it on and, as it warmed up, the fault was clearly evident; complete loss of horizontal sync, but perfect vertical sync. It lasted for only ten seconds or so, then the set came good and stayed that way. So much for the "lines across the screen" description, and the problems which some customers have in describing faults. But that's all part of the game and at least I had seen the fault.

Not surprisingly, I was already blaming the salt atmosphere and, in fact, knew exactly what I wanted to check. This set consists of a large main board, measuring about 45cm wide and some 40cm high which sits vertically across the rear of the cabinet. It has a rectangular cutout in the centre to accommodate the neck of the tube and the neck board, which is the same shape as the cutout, but slightly smaller. (It is, in fact, made as part of the main board, and punched out later).

The print side of the board faces out, and it can be unclipped at the top and folded down to reveal the component side. And on this side are a half dozen smaller boards mounted in edge connectors at right angles to the main board. They include the IF amplifier and detector, chrominance and luminance, synchronisation, supply, R-G-B, and sound board. The edge connectors have about 20 pins and each board is about 75mm x 125mm.

It was the edge connectors that I suspected. These connectors, or something very similar, are used in the same manufacturer's K12 model, and have given more than their fair share of trouble. This fact, coupled with the aforementioned salt environment, seemed to almost guarantee that this would be the problem.

This was all the more so by the reason of the number of contacts involved in the overall sync circuit. The circuit is too large to reproduce here, but the accompanying block diagram will give some idea of the arrangement. Signal from the IF and detector board is fed to edge connector pin 2 of the chrominance and luminance board and the luminance signal subsequently extracted from edge connector pin 3. This is then fed via a track on the main board to pin 6 of the synchronisation board.

This board extracts the sync pulses, and the horizontal pulses come out on pin 15 and go via the main board to pin 11 of the supply board. This board carries the horizontal oscillator and driver for the line output stage, which is on the main board. So there are no less than four edge connector contacts in the sync line between the chrominance and luminance board and the supply board; all potential trouble spots.

Anyway, at this stage I felt that a routine clean-up of the edge connectors should sort out any of their troubles and put the set back in business for a few more years. And so the boards were duly extracted, the contacts cleaned and lubricated with CRC2/26, the boards replaced, and the set checked out. It worked perfectly, with no hint of trouble. And so I regarded the job finished, but took the routine precaution of advising the ladies to contact me immediately if the fault showed again.

Which was just as well, because that cure lasted only a couple of days. Then there was a phone call saying the fault was back, exactly as before. This time I didn't muck about. I fished out a loan set and made another call. Again, at switch-on in the house, the fault showed up for a few seconds as the set warmed up, then vanished. And the ladies' story was that it would sometimes do that, then run all night. At other times it would come straight on, then fail an hour or so later, often for long periods.

So I loaded the set into the van and took it back to the shop. I had a feeling that it might be a long battle. The only good point was that the fault seemed to appear fairly frequently, and I hoped it would continue to do so. In fact, it turned a bit stubborn. For the next three days the set never missed a beat and I was wondering what to do next when it suddenly changed it's mind and turned on a real display, failing at almost every switch-on.

A stroke of luck

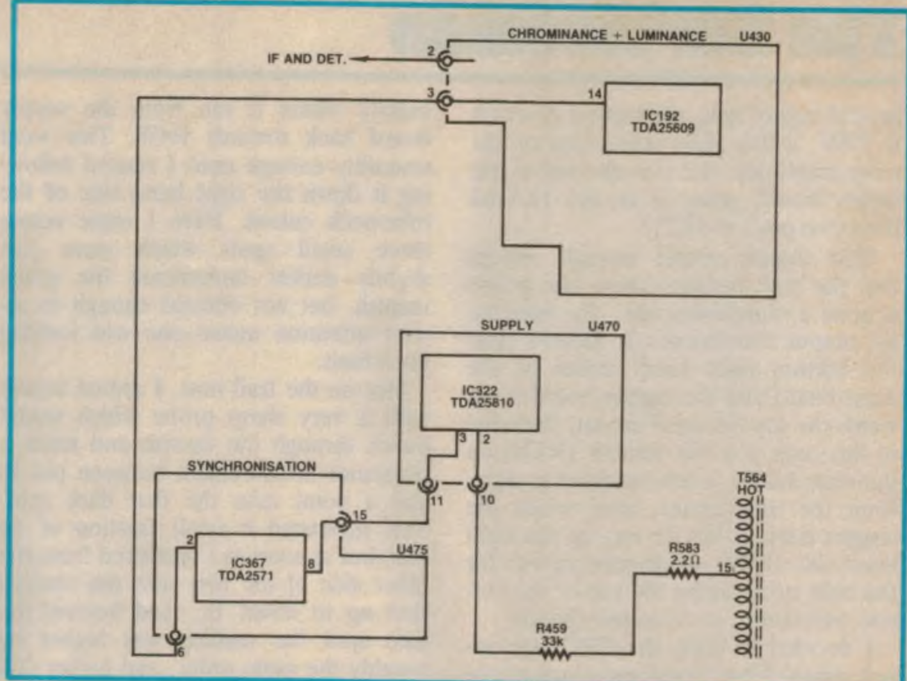
When it did I was ready. By a stroke of luck I had another such set in the shop, waiting for the owner to pick up when he returned from a country trip. Assuming the edge connectors were no longer suspect, then one or other of the three boards was the next likely culprit. So with another on hand it was a golden opportunity; to substitute known good boards.

I started with the chrominance and luminance board, even though I imagined that a fault on this board would probably produce other symptoms. In fact, the set obligingly failed almost immediately, thus clearing that one. I then substituted the synchronisation board. This worked for the best part of a day, then the fault showed up again. So that was two down and one to go.

At this point — inevitably I suppose — the owner of the other set appeared. There was nothing I could do, of course, except pass the set over with a smile and be thankful that I had at least ruled out two boards. But where did I go from here? It didn't take me long to decide that the CRO was the next logical weapon, in an effort to find out just where the sync information was being lost.

One of my more recent aquisitions in this regard is a dual-trace CRO, the BWD 525. With the aid of an external module, which I have, this becomes a triple trace instrument and could, if necessary, be expanded to four traces with another module.

I set up the CRO with one input monitoring the luminance signal where it emerged from the chrominance and luminance board (pin 3), one where it entered the synchronisation board (pin 6), and the third where it entered the supply board on pin 11. This may seem like a duplication of effort at first glance, because I had already cleared two of these boards, but I had a good



This block diagram shows the interconnecting paths between the three relevant sub-boards of the Philips KL9A-2. Note the number of connectors involved in the sync path.

reason for this approach.

It was not so much the boards that I was checking, but the paths between them on the main board. As well as the actual copper tracks — which could have developed a hairline crack — there were some minor components, not shown on the block diagram, which could have either opened or shorted in the path. In short, I wanted to be absolutely sure that the sync pulses were actually reaching the supply board or, if they weren't, where they were going astray.

Well, the setup worked exactly as I had hoped. It wasn't long before I was able to establish that the sync pulses were not only reaching the supply board, but were intact right up to pin 3 of IC322 on that board (TDA25810). So what now? The supply board itself was a logical suspect, by reason of either the IC or one of the discrete components.

I considered changing the IC, but decided not to rush in until I could at least make a few more observations. Unfortunately, at this stage, the set decided not to cooperate. I ran it all day and every day for over a week, switching it on and off, heating it, letting it cool, and all the other tricks that I could think of, all to no avail; it just kept going.

I was beginning to wonder whether, somehow or other, I had inadvertently "fixed" the fault, at least temporarily — a prospect which didn't bring me much joy. It was only when I let the set stand over the weekend and switched it on on the Monday morning that I realised that the fault was still there. Unfortunately, it appeared for only a few seconds, and was of little real help.

On the other hand, its refusal to fail had forced me to think a lot more about the circuit. Was there really a fault in the supply board? For the most part it appeared to be working correctly, in that it was still delivering drive to the line output stage. So, if this much was working and the pulses were reaching the board, why wouldn't the system lock up?

Flywheel circuitry

This started another train of thought. If there was nothing wrong with the board, what else could cause sync failure? And suddenly I remembered how some of us were caught in the early days of monochrome TV, before we had fully grasped the significance of horizontal flywheel circuitry. Regardless of the details of the flywheel circuit, all such systems need a reference pulse from the horizontal deflection system, for comparison with the incoming sync pulses, in order that correction voltages can be generated. No reference pulse, no sync.

It took only a few moments perusal of the circuit to find what I sought. The reference pulse comes off pin 15 of the horizontal output transformer (T564). The pulse comes via a 2.2 ohm safety resistor (R583) and is used to create

The Serviceman

several supply rails, the highest of which is 175V, which gives some idea of the pulse amplitude. But it is also fed to the supply board, going in on pin 10, and thence to pin 2 of IC322.

This sounds simple enough, except that the path between these two points is quite a roundabout one. The horizontal output transformer is located near the bottom right hand corner of the main board and the supply board is towards the top left hand corner. Included in this path is a 33k resistor (R459) on the main board, a few centimetres away from the transformer, after which the copper track makes its way up the right hand side of the rectangular cutout for the tube neck, along the top of the cutout, and thence to the supply board.

I decided to bring the CRO into action again. I connected one trace to pin 10 of the supply board, one to the 33k resistor, on the supply board side, and the third trace on the other side of this resistor. Then I duly noted the waveforms while the set was functioning normally — the amplitude was down to about 10V at the supply board, due to the 33k resistor — and waited for the fault to appear.

And I kept on waiting. Day after day went by and nothing I could do would induce the fault to appear. After a week or so of this I was feeling desperate. For something to do, as much as any clear idea of what to expect, I reached for the multimeter — a digital type with an excellent low ohms capability — and attacked the pulse reference line.

I had already checked the two resistors in the line, R583 and R459, so I started at R583 and measured up to R459; a distance of only 50 or 60mm along the track. This proved to be a dead short. Next, I measured from the other side of R459 to pin 10 of the supply board; the long copper path I have already described.

And that was the breakthrough, because it measured several thousand ohms; several thousand ohms which should not have been there. Small wonder we had sync problems. The only question remaining was the cause of this extraneous resistance. A hairline crack? Perhaps, but these seldom create an intermediate condition; they usually vary between open and closed.

Dark spots

Anyway, I began a painstaking examination of the copper track, tracing exactly where it ran from the supply board back towards R459. This went smoothly enough until I started following it down the right hand side of the tube-neck cutout. Here I came across three small spots which were just slightly darker underneath the green varnish, but not obvious enough to attract attention unless one was looking for a fault.

Hot on the trail now, I armed myself with a very sharp probe which would punch through the varnish and made a resistance measurement between pin 10 and a point near the first dark spot. This measured a small fraction of an ohm but as soon as I measured from the other side of the first spot the reading shot up to about 1k. And beyond the next spot the reading was higher by roughly the same order, and higher still beyond the third spot.

With the edge of a knife I began scraping away the varnish, a process which would, in normal circumstances, have taken me down to a bright copper track. Instead, all I found was a patch of copper oxide, or some similar compound. And while I was doing this I realised that another track, immediately adjacent to this one, had some similar dark spots on it. Further investigation confirmed that there was trouble here too, although there was some copper left, and failure was still in the future. Thus alerted, I went over the rest of the board, but could find no further evidence of trouble.

I'm not sure what function the second track performed, nor was I inclined to spend more time finding out. I simply bridged both faults with lengths of tinned copper wire. After this it was hardly necessary to test the set, although I did run it for a couple of days before returning it to the owners.

Which was a satisfactory conclusion from a practical point of view, but leaves unanswered the question as to why this corrosion occurred. In talking it over with colleagues a couple of suggestions have been advanced. My own theory is that it was basically due to salt atmosphere, possibly aggravated by a heavy accumulation of dust in that area. This, in turn, was possibly encouraged by the high focus voltage (5.4kV) on the neck board, which sits in almost the same place as the main board.

This dust would harbour moisture, salt laden moisture in this case, and could contribute to the problem. But what about the varnish; wouldn't this protect the copper pattern. Here a colleague suggested that the varnish coating may have been faulty, possibly containing a clutch of pinholes in this area.

Another colleague suggested that it may have had nothing to do with the salt environment at all and that this was purely coincidental. His theory was that the board was contaminated during manufacture, some corrosive substance having been splashed on it, or not washed off it, before the varnish was applied.

So there it is, take your pick — or come up with your own ideas if you like; I'd be happy to hear them.

To change the mood completely, here is a story from one of my readers, who operates a service business in Wynnum, Queensland. It is one of several stories he submits, all of which suggest that his area probably has more weirdos per square kilometre than average. Anyway, here's one of his experiences. He calls it:

Fred's electric soup

This is the story of Fred's encounter with a faulty electrical appliance. Fred is inclined to drink a bit, and is best avoided on any day except payday, which is the only time that he does not try to borrow money. The kindest remark one could make of him is that he does not drop in very often.

Whilst the rest of the country works in dollars and cents Fred measures value in bottle currency. In Fred's monetary system two bottles worth is reasonable, but ten bottles worth is downright extravagent.

Apart from everyday items, this system also applies to TV or audio repairs. Fred would consider a few tinnies to be adequate payment for a TV service — including picture tube replacement — presentation of an account and requests for payment failing to evoke any response other than a pained expression.

Some time back, he presented a 3-in-1 unit for service, and politely pointed out that if the work was done in my spare time I would not have to charge for labour!

Fred is in the habit of attending to his thirst until closing time, then wandering home for a hot meal. This usually consists of a can dropped into a saucepan of water. Unfortunately, Fred dozed off one night whilst waiting, and the water boiled away. The end of the can eventually blew off, and a jet of baked beans shot skywards, covering the ceiling and wall. Fred managed to clean up most of it, except for a dark patch on the plaster directly above the stove, which makes an interesting conversation piece.

The secondhand crockpot

After this unhappy incident, Fred decided to buy a crockpot. What a good idea, thought Fred, I can come home to a hot meal, and no waiting either.

Off went our boy to the nearest store, "to pick out a good one". Fred lost his sudden passion for new appliances when he read the price tags. So — on to the next stop — the local secondhand shop, where such goods are to be had for less bottles.

On arriving home, Fred could not wait to try out his new toy. In went the water and ingredients, and in went the spoon to stir it. But Fred suddenly found himself in receipt of a hearty handshake from the secondary winding on the local stepdown transformer.

"Arrgh" said Fred, staggering back and retreating towards the fridge for reinforcements. After a bit of courage was restored, Fred took the offending item to the local "fixit" shop for service, where the Megger was connected and the appliance duly pronounced fit and healthy. Of course, there was a $15 charge for the privilege of testing it.

A still-shocked Fred was a bit dubious. Thus, a demonstration took place on the shop counter, with some explanation on the working of Meggers, and assurances that the unit was completely safe. A confident Fred headed home for a hot meal.

But that was not the end of it. Fred was zapped again. This time it probably felt worse as he was not expecting it.

The next morning a very white-faced Fred arrived on my doorstep and related the above. We were tempted to remark that it was a reversal of roles (something biting Fred for a change). However, this was withheld to avoid probable hospitalisation. Our electric warrior departed for his current place of employment (sorry about that!), and we were left with a mystery.

Obviously, something was seriously wrong, but what? The previous tests had indicated a no-fault condition, when in fact a fault did exist. The answer must lie inside the unit, so off with the base. Just remove a few screws. Just remove a few well-rusted-in screws. I spent a fruitless five minutes trying before giving up and reaching for the power drill.

For those readers who have not dismantled a crockpot . . . This particular model, is a single bowl type; that is, the bowl is fixed to the case, and is only removable with the use of tools. Examination of the bowl showed that the inside was coated with glazing, and the outer unglazed surface carries five or six turns of fine resistance wire, part way up from the bottom. These are fixed in place by ceramic cement at strategic points.

Control of temperature is by a rotary switch, the principle being similar to that of an electric blanket.

On close inspection, everything was intact. There were no loose or broken wires and all connections were tight and dry. Apart from a little rust on the steel case, everything looked A1. A check was run with the meter set on the "x 10 Megohm" range. All readings showed infinity. There was only one test remaining, and that was to fill the bowl with warm salt water to simulate actual working conditions.

It soon became obvious that this idea was not practical, as the unit could not be turned over if the need arose. Also, there was the possibility of spilling several litres of salty water over the bench, which was not appealing.

A workable method was finally found by applying a paper tissue to the inside of the bowl, then wetting this with a strong solution of salt and water. The wet tissue adhered to the glaze, and the whole unit could be manipulated into any position without mess. One probe was applied to the wet tissue, and the other to the resistance wire.

TETIA Fault of the Month

Blaupunkt "Cardona"
Symptom: Vertical collapse, not caused by vertical output transistors or their feed resistor. The fault is sometimes intermittent.
Cure: R643 (1.5 ohm, 4W) on power regulator board open circuit (or intermittent). This resistor feeds 24V to vertical oscillator. The rest of the vertical stage runs off the 30 volt rail.

This information is supplied by courtesy of the Tasmanian branch of The Electronic Technicians' Institute of Australia. Contributions should be sent to J. Lawler, 16 Adina St, Geilston Bay, Tas. 7015.

A real shocker

A reading was expected on the "x 10 Megohm" range which goes to show that the answer was decided before the question was asked. The final reading was under 30 ohms on a small area of the bowl. Very lethal.

Examination of the glaze with a magnifier, revealed many vertical hairline cracks directly on the area where the heating wire is positioned. Conductive liquid would penetrate these cracks and come into direct contact with the wires. No wonder a shock was received under these conditions.

Two points arise from the above. Firstly, how many readers own such appliances, and are they in the same condition?

Secondly, the appliance may be earthed in accordance with the appropriate electrical requirements, but this applies only to the metal case. Since the metal bowl is an insulator, it is not possible for a fuse to blow, as the inside is isolated from the case, and there is no electrical path between the two. This then allows any liquid inside the bowl to float at mains potential. Ugh!

Thank you K.H. for a most interesting story. Apart from the humour of the situation, it does contain a sobering thought involving the safety of these and similar appliances. Unfortunately, I can't answer your questions regarding the market situation. I am not an authority on crockpots although, like yourself, I have encountered my share of crackpots.

Come to think of it an alternative title for this story could be "Crackpots and Crockpots".

'Nuff said!

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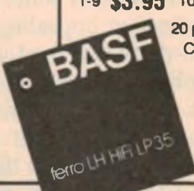

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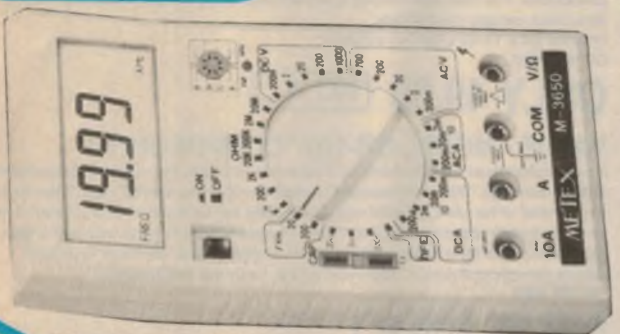

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	Resolution	100uV, 1mV, 10mV, 100mV, 1V
	Accuracy	200mV-200V±(0.8% rdg+ 3 dgts) 750V±(1.2%rdg+ 3 dgts)
	Input Impedance	10M ohm
DC Current	Range	200uA, 2mA, 20mA, 200mA, 20A, 10A
	Resolution	100nA, 1nA, 10uA, 100uA, 10mA
	Accuracy	200uA-20mA±(0.5%rdg+ 1 dgt), 200mA±(1.2%rdg+ gt) 10A±(2.0%rdg+ 5 dgts), (10A range unfused)
	Max Input Current	10A (20A up to 60 sec)
AC Current	Range	2mA, 20mA, 200mA, 10A
	Resolution	1uA, 10uA, 100uA, 10mA
	Accuracy	2mA-20mA±(1.0%rdg+ 3 dgts), 200mA±(1.8%rdg+ 3 dgts) 10A±(3.0%rdg+ 7 dgts), (10A range unfused)
Resistance	Range	200, 2k, 20k, 200k, 2M, 20M ohms
	Resolution	0.1, 1, 10, 100, 1k, 10k ohms
	Accuracy	200 ohm ±(0.5%rdg+ 3 dgts) 2k ohm - 2M ohm ±(0.5%rdg+ 1 dgt) 20M ohm ±(0.5%rdg+ 2 dgts)
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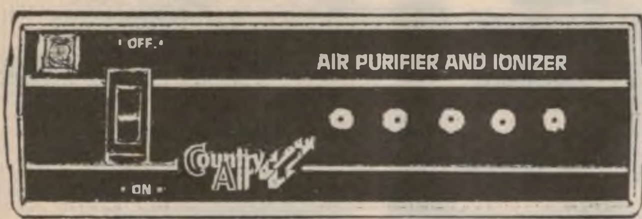


4 $^1/_2$ DIGIT ACCURACY 3 $^1/_2$ DIGIT PRICE!!

AND DIGITAL HOLD TO BOOT!

Just think a multimeter with 0.15% accuracy on most ohms ranges. 0.05% on DC volts and 0.5% MAX on DC current!! STAGGERING, plus, continuity buzzer and LED symbol, auto polarity, auto zero, vinyl case and DATA HOLD as well!! NOT TO MENTION the transistor and diode tester!!

SPECIFICATIONS
* 0 - 1kV DC 0.05% * 0 - 750V AC 0.8% (max) * 10A DC 0.5% (max) * 0 - 10A AC 1% (max) * 20M ohm 0.5% (max)

FEATURES
* All ranges fully protected * Auto zero * 0.5" high LCD * Diode test (1mA fixed current) * LCD display feature * Functional annunciators * Extremely accurate * 20 page instruction manual included
Cat. QM-1550

ONLY $179.00 Illustration 1

10 AMP DIGITAL MULTIMETER + TRANSISTOR TESTER & CAPACITANCE METER

The big daddy - this superb unit features 0.5" high digits, CMOS logic, auto polarity etc.
Cat. QM-1540
A BARGAIN AT
$129.00 Illustration 2

1.

2.

3.

10 AMP DIGITAL MULTIMETER WITH TRANSISTOR TEST FACILITY

Superb features and specifications. Includes 0.5" high digits, single function range switch, long battery life, etc.
Size: 170(H) x 90(W) x 35(D)mm.
SEE THE JAYCAR 1986 CATALOGUE FOR FULL SPECS
Cat. QM-1530

ONLY $89.95 Illustration 3

HANDS FREE TELEPHONE CONVERTER

JAYCAR NEW FOR 1987

This device allows any handpiece type telephone to be converted to complete hands-free operation. Simply drop your regular telephone handpiece into the cradle and talk via the headset/microphone unit provided. Not only is this an ideal hands-free phone, it's great for people who are in a noisy environment or are hard of hearing. It can also be used as a conference phone (with the addition of an extension speaker) and for off-line telephone conversation recording.

OTHER FEATURES
- Mute switch fitted (your voice is cut off to other party)
- Use with any handset
- No wiring necessary
- No Telecom restrictions
- Has NiCad (AA) charge circuit (needs AC adaptor)
- Low power consumption
- Auto power off
- Very comfortable headset
- Volume control for receiving voice

A very comprehensive device
Cat. YT-7075

ONLY $59.95

GORE HILL STORE OPEN SATURDAYS UNTIL 4 p.m.

MULTICOM II from Avtek

Turn your IBM PC (or clone) and Multimodem into a complete 'Smart Modem" & SAVE!!

That's right! With Multicom II software you can configure your IBM PC to work as a smart modem. Your old Avtek Multimodem (either auto answer or not) is also required. Simply load the software diskette provided, follow the instructions in the 32 page comprehensive manual supplied and enjoy:-

- Dial up communications with both (ASCII) bulletin boards and Videotex (Viatel) services in the one package. No other package integrates all features.
- Allows autodialling and redialling. No more wasted time getting onto the bulletin board.
- Easy "one keystroke" logon to Viatel or any other service or bulletin board. Viatel support of modems not supporting split board rates.
- Superb menu driven mode with complete control of communications parameters. Viatel, YAM and Modem 7 batch transfer protocols.

A complete communications package for IBM PCs and compatibles. Miles ahead of Crosstalk, it integrates a superb Viatel package to boot. Works superbly with Avtek Multimodem too, it provides full autodialling and autoanswer facilities on the Multimodem.
Cat. XS-4840

ONLY $149.50

TELEPHONE EXTENSION BELL

This compact unit is supplied with 10 metres of cord fitted with a standard Telecom plug. Simply plug it into a wall outlet and it will ring at the same time as your telephone. A LED is fitted as well which will flash. (Note. If you only have one telephone outlet a double adaptor will be required. (Cat. YT-6020 $7.50).
Cat. YT-6030

ONLY $24.95

OWN A PORSCHE 928 for under $50!!

A car many of us dream about that you can now own!!
How would you like a gleaming Porsche RC928 in black or pink - all 7 inches of it - gleaming at you on your desk. Not only does it fill you with pride but you can talk to it and it will talk back! Because it's really a telephone!
Thta's right! Impress your friends with your new-found wealth. Comes complete with generous cord with Telecom plug already fitted. Features pushbutton dialling, on/off ringer switch, mute (removes your voice) button, redial (up to 17 digits) button and instructions. Uses no batteries. Simply plug in and you're away!
Cat. YT-7070

ONLY $49.95

COMPUROBOTS 1987 RANGE

Jaycar is proud to announce our 1987 'Turtle' robot line-up. We have expanded our range to 3 models - selected for value-for-money and performance from a large number of overseas types.
Prices start from a modest $49.95! All robots are supplied in attractive gift packaging.

ECONOMY Model CR-400 "FRIENDLY LITTLE ROBOT"

This unit is roughly 150mm diameter and 210mm high. The CR-400 is programmed via a 8-key membrane keypad on its 'chest'. Programmable actions include: Music sound, flash 'eye' (light on head), turn in either direction, circle, etc. Up to 18 consecutive entries are permissable. This robot also features a very effective tactile bumper switch and movable arms which can grip small objects.
Uses 4 x AA & 1 x 9V x cell (not supplied)
Cat. XR-1020

ONLY 49.95 PIC 'A'

VALUE - MODEL CR-100 "COMPUROBOT"

A very sophisticated robot for the price. This unit which measures roughly 150mm diameter and 1650mm high. This microprocessor controlled unit is programmed via a 25 key keypad on the 'head' of the robot. Up to 48 separate routines can be entered into a program. The robot has a multi-speed gearbox, can travel in 4 separate directions as well as at angles and curves. It has lights and can make sounds. Hundreds have been sold to primary schools throughout Australia. Requires 4 x AA & 1 x 9V cell (not included).
Cat. XR-1024

$69.95 PIC 'B'

PERFORMANCE - MODEL CR-200 COMPUROBOT II

This highly sophisticated robot has it all. The robot is programmed via a wireless infra-red hand held controller with a 25 key keypad. A very comprehensive 30 page instruction booklet is also provided. Up to 64 program steps can be accommodated in the robot memory. Simple editing functions are a feature of this unit, which uses LOGO-type commands. The unit will go in any direction as well as make a number of different noises, flash lights etc. It beeps every time a key entry has been entered so that it verifies entry. The robot has two (non motorised) mechanical arms to actually carry a payload. A crayon attachment is also provided to enable the robot to "draw".
When the I.R. controller is not in use the robot has a holder to carry it about. Another very valuable feature is an auto-turn-off facility, which conserves battery life.
A highly recommended product.
Measures 230(H) x 210(W) x 175(D)mm
Rugged ABS plastic case. Uses Japanese quality Mabuchi motors.
Batteries required 4 x C (for robot); 4 x AA (for controller)
Cat. XR-1028

$129.95 PIC 'C'

DIGITAL SOUND HEADPHONES

We have introduced a range of high quality attractively boxed stereo headphones specifically designed to handle the dynamic range of CD players.

SA700

These phones feature 32 ohm Mylar drivers and low fatigue headband assembly. A 10' cord is provided with a quality METAL 3.5mm stereo plug. The headband has a separately adjustable strap to get a good 'fit'. Many otherwise good headphones have poor head fit. Sponge rubber earpads.
Cat. AA-2012

$29.50

SA800

The big feature of these 'phones is the obvious quality. The main headband is stainless steel with a sub-band that is adjustable to a considerable degree. The muff pads are beautifully made from the softest leather-like material that we have ever seen. It is sewn up as a foam filled ring - and it might even BE leather! It gives an extremely comfortable fit to your ear and effectively seals out external noise. A generous 10' heavy duty cord is provided terminating in a quality metal 6.5mm stereo plug.
Cat. AA-2022

$39.50

SA888

Similar to model SA880, except with larger Mylar drivers and further development of the earpad assembly. Simply the finest 'phones we have tested in a long, long time. They compare very favourably with pricey German 'phones.
Cat. AA-2023

$59.50

SPECIFICATIONS:
Speakers - high velocity mylar diaphragm driver
Impedance - 32 ohms
Output SPL - 102dB (1mW)
Freq. Response - 20Hz - 25,000Hz
Rated input - 100mW
Cord - 10ft with 6.3mm stereo plug

WORKHORSE POWER AMP MODULE AEM 6506

This is the obvious successor to the fabled ETI480 amps. This kit will give around 100W rms into 4 ohms with recommended transformer. It is actually cheaper than the 480 which required an expensive power supply. The AEM 6506 has power supply filter caps INCLUDED! You only need to connect up a power transformer and bridge rectifier. It is very easy to build - even for a novice. No bias adjustment!
Cat. KM-3050 ONLY $35.00 Transformer extra

JAYCAR NEWTON 1987

Hills

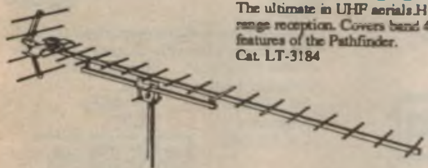
TRUCOLOUR UHF ANTENNA

HILLS TV ANTENNAS

Jaycar now has available the Rolls Royce of TV antennas - Hills.

TRUCOLOUR UHF

The ultimate in UHF aerials. Hills new 18 element antenna for long range reception. Covers band 4 (520 - 620MHz), and has all the features of the Pathfinder.
Cat. LT-3184



$89.50

PATHFINDER UHF/VHF

Designed for perfect pictures in metropolitan and fringe areas. Features include new UHF Dipole design. Ellipsoidal boom for strength, all elements and boom anodised for long life. Element insulators are ultraviolet stabilized for long life. Complete with Balun. The very best antenna.
Cat. LT-3152

$139.50

HILLS AND JAYCAR No.1 FOR ANTENNAS

While you are home over the New Year break why not get on the roof and update your TVreception. . .

JAYCAR No1 for TV AERIALS

UHF/VHF GUTTER GRIP

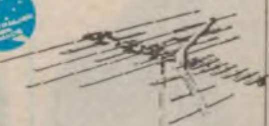
A combination aerial for good reception areas.
Cat. LT-3175

$44.95

"TRIBAND" OUTDOOR ANTENNA UHF/VHF/FM

Suitable for most VHF and UHF applications. Triband antenna for VHF channels 2 - 12, FM channels and UHF channels 21 - 69. Excellent performance for medium to poor signal areas.
Cat. LT-3145

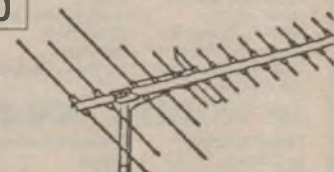
$85.00



UHF/VHF METRO

For those who want to receive VHF as well as UHF. This is the you need. Suitable for metropolitan areas. Use LT-3026 Balun for coaxial.
Cat. LT-3160

$65.00



TWEETY PIE 116dB

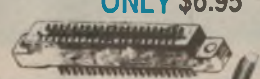
This incredible little piezo screamer (measures 57(L) x 33(H) emits a 116dB wail. It's deafening! As used in the screamer car alarm kit.
Cat. LA-5255

ONLY $16.95

COMMODORE COMPUTER EDGE CONNECTOR - AT LAST!

A card edge connector that fits on the expansion port of Commodore computers. This high quality connector features gold plated bifurcated contacts (2 rows of 12 contacts) on the correct pitch. A very difficult to obtain part and a must for Commodore enthusiasts.
Cat. PA-0888

ONLY $6.95



NEW GENERATION CORDLESS PHONE

Microprocessor controlled - 200 metres range and absolute security

Quite simply the finest cordless phone we have appraised. Naturally it is in total conformity to the 1986 Telecom specifications and is Telecom approved.
The range with the 39/30MHz RX/TX FM system is fabulous - as against the very short range cordless phones of yesterday.

FEATURES:
- Operating range up to 750ft (250m)
- Security code system with 16,384 combinations
- Last number redial
- LED indicator on handset for low battery indication
- Hearing aid compatible

Cat. YT-7065

TELEMAIL PHONE NUMBERS

(008) 022 888
TOLL FREE
FOR ORDERS ONLY
(02) 747 1888
HOTLINE

PENLIGHT NiCads

Don't keep wasting money buying throwaway batteries - step up to rechargeable NiCads.
SUPERB "ROCKET" BRAND AA PENLIGHT 450mA/h
Cat. SB-2452
$2.95 each
SPECIAL 4 for $10

"ULTRA FIDELITY" PREAMPLIFIER

Ref: AEM Oct - Dec 1985
Cat. KM-3030
$319.00

NEW DIODE PACKS from as low as 7.5¢!

Jaycar now has bulk packs of popular 1N4004 & 1N4007. Buy in bulk and SAVE!
Cat. ZR-1005 100 pieces of brand new, prime spec 1N4004 diodes **ONLY $7.50/pack**
Cat. ZR-1008 100 pieces of brand new prime spec 1N4007 1000 P.I.V. 1 AMP diodes
ONLY $14.00/pack

THE ULTIMATE

AEM 6000 POWER AMPLIFIER

The 6000 series power amplifier by David Tillbrook is the culmination of over 7 years work on power amp design using Mosfet technology.

$998.00

The Jaycar kit includes:
- 300VA toroids (pre-amp toroid extra)
- Metal work identical to prototype
- Original diecast heatsink

Commercial equivalents cost between $2,500 & $3,500
Cat. KM-3020

SPECIFICATIONS:

Output Power	240W RMS per channel into 8 ohms (360W RMS into 4 ohms)
Damping Factor	>300 (100Hz 8 ohms)
THD	<0.005% @ 1kHz @ 200 watts
S/N Ratio	400Hz - 20kHz noise bandwidth >118dB 'A' - weighted

WE WILL NOT BE RELEASING THIS KIT UNTIL FEB 1987

Z80 MICROPROCESSOR SELLOUT

By todays standards the old Z80 is a pretty pedestrian CPU. Nowadays we only stock the 4MHz 'A' version. But guess what? We have found a cache of old Z80 parts! They were once hardto get and will become hard to get in the future. So at the prices shown below grab a few spares while you can! Standard 1.7MHz.

Z80 CTC Cat. ZZ-8036
1-9 $2.00 ea 10+ $1.50 ea
Z80 PIO Cat. ZZ-8037
1-9 $3.00 ea 10+ $2.00 ea
Z80 DMA Cat. ZZ-8038
1-9 $6.00 ea 10+ $5.00 ea

SPEAKER CORNER

FOSTER SPEAKERS

WHITE CONE WOOFER $24.95

Best value 8" woofer we've seen. Excellent sound and a beautifull looker. Ferrofluid 30 watts r.m.s., frequency response 50 - 3000Hz, resonance frequency 50Hz.
Cat. CW-2111

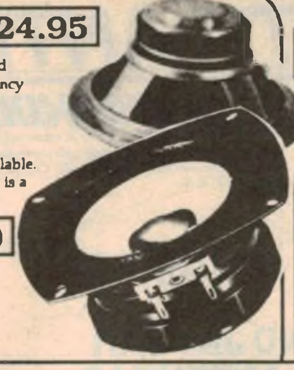
4" WIDERANGE C100K03 $21.50

This ever popular widerange/midrange is now available. Ideal where high quality is needed, but where space is a premium.

SPECIFICATIONS

Impedance	8 ohms
Power	3 watts
Max Power	10 watts
Resonant Frequency	80 ± 15Hz
Frequency Range	fo to 17,000Hz
SPL	90 ± 2dB/W
Flux Density	10,000 Gauss

Cat. CE-2312



MAGNAVOX

12MV-012

The 12MV is a high power high fidelity woofer utilising a 38mm diameter long throw voice coil wound on an aluminium former and high compliance suspension with a polyurethane foam roll surround, resulting in excellent linearity at very high input powers.

Power Handling	100 watts r.m.s.
Resonant Freq.	23Hz
Freq. Range	fo - 3000Hz
Sensitivity	96dB

Cat. CW-2125

$69.50 ea

8JX

The 8JX is a 8" twin cone speaker suitable for medium power handling applications.

Power Handling	30 watts r.m.s.
Resonant Freq.	44Hz
Freq. Range	fo - 14kHz
Sensitivity	93dB

Cat. CE-2333

$26.50 ea

POLYPROPYLENE CONE WOOFERS

HIGH QUALITY AT LOW COST

12" WOOFER $79.50

Power Handling	80 watts rms system
Impedance	8 ohms
Resonant Frequency	23.2Hz
Sensitivity	92.3dB 1 watt 1 metre
Eff. Freq. Response	23Hz - 5kHz
Electromagnetic Q	QES 0.481
Peak Cone Excursion	2 x/max x 1.6mm

Cat. CW-2130

10" WOOFER $69.50

Power Handling	70 watts rms system
Impedance	8 ohms
Resonant Frequency	24.3Hz
Sensitivity	91.9dB 1 watt 1 metre
Eff. Freq. Response	24Hz - 6kHz
Electromagnetic Q	QES 0.398
Peak Cone Excursion	2 x/max x 1.25mm

Cat. CW-2116

8" WOOFER $42.50

Power Handling	60 watts rms system
Impedance	8 ohms
Resonant Frequency	23.2Hz
Sensitivity	88.2dB 1 watt 1 metre
Eff. Freq. Response	23Hz - 5kHz
Electromagnetic Q	QES 0.481
Peak Cone Excursion	2 x/max x 1.6mm

Cat. CW-2114

5" MIDRANGE FERROFILLED Cat. CM-2085 $29.50

LOUD PLATE TWEETER Cat. CT-2030 $39.50

10" PASSIVE RADIATOR Cat. CR-2180 $36.50

12" PASSIVE RADIATOR Cat. CR-2190 $47.50

AM/FM STEREO TUNER SYNTHESISED

Ref: EA December '85 - Feb '86
Cat. KA-1635

$499.00

REMOTE CONTROL

Ref: EA April 1986
Cat. KA-1636

$99.50

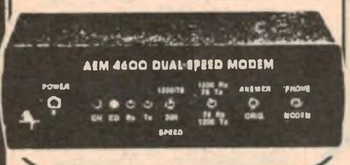
JAYCAR NUMBER ONE FOR SUPERIOR KITS

AUSTRALIAN MADE

AEM 4600 DUAL SPEED MODEM

Ref: AEM December 1985
Cat. KM-3040

$179.00



LOW DISTORTION AUDIO OSCILLATOR

See EA December 1986
Cat. KA-1680

$139.00

DELUXE CURRENT SENSE CAR ALARM

Ref: AEM October 1986 AEM 8501
This high quality Tillbrook designed unit includes case and Scotchcal front panel.
Cat. KM-3048 ONLY $98.50

RS232 TO COMMODORE

Ref: ETI July 1986
Supplied without Commodore edge connector
Cat. KE-4722

$16.95

SCREAMER CAR ALARM

$32.50

Ref: EA August 1986
Incorporates two sensors and utilises a piezo screamer inside the car.
Cat. KA-1675
SHORT FORM - INCLUDES PIEZO

TURBO TIMER

See EA Sept 1986
A simple sensor system to prevent car ignition being turned off before the Turbo unit has cooled down (approx. 90 seconds. A must for those with turbo charged cars.
Cat. KA-1679

$29.95

DIGITAL SAMPLER ETI 142

Cat. KE-4720

$119.00

LIGHT SAVER

Ref: EA June 1986
Supplied without plate and epoxy.
Cat. KA-1670

$15.99

ELECTRIC FENCE KITS

THE BABY
Mains or battery powered. This electric fence controller is both inexpensive and versatile.
It should provide an adequate deterrent to all manner of livestock. Additionally, its operation conforms to relevant clauses of AS 3129. (Kit does not include auto ignition coil which is required).
Cat. KA-1109 **$21.50**
See EA September 1982

THE STOPPER
Because this circuit uses a special output transformer it is far more likely to work into false loads such as tall grass or dirty insulators & has less current drain. Needs no auto coil and is supplied with HT cable and heavy duty clip.
Cat. KA-1680 **ONLY $49.95**
See EA December 1985

THE STUNNER
If you want a really potent electric fence for long fence runs, this is the one. It has a much lower output impedance for fences more than 1km long. It's our "industrial strength model". 240V operated.
Cat. KA-1678
$229.00
See EA October 1986

QUARTZ CRYSTAL CLOCK MOVEMENT
* Very compact * Powered by one 1.5V AA battery that lasts for 1 year * 56mm square, 15mm deep
* Very accurate
Fit your own custom clock face. Great for novel applications such as fitting to pictures. Supplied with 3 sets of hands.
Cat. XC-0100
$12.95

Includes 3 sets of hands

PLAYMASTER 60/60 STEREO AMPLIFIER
High quality, low priced stereo amplifier from Electronics Australia.
See EA May, June and July 1986
Cat. KA-1650

$299.00

AUSTRALIAN MADE

Jaycar is proud to advise that we have recommenced distribution of quality Australian made "Adcola" soldering irons. Adcola soldering equipment is made in Australia & sold all around the world.
Whilst Adcola equipment is very high quality, the fact that it is locally made is now a great benefit. The downward movement of the A$ has made Adcola products very competitive - even against low cost Asian imports!
We therefore strongly recommend that you seriously consider Adcola products - especially their temperature controlled soldering equipment before you buy inferior imported units.

SPECIAL ANNOUNCEMENT

THE HEART OF THE TEMPERATURE CONTROLLED SYSTEM

E024

AUSTRALIAN MADE

The Adcola E024 power controller is basically an SEC approved power supply. But it's a lot more sophisticated than that of course! The unit will power either the CT-6, CT-7 or desoldering pencil. The E024 accurately monitors a temperature element wound in each of these irons. An electronic control circuit then meters power to the pencil in accordance with the temperature selected on the front panel of the E024. The temperature is continuously adjustable from 200 - 400°C (400 - 750°F), accurate to an amazing ±5°C! Power is supplied to the pencils via a 'zero crossing' controller. This effectively means that power to the pencils is switched on and off only at the point on the AC power supply where the voltage passes through zero. By switching power in this sophisticated way spikes caused by commutating AC are avoided. (the major competitors electro-mechanical switch operates randomly at ANY POINT of the AC!)
An extra special electrostatic shield is wound between the primary and secondary of the power transformer to virtually eliminate mains-borne spikes - no damage to MOS devices! To further reduce static voltage effect an optional auxiliary ground lead is provided to earth the equipment to be soldered to the same potential as the soldering equipment. In this way the effective tip EMF is limited to around 10 millivolts! This is far below the damage level for all MOS devices of course. We believe that the E024 unit has by far the best static control in its class! The E024 is supplied with generous mains cord, soldering guide, technical instructions (including internal schematic and parts list), soldering iron stand, tip cleaning sponge and secondary ground lead. It is fused on the AC mains. It is guaranteed for 12 months.
Cat. TS-1475 **$139.50**

ADCOLA T.C. DESOLDERING SYSTEM! 10% OFF!! SPECIAL JANUARY OFFER
Buy the E024 power unit and CT-207 desoldering iron this month and get a professional temperature controlled desoldering system for under $200.00!!
That's right, the package deal for the 2 is only $199.00 - and that includes sales tax!!
SAVE 10% - ONLY $199 THE TWO

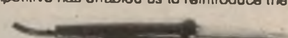
You get a choice - - -
DIAL YOUR SOLDERING at a great low price!
Jaycar's philosophy is to give you a CHOICE by providing you with a range of great products! So with Jaycar you can choose from many soldering products. The Adcola range is shown below:
40 WATT The CT-6 is a light-weight pencil with a very high capacity heating element for very low thermal inertia. It is supplied with a #20415 1.5mm tip as standard. Also supplied standard are: burn proof silicone rubber cord, thermal shield and plug for connection to E024 controller unit. Cat. TS-1478 $39.95
80 WATT The CT-7 is similar to the above unit but with 80 watt thermal capacity. Cat. TS-1480 $42.50
DESOLDERING PENCIL Type CT-207. This is similar to the pencils above except that it has a hollow temperature controlled tip (replaceable) which is connected to a vacuum bulb located on the handle. The bulb is placed conveniently so that it can be depressed by the operators index finger.

PROFESSIONAL IRON CLAD SOLDERING IRON TIPS
Spare tips for the Adcola CT-6 and CT-7 are available from Jaycar. Each tip is N.C. machined from pure copper, clad with iron (actually thicker at the point!) then Nickel-Chrome plated and pre-tinned with 60/40 solder. Each tip is supplied with an anti-sieze ferrule at no extra charge.

For CT-6 and S-30 Irons		
#20407 0.7mm Chisel point	Cat. TS-1484	$4.95
#20415 1.5mm Chisel (standard)	Cat. TS-1485	$4.95
#20430 3mm Chisel point	Cat. TS-1486	$4.95
For CT-7 and S-50 Irons		
#50407 0.7mm Chisel point	Cat. TS-1488	$5.95
#50425 2.5mm Chisel point	Cat. TS-1487	$5.95
#50430 3mm Chisel point	Cat. TS-1490	$5.95

FAMOUS ADCOLA S-30 & S-50 REINTRODUCED
Jaycar's policy is to support Australian manufacturers where possible. This, along with the fact that the Adcola models are now internationally competitive has enabled us to reintroduce these popular models.

S-30



A high quality 30 watt non T.C. iron suitable for general hobby use. Idles at the correct temperature for PCB work. Tips will not seize in iron. Uses same tips as CT-6 pencil.
Cat. TS-1492
240V mains operation **$27.95**

S-50
Similar to the above unit but with a 50 watt thermal capacity. Uses same tips as CT-7 pencil.
Cat. TS-1494 **$29.95**

SHOWROOMS

SYDNEY 117 York St (02) 267 1614 Mon - Fri 8.30 am - 5.30 pm Thurs until 8.30 pm Sat 9 am - 12 noon
CARLINGFORD Cnr Carlingford & Pennant Hills Rd (02) 872 4444 Mon - Fri 9 am - 5.30 pm Thurs until 8.30 pm Sat 9 am - 12 noon
CONCORD 115 Parramatta Rd (02) 745 3077 Mon - Fri 8.30 am - 5.30 pm only
HURSTVILLE 121 Forest Rd (02) 570 7000 Mon - Fri 9 am - 5.30 pm Thurs until 8.30 pm Sat 9 am - 12 noon
GORE HILL 188 Pacific Hwy (Cnr Bellevue Ave) (02) 439 4799 Mon - Fri 9 am - 5.30 pm Sat 9 am - 4 pm

Jaycar ELECTRONICS
INCORPORATING ELECTRONIC AGENCIES
QLD. BURANDA 144 Logan Rd (07) 393 0777 Mon - Fri 9 am - 5.30 pm Thurs until 8.30 pm Sat 9 am - 12 noon
HEAD OFFICE 115 Parramatta Rd Concord 2137 (02) 747 2022 Telex 72293
ROAD FREIGHT ANYWHERE IN AUSTRALIA **$13.50**

VISA | bankcard | MasterCard | AMERICAN EXPRESS Cards Welcome

MAIL ORDER VIA YOUR PHONE

MAIL ORDERS
P.O. Box 185 Concord 2137
(02) 747 1888 **HOTLINE**
(008) 022 888 **TOLLFREE FOR ORDERS ONLY**

POST & PACKING

$5 - $9.99	$ 2.00
$10 - $24.99	$ 3.75
$25 - $49.99	$ 4.50
$50 - $99.99	$ 6.50
OVER $100	$10.00

JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR

Listen to the world with this nifty

Three-band shortwave radio

If you think that hobby electronics these days is just a matter of plugging in ICs, this shortwave radio will change your mind. Although it does have an IC, you'll still have to get down to the real nitty-gritty: winding coils, aligning and tuning. And when it's all finished, you can tune in to the many international broadcasts operating on the shortwave bands.

by COLIN DAWSON

Recently, after checking through our file of shortwave radio projects, we realised that it has been over six years since our last design. The "1980 Multiband Superhet" used discrete components throughout its RF sections. Our latest design — the Three Band Shortwave Receiver — is rather more up-to-date in that it uses a single AM radio IC.

The front panel controls are for volume, tuning and band switching.

These devices have become so cheap in the last few years that it is not economical to use discrete components any more. Furthermore, you can have all of the benefits of a sophisticated design without using lots of components.

The AM radio IC is the Philips TEA5550. Its main use is in car radios, where it is used by the thousands. It is also ideal for a simple shortwave receiver. It is quite sensitive, requiring an input of only about 20uV, and its automatic gain control (AGC) operates over a range of 86dB, which is very large indeed.

This last feature means that the IC can accommodate a huge range of input signals — you can operate at only a few kilometres from the transmitter, or from thousands of kilometres away. It can also compensate for fading signals which can be a real problem on the shortwave bands.

Virtually all you need for a basic radio based on the TEA5550 are several inductors (for tuning and for the oscillator) and an audio amplifier. Our circuit goes a little further than this because we wanted good performance while still keeping the total circuitry fairly simple.

Main features

As it stands, our new receiver can tune from 0.48MHz to around 17MHz over three bands. There is, however, a small gap in the coverage between Bands 1 and 2. Band 1 (the broadcast band) covers the range from 0.48MHz to 1.9MHz; Band 2 from 2.15MHz to 7.7MHz; and Band 3 from 6.12MHz to 17.12MHz.

Instead of opting for a simple passive RF stage (the "front end"), we have designed an active stage around a dual-gate Mosfet. The advantage here is that instead of losing signal through the front end, there is actually a moderate amount of gain which improves the overall sensitivity.

The payoff is that very high input signals may overload the front end. Should this happen, there is provision for an optional Local/DX switch.

An audio amplifier has also been included in the design, as the TEA5550 is only capable of delivering about 150mV. We used a four-transistor design which can drive either headphones or an eight ohm loudspeaker. The idea of using a hybrid "one chip" audio amplifier was certainly appealing, but the discrete design has the advantage of using garden variety components. And it works better than most small IC amplifiers.

Current drain for the circuit is quite hefty at 30mA. Carbon zinc batteries would at best give about five to six hours use while alkaline cells would give about 15 hours. Unless they are rechargeable, this would suggest batteries as being unsuitable as a long term power supply.

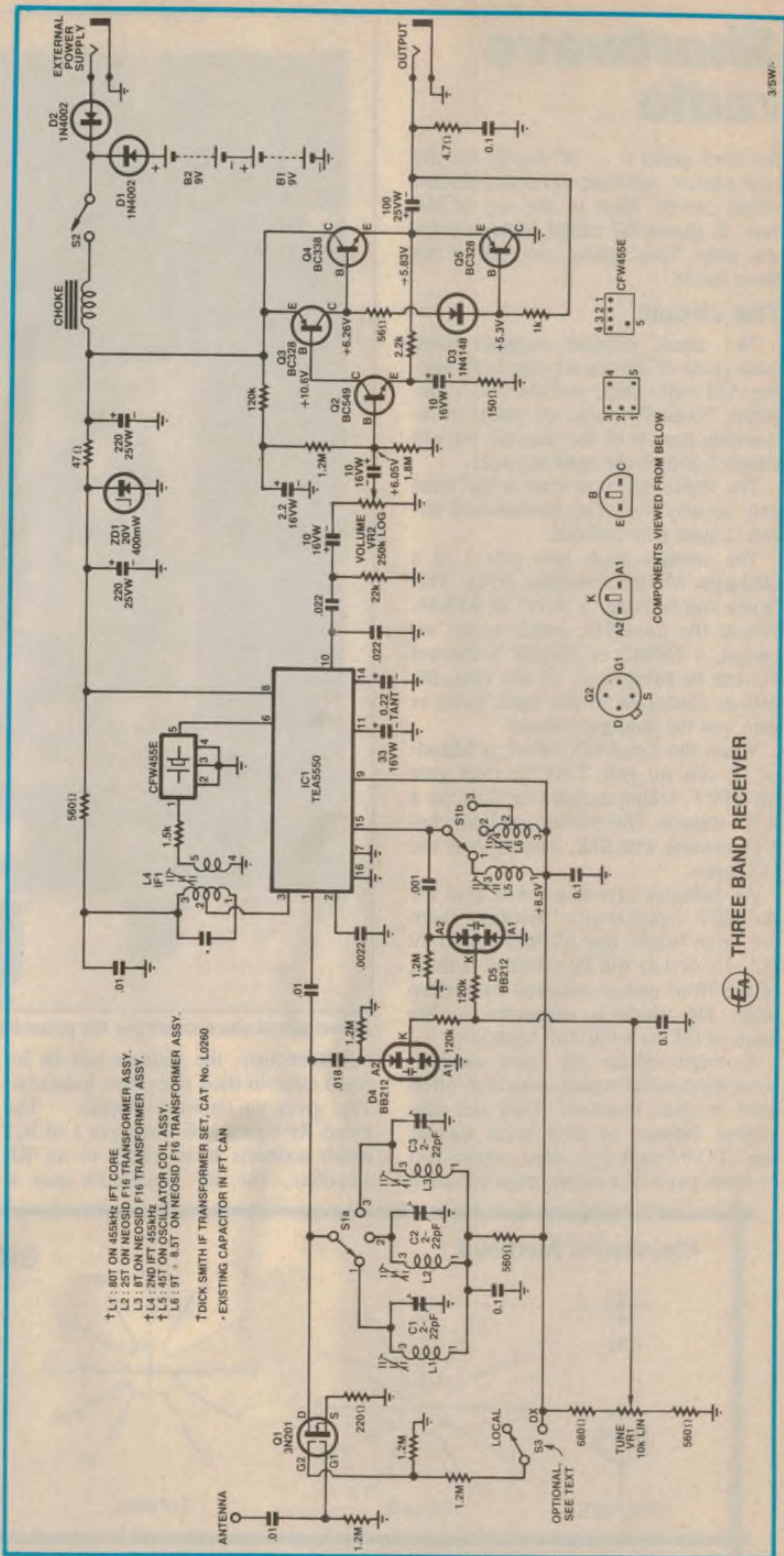
For this reason, there is a socket for connection of an external power supply on the back panel. Any DC voltage between 11V and 20V is suitable. The obvious choice is a 12V power supply. A mains plugpack could be used (it will increase the hum level), but better still would be the 12V car power supply.

In some ways, the radio is ideally suited for in-car use. It includes a noise suppression choke to minimise interference from the alternator and ignition system, as well as protection from dangerous voltage spikes. If you could contrive a suitable adaptor, the car's antenna would be quite suitable.

So that you will be able to interpret

TUNE	BAND 1	BAND 2	BAND 3
0	.480	2.15	6.12
1	.622	2.71	7.22
2	.764	3.26	8.32
3	.906	3.82	9.42
4	1.05	4.37	10.52
5	1.19	4.96	11.62
6	1.33	5.48	12.72
7	1.47	6.03	13.82
8	1.62	6.59	14.92
9	1.76	7.14	16.02
10	1.90	7.70	17.12

This actual size artwork can be attached to the top of the tuner to indicate the tuned frequency.



The receiver may be powered from batteries or from an external power supply.

Shortwave radio

the front panel 0 — 10 display for the tune control, we have devised a placard which can be fixed to the top of the case. It shows the tuned frequency for any given Tune setting, on each of the three bands.

The circuit

The circuit diagram suggests three main parts of the circuit: the front end, the AM radio chip, and the audio amplifier. Naturally, there are plenty of interesting aspects of the chip but we will simply highlight the main features.

The logical place to start is the front end, so why not? The fundamental circuit is quite conventional.

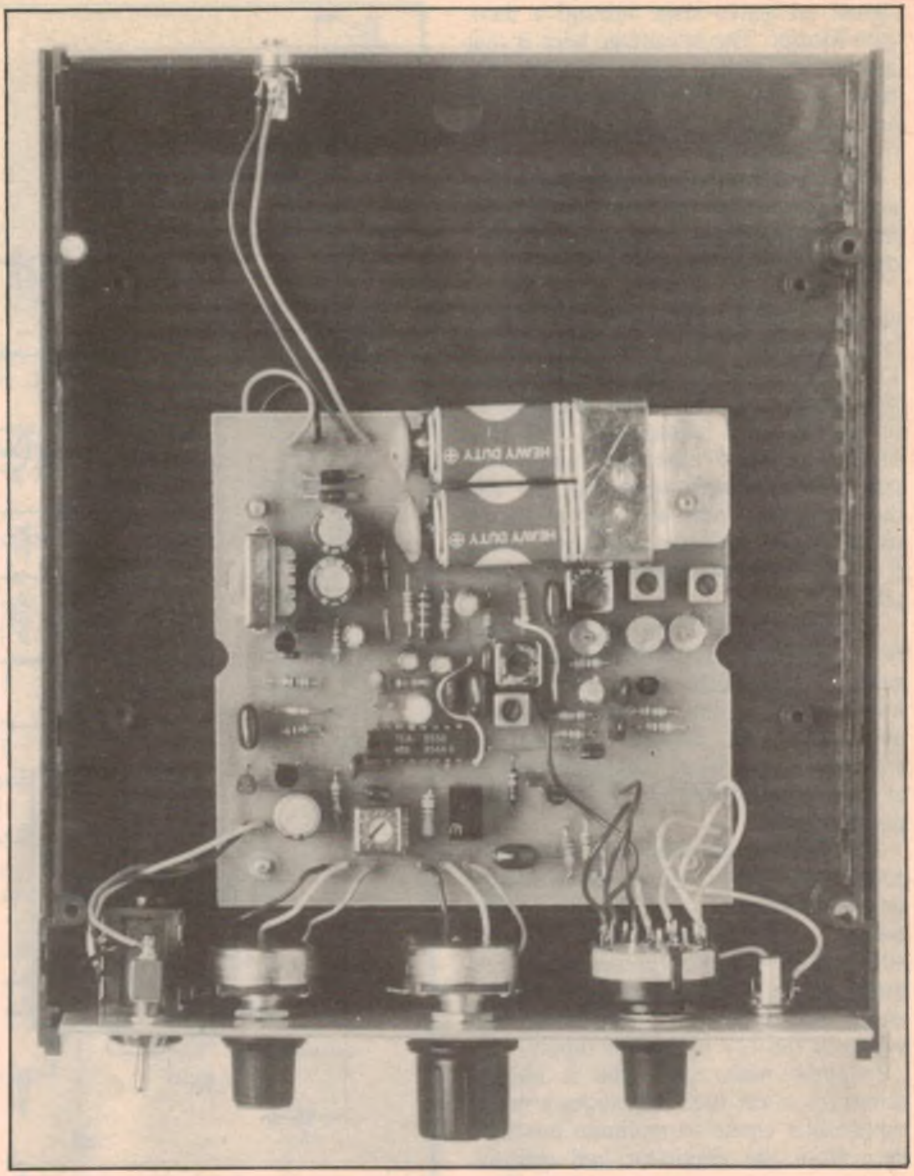
The antenna feeds into gate 1 of a dual-gate Mosfet transistor (Q1). This device can be either a 3N201 or BFR84. Where the Local/DX switch is not required, a 2N5485 or 2N5484 N-channel Fet can be substituted. In this case, the gate is connected to the same point as gate 1 of the dual-gate Mosfet.

When the Local/DX switch is included, it acts on gate 2 of the dual gate MOSFET, taking it high (for DX) via a 1.2M resistor. Our version, as built, has a permanent wire link, keeping it in the DX mode.

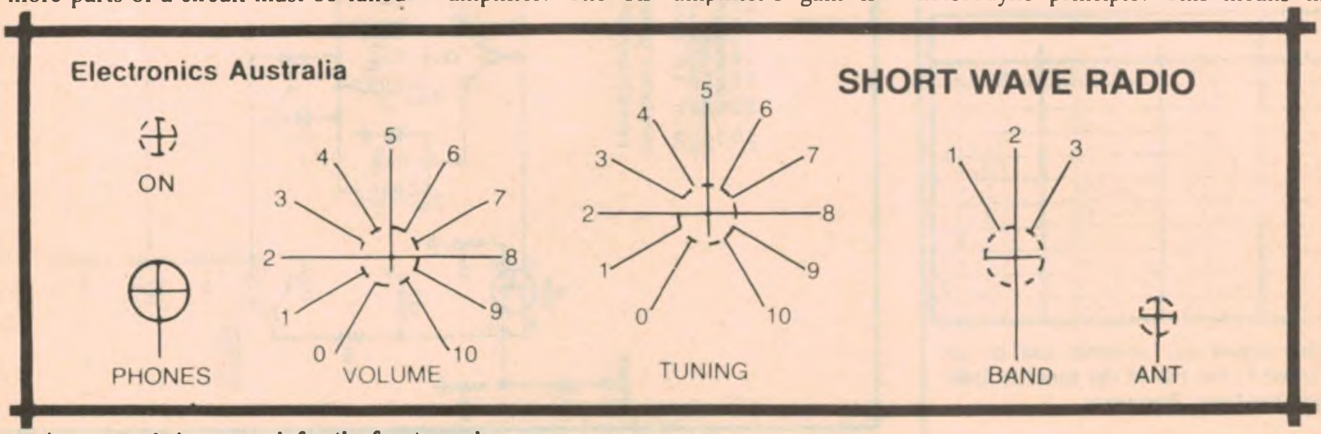
An inductor acts as a tuned load for the FET input device. Because there are three bands, one of three inductors (L1, L2 or L3) will be selected. Tuning of the front end is achieved by varicap diode D4 which is connected to the drain of Q1 via a 0.018uF capacitor.

Varicaps replace the more cumbersome mechanical tuning capacitors often used in small receivers. They are convenient because of their much smaller size (TO-92 package). Also, where two or more parts of a circuit must be tuned simultaneously, the varicaps can be located close to their respective inductors. This gives an improved layout. The tuned RF signal is fed into pin 1 of IC1 which connects it internally to an RF amplifier. The RF amplifier's gain is controlled by the internal AGC (automatic gain control) so that it (and following stages) will not be overloaded when large signals are fed in.

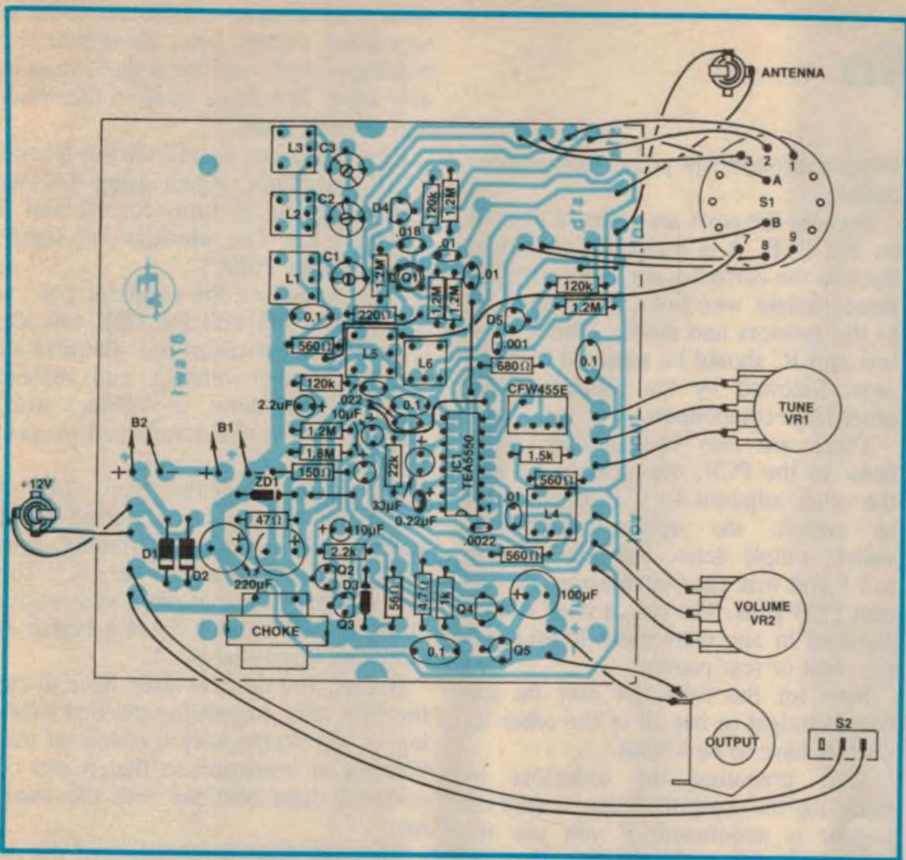
The TEA5550 operates on the superheterodyne principle. This means that



Above: actual size artwork for the printed circuit board.



Above is an actual size artwork for the front panel



Assemble your tuner exactly as shown in this wiring diagram.

the incoming RF signal is mixed with a local oscillator operating at a higher frequency. The difference in the two frequencies is the intermediate frequency (IF). In this case, it is 455kHz which is a standard IF for AM radios.

From the RF amplifier, the signal is passed to a double balanced mixer. This type of mixer cancels both the RF signal and the oscillator signal, leaving only "difference" signals. One of these is the wanted IF signal.

The next time the signal is sighted is at pin 3 of IC1, the mixer output. This is fed into the IF stage. We initially tried a design with three IF transformers, but rejected the third transformer on the grounds that the circuit was too hard to align. This then left a two-transformer IF stage.

Unfortunately, this circuit was found to be subject to FM breakthrough on Band 3. So we scrapped the second IF transformer and replaced it with a CFW455E ceramic filter. This gave far better results in terms of selectivity and FM rejection, and more than justifies the extra $5 cost. The resulting circuit is also much easier to align than the previous scheme.

The sole IF transformer used comes from the Dick Smith IFoscillator kit (DSE Cat.L-0260) which comprises three IF transformers and one oscillator coil. We used the second IF transformer from the kit for IF1 (this is colour-coded according to data supplied with the coil set).

Back now to the circuit. From the first IF transformer, the signal passes to the CFW455E ceramic filter. Unlike an IF transformer, this device requires no adjustment. It is set to 455kHz at manufacture and has a 3dB bandwidth of plus and minus 5.5kHz. This gives quite a narrow bandwidth, which is a desirable characteristic for communications receivers.

Because of the sharp roll off (80dB at plus and minus 100kHz), the ceramic filter gives very good rejection of adjacent stations and images (stations which are at local oscillator frequency plus the IF instead of at the local oscillator frequency minus the IF).

The filtered IF signal is fed back into pin 6 of the TEA5550. This is the input for the IF amplifier, which consists of three stages. The second is controlled by the AGC.

Before emerging from the IC, the signal is fed to a detector. This recovers the audio signal from the IF stage and presents it at pin 10. Because it still has a substantial 455kHz content, the signal is then fed to a filter stage consisting of two 0.022uF capacitors and a 22k resistor.

Following the detector filter, the signal is fed to the volume control and thence to a power amplifier (Q3-Q6). This four-transistor amplifier is a circuit we have used on many previous occasions and is ideal for the application. It is stable, and can deliver about 1 watt to an eight ohm loudspeaker.

Local oscillator

As yet, we have not talked about the internal oscillator circuit of the TEA5550. This is tuned with the LC circuit between pin 15 and pin 9. Only two coil assemblies are needed here: one to cover the broadcast band and the other, which is tapped, to cover the two shortwave bands.

In order to tune the local oscillator frequency, another varicap diode (D5) is used. In fact, D4 and D5 are controlled simultaneously by the "Tune" control (VR1).

Note that because the local oscillator has to operate with a smaller range of capacitance than the RF stage tuning, a series 0.001uF capacitor is used with D2. The 0.018uF capacitor in series with D4 is necessary to prevent DC from biasing this varicap but, at the same time, is large enough to have negligible effect on the range of adjustment.

Power for the circuit is normally supplied by two internal 9V batteries and these are connected to the on/off switch (S2) via D1. If an external power supply of more than the battery voltage (18V) is connected, power will be fed in through D2 to S2.

This arrangment prevents the external power supply from being connected directly to the internal batteries. Even if the batteries are not used, D2 should still be included to protect against reverse polarity connection of the power supply.

Following S2, the power supply feeds into a noise suppression choke (DSE Cat.L-1900). Its function is to suppress ignition noise when the circuit is powered from a car battery. The output of the choke is filtered by a 220uF electrolytic capacitor and the resultant DC rail used to power the audio amplifier.

A 47 ohm resistor and an additional 220uF capacitor decouple the supply to IC1. This is necessary to prevent supply fluctuations brought about by the amplifier operation from upsetting the front end. In addition, a 20V zener diode (ZD1) is included to protect the IC from excessive input voltages.

Shortwave radio

Construction

The printed circuit board (PCB) for the shortwave radio has been made as small as possible while still keeping it reasonably easy to assemble. This board is coded 87sw1 and measures 111 x 106mm. We initially designed it to suit the compact Pac-Tec case which measures 129mm wide by 39mm high by 133mm deep (Cat.CN5-125K).

It is certainly an attractive case but unfortunately it is now quite expensive. Most constructors will therefore probably install the board in a somewhat larger but cheaper case such as the one used for several recent transceiver projects. This case is available from Dick Smith Electronics (Cat.H-2520).

We have designed front panel artwork to suit both the Pac-Tec case and the one from Dick Smith Electronics.

If the Pac-Tec case is used, the first task is to file two cutouts in the PCB to clear the internal pillars of the case. These cutouts are marked out with two 6mm-diameter semicircles on the copper pattern. Check that the board fits comfortably around the pillars before continuing.

Because the parts are rather a tight fit on the PCB, it is important to mount them in the correct order. Start with the three straight wire links, then move on to the resistors and diodes. The transistors and IC should be soldered in place next, followed by the capacitors and other large components.

There are also two insulated wire links on the PCB, one next to L5 and the other adjacent to IC1. If you wish to include the optional Local/DX switch, simply delete the link adjacent to L5 and wire the switch across the vacant PCB pads. The switch itself can be installed in any convenient location on the front or rear panels.

Now for the coils. L4 may be soldered straight in but all of the other inductors have to be wound.

Start preparing the inductors by removing the capacitor from L1 (the capacitor is underneath if you use the same DSE coil set as we did). Remove all the existing windings and replace them with 80 turns of 0.08mm (40 B&S) enamelled copper wire. Distribute the windings evenly and keep them reasonably tight. Terminate (solder) the windings on pins 1 and 3.

L2 and L3 are wound on the Neosid F/F16 assemblies. Again using 0.08mm wire, wind on 25 turns for L2 and 8 turns for L3. The windings are terminated on pins 1 and 3.

L5 is wound on the oscillator coil assembly supplied with the DSE coil set. Ours was colour-coded red. Remove all of the existing windings and replace them with 45 turns of 0.08mm wire. This winding is also terminated on pins 1 and 3.

The other oscillator coil, L6, is wound on the remaining Neosid F/F16 assembly. It is a tapped winding, consisting of first 9 turns and then 8.5. The first winding begins at pin 3 and finshes at pin 2. The second winding begins at pin 2 and finishes at pin 4.

In fact, you don't actually have to cut the wire after completing the first winding — just scrape back a couple of millimetres of insulation so that it can be soldered, then continue with the winding.

This completes construction of the inductors. Before proceding further, use a tiny blob of super-glue to secure the plastic slug carriers in L1, L4 and L5. These can become loose with repeated adjustment, leading to inaccurate settings.

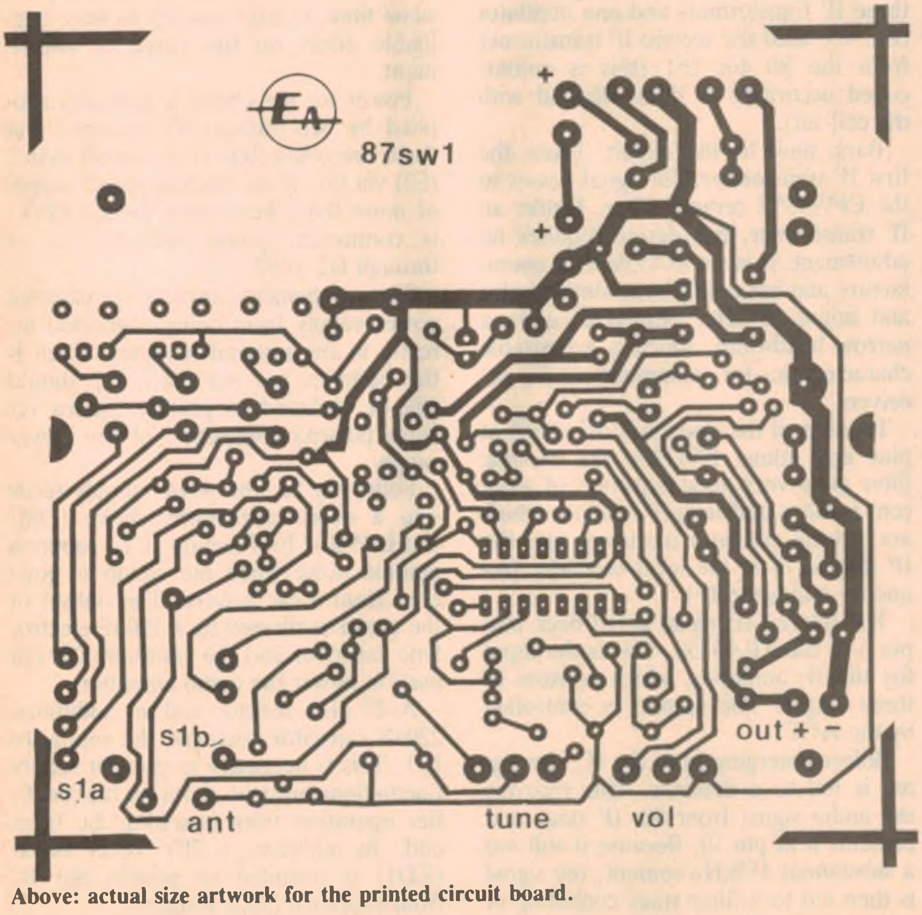
Make sure you don't get super-glue on any of the slugs though, otherwise you will not be able to turn them. The inductors can now be soldered into place on the board.

Drill holes in the front and rear panels as required. The front panel label can be used as a template for drilling the front panel. Connect all of the off-board controls and components as shown in the wiring diagram.

Note that a double-pole three-position slide switch (DSE Cat.S-2030) is used for S1 if you intend using the small Pac-Tec case. If the larger DSE case is used, a rotary switch is used in place of the slide switch.

When the wiring has been completed, the PCB can be installed in the case and secured using machine screws and nuts. We also used nuts to act as spacers between the PCB and the case.

Now check your work carefully before installing the two 9V batteries. In particular, check that you have correctly oriented the IC, transistors, diodes and electrolytic capacitors. We bent up a battery clamp from a piece of scrap aluminium.



Above: actual size artwork for the printed circuit board.

Testing

The receiver is now be ready for testing. At switch on, the first voltage to check is the regulated supply at pin 9 of IC1. This should be very close to 8.5V. Note that the input voltage must be at least 11.6V for reliable regulator operation.

If the reading you get at pin 9 is less than 8.5V, start looking for short circuited tracks and bad solder joints.

Next, check the voltages around the audio amplifier. They should closely agree with those marked on the circuit diagram. Note that an 8-ohm loudspeaker or dummy load in the form of an 8-ohm resistor is necessary for the amplifier to function properly. With no load it latches up (harmlessly) and the voltage readings are meaningless.

Note also that the voltages marked on the circuit are for no-signal conditions and assume a 12V supply. The measured voltages should be within about 10% of those given on the circuit.

Assuming that all is in order, it's time to start the alignment procedure.

Alignment

Oscillator adjustment: The following procedure will be more straightforward if you have an RF signal generator and a frequency meter (DFM), but neither is essential. First of all, set the Tune control fully anticlockwise, connect your DFM to pin 15 of IC1, and adjust the slugs of L5 and L6 to set the lowest frequencies for Band 1 and Band 2. You should get readings of 942kHz and 2.605MHz respectively.

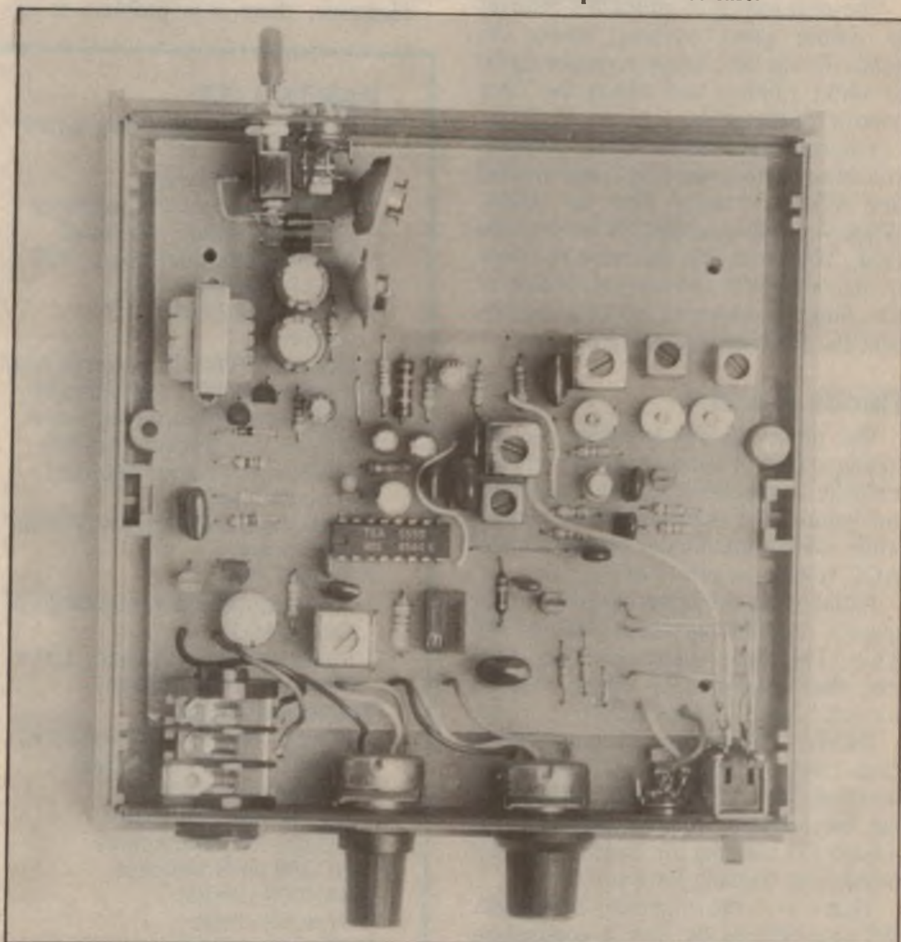
Remove the DFM after this procedure.

If you don't have a frequency meter, set both slugs 2-1/4 turns from the fully extended position. Be careful during the adjustment procedure not to bottom out the slugs too firmly — you may crush the fine wires leading to the core.

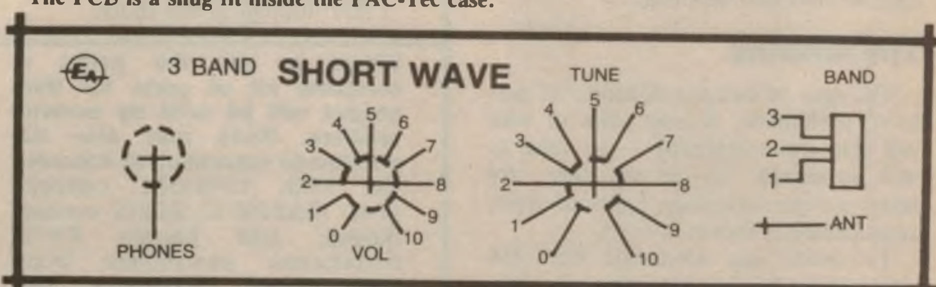
IF alignment: The next step is to align the IF stage. You will need a signal source of some type. It can be either a signal generator or a transmitted signal. A broadcast station will be OK, as long as it is at good signal strength and there are no other strong stations operating on adjacent frequencies.

Switch to Band 1 and tune to an input frequency of around 800kHz. This done, use your multimeter to monitor the AGC voltage at pin 14 of IC1. The highest voltage you can expect is 2.6V DC. If pin 14 goes immediately to somewhere over 2V, reduce the input signal. (It will be impossible to observe the peak if the AGC has already

If size is important, the PCB can be installed in this compact Pac-Tec case.



The PCB is a snug fit inside the PAC-Tec case.



This is the actual size front panel artwork for the Pac-Tec case.

reached its highest level).

Now slowly adjust the Tune control until the AGC peaks. The peak will be fairly sharp, so be carefull. The local oscillator will now be 455kHz above the incoming RF signal.

With the Tune control at this setting, adjust the slug of L4 until the reading peaks once more. Finally, repeat these last two steps a couple of times to make sure you have the best setting. From now on, don't touch L4.

RF tuning: Without changing any of the settings from the above procedure, adjust L1 for the best AGC peak. The peak won't be quite so strong this time. When you find it, the RF tuning has been set to match the oscillator — but only for this relatively low frequency.

The next step is to adjust the receiver to ensure good tracking across the band. To do this, select an input signal of about 1.6MHz and adjust the Tune control for the peak.

You can expect a few 'ghost' peaks as you sweep across the range, but the real one will be stronger than the others. When you find it, adjust C1 for the best peak. We found that this occurred close to the minimum capacitance setting of C1. Finally, return to 800kHz and repeat the RF tuning procedure.

Bands 2 and 3

The procedure for adjusting the RF tuning stages of bands two and three is virtually a repetition of the foregoing. As before, the relevant coil is peaked while using a multimeter to monitor the AGC voltage on pin 14 of the chip.

Initially, set the input signal to a frequency representing about 25% of full scale. This done, peak the Tune control, then peak the RF tuning coil (L2 for band 2 and L3 for band 3).

Finally, check the tracking across each band by tuning to an input signal at about 75% of full scale, and adjusting the relevant trimmer capacitor. C2 adjusts the tracking for Band 2 while C3 adjusts the tracking for Band 3.

That's it — the alignment is finished. All you have to do now is connect an antenna and start listening.

The antenna

The type of antenna depends on personal preference. A long piece of wire will give good sensitivity — to noise as well as signals. To cut the noise, try using a noise cancelling balanced input transformer as shown in Fig.1.

To derive any advantage from the noise cancelling transformer, the antenna has to be a loop type. We found that a 100mm-diameter loop of 15 turns worked very well for Bands 1 and 2, and reasonably well for Band 3.

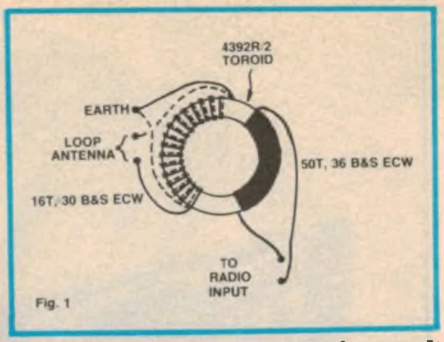


Fig.1: the balanced input transformer. It uses a 16-turn bifilar winding for the primary (antenna side) and a 50-turn winding for the secondary.

However, there is a problem in selecting the core material. We don't know of any that is suitable for use from 0.5MHz right through to 15MHz. We experimented with a toroidal core (type 4392R/2 from Neosid) which worked quite well for Bands 1 and 2, but actually stopped the radio from working on part of Band 3.

An alternative scheme used a ferrite VHF antenna balun as sold by Jaycar and Altronics. We wound on 10 turns for the primary (which goes to the loop antenna) and 16 for the secondary.

Predictably, this worked best for Band 3 and rather poorly on Band 1. The obvious conclusion from these experiments is that two antenna coupling transformers are necessary to cover the full range (you will have to switch between them). EA

PARTS LIST

- 1 2-pole 3-position rotary switch (see text)
- 1 SPDT toggle switch
- 1 SPDT toggle switch (optional Local/DX switch, see text)
- 1 plastic instrument case, DSE Cat.H-2520 (see text)
- 1 PCB, code 87sw1, 111 x 106mm
- 1 Murata CFW455E ceramic filter
- 5 metres 0.08mm diameter (40 B&S) enamelled copper wire
- 2 3.5mm jack sockets (mono)
- 1 6.5mm jack socket (stereo)
- 3 knobs to suit
- 2 9V batteries (Eveready 216 or equivalent)
- 2 battery clips
- 1 noise suppression choke (DSE Cat.L-1900)
- 1 front panel to suit case, 120 x 33mm or 168 x 50mm

Semiconductors

- 1 Philips TEA5550 AM radio IC
- 1 3N201, BFR84 dual gate Mosfet (see text)
- 1 BC549 NPN transistor
- 2 BC328 PNP transistors
- 1 BC338 NPN transitor
- 2 1N4002 diodes
- 1 1N4148 diode
- 2 BB212 varicap diodes
- 1 20V 400mW zener diode

Capacitors

- 2 220uF 25VW electrolytics
- 1 100uF 25VW electrolytic
- 1 33uF 16VW electrolytic
- 3 10uF 16VW electrolytics
- 1 2.2uF 16VW electrolytic
- 1 0.22uF 16V tantalum
- 4 0.1uF greencaps (metallised polyester)
- 2 0.022uF greencaps
- 1 0.018uF greencap
- 3 0.01uF greencaps
- 1 0.0022uF greencap
- 1 0.001uF greencap
- 3 2-22pF trimmer capacitors

Inductors

- 1 455kHz IF transformer with integral capacitor (from DSE coil kit)
- 1 455kHz IF transformer assembly (from DSE coil kit)
- 1 broadcast band oscillator coil assembly (from DSE coil kit)
- 3 Neosid F/F16 transformer assemblies

Resistors (5%, 0.25W)

1 x 1.8M, 6 x 1.2M, 3 x 120k, 1 x 22k, 1 x 2.2k, 1 x 1.5k, 1 x 1k, 1 x 680 ohms, 3 x 560 ohms, 1 x 220 ohms, 1 x 150 ohms, 1 x 56 ohms, 1 x 47 ohms, 1 x 4.7 ohms, 1 x 250k log potentiometer, 1 x 10k linear potentiometer

Where to get the parts: a complete kit of parts for this project will be sold by several retailers. Parts may also be purchased separately as follows: the PCB, CFW455E ceramic filter, TEA5550 IC, BB212 varicap diodes, and Neosid F/F16 transformer assemblies from Geoff Wood Electronics; the choke (Cat.L-1900), CFW455E ceramic filter (Cat.L-1610), and case (Cat.H-2520) from Dick Smith Electronics. The PCB is also available from RCS Radio and from Acetronics PCBs.

Note: stocks of the TEA5550 are not expected to be available until about mid-January.

$1.95

HOLIDAY PROJECT BOOK

Produced by Electronics Australia in conjunction with Dick Smith Electronics

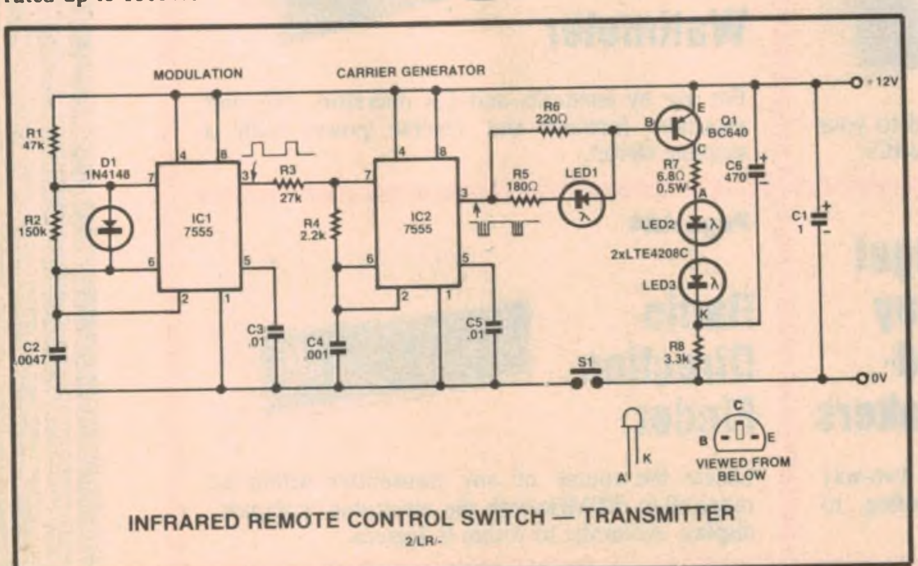
Don't get up. Press the button on this

Infrared remote control switch

Want to switch your TV set on or off from the comfort of your lounge chair? This infrared remote control unit can switch any appliance at the touch of a button.

by GREG SWAIN

The receiver is capable of switching mains appliances rated up to 1800W.



The transmitter circuit uses two TLC555 timers to generate a modulated carrier signal.

There are many situations where it would be convenient to switch a mains-appliance on or off without actually having to walk over to the mains outlet.

With this project, you can turn the TV set off after the late night movie without getting out of bed, control a table lamp from your lounge chair, or switch an outside light on when you arrive home late at night.

Other possible uses include switching a radio on or off, operating motorised curtains, or controlling an electric jug. Press the transmitter button once and the appliance turns on. Press it again and the appliance turns off. What could be neater?

The project can also be used as an ad-killer for TV. Normally, it uses a relay to switch power to a mains output socket. However, the wiring can easily be modified so that the relay contacts switch a loudspeaker in and out of circuit.

Presentation

The Infrared Remote Control Switch comes in two parts: a small handheld infrared transmitter, and a companion receiver.

The transmitter is truly pocket size and is housed in a neat little plastic case with an integral clip on the back and a pushbutton on the top. It can be carried around in your pocket or clipped to your shirt. The receiver is also housed in a plastic case and is fitted with a 3-pin mains socket on the rear panel.

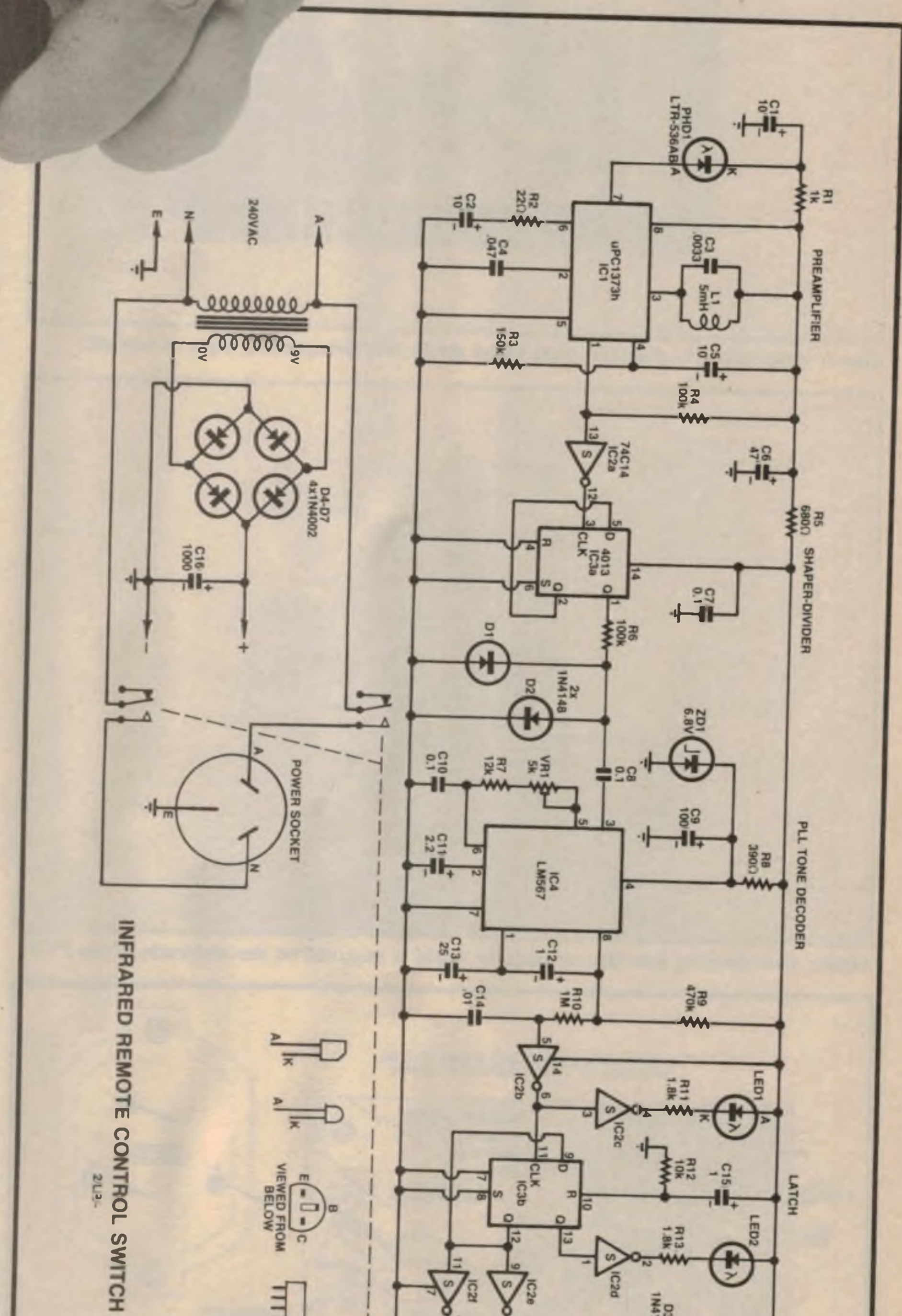
Overall dimensions are 36 x 60 x 20mm (W x D x H) for the transmitter, and 95 x 135 x 48mm (W x D x H) for the receiver.

How it works

In use, the receiver is simply plugged into the mains and the appliance to be controlled plugged into the socket on the rear panel. Appliances with ratings

Left: the compact handheld transmitter unit.

Below: the receiver circuit consists of a preamplifier/detector (IC1), a phase lock loop tone decoder (IC4), and an output latch circuit (IC3b).



up to 1800W can be used, the limit being set by the ratings of the relay contacts and associated wiring.

When the transmitter button is pressed, the transmitter sends out a burst of modulated infrared light. At the same time, a small red LED adjacent to the button lights to indicate that a signal is being transmitted.

The receiver unit decodes the transmitted signal and switches the internal relay to control the mains outlet. Two front-panel LEDs indicate the receiver status. The first, labelled 'SIG' (short for signal), comes on whenever a signal is received from the transmitter. The second, labelled 'ON', turns on when the relay turns on.

Provided the line of sight between the transmitter and receiver is clear, a control distance of about 12 metres can be expected. This range is dependent on several factors. Electrical noise, strong light or strong RF signals may affect the sensitive high gain front-end of the receiver but, even under adverse conditions, the system will still operate over the full length of an average-size room.

Note that the transmitter is designed to deliver maximum output when the button is first pressed. After that, the transmitter output drops to a much lower level. Once the button has been pressed, maximum output can only be regained by releasing the button for approximately 10 seconds.

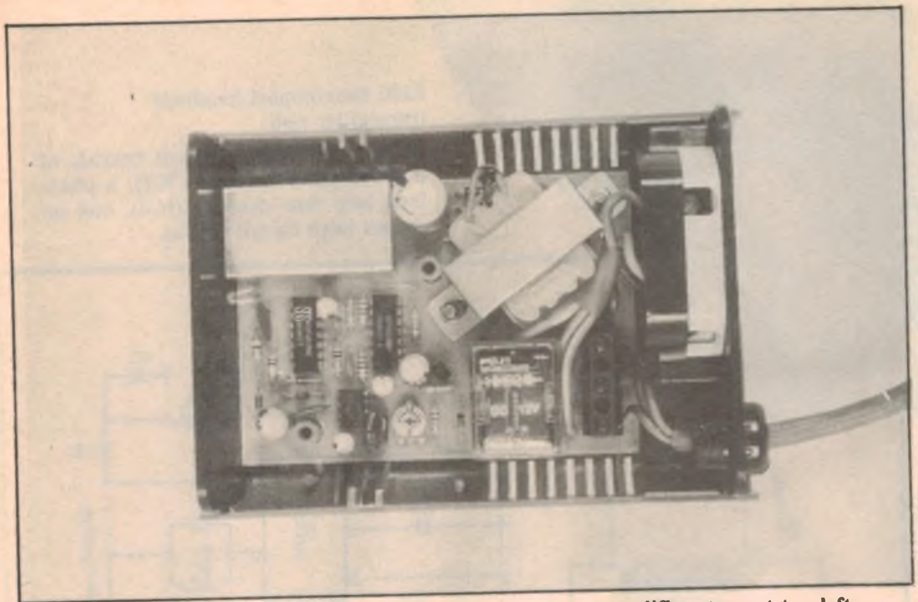
This feature is designed to increase battery life.

Circuit details

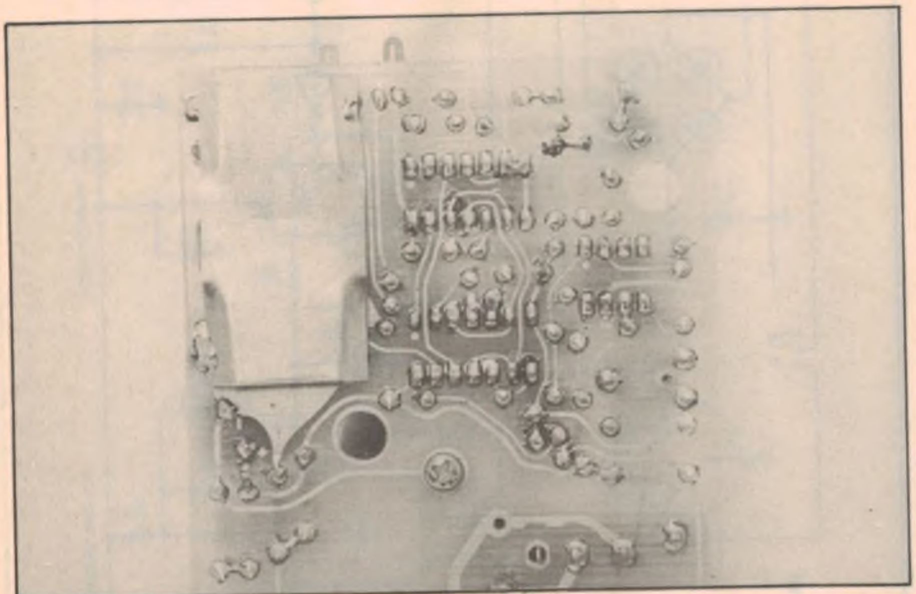
Let's now take a look at the circuit. We'll begin with the transmitter.

At the heart of the transmitter are two TLC555 timer ICs. These generate a 35kHz carrier signal which is pulse modulated at 1.5kHz. This is done so that the receiver can selectively decode the signal from the transmitter and re-

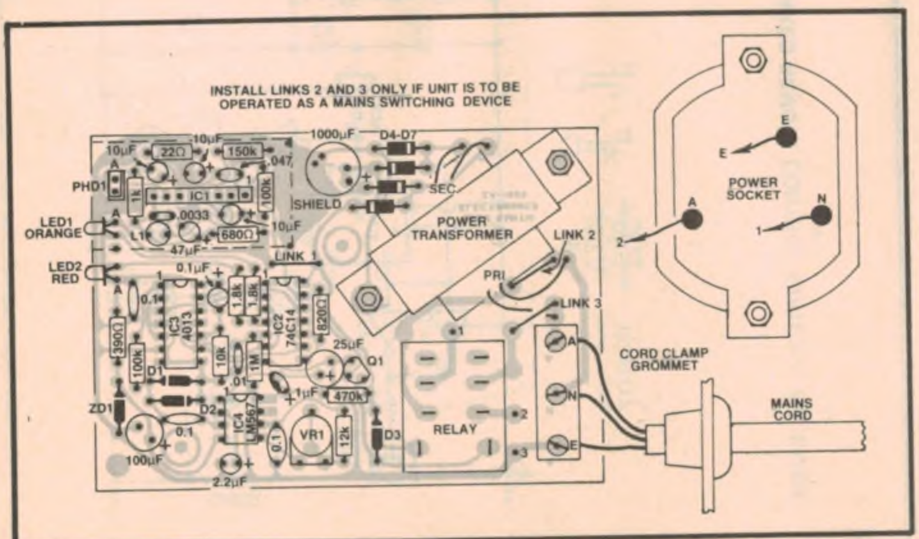
Infrared switch



Above: view inside the receiver. Note metal shield over preamplifier stage at top left.



Above: view showing how the rectangular shield is mounted on the underside of the PCB.



Parts layout and wiring diagram for the receiver. See note regarding links 2 and 3.

ject signals from other sources.

The TLC555 is essentially a CMOS version of the familiar 555 timer. IC1 is wired in astable mode and generates the 1.5kHz modulating frequency, as set by R1, R2, C2 and D1.

Note that D1 is forward biased during the charge cycle and reverse biased during the discharge cycle. It thus modifies the output frequency and gives a 1:3 output duty cycle, as determined by the ratio of the two timing resistors.

The output from IC1 appears at pin 3 and consists of a pulse train that is alternately high for 160μs and low for 500μs. This pulse train is used to control IC2 which is the carrier generator.

R3, R4 and C4 set the output frequency of IC2. When pin 3 of IC1 is high, IC2 is enabled and generates the 35kHz carrier signal. Conversely, when the output of IC1 is low, IC2 is disabled and its output remains high.

The resultant pulse modulated carrier signal appears at pin 3 and drives transistor output stage Q1 and two infrared LEDs (LED 2 and LED 3). At the same time, LED 1 is rapidly pulsed on and off by the carrier signal and thus appears to be continuously lit.

Resistor R7 limits the peak current through the two infrared LEDs to about 1A. While this level of current may seem excessive, the LEDs are in fact operated well within their ratings due to the low duty cycle of the carrier waveform (approx 1:15).

Power for the circuit is derived from a small 12V lighter battery and is switched to the circuit via S1 (which serves as the transmit switch). Because the battery is quite small, some form of energy management is necessary otherwise it would soon go flat. This is where C6 and R8 come in.

Initially, with S1 off, C6 charges via R8 to the full potential of the battery. Thus, when S1 is pressed, the full battery voltage is applied by C6 to Q1 and the infrared LED output stage. This scheme ensures maximum initial output from the infrared LEDs and increases the maximum range.

C6 subsequently quickly discharges via the forward-biased output stage. Resistor R8 then comes into play and limits the current through the output stage to about 2mA. The transmitter will now still operate, but over a much reduced range.

Maximum range can only be achieved again by releasing S1 for about 10s, as noted previously. This time is set by the time constant of R8 and C6, and the internal resistance of the battery.

If it were not for the above scheme, the range would either be severely limited or the battery would quickly go flat. As it stands, the battery should last for many months before requiring replacement.

Receiver

The receiver circuit can be broken up into three broad sections: an input preamplifier/detector, a PLL (phase lock loop) tone decoder, and an output latch/relay driver circuit.

The incoming infrared light is picked up by an LTR-536AB photodiode (PHD1) and applied to pin 7 of IC1. Made by NEC, this IC is a dedicated high-gain preamplifier/detector designed specifically for use in infrared remote control systems. It provides bias for the external photodiode and contains an amplifier stage, a limiter, a peak detector, and an output waveshaping buffer.

The internal amplifier stage is tuned by L1 and C3. These set the centre frequency to 35kHz to match the carrier frequency generated by the transmitter. The following detector stage extracts the 1.5kHz modulation signal from the carrier and passes it via the waveshaping buffer to the output (pin 1).

The resultant 1.5kHz signal is subsequently buffered by Schmitt trigger IC2a and applied to the clock input of IC3a, a 4013 D-type flipflop. IC3a divides by two and converts the input waveform to a 50% duty cycle.

The 750Hz output from IC3a is extracted from pin 1, clipped by diodes D1 and D2 and coupled via C8 to pin 3 of IC4, and the LM567 tone decoder IC. Inside the tone decoder is a phase lock loop. VR1, R7 and C10 set the centre frequency of the PLL to 750Hz, while C11 sets the detection bandwidth.

Whenever it receives a 750Hz signal, IC4 switches its pin 8 output low. C12, in conjunction with C13, stretches the output pulse to around 1.5 seconds, while R9, R10 and C14 provide further output filtering. IC2b and IC2c buffer the low output from IC4 and drive LED 1 (the signal received LED).

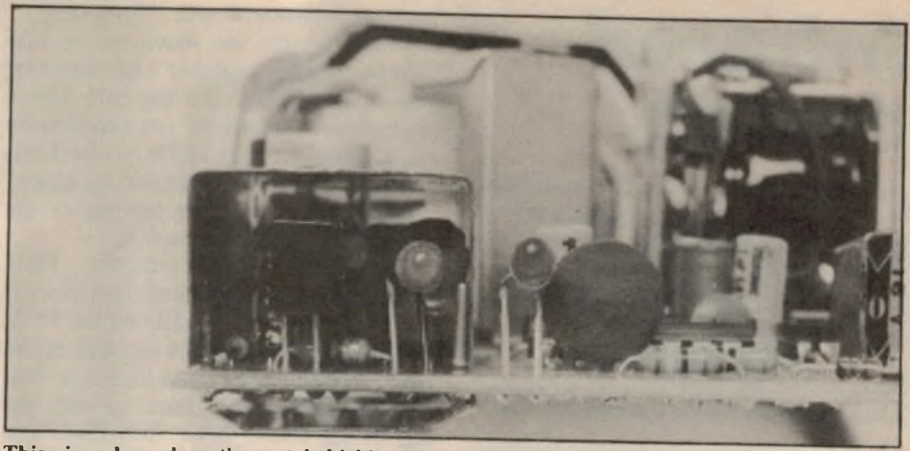
Latch circuit

IC3b forms the output latch circuit. Each time pin 6 of IC2b switches high, IC3b toggles, its Q and Q-bar outputs going alternatively high and low. The Q-bar output drives output transistor Q1 via parallel Schmitt inverter stages IC2e and IC2f.

When Q-bar is low, Q1 turns on and activates the output relay. At the same time, the Q output drives LED 2 via IC2d to indicate the "ON" condition. When the next pulse is received from IC2b, Q-bar goes high, Q goes low, and Q1, the relay and LED 2 switch off.

C15 and R12 provide power-on reset for IC3b. This sets Q low and Q-bar high and ensures that the relay remains off when the receiver is first powered up.

Power for the circuit is derived from a mains transformer with a 9V secondary. This drives a bridge rectifier (D4-D7) and a 1000µF filter capacitor (C16) to provide a nominal 12V rail (depending on the load). R1/C1 and R5/C6 decouple the supply rail to the photodiode and IC1, while ZD1 provides a regulated 6.8V supply for the LM567 tone decoder.



This view shows how the metal shields, photodiode and LEDs are mounted on the receiver PCB.

RECEIVER PARTS LIST

- 1 plastic case assembly with pre-punched panels and screened lettering
- 1 printed circuit board, code ZA-1655, 100 x 70mm
- 1 3-pin 10A mains socket (HPM55)
- 1 9V 150mA mains transformer
- 1 3-core mains cord with moulded plug
- 1 1 PC-mounting mains terminal block
- 1 12V DPDT relay, 240V 10A contacts
- 1 5mH RF choke
- 2 pre-made tinplate shields
- 4 PC stakes
- 3 75mm lengths of 24/0.2mm hookup wire (brown, blue and green)
- 2 3 x 9mm Philips-head screws
- 2 3 x 19mm Philips-head screws
- 4 3mm hex nuts
- 4 3mm washers

Semiconductors

- 1 uPC1373H preamplifier
- 1 74C14 hex Schmitt inverter
- 1 4013 dual D-type flipflop
- 1 LM567 PLL tone decoder
- 1 BC337 NPN transistor
- 4 1N4002 diodes
- 3 1N4148 diodes
- 1 6.8V 400mW zener diode
- 1 LTR-536AB (BPW50) photodiode
- 1 3mm red LED
- 1 3mm orange LED

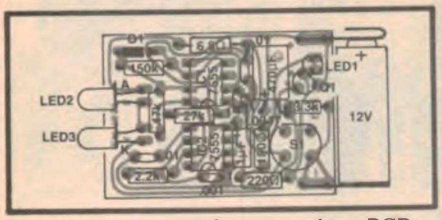
Capacitors

- 1 1000µF 16VW PC-mounting electrolytic
- 1 100µF 25VW PC-mounting electrolytic
- 1 47µF 35VW PC-mounting electrolytic
- 1 25µF 25VW PC-mounting electrolytic
- 3 10µF 25VW PC-mounting electrolytics
- 1 2.2µF 25VW PC-mounting electrolytic
- 2 1µF 50VW PC-mounting electrolytics
- 3 0.1µF ceramics
- 1 .047µF ceramic
- 1 .01µF ceramic
- 1 .003µF ceramic

Resistors (0.25W, 5%)

1 x 1MΩ, 1 x 470kΩ, 1 x 150kΩ, 2 x 100kΩ, 1 x 12kΩ, 1 x 10kΩ, 2 x 1.8kΩ, 1 x 1kΩ, 1 x 820Ω, 1 x 680Ω, 1 x 390Ω, 1 x 22Ω, 1 x 5kΩ miniature horizontal trimpot.

Infrared switch



Above: parts layout for transmitter PCB.

Construction

Construction is straightforward, with the parts accommodated on two small printed circuit boards (PCBs). The transmitter board is coded ZA-1657 and measures 32 x 45mm, while the receiver board is coded ZA-1655 and measures 100 x 70mm.

Begin construction by installing the parts on the transmitter PCB. No special procedure need be followed, but note carefully the orientation of the ICs, transistor, LEDs and electrolytic capacitors when they are being installed.

Capacitors C1 and C6 should be installed so that they lie flat against the PCB, as shown in the layout diagram. Bend their leads as appropriate before soldering them in position. Note that the flat side of the switch body faces towards R8.

The two infrared LEDs (grey) are mounted with their leads bent at right angles, 4mm from the LED bodies. The cathode (K) lead is adjacent to the flat edge on the side of each LED. The indicator LED (LED 1) should be left off the board for the time being.

The case must now be modified to accept the two infrared LEDs. To do this, position the PCB in the bottom half of the case and mark the two LED centre points. A rat-tail file can then be used to file two semi-circles in the front lip of the case. These semi-circles should each be 5mm in diameter and 2.5mm deep.

This done, the two halves of the case can be clipped together and matching semi-circles filed in the top half. Check your work regularly as you progress by introducing the two LEDs to the holes (you can do this from outside the case).

Don't make the holes too big — the LEDs should just be a neat fit.

Finally, the red indicator LED (LED 1) can be soldered into circuit. To do this, install the LED on the PCB, position the board in the top half of the case, and adjust the lead length so that the top of the LED lines up with the top of its access hole. The leads can then be soldered and trimmed.

Note that the holes for the pushbutton switch and the indicator LED are part of the original case moulding.

Construction of the transmitter can now be completed by fitting the battery (watch the polarity) and clipping the two halves of the case together.

Receiver assembly

Because IC1 (uPC1373H) in the transmitter is a high-gain stage, it must be shielded from adjacent circuit components. This takes the form of a simple U-shaped shield mounted on top of the PCB, and a rectangular shield plate mounted on the underside of the PCB.

The shield components are cut from 0.3mm-thick tinplate and are supplied ready-made with the kit. They are supported on the board by means of four PC stakes.

Begin assembly of the receiver PCB by fitting the PC stakes to the shield corner positions. After that, the various components can be installed, but leave C16 and the transformer off the board for the time being.

As before, take care with the orientation of the semiconductors and electrolytic capacitors. Pin 1 of IC1 is indicated by a bevelled edge at one end of the IC. The IC should be installed with this adjacent to R4 (100kΩ).

Note that there are three wire links on the PCB. Link 2 and Link 3 should be installed only if the unit is to be operated as a mains switching device. These links should be sleeved with spaghetti insulation.

TRANSMITTER PARTS LIST

- 1 plastic case assembly
- 1 printed circuit board, code ZA-1657, 32 x 45mm
- 1 pushbutton switch (S-1200 type)
- 1 positive battery contact
- 1 negative battery contact
- 1 mini 12V battery

Semiconductors

- 2 TLC555 or 7555 CMOS timers
- 1 BC640 PNP transistor
- 1 1N4148 diode
- 1 3mm red LED
- 2 LTE-4208C (LD271) infrared LEDs

Capacitors

- 1 470μF 16W electrolytic
- 1 1μF 50W electrolytic
- 2 .01μF ceramics
- 1 .0047μF ceramic
- 1 .001μF ceramic

Resistors (0.25W, 5%)

1 x 150kΩ, 1 x 47kΩ, 1 x 27kΩ, 1 x 3.3kΩ, 1 x 2.2kΩ, 1 x 220Ω, 1 x 170Ω, 1 x 6.8Ω 1/2W

The LTR-536AB photodiode must be stood off the PCB by 4mm. Make sure that it is correctly oriented — the cathode lead is indicated by the bevelled edge on the top of the case.

The two indicator LEDs are installed with their leads bent at right angles about 4mm from their bodies. These should be installed at full lead length. Later on, they will have to be manipulated to fit through matching holes in the front panel.

Take care when installing the two LEDs. LED 1 should be installed with its anode adjacent to PHD1, while LED 2 has its anode adjacent to C7 (0.1μF).

Once all the components have been fitted, the metal shields can be installed. These are simply solder tacked to the four PC stakes previously fitted to the board. After that, C16, the mains transformer, and the relay can all be installed.

Trim the leads of the transformer to a suitable length before soldering them to the PCB. The centre tap of the secondary is not used — it can be cut short and covered with heatshrink tubing or insulation tape.

The transformer is secured to the PCB using machine screws and nuts.

continued on page A11

Where to buy the kit

This project was developed at the Research and Development Department at Dick Smith Electronics Pty Ltd. It can be purchased as a kit of parts, either by mail order or from your nearest Dick Smith Electronics Store.

The kit comes complete and includes fibreglass PCBs, plastic cases, pre-punched panels with screened lettering, and a construction manual. The cost is $69 plus postage and packing charges where applicable.

Mail orders should be sent to: Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde, NSW 2113. Phone (02) 888 2105.

Easy-to-build unit uses pre-aligned module

UHF Converter for Channel 28

Are you one of the thousands suffering from lack of SBS programs on channel 0 because your set doesn't have UHF? Build this UHF to VHF converter and come back to the world of good TV programs, minus advertising. The circuit goes together easily and does not require any alignment or adjustments.

by LEO SIMPSON & BOB FLYNN

Since Channel 0 ceased transmissions on January 5th this year, tens of thousands of people have contacted Special Broadcasting Service offices in Sydney and Melbourne asking what they have to do to receive Channel 28. We answered these questions in detail in the December 1985 issue in an article entitled "What to do about Channel 0/28"*

In brief, if your present TV set does not have a UHF tuner, you have two choices, short of buying a new TV set incorporating UHF. First, if you have a VCR, you can use that to tune to UHF, substituting for the tuner in your TV set. (Unless your VCR is quite old, it is almost certain to include a UHF tuner.)

Second, you can buy or build a UHF adaptor. That is the reason for this article.

There are two ways of building a UHF to VHF converter. The first is to feed the UHF signal to an untuned amplifier stage and then into a mixer stage where the incoming signal is heterodyned with the tunable oscillator to produce a VHF output. This approach has the benefit of simplicity but can be very hard to tune and tends to be plagued with spurious outputs.

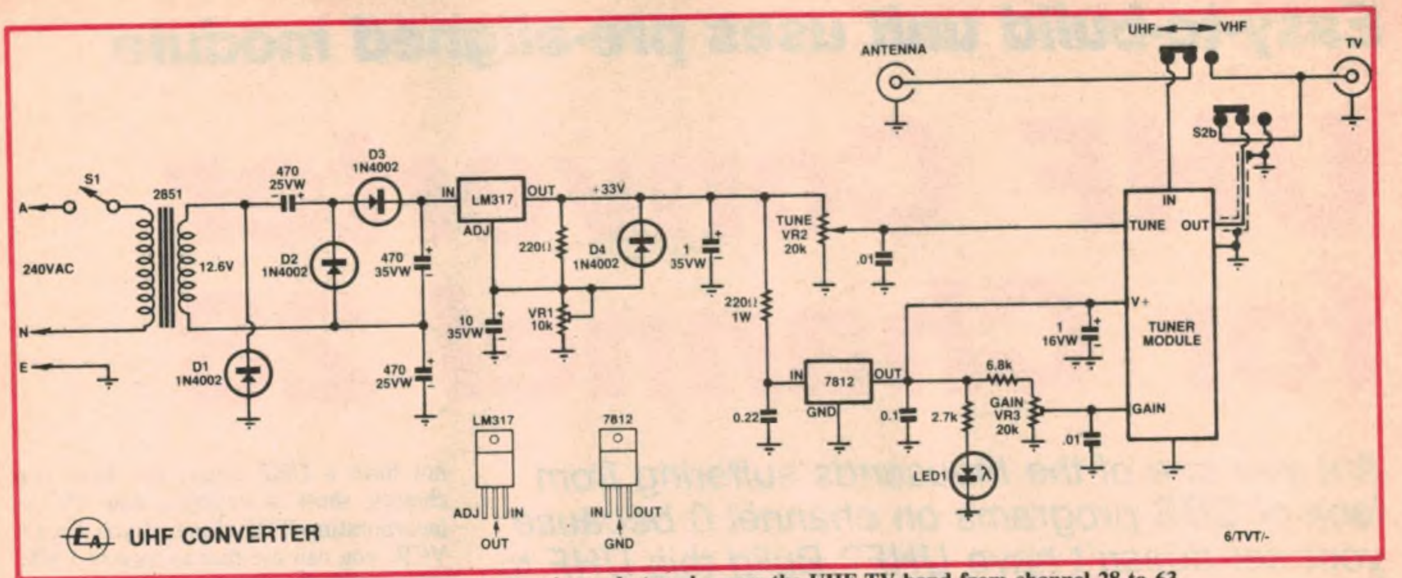
The fact that the input stage is untuned also means unwanted strong signals are prone to break through the mixer and cause interference.

The second way is to use a standard UHF tuner module which has been modified to have its output at one of the low VHF channels instead of the TV intermediate frequency of 36.87MHz. We have tried both ways and have plumped for the second because it is straightforward, requires no adjustment and is easy to tune.

We have arranged for the supply of a suitable tuner module from Dick Smith Electronics. Construction is simply a matter of installing this module on a printed circuit board, together with power supply components. The board is then assembled into a case with transformer and hardware.

Technical details

The tuner module covers both UHF bands 4 and 5 — ie, from channel 28 to 63 (526 to 820MHz) — and is a conventional varicap unit intended for use in TV sets with pushbutton station selection. In our case, it is continuously tuned by a 30-turn potentiometer which



The circuit uses a pre-aligned module and can be continuously tuned across the UHF TV band from channel 28 to 63.

feeds a DC control voltage to the internal varicaps.

Overall dimensions of the module are 93mm long, 40mm high and 25mm deep.

The output of the module is at VHF channel 1 — ie, nominally at 57.25MHz — and is via one of five PC pins along one side of the module. The other four pins are for DC tuning voltage, positive supply, negative supply, and gain control. The UHF input is via an RCA-style socket at one end of the module.

Now let us have a look at the circuit. This mainly consists of the power supply for the tuner module plus the input and output connections.

The power supply uses a small power transformer with a 12.6V secondary. This feeds a voltage tripler circuit consisting of D1, D2, D3 and the three associated 470μF capacitors. This provides an unregulated supply of about 42V DC which is fed to an LM317 adjustable 3-terminal regulator to give 33V DC. This supply is used for the varicap tuning voltage.

Note: in theory the voltage tripler circuit should give an output of about three times the peak AC input voltage or around 60V but this type of supply circuit and the specified transformer have fairly poor regulation and so the output is loaded down to around 42V.

An additional 12V 3-terminal regulator, fed from the 33V supply via a 220Ω 1W resistor, is used to power the tuner module. It also feeds the 20kΩ gain control via a 6.8kΩ resistor and the LED power indicator via a 2.7kΩ resistor.

The gain control pin for the tuner

PARTS LIST

- 1 PCB, code 6cv4, 107 x 92mm
- 1 metal box with black crinkle enamel cover, DSE Cat No H-2743 or equivalent.
- 1 varicap-tuned UHF tuner module with output at Australian channel 1 (available from Dick Smith Electronics)
- 1 power transformer with 12.6V secondary, Ferguson PF2851 or equivalent
- 1 DPDT slide switch
- 1 SPST push-on, push-off switch
- 2 chassis-mounting 75 Belling Lee sockets
- 1 RCA plug
- 1 2-way insulated mains terminal block
- 3 solder lugs
- 1 3-core mains cord and moulded 3-pin plug
- 1 cordgrip grommet or grommet and mains cord clamp

Semiconductors

- 4 1N4002 100PIV silicon power diodes
- 1 red light emitting diode and bezel
- 1 LM317 adjustable 3-terminal regulator
- 1 7812 12V 3-terminal regulator

Capacitors

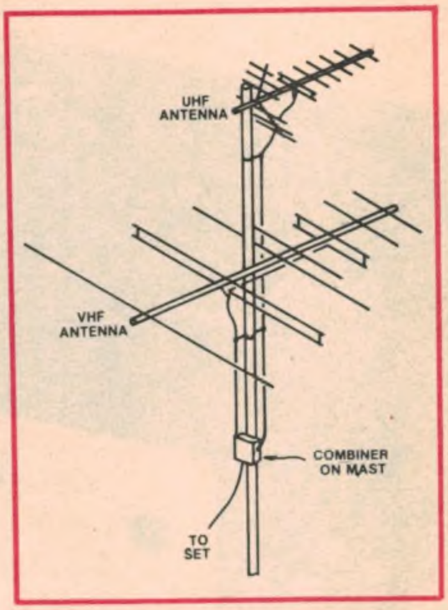
- 1 470μF 35VW PC-mounting electrolytic
- 2 470μF 25VW PC-mounting electrolytic
- 1 10μF 35VW PC-mounting electrolytic
- 2 1μF 35VW PC-mounting electrolytic
- 1 0.22μF 25VW ceramic
- 1 0.1μF 25VW ceramic
- 2 .01μF 50VW ceramic

Resistors

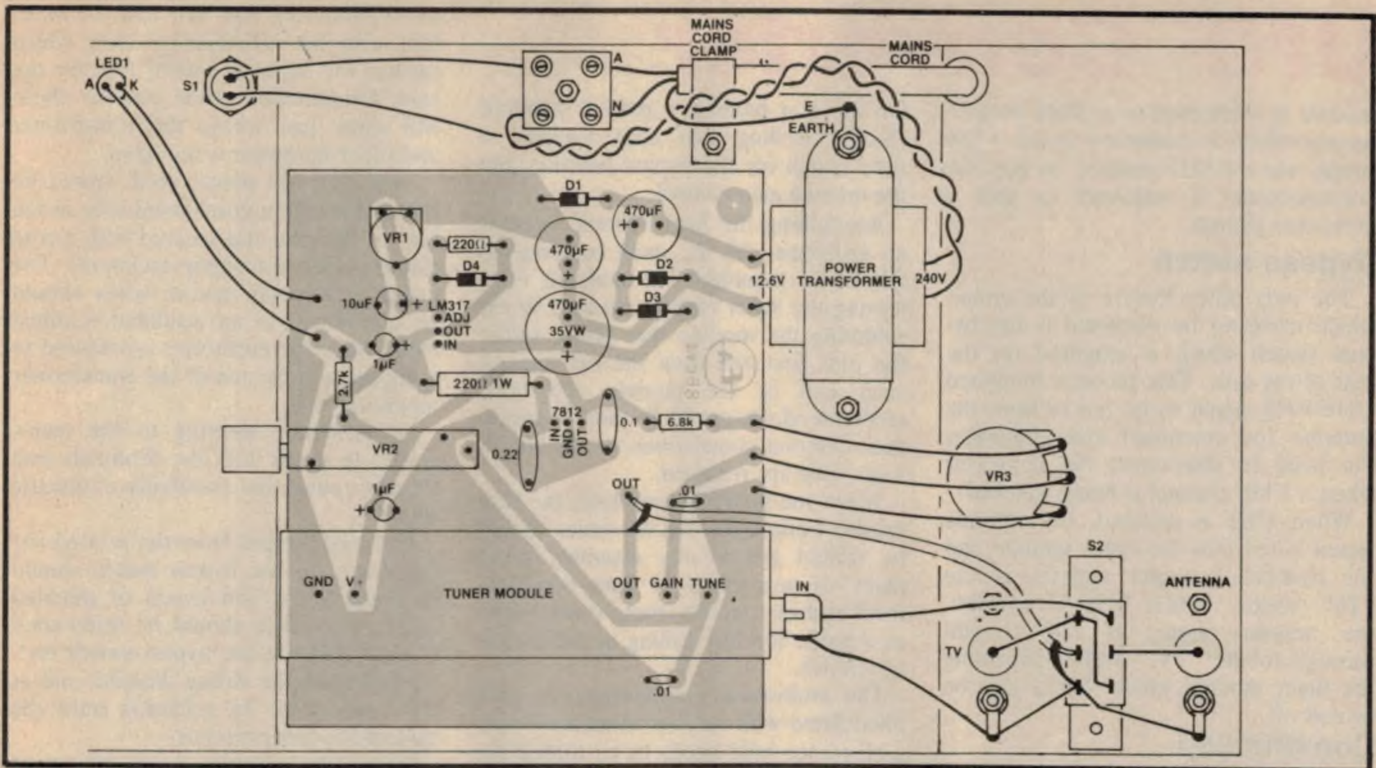
(10%, 0.5W unless stated)
1 x 6.8kΩ, 1 x 2.7kΩ, 1 x 220Ω, 1 x 220Ω/1W, 1 x 20kΩ multi-turn potentiometer with integral knob, 1 x 20kΩ linear potentiometer, 1 x 10kΩ horizontal trimpot.

Miscellaneous

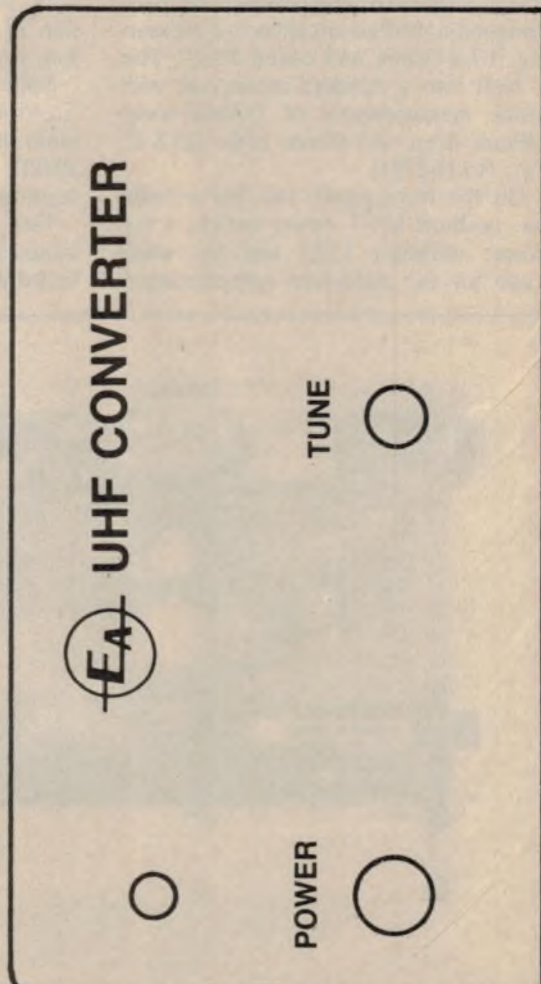
Hookup wire, 75Ω coax cable, tinned copper wire, sleeving for mains switch, screws, nuts, washers, solder.



The UHF antenna can be mounted separately or on the same mast as the VHF antenna, a metre or so above the main array. Feed the downleads to an outdoor combiner mounted high on the mast, then run a single lead to the antenna input of the UHF Converter. Use 75-ohm coax for all leads.



Above: parts layout and wiring diagram for the UHF Converter. Take care with the mains wiring.



Above are actual-size artworks for the PCB and front panel.

UHF Converter

module is connected to a 20kΩ potentiometer which is connected to the +12V supply via a 6.8kΩ resistor. In use, the potentiometer is adjusted to give a noise-free picture.

Bypass switch

The only other feature of the circuit which needs to be discussed is the bypass switch which is mounted on the rear of the case. This allows a combined UHF/VHF signal to be fed in from the antenna (or antennae) and eliminates the need to disconnect the converter when a VHF channel is being watched.

When UHF is selected, the antenna signal is fed into the tuner module and the channel 1 output appears at the "TV" socket. When VHF is selected, the antenna signal is fed straight through to the "TV" socket, bypassing the tuner module which should also be turned off.

Construction

To accommodate the tuner module and its associated components, we have designed a printed circuit board measuring 107 x 92mm and coded 86cv4. This is built into a standard metal case with inside measurements of 132mm wide, 140mm deep and 69mm high. (D.S.E. Cat. No H-2743).

On the front panel, this has a push-on, push-off SPST power switch, a red power indicator LED and the small knob for the multi-turn potentiometer. On the rear panel is a pair of standard 75-ohm Belling Lee coax sockets, a slide switch for the bypass function and the manual gain control.

Assembling the board should present no problems. All the small components should be mounted and soldered first, leaving the tuner module till last. When soldering the module into place, solder the pins first and then the two lugs at each end of the module case. We recommend the use of PC pins to terminate external connections to the board. Eight pins are required.

When the board is complete, the case can be worked on. All the holes should be drilled before any assembly takes place. If you make or have Scotchcal front and rear panels, these can be used as a guide for the drilling of the necessary holes.

The multi-turn potentiometer is supplied fitted with its own small knob and a clearance hole needs to be drilled for this in the front panel of the case. Naturally, this will affect the mounting position of the printed board, so look before you leap.

Note: we understand that Dick Smith Electronics may supply a different multi-turn potentiometer with a value of 100kΩ. They will modify the PCB artwork to suit.

The small power transformer is mounted behind the printed circuit board but there is a problem in that one of its mounting lugs will tend to interfere with the self-tapping screw which secures the adjacent rubber foot for the case. Examination of the internal photo will show just where the transformer and other hardware is mounted.

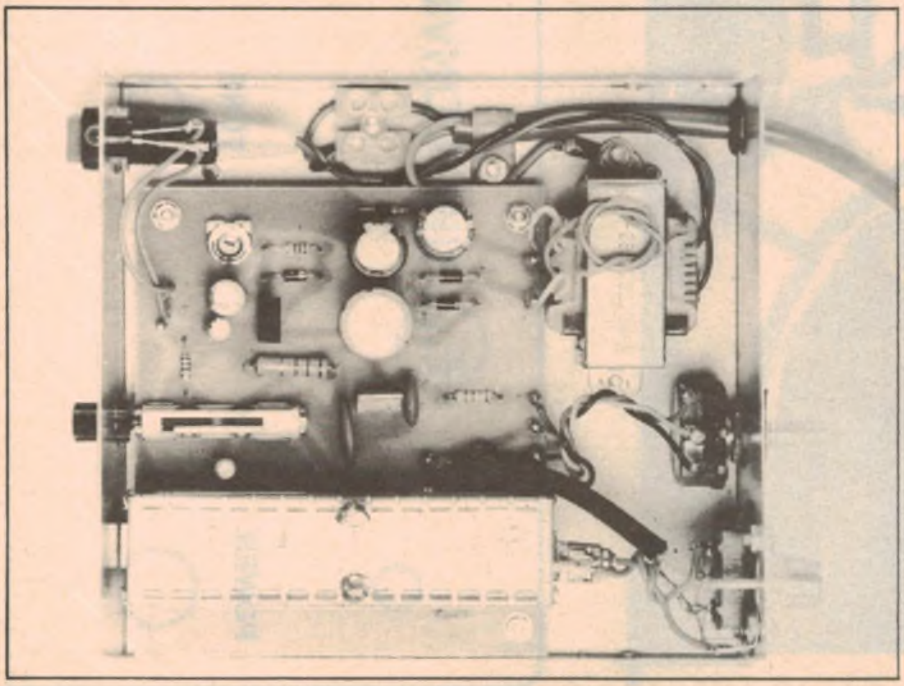
Note that the power cord should be passed through a grommeted hole in the rear of the case and secured with a cord clamp (or use a cordgrip grommet). The mains active and neutral wires should be terminated in an insulated terminal block while the earth wire is soldered to a lug secured by one of the transformer mounting feet.

Fit insulating sleeving to the mains switch to cover the live terminals and thereby reduce the possibility of electric shock.

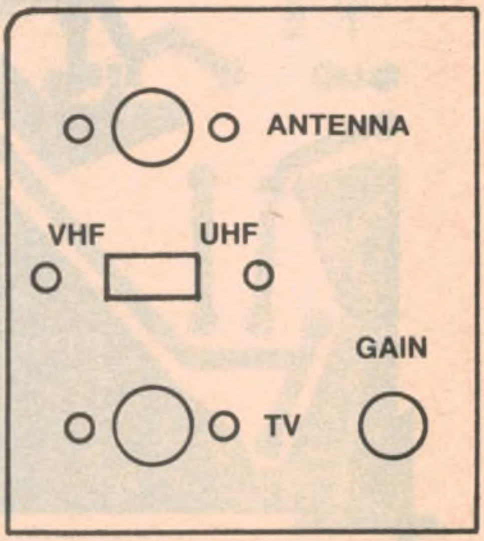
The VHF output from the printed circuit board to the bypass switch should be made via a 7cm length of shielded cable. The shield should be terminated at both ends: at the bypass switch end, as shown on the wiring diagram and at the board end, by soldering onto the case of the tuner module.

Since the distance from the input socket of the tuner module to the bypass switch is so short, it is not practical to use shielded cable. Instead, an RCA plug should be connected to the appropriate terminal of the bypass switch using a short length of hookup wire. This can be twisted together with the earth return wire from the RCA plug to the solder lug for the "Antenna" socket on the rear of the case.

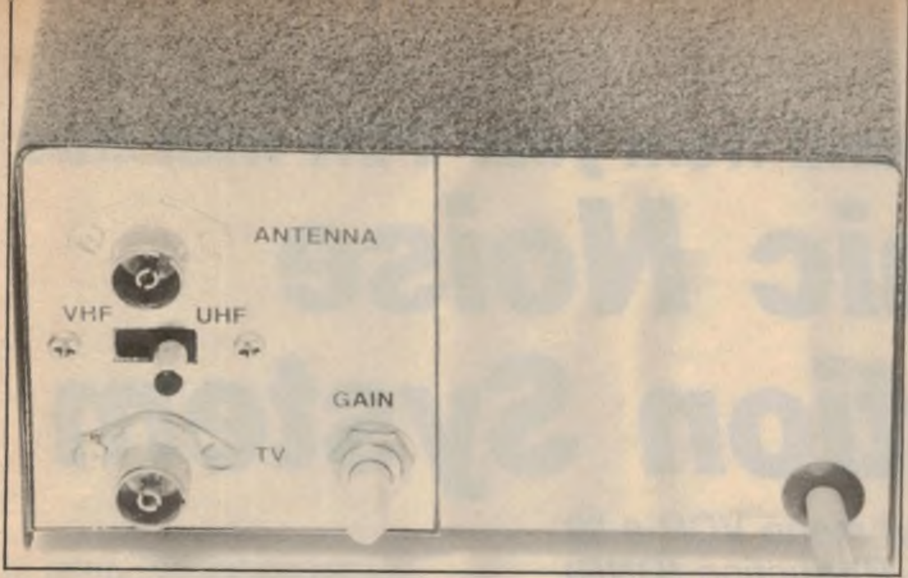
When assembly is complete, check all your work carefully. Set VR1 so that the wiper is at mid-travel. Then apply power and connect a multimeter, set to its 50V DC range, between the anode of D4 (ie, the output of the LM317)



View inside the prototype. Note transformer mounting location.



Above: actual-size rear panel artwork.



The rear panel carries the 75-ohm sockets, VHF/UHF selector switch, and gain control.

and the earth return pin for the LED. Now adjust VR1 for a reading of +33V on the multimeter.

Set gain control VR3 to its midway position and connect the converter between your antenna lead and TV set. Now comes the tricky part. You have to tune your TV set to channel one and the converter to channel 28. As a first step, rotate the multi-turn tuning potentiometer VR2 for the converter fully anti-clockwise.

You do this by rotating the knob umpteem times anti-clockwise until it comes to the click stop. This sets the converter to the bottom of UHF band four, which is where channel 28 sits. Now rotate the potentiometer about two turns clockwise which for our unit was not too far away from optimum tuning for channel 28.

Now select channel 1 on your TV set and use the fine tuning control to obtain the best picture. This will involve a "hunt back and forth" job as you tweak the TV fine tuning control and the converter tuning potentiometer, to obtain the best picture.

That done, rotate the gain control, VR3 anticlockwise until noise (snow) appears in the picture. Now rotate VR3 clockwise until the noise just disappears. That completes the setting up adjustments. You can now enjoy SBS programs.

Note: if your local SBS channel is on one of the band five channels, the above procedure is much the same except that the setting for the tuning control will be more towards mid-travel.

*If you missed our article in the December 1985 issue, photostat copies are available for $4.00 including postage. Write to the Assistant Editor, Electronics Australia, PO Box 227, Waterloo, NSW 2017.

Infrared remote control switch ...ctd from page A6

Final assembly

With the PCB assembly now completed, attention can be turned to the plastic case. This is supplied with prepunched front and rear panels.

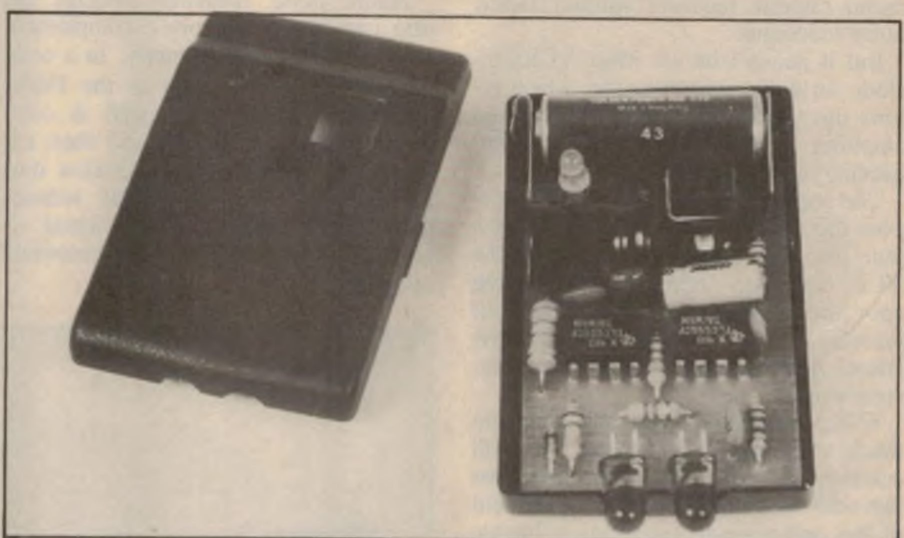
Fit the mains socket to the rear panel and wire it to the PCB using short lengths of mains-rated hookup wire. Take care with the mains wiring — the three socket terminals are clearly labelled A, N and E (active, neutral and earth).

The mains cord enters through a cord-grip grommet on the rear panel and its leads terminate in the 3-way terminal block installed on the PCB.

Next, the red bezel can be fitted to the front panel. Cut off the rear tips of the shoulders and position them so that they meet the vertical edges of the photodiode. The two indicator LEDs can then be pushed through the front panel holes and the completed assembly installed in the case.

The PCB is designed to fit over the integral mounting bosses in one of the case halves. Note that the front half of the board will be obstructed by one of two 3mm posts. This post should be removed using a pair of sidecutters.

The top half of the case should be left off until after the adjustment procedure.



Above: the transmitter PCB fits neatly into the small plastic case.

Adjustment

This procedure simply involves adjusting VR1 to set the centre frequency of the LM567 tone decoder.

To do this, set VR1 to mid-position, plug the receiver into the mains, and press the transmitter button. Check that the relay operates and that LED 1 lights for a brief period. If not, adjust VR1 until a response is obtained (keep the transmitter button pressed during this procedure).

VR1 can now be adjusted for maximum range. Progressively increase the distance between the transmitter and receiver (you'll need another person to help you) and adjust VR1 each time until the relay operates. Continue this process until the maximum range is obtained.

Finally, remove the centre-most boss of the top half of the case and clip the two halves of the case together. You can now plug a mains appliance into the receiver and switch it on and off to your heart's content.

Improve the sound from your VCR with this

Dynamic Noise Reduction System

Give the sound from your mono VCR a lift with this Dynamic Noise Reduction (DNR) System which reduces hiss and adds simulated stereo. The circuit uses the standard DNR chip from National Semiconductor.

by GREG SWAIN

Anyone who owns a mono VCR knows that the sound quality, as it finally emerges from the TV set, is pretty lousy. In fact, it's worse than from a mono cassette recorder without Dolby noise reduction.

But it needn't be so. Most VCRs include an audio output socket which allows the sound to be routed to a stereo amplifier. That's the first step to improving sound quality.

The second step is to build and interpose this Dynamic Noise Reduction System into the signal line between the VCR and the amplifier. Depending upon the circumstances, it is capable of providing a very worthwhile 18dB (maximum) improvement in the signal-to-noise ratio.

While this figure might not mean too much to many readers, your ears will certainly appreciate the difference. Less hiss adds up to much greater enjoyment of the audio sound track. As a bonus, the circuit processes the mono soundtrack to give a realistic stereo effect and provides notch filtering of the TV line frequency (15.625kHz).

Although mainly designed for use with VCRs, the Dynamic Noise Reduction System could also be used with other audio sources where noise is a problem. For this reason, the circuit is capable of accepting both mono and stereo line level inputs. No provision has been made for line frequency extraction from stereo sources, however.

So, if you want to get the best possible sound from your VCR, this project is a must. It's easy to assemble and the setting up procedure is a snack.

Noise reduction systems

Audio noise reduction systems fall into two broad categories: complementary and non-complementary. In a complementary system, such as the Dolby and dbx systems, the signal is compressed during recording and then expanded in complementary fashion during playback. This effectively reduces the noise in the playback signal — hopefully to a level below the threshold of hearing.

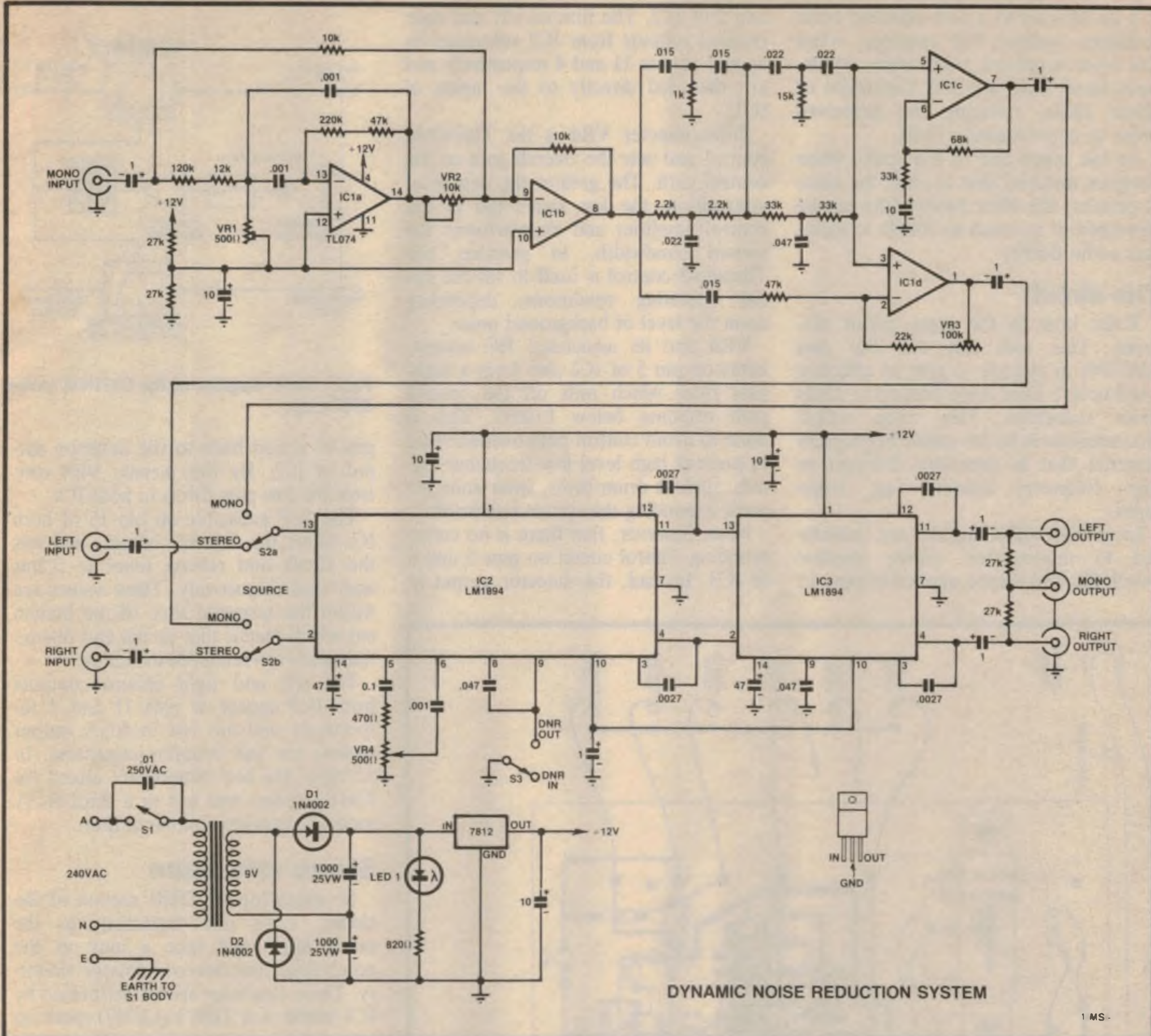
In a non-complementary system, on the other hand, noise reduction takes place in the playback mode only. This is the technique used in the DNR System described here. It's main advantage is that it can be used with almost any audio source since no signal processing is required during recording.

How it works

At the heart of the circuit is the LM1894 stereo DNR chip from National Semiconductor. The operation of this chip depends on two principles: (1) in any playback system, the audible noise is proportional to the bandwidth; and (2) desired signals above a certain level are capable of masking the background noise.

As an aside, most background noise (hiss) occurs at frequencies above 1kHz. This means that the noise can be considerably reduced by filtering out these high frequencies (ie, by reducing the bandwidth). The DNR system does this in such a way as to leave the program

The front panel controls include mono/stereo source switching, DNR IN/OUT, and threshold.



content largely unaffected.

In essence, the LM1894 monitors the incoming audio signal and continuously adjusts the system bandwidth in response to the signal amplitude and frequency content. This means that, when low-level or low-frequency signals are present, the bandwidth is deliberately restricted to filter out the unwanted high-frequency noise.

Conversely, when high-level or high-frequency signals are present, the noise is masked and the bandwidth is correspondingly expanded to pass the wanted program content.

Fig.1 is a block diagram of the LM1894 chip. In each channel is a variable cut-off low pass filter. These filters have a flat frequency response below the cut-off frequency, and a smoothly decreasing (−6dB/octave) response above the cut-off frequency.

The cut-off frequency is continuously adjusted by means of a control voltage derived from a weighted filter-cum-detector network. This so-called 'control path' provides summing of the audio input, while the weighted filter prevents high level low frequency signals from activating the detector.

Specifications

Gain	0dB; stereo input (note 1)
Frequency response	10Hz-20kHz; stereo input (note 1)
Crosstalk	−54dB; Vin = 775mV
Maximum input level	3.2V stereo; 2.2V mono @ 1kHz
Signal-to-noise ratio	75dB; stereo, unweighted, ref. 775mV
S/N ratio improvement	18dB maximum (note 2)

Note 1: Due to the effects of the stereo simulator circuitry, it is difficult to specify gain and frequency response figures for mono operation. Mono gain is approximately −6dB.

Note 2: the signal-to-noise ratio improvement is dependent upon noise content and spectral distribution of the source material.

It all adds up to a very effective noise reduction system. For example, when just noise is present at the audio inputs, both filters have a −3dB bandwidth of about 1kHz, reducing the perceived noise by approximately 14dB.

At the other end of the scale, when program material able to mask the noise is present, the filter bandwidths can be increased to as much as 30kHz to maintain audio fidelity.

The circuit

Refer now to the main circuit diagram. This uses not one but two LM1894s in cascade to give an effective 12dB/octave filter slope and up to 18dB noise reduction. This steep rolloff characteristic is better suited to program material that is relatively deficient in high frequency content (eg, video tapes).

Incoming audio signals are initially fed to mono/stereo source selector switch S2, and thence applied to pins 13 and 2 of IC2. The filtered left and right channel outputs from IC2 subsequently appear at pins 11 and 4 respectively and are then fed directly to the inputs of IC3.

Potentiometer VR4 is the Threshold control and sets the overall gain of the control path. The greater the degree of attenuation, the less signal fed to the control amplifier and the narrower the system bandwidth. In practice, the Threshold control is used to set the initial operating conditions, depending upon the level of background noise.

VR4 and its associated RC components on pin 5 of IC2 also form a highpass filter which rolls off the control path response below 1.6kHz. This is done to avoid control path overload and to prevent high level low frequency signals, such as drum beats, from unnecessarily expanding the system bandwidth.

Note, however, that there is no corresponding control circuit on pins 5 and 6 of IC3. Instead, the detector output at

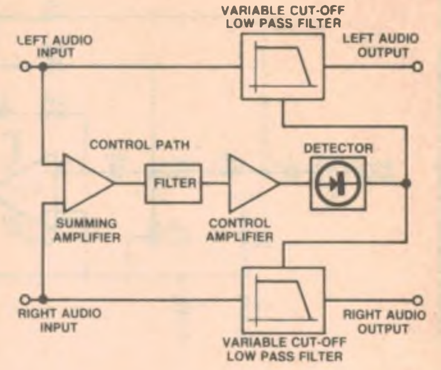


Fig.1: block diagram of the LM1894 stereo DNR chip.

pin 10 is tied back to the detector output of IC2. By this means, VR4 controls the low pass filters in both ICs.

The 1μF capacitor on pin 10 of both ICs filters the detector outputs and sets the attack and release times to 0.5ms and 60ms respectively. These values are within the response time of the human ear which means that attack and release transients are rendered inaudible.

The left and right channel outputs from IC3 appear at pins 11 and 4 respectively and are fed to RCA output sockets via 1μF coupling capacitors. In addition, the two outputs are mixed via 27kΩ resistors and fed to a third RCA socket to provide a mono output.

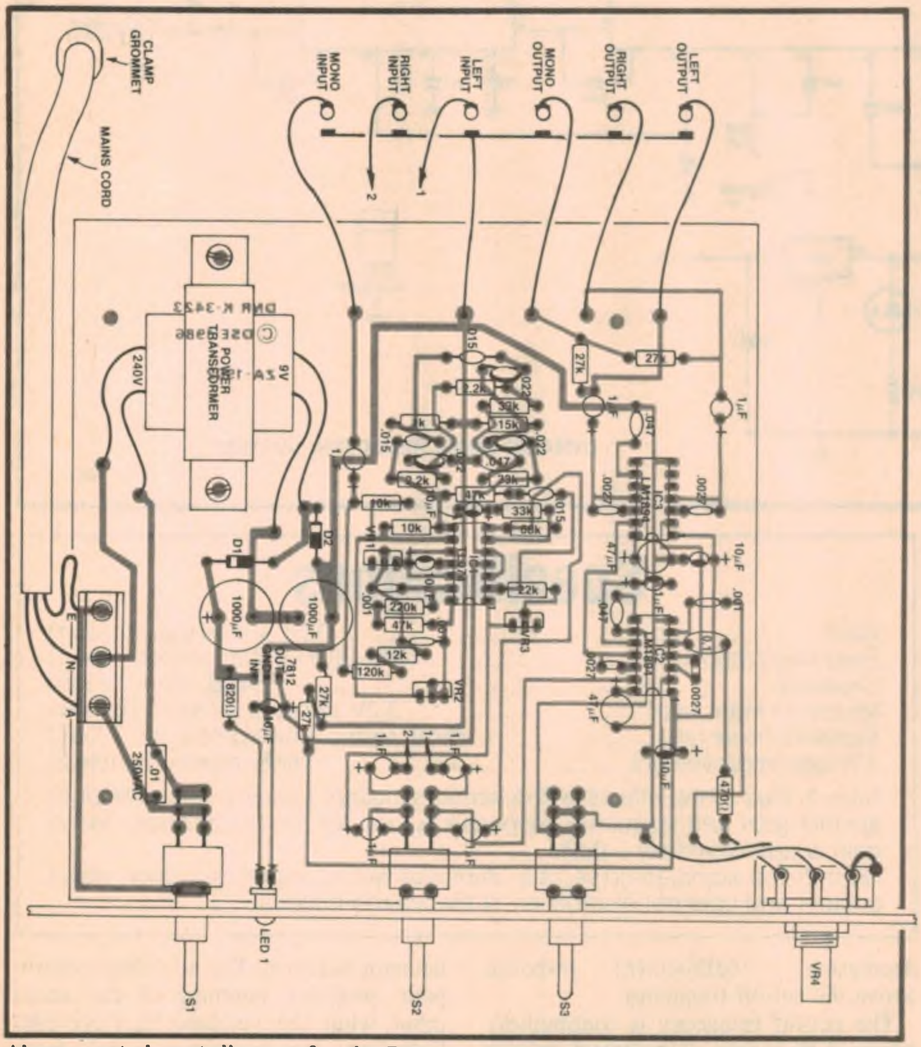
Stereo simulation

So much for the DNR section of the circuit. Let's now backtrack to the mono input and take a look at the notch filter and stereo simulator circuitry. These functions are all performed by IC1 which is a TL074 (LF347) quad op amp.

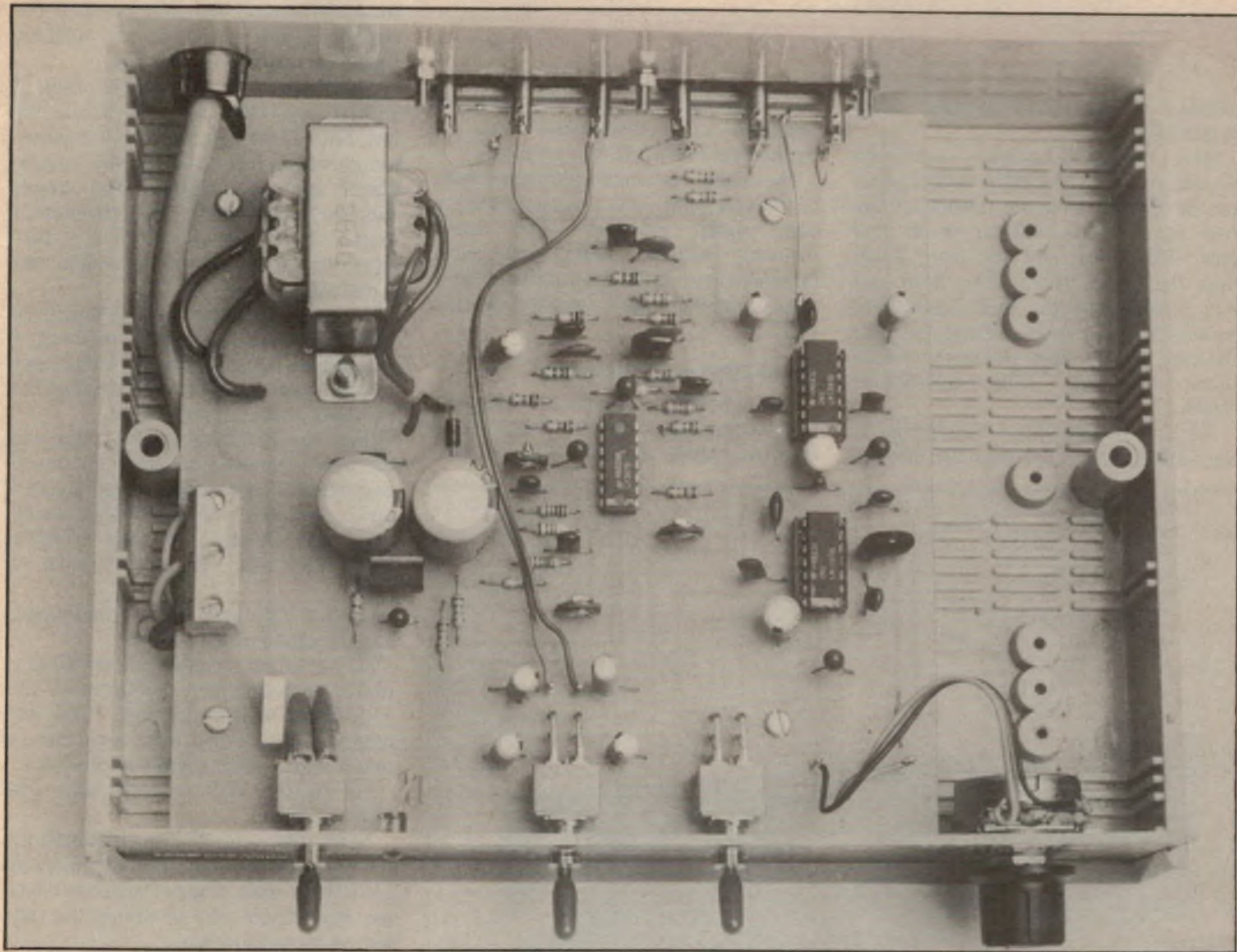
IC1a and IC1b together form the 15.625kHz notch filter circuit. Note that the bias for the non-inverting inputs of the two op amps is derived from a voltage divider consisting of two 27kΩ resistors strung across the supply rail. Trimpot VR1 sets the notch centre frequency while VR2 sets the null.

The notch filter output appears at pin 8 of IC1b and is applied to the stereo simulator circuit. This circuit is based on one that appeared in *Electronics Australia* in April 1983. It consists of op amps IC1c, IC1d and two twin-T filter networks.

Twin-T filters are so named because they consist of two T sections. One section uses an R, 2C network and the other an R/2, C network. When the exact values are chosen, the filter gives a narrow notch with almost total cancel-



Above: parts layout diagram for the Dynamic Noise Reduction System. Note that mains voltages are present on the PCB.



Virtually all the parts are mounted on a single PCB. Take care with mains wiring.

lation at its centre frequency.

In this circuit, however, the components used are deliberately off value and this has resulted in broad notches of about 20dB at 200Hz and 5kHz. These broad notches ensure effective stereo simulation.

The filtered signal from the twin-T networks is applied to the non-inverting inputs of IC1c and IC1d. IC1c applies a gain of about two to this signal, as set by the ratio of the 68kΩ and 33kΩ feedback resistors.

Unlike IC1c, IC1d is wired as a differential amplifier. Note that the output of the twin T filter network is applied to the non-inverting input, while the signal on the inverting input is derived from the output of IC1b via a 0.015μF capacitor and 47kΩ resistor. The output from IC1d represents the difference between these two input signals.

Thus, when the signals on pins 2 and 3 are common (ie, they have the same phase and amplitude), they are cancelled and IC1d has no output. When the signals are no longer common (as at the twin-T notch frequencies), only partial or nil cancellation occurs, depending upon the relative phase and amplitude differences between them.

Trimpot VR3 allows the gain of IC1d to be adjusted so that its output level matches that of IC1c. The outputs of IC1c and IC1d become the left and right channels respectively and are AC-coupled to S2 via 1μF capacitors.

Power for the circuit is derived from a 9V power transformer which drives a voltage doubler circuit consisting of D1 and D2 and the two 1000μF capacitors. The output from the voltage doubler is then applied to a 3-terminal regulator which provides a +12V rail. A red LED wired in series with an 820Ω resistor across the regulator input provides power on/off indication.

Construction

The Dynamic Noise Reduction System is available as a complete kit of parts from Dick Smith Electronics. Construction mainly involves assembly of a single PCB which is coded ZA-1502. This is housed in a plastic instrument case measuring 200 x 160 x 65mm (W x D x H).

No special procedure need be followed when wiring up the PCB although we suggest that the smaller components be installed first. The main thing to watch here is the orientation of polarised components. These include the electrolytic capacitors, the 3-terminal regulator and the ICs.

The three toggle switches are all PC-mounting types and are soldered directly to the PCB. Push them down onto the board as far as they will go before soldering. Note that S1 switches the mains — its terminals should be sleeved with plastic tubing to prevent accidental contact while the unit is being worked on.

PC stakes are used to terminate external connections to VR4 and the RCA sockets. Twelve PC stakes are required in all. The transformer leads should be

Noise Reduction System

trimmed to length and soldered direct to the PCB.

Once the PCB assembly has been completed, the 6-way RCA socket panel can be mounted on the outside of the rear panel using machine screws and nuts. This done, slip the front panel over the switch shafts. The front and rear panels, with the PCB sandwiched between them, can then be installed in the case and the PCB secured to the integral standoffs using self-tapping screws.

All that remains now is to complete the wiring. Take care with the orientation of the LED and note that the metal backshell of potentiometer VR4 is earthed via one of the pot terminals.

The mains cord enters through a hole in the rear panel and is secured using a cord clamp grommet. The active (brown), neutral (blue) and earth (green/yellow) leads are connected to a mains terminal block installed on the PCB.

Test and adjustment

To test the unit, connect it into your hifi system, switch on and check that all controls operate correctly. All you have to do is connect the unit between the output of your VCR and the auxiliary inputs to your stereo amplifier.

Alternatively, if you intend using it with a non-Dolby cassette player, the unit can be installed in the tape monitor loop between the outputs of the cassette player and the amplifier. The system can also be installed in the tape monitor loop if it is to be used with a graphic equaliser, or used with more than one signal source.

Note that the DNR system should be installed in the signal path in front of the graphic equaliser (or any other tone control system), since adjustment of the equaliser alters the noise floor.

Both the 15.625kHz notch filter and the stereo simulator require some initial adjustment. These adjustments are carried out under actual listening conditions and involve tweaking trimpots VR1, VR2 and VR3. Here's what to do:

(1) Set VR1 and VR2 to mid-range, and the DNR switch to out.

(2) Switch on, wind up the treble control of your amplifier, and listen for the 15.625kHz whistle. Adjust VR1 for minimum level, then VR2 (rejection of better than −40dB should be possible).

(3) Adjust VR3 for left and right stereo balance.

Note: VR1 and VR2 in the notch filter can also be adjusted by injecting 15.625kHz from a signal generator into the mono input and observing the output on an oscilloscope.

The rear panel carries the 6-way RCA socket panel.

Using the DNR System

Careful adjustment of the Threshold control is required if you are to get the best possible sound when using DNR. The procedure is really very easy: apply tape noise to the input (ie, no program material) and adjust the Threshold control to a point slightly below where the noise comes up. This will ensure that the filters achieve optimum bandwidth when program material is present.

Note that the Threshold setting will have to be altered for different sources, depending upon the noise level. You can compare the subjective improvement by switching the DNR unit between IN and OUT. The DNR action should be most apparent between tracks and during soft passages, when it should remove nearly all of the hiss.

Finally, do not wind the Threshold control back too far. The high frequency response of program material will be noticeably restricted if you do. With just a little practice, you'll soon learn to accurately set the Threshold control by ear.

Where to buy the kit

This project was developed in the Research and Development Department at Dick Smith Electronics Pty Ltd. It is available as a kit of parts only, and can be purchased by mail order or from your nearest Dick Smith Electronics store.

The kit comes complete and includes a pre-drilled fibreglass PCB, a plastic case, pre-punched panels with screened lettering, and a construction manual. The cost is $99.00 plus postage and packing charges where applicable.

Mail orders should be addressed to: Dick Smith Electronics Pty Ltd, PO Box 321, North Sydney, NSW 2113. Phone (02) 888 2105.

Note 1: PCB artwork copyright Dick Smith Electronics Pty Ltd.

Note 2: The word "DNR" and the symbol used on the front panel of this project are registered trade marks of National Semiconductor Corporation, USA. Under the terms of the licencing agreement with National Semiconductor, the LM1894 cannot be purchased separately, either from Dick Smith Electronics or from any other source (except as a replacement item).

An easy-to-build UHF wattmeter

Dick Smith Electronics has just released a UHF wattmeter kit suitable for use by amateurs and CB operators. Featuring stripline circuitry, the kit is easy to build and use, and allows measurements of forward and reverse power to be made. SWR can be calculated from these using a simple conversion chart.

This project was conceived early in 1984 by Gil McPherson and Garry Crapp of Dick Smith Electronics. It was prompted mainly by enquiries from people who had built the "Explorer" UHF transceiver kit. This very popular project was published in *Electronics Australia* in September, October and November, 1983. Over 500 of these transceivers have been built to date, so there is certainly a need for an instrument of this type. Naturally many other people could use such a device, amateurs and CB operators in particular.

Basically, the unit is an insertion type RF wattmeter, capable of measuring power in either forward or reverse directions, into a 50Ω load. These measurements allow for the calculation of VSWR. By making use of this ability to simply calculate SWR, the fiddly controls and complex scales normally required on an SWR meter have been done away with. There are only two scales on the Dick Smith UHF Wattmeter, a 10W scale and a 50W scale. There is a forward/reverse switch to select the measurement direction, and a range switch to select the appropriate power range.

The ability to measure reverse power directly is especially useful when tuning an antenna system. In this situation it is necessary to minimise reflections, and the ability to continuously monitor the power reflected from the antenna is invaluable. Similarly, the same feature is useful when testing a suspected faulty antenna.

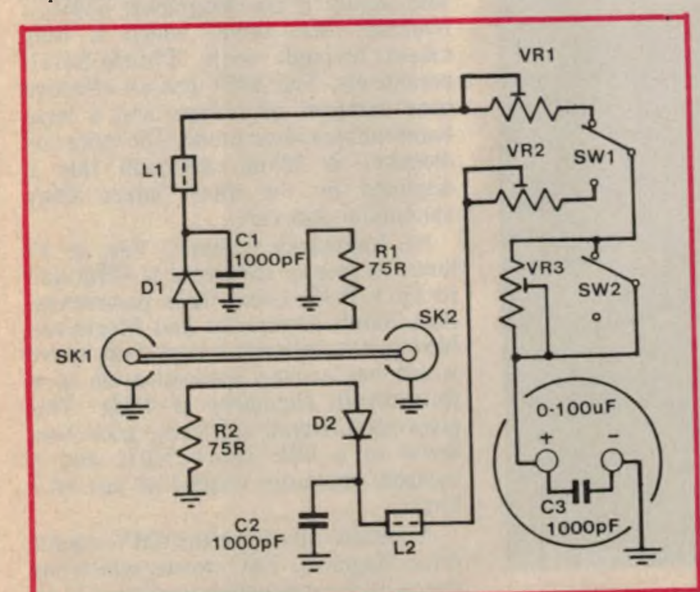
The accompanying circuit diagram shows just how simple the UHF Wattmeter is. The heart of the circuit is the stripline in which the coupling currents are sampled. These are rectified and used to drive the meter movement. The stripline is etched onto a printed circuit board, which holds the 75Ω resistors, the hot carrier diodes, and the feedthrough capacitors C1 and C2.

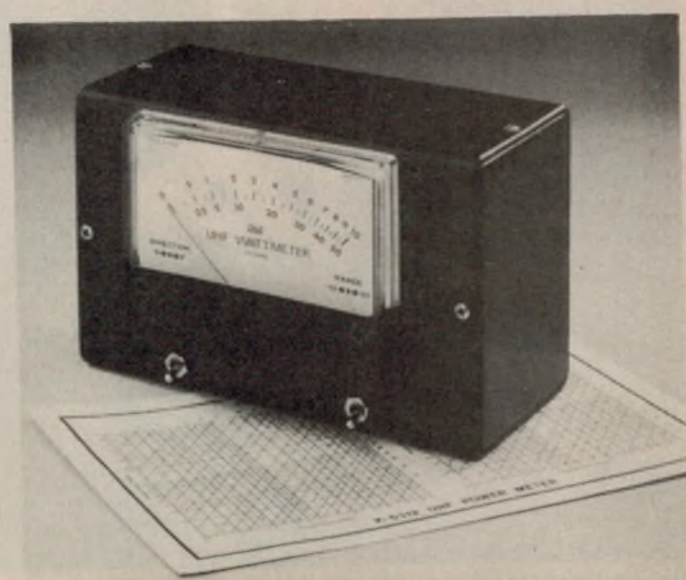
The trimpots and the switches are mounted on a second printed circuit board which is held in place in the case by means of the switches themselves.

As can be seen in the accompanying photograph, the UHF Wattmeter is housed in a black aluminium case. The input and output BNC sockets are mounted on the rear of this box.

This kit is available only from Dick Smith Electronics, who are supplying it complete with all parts and a comprehensive instruction and assembly manual. The manual sets out a detailed construction procedure, as well as a calibration procedure which requires no more equipment than a variable power supply, a multimeter and a 100Ω resistor. In addition, for a fee, Dick Smith Electronics will calibrate your completed wattmeter against a Bird Model 43 Throughline Directional Wattmeter, an industry standard instrument.

Retail price for the Dick Smith UHF Wattmeter is $49.95. This price includes all components necessary to get the wattmeter going, the instruction and assembly manual and a chart for the calculation of SWR from the forward and reverse power readings. The Dick Smith catalog number for the kit is K 6312. The charge for calibration is $15.00.





No skill required. Build these

Budget 2-way Loudspeakers

by LOUISE UPTON & LEO SIMPSON

The only tools required are a screwdriver and a soldering iron.

When Dick Smith Electronics approached us with the idea of producing a new compact loudspeaker system which would suit those on a budget, we leapt at the idea. After all, most people do not have large living rooms so a compact speaker system is likely to have wide appeal. This is supported by trends in the high fidelity marketplace where compact speakers are booming while the larger systems are in the doldrums.

Still, while compact speakers may be all the go, no one wants to sacrifice overall performance to gain those svelte dimensions. We want wide-range sound, plenty of power handling, reasonable efficiency and the capacity to handle bass boost — to kick things along at the odd party or two.

This new system from Dick Smith Electronics really fits the above prescription to a tee. It is a two-way system with a bass reflex enclosure of 16.7 litres internal capacity.

The loudspeakers are made by Magnavox (Australia) Pty Ltd, a company which has turned out a number of very successful hifi drivers in the past. The woofer is the Magnavox 6MV, a nominal 15cm driver which is fully characterised with Thiele-Small parameters. The 6MV has an effective cone diameter of 115mm and a large foam rubber roll surround. The voice coil diameter is 38mm, although this is disguised by the much larger shiny aluminium dust cap.

Its compliance volume, Vas, is 19 litres, its free-air resonance is 47Hz and its Qt is 0.36. Using these parameters, Dick Smith Electronics and Magnavox have jointly designed a vented enclosure which has a close approximation to a Butterworth alignment of 49Hz. This gives good overall efficiency, good bass down to a little below 50Hz and a compact enclosure volume of just 16.7 litres.

A suitable match for the 6MV woofer is the Magnavox 3AC tweeter which has closed-back construction to allow it to be

Fancy a low cost compact loudspeaker system that is a cinch to build? If so, here is the ideal answer. This two-way system from Dick Smith Electronics costs just $229 for a complete kit of two loudspeakers, with everything included. You can easily put them together in a couple of evenings.

housed in the same enclosure as the woofer. This has a curvilinear cone with an effective diameter of 81mm and a frequency response up to beyond 18kHz. Specifications for both the woofer and tweeter are shown in the panel accompanying this article.

The tweeter is about 5dB more sensitive than the woofer which means that it has to be fed via an attenuator to match it precisely to the bass driver.

PARTS LIST

- 2 enclosure kits, including grille cloth frames
- 2 6MV 8Ω woofers
- 2 3AC 8Ω tweeters
- 2 0.74mH air-cored inductors
- 2 0.35mH air-cored inductors
- 2 P 1764 two-way terminal panels
- 2 crossover PCBs
- 2 PVC 50mm ID vent tubes
- 28 self-tapping screws 6g × 12mm
- 16 countersunk woodscrews 8g × 25mm

Capacitors

- 4 22μF bipolar electrolytics
- 2 10μF bipolar electrolytics
- 6 6.8μF bipolar electrolytics
- 2 4.7μF bipolar electrolytics

Resistors

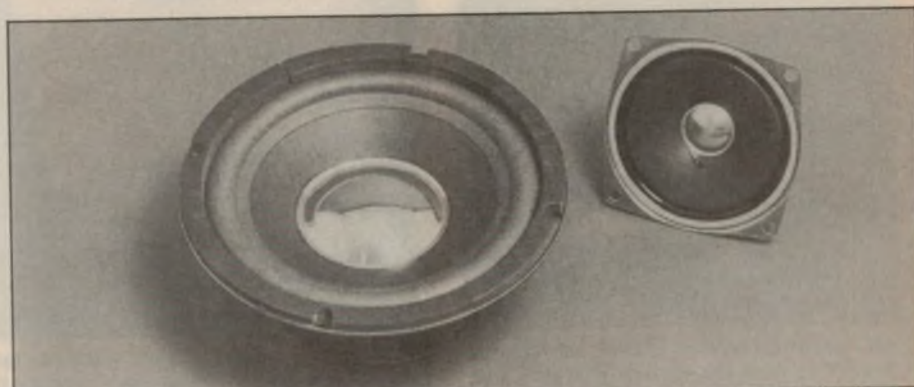
6 × 22Ω 1W, 4 × 12Ω 0.5W

Wire

- 1.6m red insulated wire (13 × .12mm or similar)
- 1.6m black insulated wire (13 × .12mm or similar)

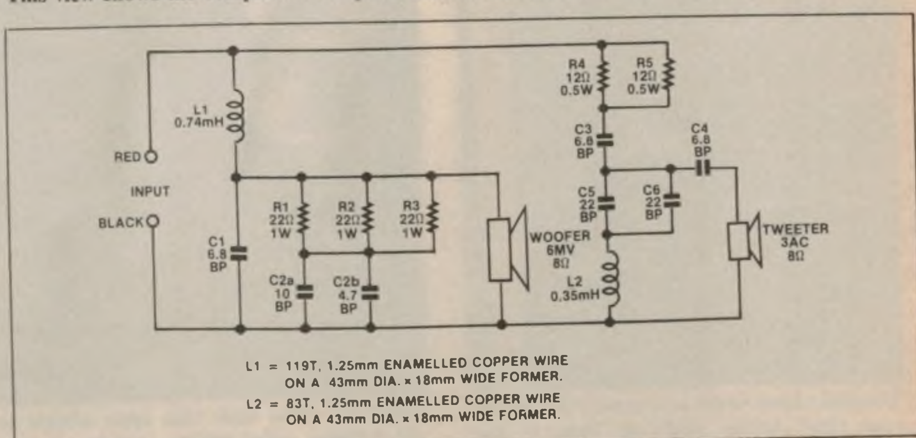
Miscellaneous

0.8m × 0.7m Innerbond lining, contact adhesive, PVA glue, draft excluder tape (Engel's No. 5 or equivalent).



The system uses the Magnavox 6MV (15cm) woofer and the 3AC tweeter.

This view shows the complete kit of parts for one loudspeaker. Note the pre-cut cabinet.



The crossover is a second order network with impedance equalisation for the woofer.

The assembled cabinet is held together by strips of masking tape until the glue dries. The woofer cutout is adjacent to the base board.

Apply a small amount of white sealant to the rear of the crossover PCB before securing it to the rear panel with self-tapping screws.

Budget 2-way loudspeakers

The input leads must be passed through the rear panel before soldering them to the terminal panel.

Solder the input leads then apply sealant to the terminal panel before screwing it into position.

Crossover network

The crossover network is a second-order network for both the woofer and tweeter. This means that both the tweeter and woofer signal drive is rolled off at 12dB/octave. For the woofer, L1 and C1 roll off the signals above 2.4kHz. In addition, the parallel combination of R1, R2 and R3 (7.3Ω) in series with the parallel combination of C2a and C2b (15μF), provides impedance equalisation for the woofer.

This is necessary to remove the effect of the voice coil inductance which would otherwise reduce the efficacy of L1, C1, and stop the 12dB/octave rolloff slope from being achieved.

The high frequency section is an elliptical filter which, in addition to its role as a high pass filter, also effectively prevents unwanted response from the tweeter at its resonance peak (approximately 1.3kHz). The 6Ω series resistance (R4 and R5 in parallel) provides the required 5dB attenuation as well as the correct source impedance for the high pass filter.

The power ratings of the resistors used in the crossover have been chosen to be adequate for use when playing normal program material. Anyone who wishes to apply continuous high level test signals to the system may have to fit higher rated components.

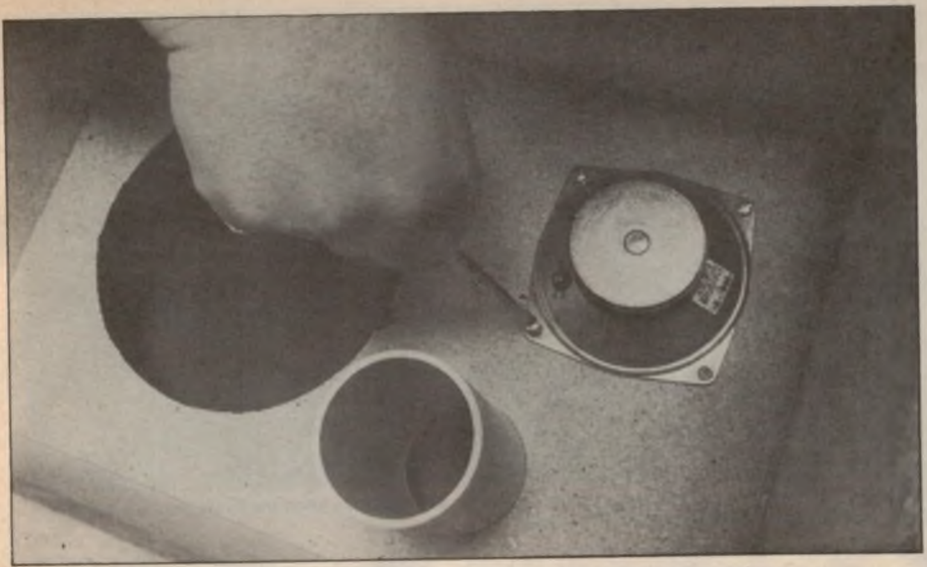
The frequency response of the complete system is within ±4dB over most of the audible frequency range. These figures are very good for a budget loudspeaker system and will stack up well in comparison with many more expensive "name" systems. In practice, the bass response is smoothly maintained down to just below 50Hz and it can easily handle bass boost if the situation seems to need it. Treble response is well maintained up to the limit of audibility with some "presence" in the midrange which tends to slightly increase the overall efficiency, which is quite reasonable anyway.

Power handling is quoted nominally at 40 watts but they will comfortably handle the full power of a 100 watt per channel stereo amplifier on normal program material.

Taken all round, the new System 17 is a bargain loudspeaker system which gives a surprising amount of "sound punch" for your dollar. It's easy to build too. We'll let Louise Upton take up the story at this point.

Construction

"If you can do it, anyone can!" With this back-handed compliment, I was given the task of putting these nifty little speakers together. Tackling such a task for the first time was a trifle daunting. The question entertaining everyone was,



The tweeter is mounted on the inside of the baffle using four 12mm self-tapping screws.

"Would it work when I had finished?" With a stiff upper lip, I set to work.

Before me lay all the components for a pair of high quality loudspeaker systems at a bargain price. Designed in line with the universally highly-regarded "Thiele/Small" parameters outlined in our August and September 1981 issues, these new bookshelf speakers certainly looked as though they would fulfil their promises. All that remained was to prove the theory in practice. I decided to make one complete enclosure at a time, and so learn from any mistakes I might make with the first one.

To make things as easy as possible the enclosure is essentially a wraparound construction. The four sides of the enclosure are precision machined so that they will fold up around the front baffle, to form a box. In this way, no special tools or wood-working skills are required. As they said, "if I could do it, anybody could."

The procedure for putting the enclosure together is delightfully simple. Lay out the continuous side piece on a flat surface such as the floor or large table. The three fold joints should be flexed as little as possible because it is only the external veneer which keeps the whole thing from breaking into four pieces at this stage. Then run a fillet of PVA glue (such as Selleys Aquadhere) into each of the V-cuts for the three fold joints and then into the rebate for the baffle board.

Next, place the baffle board into the rebate for what will become the base panel (ie, the woofer cut-out should be closest to the base board).

The enclosure is then carefully wrapped around the baffle, making sure that no stress is placed on any of the three corner joints. That done, the final corner is held together with strips of masking tape or pressure sensitive tape, applied to place as much pressure on the joint as possible. (This is shown in one of the photographs).

Draft exclusion tape is applied to the cleats to provide an airtight gasket for the rear panel.

Make sure that you don't transpose the loudspeaker leads.

Leave the enclosure for about 30 minutes or so, to give the PVA glue plenty of time to dry.

The rear panel is then a push-fit into the now-formed box and it is secured with eight wood-screws into the four cleats which are already fitted to the wraparound section of the enclosure. That does not happen until later though.

Constructing the crossover network seemed the next logical step. Two prewound air-cored inductors, a variety of resistors and bipolar capacitors, and the flying leads sat waiting to be assembled and soldered into the printed circuit board.

I glued the two coils onto the printed circuit board with contact cement. This is necessary because the coils are too heavy to be supported by their leads alone.

Once the coils are in place, they can be soldered into circuit. Don't forget to scrape the enamel off the ends of the copper leads before soldering them into place. The capacitors were bipolar and so did not have a specific orientation. This means that they could be soldered into the board either way around. The same can naturally be said of the resistors.

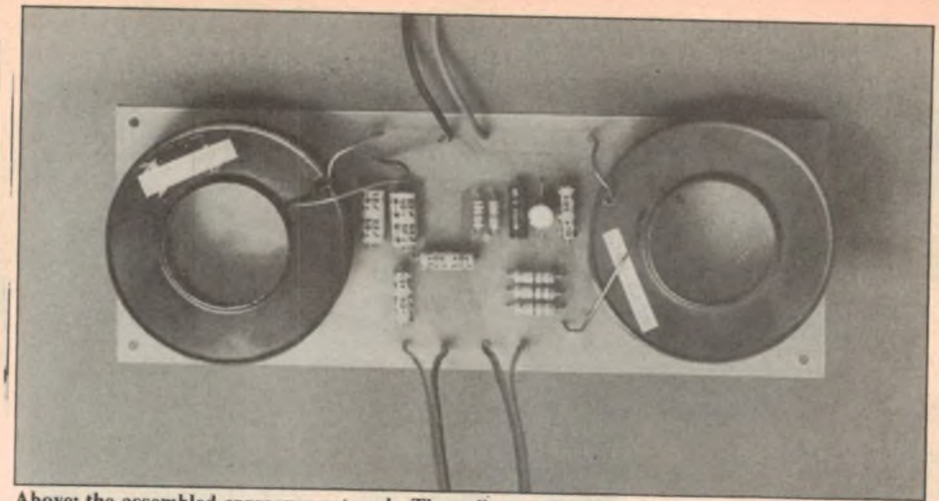
One tip that I found handy though, is to place all the components on the board so that their values can be easily read. This made it so much easier to check my work when all the components were in place.

To secure the crossover network in place on the back panel use a small amount of white sealant (such as Bostik) under the non-copper areas of the PCB and then screw the PCB to the rear panel, using four 12mm long self-tapping screws.

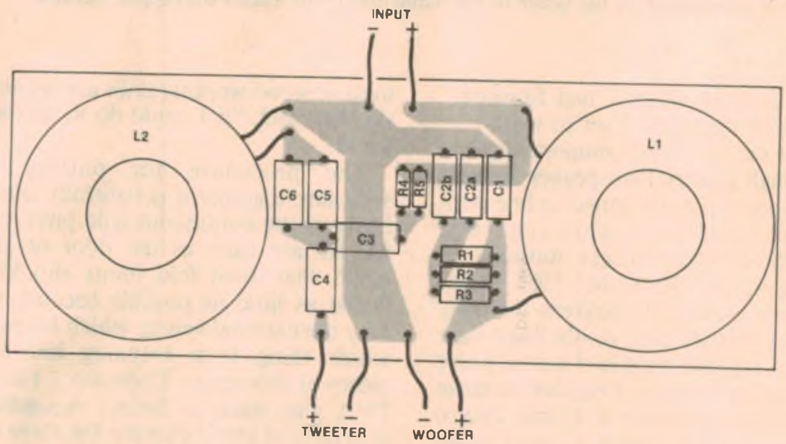
The next few steps involve fixing the terminals to the rear panel. This step confused me, so you have to follow the wiring diagram exactly.

Use a red wire for the positive (+) input wire and a black wire for the negative (−) output. The same applies to the flying leads connecting the tweeter and woofer.

Tin the ends of all the wires and the terminal connections before attempting to solder the leads from the crossover to the terminals. Pull the wires through the hole in the rear panel and connect the red wire to the red terminal and the black to the black. To fix the terminals to the rear panel apply some sealant to the back of the terminals and then screw them into place, using two 12mm long self-tapping screws.



Above: the assembled crossover network. The coils are glued in position using contact adhesive. Below is the parts layout for the PC board.



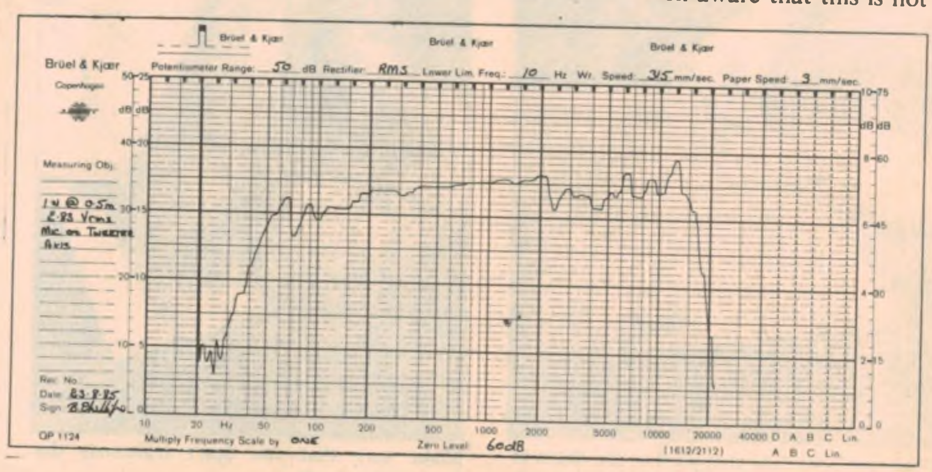
At this stage the use of a multimeter to check for continuity in the circuit can quell a number of mounting fears about how the whole thing is progressing, or not progressing, as the case may be.

Switch your multimeter to the low "Ohms" range and check the continuity of all leads and connections to the board.

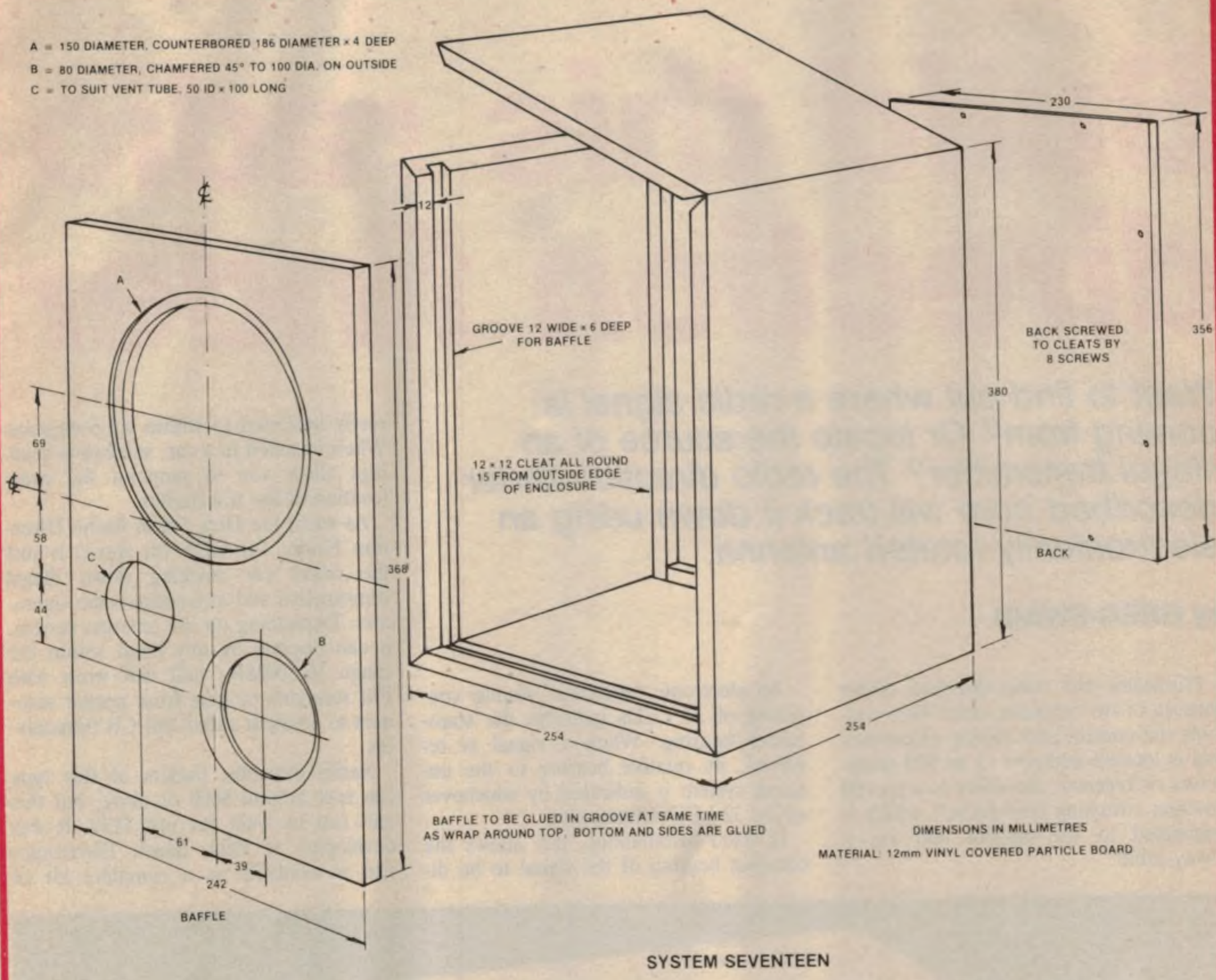
Baffle assembly

After checking the crossover network and its connections, I was able to turn my attention to the baffle board. The first step was to mount the vent tube which is a piece of PVC pipe, 110mm long and with inside diameter 50mm. This is secured into place with contact cement.

The way I did it was to apply the contact cement to the outside of the tube and then force it into the appropriate baffle hole, making sure that it is properly aligned with the baffle front surface. I am well aware that this is not



Budget 2-way loudspeakers



Dimensional details for the System 17 enclosure. Note that it is drawn in the upside down position in which it is assembled.

the usual way to use contact cement but if you do it the regular way, applying it to two surfaces and letting them dry, it would be impossible to push the tube fully into place before the adhesive "grabbed" the tube.

That done, the tweeter could be screwed into place, inside the enclosure, using four 6g × 12mm self tappers.

Mounting the woofer was a different process. It is secured to the front of the baffle, rather than the rear, as for the tweeter. This means that a bead of white sealant has to be run around the rear of the woofer flange, before it is set into place and secured with four 12mm long self-tapping screws.

Solder the four flying leads to the speakers, making sure that the connections have all been tinned to give a proper joint. Make sure that you don't confuse the wires to the tweeter and woofer. I actually did this on one of the pair of speakers so that the woofer was receiving the tweeter drive and vice versa.

This resulted in a very emasculated sound from the speaker system and the fellows in the laboratory all fell about laughing and giving each other bruises from excessive nudging.

The next step, after connecting all the flying leads, is to loosely roll up the supplied Innerbond filling material and place it into the enclosure. It is supposed to just loosely fill the space, not be jammed tightly into it.

Most important, the four cleats which secure the rear panel have to be treated to stop air leaks. The enclosure has to be airtight, otherwise the vent tuning will be degraded. The way we provided a seal was to apply strips of draft exclusion tape (adhesive backed foam: Engles No. 5) to the cleats. This produces an effective air seal gasket which is not likely to be ruined if the rear panel has to be removed in the future, for any reason.

Finally, I was able to push the rear panel into place and secure it with eight countersunk screws. Shortly after, I discovered to my chagrin that the speakers were wrongly connected, as outlined above, and had to remove the rear panel to correct my mistake.

Still, making the second system was much easier and I was able to avoid making any mistakes the second time around.

The most satisfying step was to connect the newly completed speakers to my stereo system and listen. The sound was great!

Track down hidden transmitters

Build this radio direction finder

Want to find out where a radio signal is coming from? Or locate the source of an illegal transmitter? The radio direction finder described here will track it down using an electronically rotated antenna.

by GREG SWAIN

Physically, the radio direction finder consists of two separate units. One contains the control and display electronics and is located adjacent to an FM transceiver or receiver; the other is a special antenna switching unit (ASU) which is connected to the control unit via a 4-way cable.

An electronic "compass" display consisting of 32 LEDs indicates the transmitter bearing. When a signal is received, its relative bearing to the antenna system is indicated by whichever of the 32 LEDs illuminates.

In fixed installations, this allows the compass bearing of the signal to be directly indicated to within ±5.6 degrees. When installed in a car, successive readings allow you to pinpoint the exact location of the transmitter.

As such, the Dick Smith Radio Direction Finder (or RDF for short) is just the ticket for tracking down illegal transmitters and anti-social radio operators. Depending on the antenna system, it can operate on any band within the range 50-500MHz and will work with FM receivers ranging from pocket scanners to amateur radio and CB transceivers.

Radio direction finders of this type can cost around $600 or more, but this unit can be built for just $139. It was developed at Dick Smith Electronics and is available as a complete kit of

The relative bearing of the transmitter is indicated on a 32-LED compass rose.

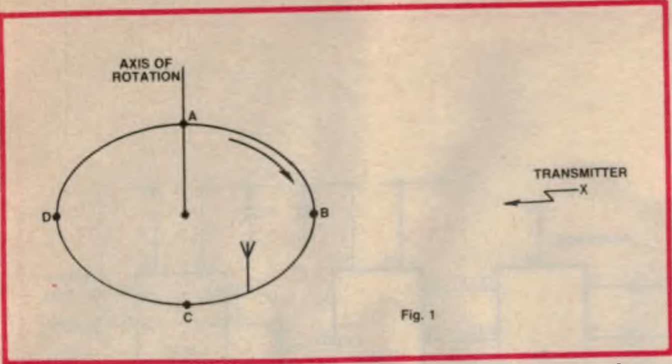


Fig. 1: signals received by an antenna mounted on the edge of a rotating disc are frequency modulated due to the Doppler effect.

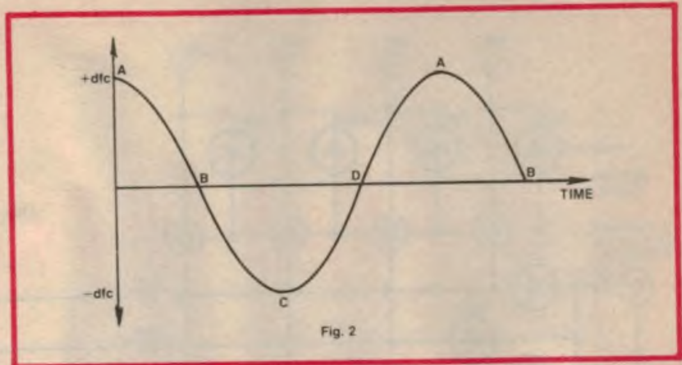


Fig. 2: this graph illustrates the frequency shift as the antenna moves towards and away from the transmitter.

parts. We think it will be especially popular with amateur radio operators.

How it works

The theory of operation is reasonably simple. Radio signals received on a rapidly moving antenna undergo a frequency shift due to the Doppler effect, an effect well known to anyone who has observed a moving car with its horn blowing.

Consider a single antenna mounted on the edge of a rapidly spinning disc. As the antenna moves towards the source of the RF carrier, the apparent frequency will increase due to the Doppler effect. Conversely, as the antenna moves away, the frequency will decrease.

Thus, the rotating antenna causes frequency modulation of the received carrier. When this type of antenna is connected to an FM receiver (the type most often used on 2 metres), a tone is heard.

By analysing the phase of this tone, the direction of the transmitter can be determined.

To avoid the obvious drawback of a mechanically rotated system, the Dick Smith RDF simulates a rotating antenna electronically. Four vertical whip antennas are arranged around a circle of diameter .07-0.4 wavelengths. These are electronically switched clockwise in sequence such that all four antennas are scanned once every 1/1250th of a second.

This situation is equivalent to one vertical antenna mounted on the perimeter of a disc spinning at 1250 revolutions per second. For a diameter of say 800mm (for the 2-metre band), this results in a tangential velocity of 3140 metres per second.

The deviation of the received carrier is determined as follows. For $V << C$, we can neglect relativistic effects and write:

$$Fr/Ft = 1 - V/C$$
$$\text{also } dF = |Fr - Ft|$$
$$\text{therefore } dF = Ft \times V/C$$

where Fr is the received frequency, Ft is the transmitter frequency, dF is the frequency shift, C is the velocity of light (3×10^8 m/s) and V is the antenna velocity.

For V = 3140 m/s and Ft = 144MHz, the carrier will deviate 1.5kHz at a rate of 1250Hz. For lower carrier frequencies, the deviation will be proportionally lower.

Note, however, that the 1250Hz modulating tone remains constant as it is a function of the antenna switching rate only.

The output from the FM receiver is applied to the signal input of the RDF adapter and compared with an internal reference phase. The resultant phase angle appears as a 5-bit binary code and this is decoded to a one-of-32 output to drive the appropriate indicator LED.

In addition, the detected audio tone can be monitored on an internal loudspeaker. This provides audible indication that the receiver is correctly tuned to the transmitter frequency.

The circuit

Antenna switching is accomplished by first deriving a 2-bit binary code from a 1MHz master oscillator. Here's how it's done:

Inverter stages IC2a, b & c (4069) form the 1MHz oscillator with buffering provided by IC2d. This clocks decade counters IC4 and IC7, both of which divide by five to produce a 40kHz signal on pin 1 (CK) of IC10.

IC10 is a 4024 7-stage binary counter. Its Q1-Q5 outputs directly drive the D1-D5 inputs of IC12, a 40174 hex latch, while Q4 and Q5 also drive IC9 which is a 4555 one-of-four decoder.

What happens is that IC9 accepts a 2-bit binary code from IC10 and provides the quadrature antenna switching signals. These signals are interfaced by a 1488 line driver (IC6). The outputs of IC6 swing positive and negative in sequence to provide bias for the matrix diodes (D201-D208) in the antenna switching unit (ASU).

The diode matrix is arranged so that, at any given instant, three of the antennas are effectively shorted and only one is coupled to the receiver. For example, when pin 11 of IC6 is low (−9V), D205-D207 are forward biased and short out antennas 2 to 4.

At the same time, D201 will also be forward biased while D202-D204 are turned off. Antenna 1 will thus be connected to the receiver.

The detected audio tone from the FM receiver is applied to the input of the RDF adapter, limited by D1 and D2, and filtered by a single-pole active low-pass filter stage (IC5). This chip is described by National Semiconductor as an MF5 Universal Monolithic Switched Capacitor Filter. Basically, it is a general purpose active filter building block.

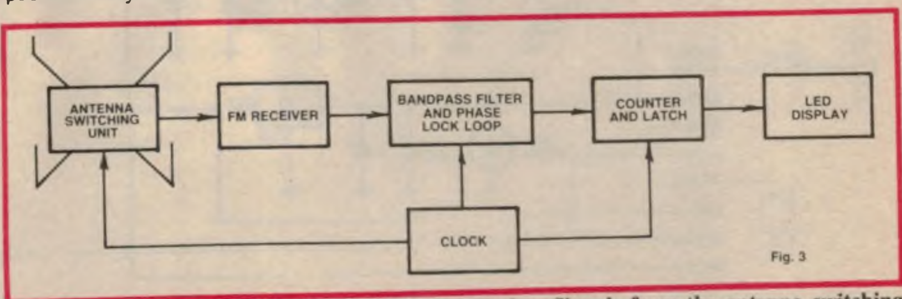
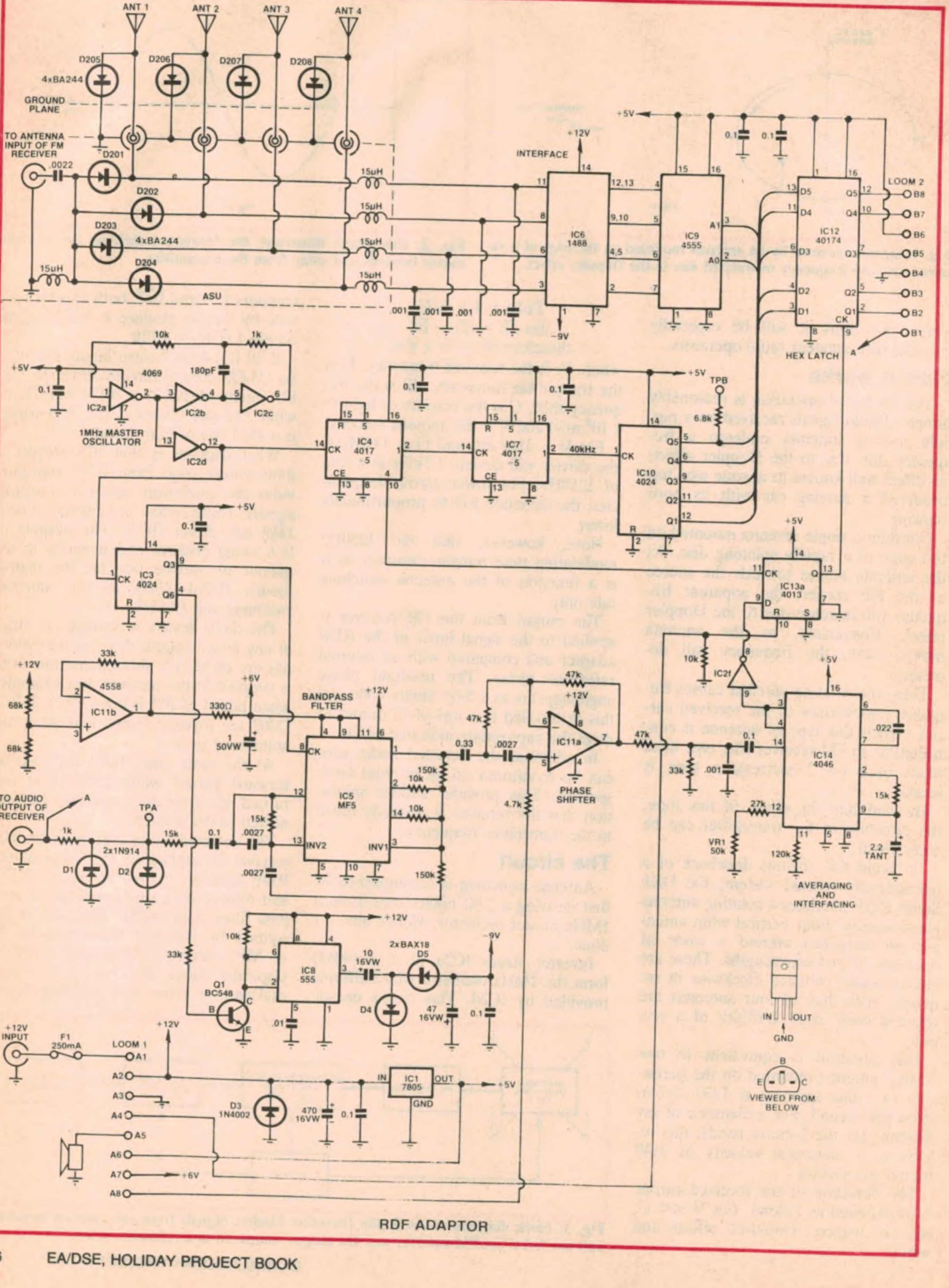
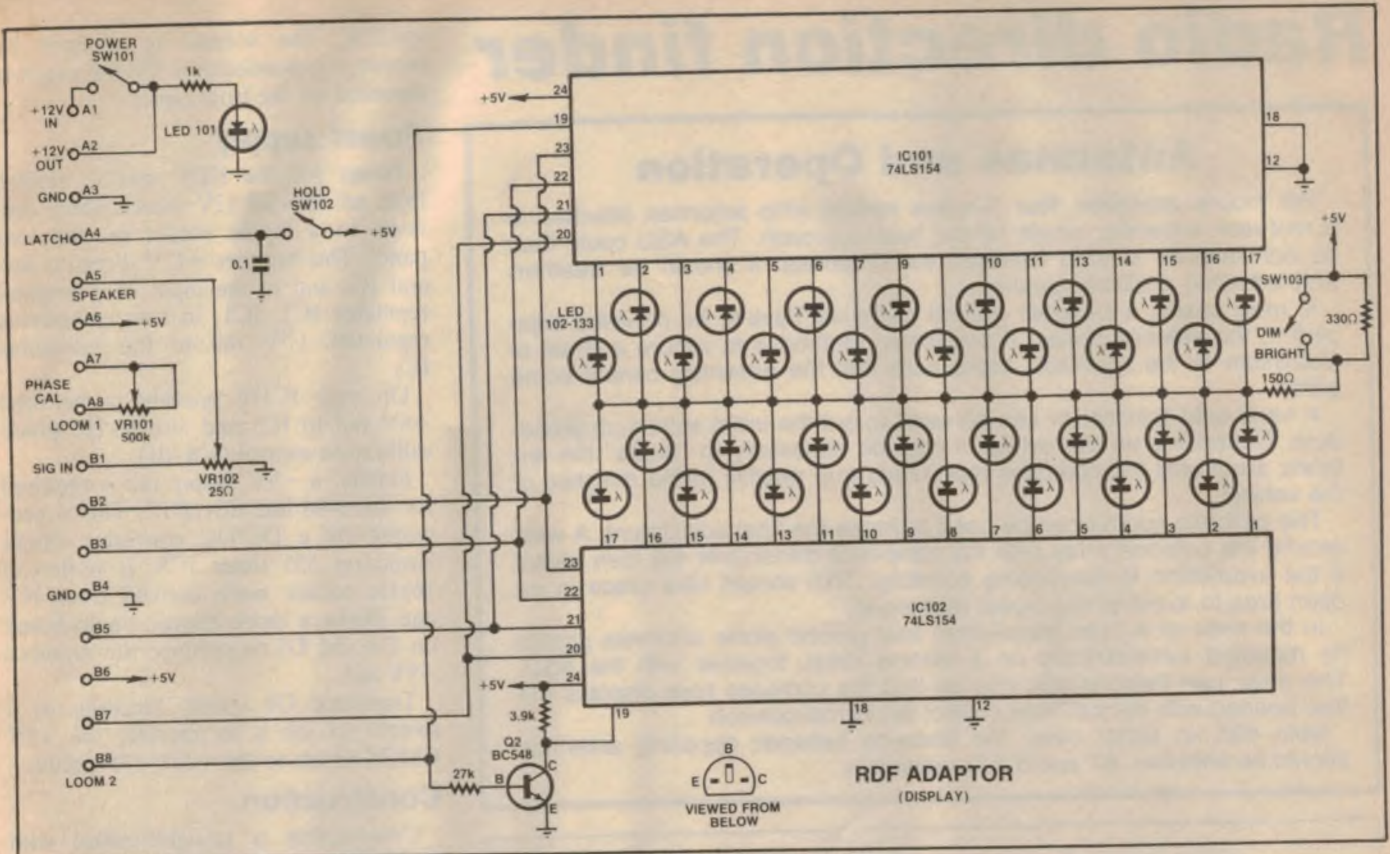


Fig. 3: block diagram of the Radio Direction Finder. Signals from the antenna switching unit are fed to an FM receiver and the output compared to a reference phase.


ANT 1
ANT 2
ANT 3
ANT 4
D205
D206
D207
D208
4xBA244
GROUND PLANE
TO ANTENNA INPUT OF FM RECEIVER
D201
D202
D203
D204
.0022
15µH
ASU
INTERFACE
+12V
IC6 1488
-9V
.001
+5V
0.1
IC9 4555
IC12 40174
LOOM 2
HEX LATCH
1MHz MASTER OSCILLATOR
4069
IC2a
IC2b
IC2c
IC2d
180pF
10k
1k
IC4 4017
IC7 4017
40kHz
IC10 4024
TPB
6.8k
IC3 4024
IC13a 4013
IC2f
IC14 4046
AVERAGING AND INTERFACING
VR1 50k
2.2 TANT
120k
27k
15k
.022
33k
68k
4558
IC11b
+6V
330Ω
1 50VW
BANDPASS FILTER
IC5 MF5
INV1
INV2
150k
0.33
.0027
47k
4.7k
IC11a
PHASE SHIFTER
TO AUDIO OUTPUT OF RECEIVER
TPA
2x1N914
D1
D2
IC8 555
2xBAX18
D5
D4
10 16VW
47 16VW
Q1 BC548
.01
+12V INPUT
F1 250mA
LOOM 1
IC1 7805
IN
OUT
GND
D3 1N4002
470 16VW
VIEWED FROM BELOW

RDF ADAPTOR



The control and antenna switching circuitry is at left while above is the display circuit.

Radio direction finder

The rest of IC5 is configured as a second-order bandpass filter to remove unwanted audio modulation from the 1250Hz tone. The centre frequency of the filter is set to 1250Hz by the clock signal applied to pin 8. This clock signal is derived via IC3 which divides the 1MHz master oscillator signal by eight.

Note that the clock for the bandpass filter is derived from the same source as that used to switch the antennas. This means that the filter is automatically centred on the scanning tone, even when there is some frequency drift.

The output of IC5 (pin 1) is a sine wave with a nominal frequency of 1250Hz. This signal is applied to op amp IC11a which functions as a phase shifter. Adjustment of the phase shifter is by means of VR1.

The job of the phase shifter is to allow calibration of the circuit and to compensate for any audio phase shifts in the receiver.

From there, the signal is further processed by a 4046 phase lock loop (PLL). The function of this stage is to average out any modulation present in the passband of IC5 and to produce a 1250Hz square wave which is essentially free of noise and jitter.

It is this signal that is used to latch IC12. The output of the PLL (pins 3 & 4) is first inverted by IC2f and applied to D-type flipflop IC13a. Subsequently, when D goes high, IC13a latches IC12 on the first positive-going clock pulse from pin 10 of IC4.

The result of all this is that IC12 is latched with a 5-bit code which is directly related to the transmitter direction. A phase comparator function is thus performed.

Note that IC13a is necessary to prevent the latching signal from coinciding with a change of data on IC12's inputs.

A pair of 74LS154 one-of-16 decoders (IC101 and IC102) on the display board converts the 5-bit code to a one-of-32 output. These decoders directly drive the 32 display LEDs to indicate the transmitter position.

Switch SW102 allows the display to be held or "frozen" by resetting IC13a. SW101 serves as a power on/off switch, while SW103 allows the display to be dimmed by switching a 330Ω resistor into the common anode circuit of the LED display.

To make the unit as easy as possible to use, the audio output from the FM receiver is also fed to an internal loud-

Where to buy the kit

The Radio Direction Finder described here was developed by the Research and Development Department at Dick Smith Electronics Pty Ltd. It is available as a complete kit of parts by mail order or from your nearest Dick Smith Electronics store.

The kit comes complete and includes a perspex front panel, screen-printed fibreglass PC boards, antenna bases, plugs and sockets, and a detailed construction manual. The cost is $139 plus postage and packing charges where applicable.

Mail orders should be sent to: Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde, NSW 2113. Phone (02) 888-2105.

Note: all PC artworks for this project are copyright Dick Smith Electronics Pty Ltd.

Radio direction finder

Antennas and Operation

For mobile operation, four ¼-wave vertical whip antennas attached to a roof-rack assembly would be the best approach. The ASU could then be conveniently located between the antennas. It should be weatherproofed using a silicone sealant.

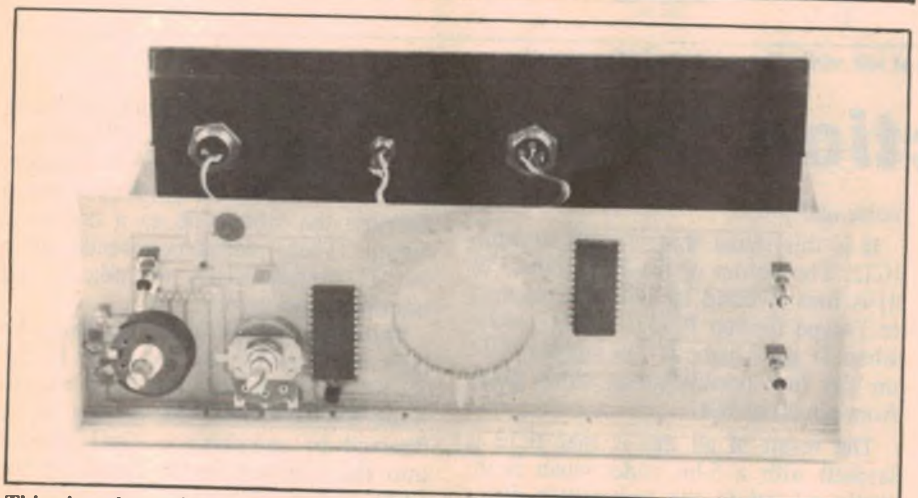
In most cases, a separate ground plane will have to be provided adjacent to the antenna bases. A suggested method is to secure a sheet of aluminium to the roof-rack. Make sure that the assembly cannot come adrift.

A hand-held transceiver can be used to aid the initial setting-up procedure. Depending on the set-up, it may be necessary to "rotate" the antenna array until the compass rose reads true relative to the direction of the vehicle.

The calibrate control can be used to make the final adjustment. A walk around the antenna array with the hand-held transceiver will then reveal if the installation is functioning correctly. This should take place in an open area to avoid strong signal reflections.

In the case of a fixed installation, four ground plane antennas should be mounted symmetrically on a vertical mast, together with the ASU. The array can then be adjusted so that the compass rose displays the true bearing with the calibrate control set to mid-position.

Note that, in either case, the distance between opposing antennas should be between .07 and 0.4 wavelengths.



This view shows the completed display board. The pot leads are soldered to PC stakes.

speaker. The volume is adjusted by means of potentiometer VR102 which is mounted on the front panel.

Power supply

Power for the RDF unit is derived from an external 12V source which connects to a 2-pole socket on the rear panel. This supplies +12V direct to several ICs and to the input of 3-terminal regulator IC1. IC1, in turn, supplies a regulated +5V rail to the remaining ICs.

Op amp IC11b provides a buffered +6V rail to IC5 and also to the phase calibration control (VR101).

Finally, a −9V supply rail is required for the 1488 line driver IC. This is generated by a DC-DC converter circuit based on 555 timer IC8. It buffers a 16kHz square wave derived from IC3 and drives a diode charge pump based on D4 and D5 to produce the required −9V rail.

Transistor Q1 simply functions as a switch. Its job is to interface the +5V CMOS circuit to the +12V 555 circuit.

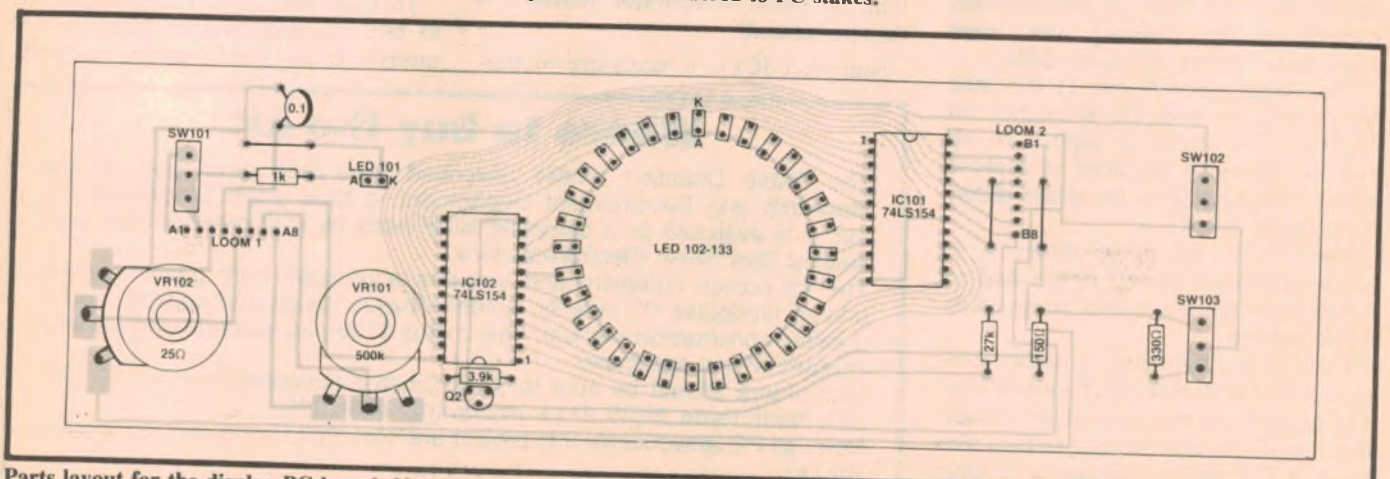
Construction

Construction is straightforward with most of the parts mounted on three PC boards, two in the main unit and one in the ASU. These boards are coded ZA-1543a, ZA-1543b and ZA1543c.

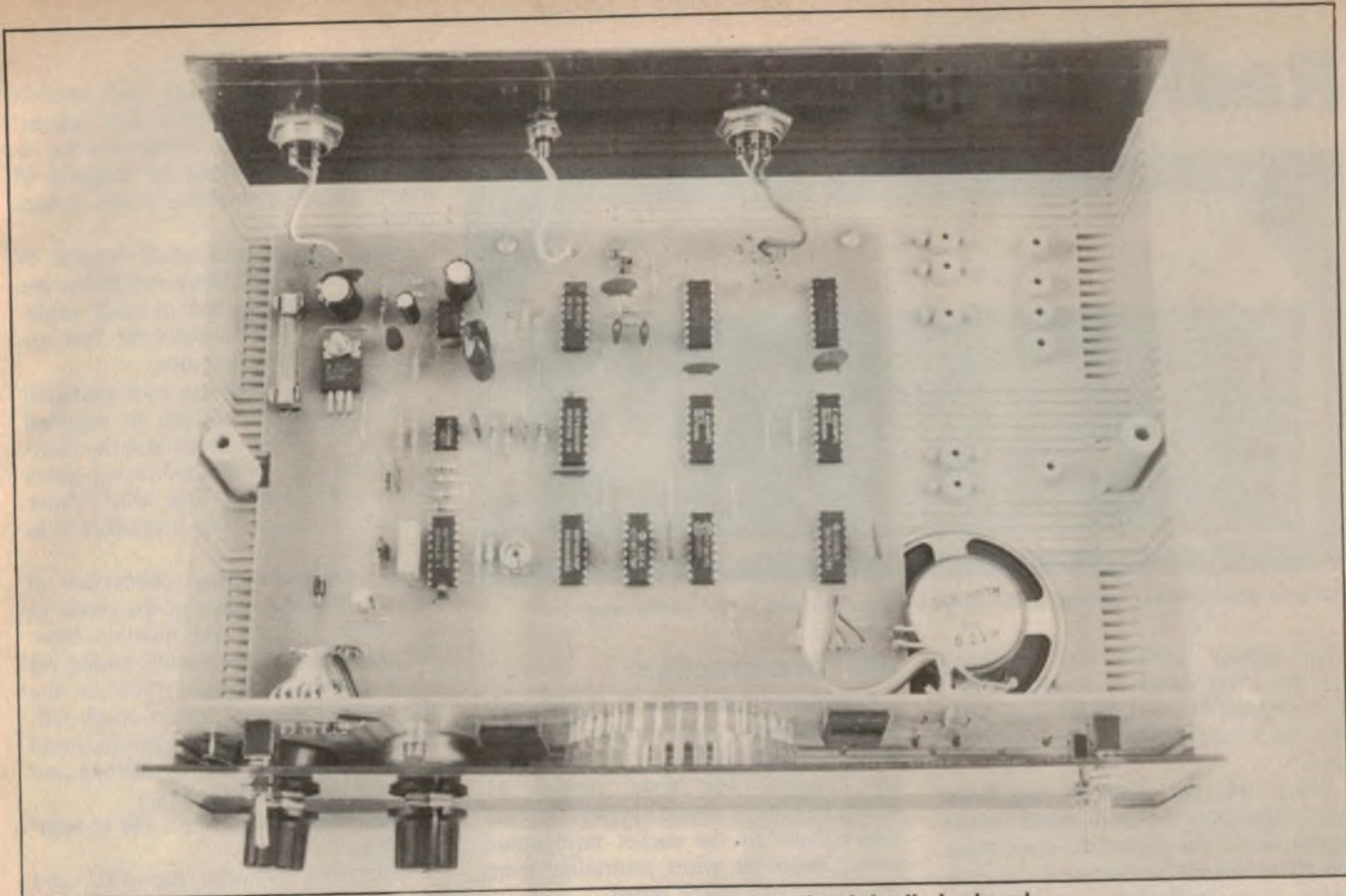
A plastic instrument case fitted with a perspex front panel houses the control electronics, while the ASU board is housed in a plastic zippy case.

Begin by constructing the main PC board (ZA-1543a). No special procedure need be followed when assembling the board although we suggest that the larger components be left till last. Note carefully the orientation of the semiconductors and electrolytic capacitors when they are being installed.

The 7805 regulator is installed so that



Parts layout for the display PC board. Note that the two ICs face in opposite directions.



View inside the assembled RDF adaptor. Note mounting details for the front panel and the display board.

its metal tab lies flat against the board. It is then secured using a machine screw and nut. Note that PC pins are used to terminate all external wiring connections.

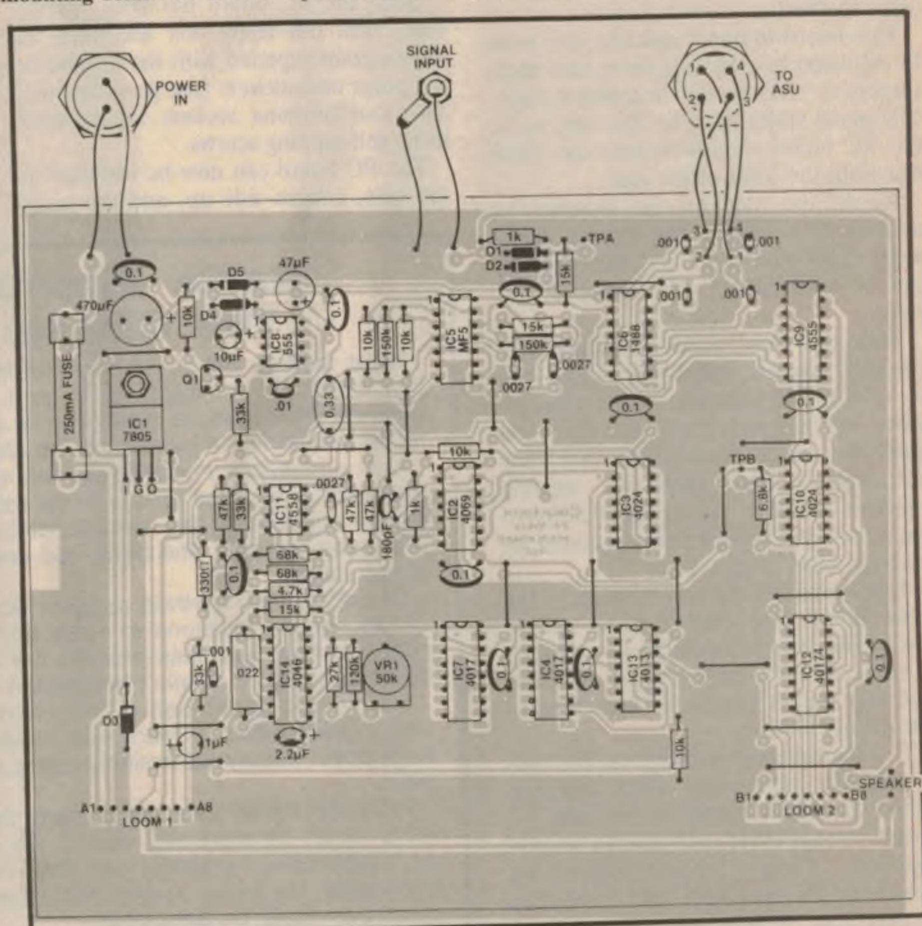
The display board (ZA-1543b) is constructed next. Begin by mounting all parts except for the two potentiometers and the 33 LEDs. Be careful with the orientation of the two LS154 decoder ICs as they face in opposite directions.

PC pins are used to terminate the wiring connections to the main board and to terminate the pot terminals. With the exception of the pot terminals, these should all be mounted on the copper side of the board.

Next, press all the LEDs into the board, noting that the yellow LEDs should be used for the quadrant markers and the red LED for power indication. Make sure that all the LEDs are correctly oriented — the anode lead is the longer of the two.

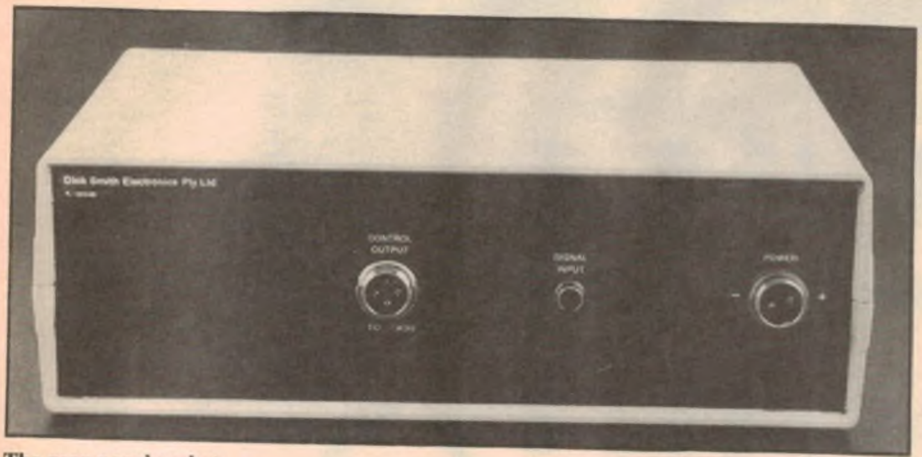
Do not solder them in at this stage as they must be aligned with the front panel later on.

Attention can now be turned to the perspex front panel. Using a smooth file, carefully file a radius on each corner. This is to prevent the right-angled corners of the panel from biting into the instrument case when it is eventually assembled.



Parts layout for the main PC board. Take care with component orientation.

Radio direction finder



The rear panel sockets connect to the ASU, FM receiver and +12V power supply.

The spacing between the PC board and the front panel is adjusted next. This procedure should be followed carefully, as it sets the length of the LED leads.

Attach the two pots to the front panel, then bolt the front panel to the display board via the switch nuts. Note that there should be two nuts on each switch — one behind the panel and the other in front.

The board-to-panel spacing can now be adjusted by inserting them into their respective slots in the instrument case. The panel slides into the first slot while the PC board should fit into the third slot from the front of the case.

Adjust the nuts on the switches as necessary to achieve the correct alignment. This done, the pot terminations can be soldered to their adjacent PC pins.

With the front panel assembly now correctly aligned, the display LEDs can be soldered in position. To do this, remove the assembly from the case and push the LEDs forward so that they butt against their respective viewing windows. Finally, solder the LEDs to the board and adjust the alignment of each by hand as necessary.

This completes the construction of the main board and display panel assemblies. The boards can now be installed in the case and the wiring to the front and rear panels completed according to the wiring diagram.

The loudspeaker is glued to the bottom of the case using epoxy adhesive while the main board is secured by means of the four self-tapping screws supplied. Wiring between the main board and the front and rear panels can be run using rainbow cable.

ASU construction

Commence construction of the ASU by installing the parts on the PC board (ZA-1543c) according to the parts layout diagram. This done, prepare 11 40mm lengths of tinned copper wire and solder them to the socket termination points, with the wires protruding from the copper side of the board.

Once the PC board has been assembled, drill the zippy box according to the diagram supplied with the kit and fit the plugs and sockets (see parts layout). The four antenna sockets are secured using self-tapping screws.

The PC board can now be installed in the case, copper side up, and the leads connected to the plugs and sockets using right angle bends (see photograph). Note the earth-loop for the 4-pole plug. This should be installed to ensure adequate shielding of the control cable.

Next, prepare four equal lengths of coaxial cable (70-100cm) and solder the line plugs to one end of each cable. These are used to connect the four antennas to the switching box.

Diodes D205-D208 are each mounted on the antenna bases which are supplied with the kit. These diodes and the coaxial cables are terminated using extra double-ended solder lugs which have also been included. The procedure is as follows:

First, solder the inner connection of the coax and the anode of the diode to the existing lug on the antenna base. This done, secure the double-ended lug to the ground-plane connection on the base of the antenna with a small self-tapping screw. Finally, solder the braid of the coax to one side of the lug and the diode cathode to the other.

Repeat this procedure for the remaining cables.

Connections between the ASU and the control unit should be run using 4-core cable, while the connection to the FM receiver should be run using coaxial cable. All you have to do is trim the cables to the desired lengths and terminate them with the appropriate plugs.

Note that the wiring connections to the plugs at both ends of the control

Radio Direction Finding: The Classic Technique

Most readers will be broadly familiar with the concept of a radio direction finder. In its most basic form, it consists of a receiver and an antenna which can be rotated on its own axis. The direction of the transmitter is then found by rotating the antenna for a signal peak or null.

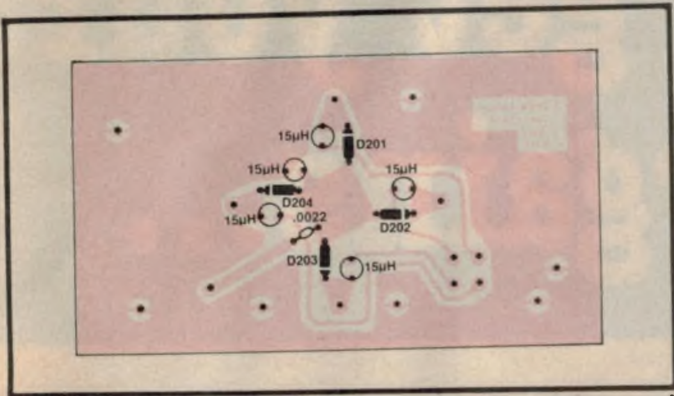
You can easily demonstrate the effect for yourself using a portable transistor radio fitted with a ferrite rod antenna. By tuning the radio to a station and rotating the radio about its vertical axis, a null will be found in the signal strength. The ferrite rod antenna will then point in the direction of the station.

Of course, this method requires that "fixes" be taken at two or more widely spaced locations in order to find the true direction of the transmitter. In fact, two fixes enables the exact location of the transmitter to be determined by simple triangulation.

The classic application of this radio direction finding (RDF) technique was in World War II. Many war movies showed how it was possible to track down enemy transmitters using special vans fitted with RDF equipment.

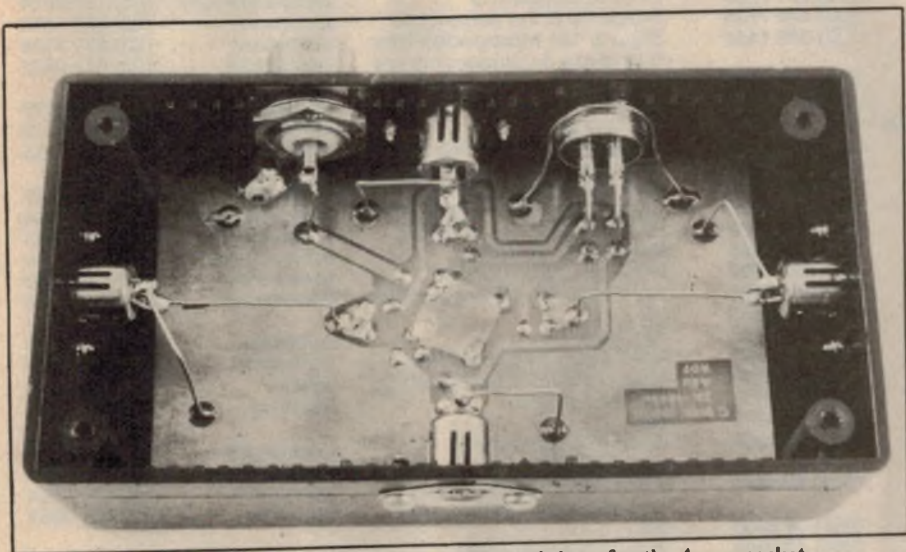
Typically, these vans were fitted with a large external loop antenna which could be manually rotated. An operator inside the van listened in on headphones for peaks and dips in the signal strength. Provided the transmitter remained in the one location for long enough, its location could eventually be pinpointed.

Direction finder

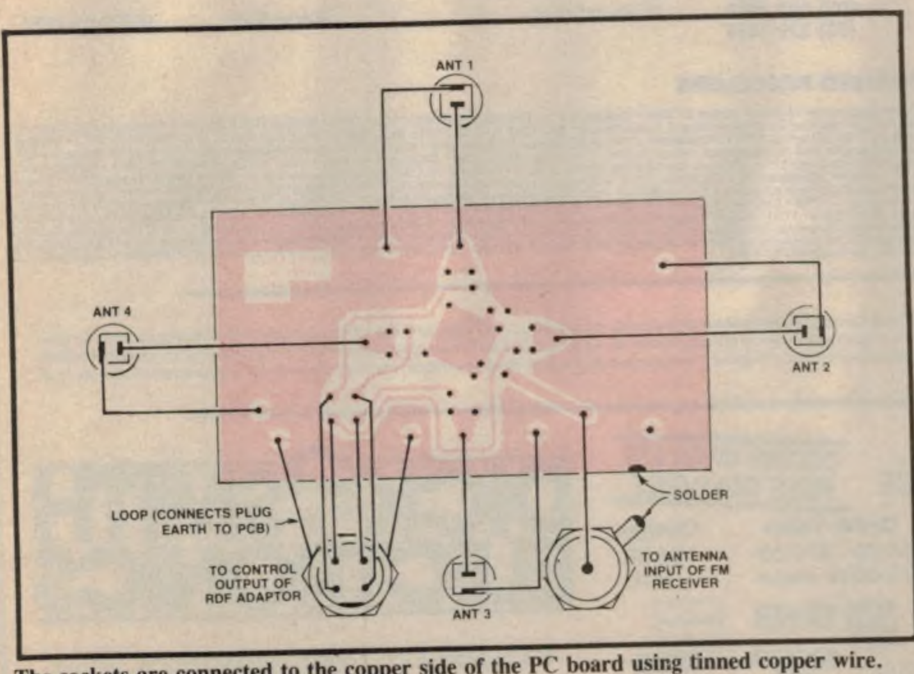


Parts layout for the antenna switching unit. The diodes are all BA244 types.

The antenna switching unit is housed in a plastic zippy case. It can be weatherproofed using silicone sealant.



View inside the antenna switching unit. Note the earth loop for the 4-way socket.



The sockets are connected to the copper side of the PC board using tinned copper wire.

cable must be made on a one-to-one basis, otherwise the antennas will not rotate in the correct sequence.

Setting up

An alligator clip lead and a small screwdriver are all that are necessary to adjust the unit.

Connect up a 12V supply (be careful of polarity!) and switch on with the hold off and the ASU disconnected. All the LEDs in the display should rapidly flicker on and off as the display is scanned.

Assuming all is well, connect the two test points (TPA and TPB) together using the clip lead and adjust VR1 until a single LED is latched. Confirm this adjustment by unhooking and reconnecting the clip lead.

If the display does not latch when the test lead is reconnected, repeat the above procedure. This adjustment brings the VCO to within the capture range of the PLL.

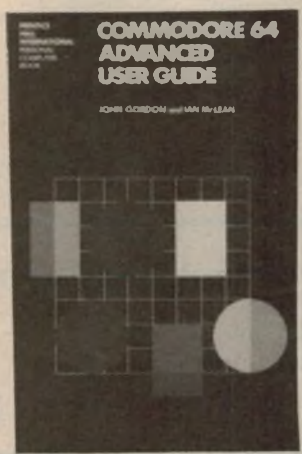
Note that, with the calibrate control at mid-position, the latched LED should be at the top of the circle.

If a dual-trace oscilloscope is available, VR1 can be adjusted for a 90° phase angle between the signal input (pin 14, IC14) and the PLL comparator input (pin 3, IC14).

Finally, the control unit can be checked out by connecting outputs 1, 2, 3 & 4 (to the ASU) in sequence to test point TPA. First, connect ouput 1 to TPA and adjust the calibrate control so that the latched LED is at 0°. The 90° LED should now light when output 2 is shorted, the 180° LED when output 3 is shorted, and the 270° LED when output 4 is shorted.

That completes the construction. Your Radio Direction Finder is now ready for use.

Books & Literature



Advanced guide to the Commodore 64

COMMODORE 64 ADVANCED USER GUIDE: by John Gordon and Ian McLean. Published 1986 by Prentice Hall, New Jersey. Soft covers, 151 x 230mm, 304 pages. Illustrated with diagrams and photographs. ISBN 0 13 152026 1. Price $34.95.

Are you one of those people with a Commodore 64 gathering dust in a cupboard? Have you let your interest slide after the initial burst of playing games? If so, this book could be just the tonic you need to rekindle the interest.

Although there are chapters on practical aspects of the computer's operation, such as data storage and handling, most readers will probably be attracted to the sections on sound and graphics generation. In this respect, the Commodore 64 is quite powerful and even experienced computer users could benefit from some extra tuition. There are some handy tips on machine code and nesting machine code routines within Basic programs.

Chapter 6 is entitled "High Resolution Graphics" and includes programs for achieving high resolution graphics, shading, perspective, 3-dimensional rotation and several other sophisticated techniques.

Combined with a chapter on input/output devices, the foregoing chapters all seem to add up to a wonderful guide to producing arcade-style games and other graphics applications. However, it it also has a fair amount of information about general programming technique (Basic and machine), along with a rundown on the options available for the Commodore 64.

If you have a C64, you should have a look at this book. Our copy was supplied by the publisher.(C.R.D.)

Op Amp Design Guide

DESIGN OF OP-AMP CIRCUITS by Howard M. Berlin. Published 1984 by Howard W. Sams & Co, Indianapolis, USA. Soft covers, 136 x 216mm, 221 pages, illustrated with many diagrams and photographs. ISBN 0-672-21537-3. Retail price $17.95.

Probably the most popular integrated circuit in use today, the op amp is one of the fundamental building blocks of electronic circuits. Currrent types — especially FET input devices — offer remarkable performance, considering that they can be bought for less than a dollar.

To understand just how good most op amps are, and to make comparisons between one type and another, there are a number of expressions that have to be understood. Terms like common-mode rejection, supply rejection, open loop gain and slew rate are amongst the basics. The first chapter of this text gives definitions of these terms, and in fact, all of the common op amp phraseology.

In fact it progresses rapidly past the introductory stage, incorporating many formulas and giving a number of experimental procedures for measuring op amp parameters.

The nine remaining chapters are titled as follows: Basic Linear Amplifier Circuits, The Differentiator and Integrator, Voltage and Current Circuits, Nonlinear Signal Processing Circuits, Generators, Active Filters, Single Supply Operation, The Norton Op amp and The Instrumentation Amplifier. Each chapter has easy to read text and detailed experimental procedures.

For those new to the subject, reading through the whole book and perhaps doing a few of the experiments would provide a useful introduction to analog electronics. Our copy was supplied by Dick Smith Electronics. (C.R.D.)

Op Amp Textbook

OPERATIONAL AMPLIFIER CIRCUITS: by Brian Moore and John Donaghy. Published 1986 by Pitman Publishing, South Melbourne. Soft covers, 156 x 234mm, 134 pages. Illustrated with diagrams. ISBN 0 85896 236 5. Recommended retail $14.95.

Here is a useful ready reference on the subject of operational amplifiers. In 134 pages it succinctly covers the main parameters of op amps and the broad applications of these ubiquitous devices. Each circuit is accompanied by the formulas which define its operation and for anyone who just wanted a quick reminder on a circuit design, it is really handy.

The major chapter headings are: Inverting and non-inverting amplifiers; Frequency response, slew rate and bandwidth; Waveform generators; Power amplifiers and power supplies; and Selected applications of operational amplifiers.

At only $14.95, it's a handy little text. Our sample copy came direct from the publisher. (L.D.S.)

Circuit & Design Ideas

Computer drive for the EA EPROM Programmer

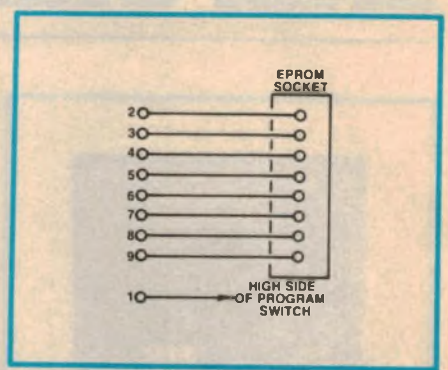
The following is a modification to the Free-standing EPROM Programmer (EA, January 1982)) to enable it to be driven from a Centronics printer port. Included are program listings for the VZ200/300 and TRS80 Models III and IV. A printer interface is required for the VZ200/300.

The hardware modifications are quite simple and mainly involve connecting the Centronics socket to the D0-D7 pins on the EPROM socket and to the high side of the program switch as shown in Fig.1. In addition, the copper tracks at pin 1 of IC5 and pins 1 and 2 of IC4 should be cut and a DPDT switch wired across the breaks.

This new switch allows the EPROM programmer to be switched to either external drive mode or to stand-alone mode.

To operate with computer drive, set the added switch to EXTERNAL, set switch S1 to WRITE, S2 to AUTO INC., and S3 to PROGRAM READY. Now load and run the program. You will have to enter the start address for data to be sent to the programmer and enter the end address.

The program takes care of most user mistakes. However, if data being sent to the EPROM is long enough to cause the address counter to reset while data is still being sent, all data sent after reset will be programmed into EPROM address 000.



Rick Buhre,
Mackay, Qld.

$20

Digital speedometer for cars

This digital speedometer circuit uses a 74C926 4-digit counter chip to count pulses derived from a sensor mounted on the car's driveshaft.

The sensor consists of an MEL12 phototransistor, a slotted disc and an infrared LED (CQY89). The slotted disc interrupts the beam between the LED and the phototransistor, thus providing a pulse train with frequency proportional to the vehicle's speed. This pulse train is then gated through to the clock input of the counter (IC3) via Schmitt trigger IC1a.

IC2, a 4017 decade counter, provides the latch and reset signals for IC3. The Q0 output of IC2 also provides the gating signal to IC1a via inverter IC1b.

Clock signals for IC2 are derived from Schmitt trigger oscillator IC1c. On the first clock pulse, Q0 goes high and gates off IC1a. On the next clock pulse Q0 goes low and Q1 goes high, enabling IC1a and resetting IC3.

Q1 subsequently goes low again and IC3 counts the number of pulses from the driveshaft sensor until Q0 goes high some eight clock pulses later. This gates off IC1a as before. The count is then latched when Q0 subsequently goes low again and is displayed on a 3-digit LED readout.

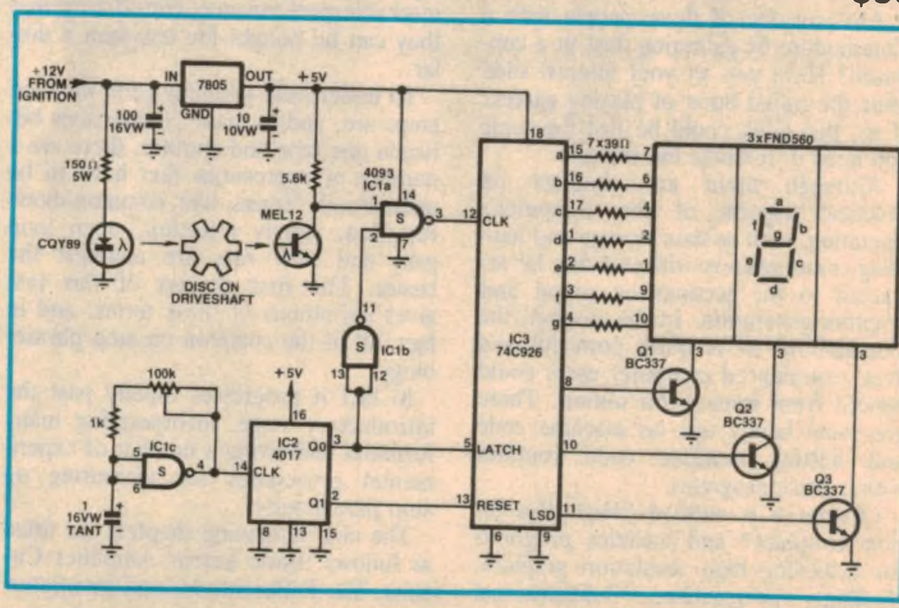
The displays are FND560 (or equivalent, eg. FND500, LTS543R) common cathode types and are switched by transistors Q1 to Q3. The display segments are driven via 39 ohm current-limiting resistors.

Power for most of the circuit is derived from a 3-terminal 5V regulator. Note, however, that the infrared LED is run directly from the +12V supply. The circuit is calibrated by adjusting the 100k trimpot on pin 4 of IC1c.

Finally, note that the sensor disc should have at least six slots otherwise the sampling time of the counter will be excessive.

Brett Harvey,
Southport, Qld.

$30



Interesting circuit ideas from readers and technical literature. While the material has been checked 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.

How to display ECG waveforms on an Apple II computer

```
10 REM
20 REM PROGRAM TO DISPLAY ECG
30 REM
40 REM WAVEFORM FROM AUDIO TONE
50 REM
60 REM
70 REM (C) S. PAYOR, 1986
80 REM
90 REM
100 DATA 0,162,128,160,2,173,96
110 DATA 192,48,251,173,96,192
120 DATA 16,251,232,173,96,192
130 DATA 48,250,232,173,96,192
140 DATA 16,250,136,208,241,138
150 DATA 41,127,141,0,3,162,4
160 DATA 201,64,240,13,48,12
170 DATA 206,1,3,16,6,142,1,3
180 DATA 206,3,3,96,238,1,3,236
190 DATA 1,3,16,8,162,0,142,1,3
200 DATA 238,3,3,96
210 REM
220 REM INSTALL MACHINE CODE
230 REM
240 REM SUBROUTINE
250 REM
260 FOR A = 769 TO 841
270 READ X: POKE A,X
280 NEXT A
290 REM
300 REM CONSTANTS
310 REM
320 CLRSCRN = 62450
330 SUBROUTINE = 770
340 COUNT = 768
350 REM
360 REM PROGRAM STARTS HERE
370 REM
380 HGR : HCOLOR = 3
390 REM
400 REM CLEAR SCREEN AND
410 REM
420 REM PLOT FIRST POINT
430 REM
440 CALL CLRSCRN
450 CALL SUBROUTINE
460 HPLOT 0, PEEK (COUNT)
470 REM
480 REM CONTINUE ACROSS SCREEN
490 REM
500 FOR FOR X = 1 TO 279
510 CALL SUBROUTINE
520 HPLOT TO X, PEEK (COUNT)
530 NEXT X
540 GOTO 440
```

With this program, the Hart Beepa project (EA, April 1985) can be interfaced to an Apple computer, enabling you to view the ECG on a video monitor. Any Apple II series computer can be used and no electrical connection between the Hart Beepa and the computer is necessary.

The Hart Beepa produces a frequency modulated audio tone which has a centre frequency of about 650Hz, and a deviation of about a semitone with a 1mV ECG signal. The sound from the Hart Beepa is fed to the Apple using an ordinary cassette recorder plugged into the "Cassette Input" socket at the rear of the computer.

A bonus of this method is that the signal can be recorded on tape if desired. For live monitoring, simply put the recorder in the "Record" mode with the tape transport in "Pause".

The BASIC program uses a machine code subroutine to count the periods of one or more cycles of audio tone. The result is a number between 0 and 127, which is suitable for direct plotting on the high resolution graphics page. Periods longer than 127 counts are returned-modulo 128; ie, the display effectively wraps around. This ensures that the trace is always on screen.

The machine code routine also has a self centering feature — the waveform always drifts slowly to the centre of the 0-127 range, so that no manual adjustment for the DC shifts is needed.

The gain is adjusted by altering the number of cycles over which the period is counted. For more gain, change "2" in the data statement on line 100 to "3" or "4". For less gain (eg, when the signal is obtained from the chest), change it to "1".

The slope of the automatic trace centering is set by the "4" just after the "162" in line 150. For a more shallow slope, increase this number and vice versa. As it stands, the slope is sufficient to centre the the trace with one pass across the screen. Any faster and the slower features of the ECG waveform will be altered by this linear ramp.

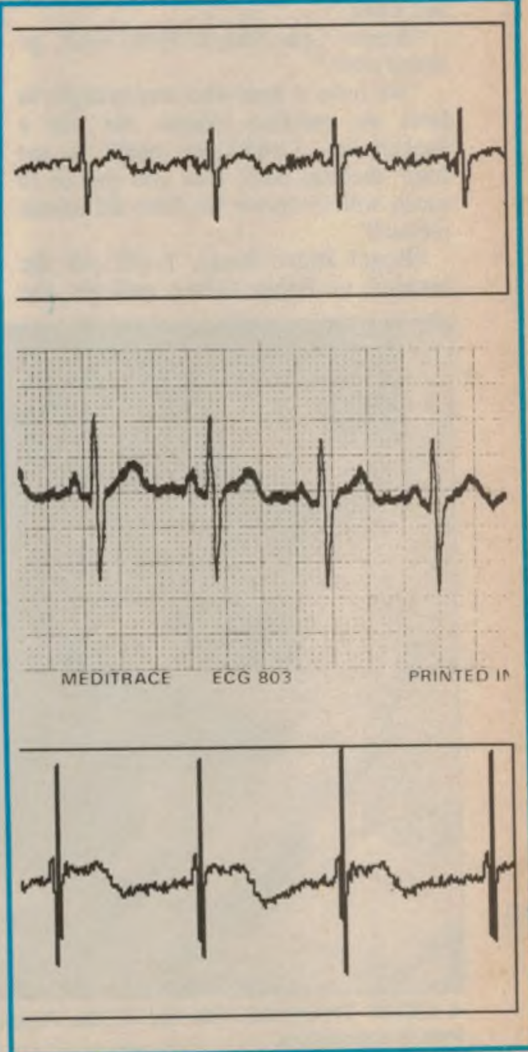
The performance of the system is comparable to a conventional ECG machine, except that the Hart Beepa works well without the need for wrist and ankle straps or conductive gel.

Fig.1(a) shows a screen dump of the waveform ontained when holding the Hart Beepa between the hands. The high frequency noise is chiefly due to muscle tremors in the arms and chest. For a comparison, a trace was made on a conventional ECG machine on the same person, with the gain set at 2. This trace is shown in Fig.1(b).

Fig.2 shows the waveform obtained with the Hart Beepa held aginst the chest. With this larger signal, the gain of the machine code subroutine should be reduced to 1 to avoid a wrap around on the sreen.

Steve Payor,
Kogarah Bay, NSW.

$45



Remote area radio in Papua New Guinea

The technician's life can be an interesting one. In this article we explore the tech's life Papua New Guinean style.

by ROBIN COLE

"Hotel Golf, Hotel Golf. This is Bravo X-ray calling. Are you standing by? Over."

"Bravo X-ray, this is Hotel Golf, go ahead over."

"We have a man who was brought in from an outlying village. He has a broken leg. I think we ought to get some medical help. Can you put us in touch with a doctor for first aid advice please?"

"Roger Bravo X-ray, I will call the hospital at Baiyer River and get the doctor there to come up on mission frequency. If you need further help give us a call."

Probably accessible only by light aircraft, P242BX is a typical outstation operated by one of many missionary societies in Papua New Guinea.

P252HG is the call sign of the headquarters of the Christian Radio Missionary Fellowship's radio communications network at Rugli in PNG.

Rugli, overlooking the beautiful Baiyer Valley, is 1800 metres above sea level and situated roughly in the geographical centre of the country some 30km north of Mt Hagen in the Western Highlands. Being in the highlands guarantees that the climate is very easy to live with — it's certainly not like the heat and humidity that most associate with a place that is only a few degrees from the equator.

The Christian Radio Missionary Fellowship (CRMF) is a service organisation providing an efficient radio network for some 40 Christian organisations. Like Bravo X-ray, the 400 plus outstations using the CRMF network are able to call Hotel Golf any day of the year between 7am and 6.30pm for assistance with any problem that might arise.

"Hotel Golf this is Bravo X-ray over."

A CRMF Technician with one of the Papua New Guinean electronics apprentices.

A baby is prepared for evacuation by plane. The whole operation was co-ordinated over the CRMF radio network.

"Bravo X-ray go ahead. Over."

"The Doctor says that the patient probably has a compound fracture and needs to be evacuated to a hospital as soon as possible."

"Roger Bravo X-ray, go ahead with the details and I will call the PHO for approval."

The Provincial Health Officer is a Government appointed doctor who can authorise a charter flight to evacuate a patient to the nearest hospital at the expense of the Health Department.

Once approval has been obtained, the Department of Civil Aviation is contacted and a plane is either sent to the outstation or if one is in the area, it is diverted to pick the patient up.

The staff at Rugli co-ordinate many such medical evacuations. So far this year in excess of 200 have been recorded in the radio log book.

In addition to the medical calls, the CRMF also assists in many other urgent situations.

Early one New Years eve we were called by the Christian Leaders Training College. A number of local louts had decided to play havoc on the campus. In an attempt to prevent the police being notified they had cut the phone lines. However CLTC had a transceiver on our frequencies and called us — we in turn notified the police who were on the campus before too much damage was caused.

The CRMF network

The CRMF radio network consists of three frequencies allocated by the Posts and Telecommunications Corporation — 3196, 5892 and 5895kHz. The entire network is now operating on single sideband (SSB) using almost exclusively Codan transceivers manufactured in Adelaide. The power utilised ranges between 25 and 100 watts PEP. In the days of double sideband (DSB) there seemed to be no end to the brands used. This included a transceiver designed and built by CRMF in Sydney between 1946 and 1956.

The outstations on the network consist of base transceivers located in the Mission headquarters, hospital or in a home. There is also a large number of portable transceivers used by doctors and church workers out on patrol to remote villages. Coastal boats and light aircraft also make extensive use of the network.

It has been said that the services of the aircraft and the radio network are a lifeline to remote outstations. You can only get an idea of the full importance

Remote radio in PNG

of this statement when you realise that the only access to many outstations is by plane or boat or, in some cases, by helicopter alone. While walking might be feasible in the dry season — if one has a day or two to spare — it is generally right out of the question to consider a two-day walk when a 20 minute plane flight will cover the same distance. You are also well above the leeches!

Servicing

The communications network is only one side of the services provided by the Christian Radio Missionary Fellowship. The Rugli radio base also boasts a well equipped radio workshop where almost all forms of radio electrical and electronic equipment are repaired.

"If it has batteries or a plug, send it to Rugli", is a quote that comes to mind.

Most of the transceivers on the network are using single, double or triple dipole antennas assembled in our workshop at Rugli. We also manufacture the 1:1 baluns as well.

Being a technician in a 'remote' workshop requires an added degree of ingenuity. Servicing such a wide range of equipment from domestic radio and hifi gear to office machines, computers, 240V generators and telephone exchanges certainly provides variety to the task in hand.

Papua New Guinea hosts a large number of international residents who bring with them a vast array of electrical equipment manufactured in their own countries. Many are wise enough to bring a service manual with them. One Lutheran missionary brought a stencil scanner in for repair and proudly presented us with the full service handbook — written front to back in German!

Not all of the technical work is done in the workshop. There are many occasions when our technicians need to travel to an outlying station to carry out installation, repairs or maintenance simply because the equipment is not transportable. PABX systems, language laboratories, 240V generators and remote controls for transceivers are the main reasons for the need to travel.

CRMF also manufactures a remote control to meet the needs of outstations. Most base transceivers are located in a small radio room (usually not much bigger than a phone box) but there are usually quite a few individuals who need to use the radio. The remote control system enables these individuals to have access to the radio from their office.

Electricity supply

The power to run the radio communications base at Rugli is derived from a 100kVA hydroelectric plant owned and operated by the CRMF. This in itself ensures the staff get an even wider range of experience, not just on the CRMF designed electronic governor or the 3.3kV HV reticulation system, but also on the 3km of water channel, together with the flumework and 200 metres of penstock.

The radio workshop at Rugli differs from other radio repair centres. Whereas most technicians are able to be selective and work on mainly one brand of equipment and then further limit themselves to only video, hifi or RF gear, our technicians find themselves working on 'anything that has wires'.

CRMF currently has two PNG electronics apprentices. Becoming a qualified PNG radio technician involves overcoming one major hurdle that is often not understood. When an Australian decides to become a radio technician he makes that decision from a deep interest in the field and also from possibly several years experience at hobby level. The majority of entrants in an electronics apprenticeship in PNG make their decision in the last year of high school when they put a tick on a page full of professions.

This factor alone requires that our qualified technicians spend considerable time assisting the trainees with both theory and practice, even though they attend annual block courses arranged by the Apprenticeship Board.

There is currently a staff of six expatriates on the base at Rugli. CRMF staff generally work on a voluntary basis and are supported by their home churches. To fully staff the operation at Rugli there should be eight to 10 fully qualified technicians.

For more information about the Christian Radio Missionary Fellowship contact Robin Cole on (03) 890 2338 or write to CRMF, PO Box 46, Blackburn, South Victoria, 3130. Ask for the 'Infopak'.

KITS KITS KITS

Hurry! All DSE kits at least 10% off and some up to 50% off — but only while stocks last!

DICK SMITH ELECTRONICS PTY LTD

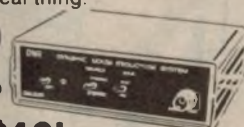
Mini Anywhere Amp

A solid performer for buskers, garage bands or anyone starting music. Connect a guitar, organ or use as a portable PA amp. Great value! Short form kit: case & speaker not included. Cat K-3447

$57.95 Was $87.95 **SAVE $30!**

Video DNR System... Simulated stereo too!

Improves VCR's sound by dramatically reducing tape hiss. Improves signal-to-noise ratio by up to 18dB. Plus you get simulated stereo sound that's so good it's hard to distinguish from the real thing.



$89 Was $99 **SAVE $10!** Cat K-3423

UHF/VHF TV Down Converter

Allows your VHF-only TV to receive UHF — Bands 4 and 5 (covering Ch. 28-63). Built-in by-pass switch eliminates the need to disconnect and re-connect antenna leads. Ideal for use with UHF videos! Cat K-3236

ONLY **$68.85** Was $76.80 **SAVE $7.95**

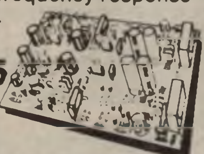
Amateur TV Transmitter

Originally intended for use as a TV distribution system (video and audio in from VCR, etc), but not approved for this purpose in Australia. We've found these perfect for amateur TV experimentation: outputs on UHF TV Ch. 35. Could be used as the basis for much higher power transmitter with suitable amplifier. Cat D-2500

ONLY **$59.95**

Ultra-Fidelity Preamp

A magic kit that can improve the performance of your amplifier. The popularity of CD players has led to an increased burden on many amps: higher signal slopes, dynamic range, etc. This easy to assemble kit has been designed for improved dynamic range, noise, distortion and frequency response characteristics. Cat K-3037



$59.95 Was $69.50

40W Bookshelf Speakers

Delivers superb sound quality through 115mm woofer and 81mm tweeter. Just a soldering iron and screwdriver is all it takes for quick assembly. Cat K-4000

$224 **SAVE $25!** Was $249

70cm GaAsfet Preamp

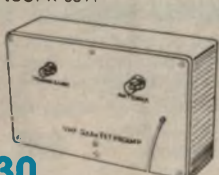
Cat K-6309

$99 Was $129 **SAVE $30**

Gives your UHF rig that extra performance! 10dB minimum gain (typical 3dB or so higher) and a noise figure less than 2dB. Includes tx/rx switching, coax relays. Suits UHF amateur or CB bands.

GaAsfet for 2m action!

Start the New Year with a saving on 2m performance. Covers 144-148MHz bandwidth with an impressive 10dB gain and a noise figure less than 2dB. Ideal for satellite use too! K-6311



JUST **$99** Was $129 **SAVE $30**

2m Linear amp

Can't reach that distant repeater? Need more oomph for DX? Then build this amp — added performance and $$$ savings! Up to 120W (CW) output from only 15W drive. For mobile and base use, 12VDC operated. Cat K-6313

$249 SAVE $50 Was $299

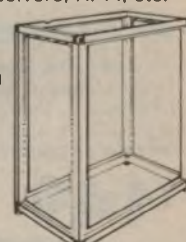
Save... build a HF Transceiver

It's easy, economical and fun! This brilliant unit covers any single 500kHz segment within 2-30MHz (80m version supplied). Covers CW, LSB and USB modes. Other band modules due shortly

$299 Was $349 **$50 OFF!** Cat K-6330

19" Zip Rack

The hobbyists' favourite storage system. Easy to assemble sections snap into place for organising amateur transceivers, Hi-Fi, etc. Cat H-2470



$149 What a good idea!

Start the New Year right... with a DSE Kit. Enjoy the latest and the best in electronics at affordable prices. All kits at least 10% OFF - 1 month only!

60W Mosfet Amp Module

Build your own amplifier – and save! Huge 60W output — use two modules for stereo. Simple one pcb construction. Frequency response: flat within +/-0.4dB from 8Hz-29kHz. Noise: -100dB at full power. Cat K-3441

Massive heatsink included!

$43.95 Was $87.95 **50% OFF!**

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How do jewellers clean precious settings without scratching? Wondered how coin collectors maintain priceless coins in mint condition? With an ultrasonic cleaner, that's how. No abrasive scrubbing or harsh cleansers... the Ultrasonic Cleaner vibrates off dirt, stains and built-up deposits. Leaves jewellery, coins, hobbyists PCBs, watch parts... most delicate objects sparkling clean. And now you can build your own with this superb Heath kit. Note: requires external 240V to 110V step down transformer.

Our M-1156 transformer is ideal. Only $74.25

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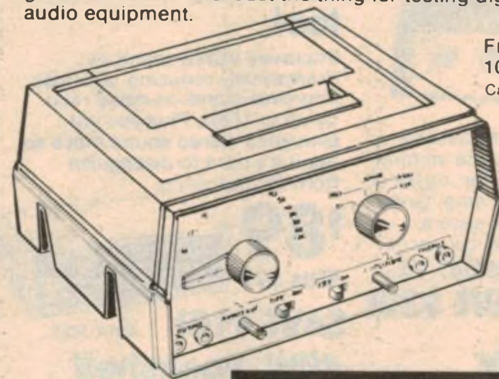
$299

For that professional sparkle that's yours anytime!

Audio generator

One of the most economical — yet reliable — sine and square wave generators available. Just the thing for testing digital circuits and audio equipment.

Frequency range: 10Hz to 100kHz.
Cat G-4010



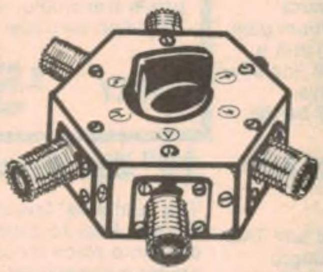
$149 ONLY

Coax switch... routes up to 4 antennas

No fuss solution to multiple antenna problems. Switches one RF source to any one of several antennas or loads while grounding all outputs not in use. 2kW PEP with maximum 1.1:1 SWR to 250MHz
Cat G-3010

$59

Forget multiple antenna hassles!



Heath Cantenna Dummy Load

The Cantenna eliminates unnecessary QRM during tune-up and minimizes mistakes while performing 'hot' gear maintenance or alignment. Handles 1kW of RF with VSWR less than 1.5:1 up to 450MHz.
Requires 4 litres transformer oil.
A one evening kit.

Cat G-3015

$49.95

What a fantastic idea!

Take advantage of DSE's special Heathkit offer... A FREE catalogue & see the manual before you buy the kit.

DSE's service is second to none. Ordering Heathkit through DSXpress is as easy as fixing a stamp to an envelope or phoning. But our service doesn't end there!

Free Heathkit catalogue — 103 pages — is available just by writing to us: Heathkit Information Service, Dick Smith Electronics, PO Box 321, North Ryde, 2113. Hurry: the Heathkit catalogue is popular reading and we have only a limited number.

See the manual before you buy... make sure that the Heathkit you want will suit your needs. We're sure it will and that's why we offer this unique opportunity: Buy the manual, check it out and if your decide to buy the kit we'll refund 50% of the manual price.

RF generator

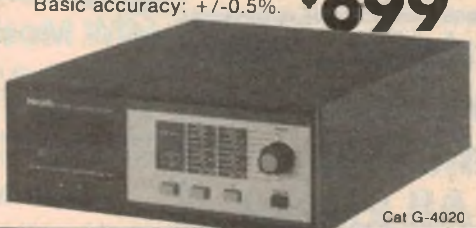
An invaluable piece of hardware for aligning tuned stages in AM/FM, TV, LW and SW receivers — modulated and unmodulated signals from 310kHz to 110MHz. Calibrated harmonics operational to 220MHz. Cat G-4005

$149

Digital LC bridge turns your workshop into a Lab

Provides accurate capacitance and inductance measurements — plus component dissipation/loss factor.
Capacitance measurement: <1.0 pF - 2000 uF. Inductance measurement: <1.0 uH — 2000 H.
Basic accuracy: +/-0.5%.

$699



Cat G-4020

Trace down problems with sound signal tracer

Keep your eyes on your work while your ears detect a good or bad signal. This way you can quickly trace through circuits in radios and TVs. Detect RF or IF stage failures, even bad components. Also use on audio circuits.

$149

Cat G-4015

DICK SMITH ELECTRONICS PTY LTD

Now Heathkit, the best kit in the world is backed by the best service — DSE!

Start the New Year with the latest and best in electronics: a DSE kit!

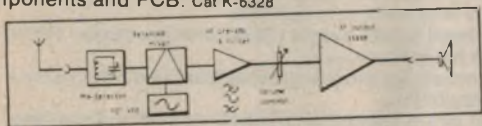
NEW KITS

Low cost alternative to pre-built amateur gear

Here's amazing value: build your own 80 metre CW transceiver for under $150!And even more: you build it section-by-section — you don't have to buy the lot at once. Famous British quality kits from CM Howes Communications, these three kits (each a separate, practical project) combine to form an 80 metre QRP transceiver with up to 5W output. Absolutely perfect for YRCS, Scout, school and club projects. And so affordable! And it's the perfect way to get into the fun and excitement of amateur radio.

Receiver Module Kit:

Operates over full 80 metre band with direct conversion receiver. Balanced mixer and FET VFO, all very easy to build on one pcb. 12V DC operated. Complete instructions with all components and PCB. Cat K-6328

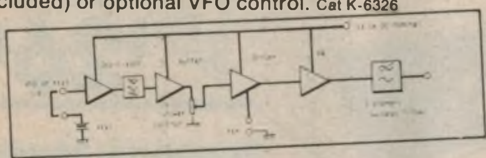


$59.95

Requires 2 x 50pF tuning capacitors Cat R-2980 ($6.95 each)

Transmitter Module Kit:

Stand-alone transmitter or add to receiver for "transceiver" operation. Easy to build — all instructions included along with pcb and components. Adjustable output up to 5W — all you add is a power supply and key. It's that simple! Your choice of crystal locked (rock included) or optional VFO control. Cat K-6326

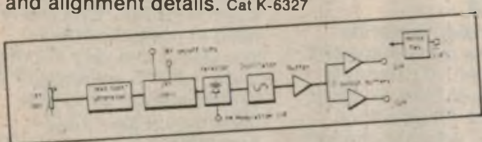


$49.95

If you want more power check out our HF Amplifier Cat K-6331. An ideal combination

VFO Module Kit:

Gives full VFO control over 3.5-4MHz — designed especially for above transmitter, but can also be used as a general purpose variable frequency oscillator. Even has provision for FM modulation to give phone capability. Instructions include various modifications and options — and alignment details. Cat K-6327



JUST $39.95

(Note: tuning capacitor not included in kit. Our R-2980 50pF tuning capacitor [$6.95] will give approx 300kHz tuning range. Other capacitors will give different ranges).

Teletext Tuner... the latest news!

Lets you use our Teletext Decoder kit (K-6315) without connecting via your VCR. Connects directly to TV antenna for access to latest Teletext info — it's that simple! Operates on all VHF & UHF TV bands. Cat K-6319

FANTASTIC

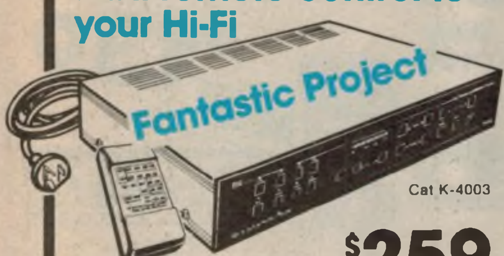
$149.50

HF Amplifier

Sick of QRP? This new kit gives your HF transceiver a new lease of life with around 10-14dB gain. That's about 100 watts out from a 4 watt drive — and it covers the full HF spectrum from 2 to 30MHz (about 50W output to 10m). Wide-band ferrites used so no tuning required for band changes (switched low-pass filter covers all amateur bands). 4 to 10W drive required (15W if 2:1 attenuator included). Cat K-6331

$349

Add remote control to your Hi-Fi



Cat K-4003

$259

Building our infrared remote control saves $$$ and effort. No need to buy a new system, convert your present Hi-Fi: full remote control over your amp's Volume. Balance, Tone, Aux, Tape and Phono controls up to 6m away!

UHF Power Amp

Most UHF transceivers are in the 2 to 10W class. Now you can lift them into the "super-rig" class with this 50W linear amplifier. Perfect for hand-helds too! Features: • 14dB gain (typical 50W out from 2W in) • Class AB • Harmonics better than -60dB • 10MHz bandwidth • 12V operated for mobile and base use. Cat K-6307

NOW ONLY **$279**

RF field strength meter

$54.95

GREAT

An invaluable piece of equipment for checking amateur gear — now build your own for a fraction of the price! • Covers 3-1000MHz (1GHz) • high sensitivity: can indicate field intensity of a 144MHz 1W hand-held transceiver from 100 metres away. Cat K-6321

You can build your life around DSE kits. Stereo components, security alarms to amateur radio... DSE has it all!

DICK SMITH ELECTRONICS PTY LTD

Marine Bargains!

The best range of marine communications... at the best prices! From hand-helds, Seaphone transceivers to antennas — all at DSE.

WHILE STOCKS LAST!

(Some items not available at all stores)

12 Channel VHF Marine

Versatile hand-held transceiver that covers any 12 of the VHF marine channels and is re-programmable for coastal cruising. Goes anywhere: on cruiser, skiff and home with you after docking (no chance of being stolen!). Features: • 0.5/2.5W power output (switchable) • sensitivity better than 0.25uV (12dB SINAD) • NiCad battery and charger. DOC Approval: 274C018
Cat D-1404

$299 SAVE $100!

VHF marine links with phone network

SAVE OVER $200!!

Limited stocks — Hurry!

Feature-packed transceiver for marine use. With access to all 55 international VHF marine channel in the 156-163 band — including Ch. 87A yachting frequency. And connect with OTC's Seaphone service, linking with land telephone network, to make calls out at sea. Plus you enjoy a host of benefits:

- **Maximum legal power output (25W) with low power 1W — switchable for harbour use.**
- **Universal mounting with reversable front panel for roof or cockpit installation.**
- **Mic, power cable, mounting brackets and full instructions included.**

DOC Approval: 274B033
Cat D-1401

WAS $499
NOW ONLY
$269

'Tackle Box' Uniden 60 Ch. VHF Marine

Versatile marine transceiver that packs a load of features and performance in a compact, go-anywhere tackle box type case. Provides access to 60 channels on the VHF marine band, Ch. 9 weather reports and the ability to make land telephone calls via coastal radio stations.
Features:

- **LED channel display**
- **Auto Ch. 16 on/off button**
- **Squelch**
- **Rubber duckie antenna with coax cable**
- **Built-in speaker... and much more.**

Cat D-1402

DOC APPROVED
$299 (Limited quantity)
SAVE $150!

10-Ch. 27MHz Marine Transceiver (Uniden)

The Seawasp: reliable marine performance at a price that won't sting your budget! 10 Channels for boat-to-boat or boat-to-shore communications. Fitted with a VHF "listen only" weather channel and instant access Ch-88 for emergencies. Cat D-1407

NOW ONLY **$139**

SAVE $60!
WAS $199

Economy Marine Transceiver

Introducing the Dragon — our latest, feature-packed transceiver designed for both the professional mariner and weekend sailor. Everything you need in marine safety is included... at a very affordable price. • All 10 channels in the 27MHz marine band with maximum legal output • Automatic noise limiter and ceramic filter for minimum interference • Variable squelch control • LED frequency display • Doubles as PA amplifier with optional horn speaker. Cat D-1717

$139
NEW!

Hornet II AM/SSB Marine

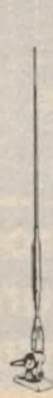
A superb marine transceiver that operates on the 27MHz band with the capability of future expansion without the need to buy crystals! At sea SSB gives you that extra range when you need it most. Plus Hornet II handles all local AM transmissions for real versatility. It even doubles as a PA amp (with optional speaker). Features:

- **All 9 channels fitted**
- **LED channels display**
- **Noise blanker and automatic noise limiter — reduces impulse noise.**

DOC Approval: 244O10

SAVE $80!
Cat D-1716

NOW ONLY
$249
WAS $329



VALUE!

27MHz Helical Whip

Suits most hull types. With base, cable and simulated ground plane. Cat D-4070

$59.95

VALUE!

VHF Marine Whip Antenna

Includes 'any-which-way' base with emergency quick release lever. Cat D-4016

$74.50

DICK SMITH ELECTRONICS

Keeping you AFLOAT!!

AMATEUR ANTENNAS

The best and nothing but...

Multi-band HF mobile antenna system

Into HF mobile? No-one wants a Christmas tree! Here's the solution. The high strength deluxe antenna base is especially made to take the extra stresses of HF whips. Standard 5/16, 24TPI fitting means it's suitable for a huge range of VHF whips — as well as these HF beauties.

Cat D-4313 **$14.95**

Changing bands is as simple as swapping to the whip you want!

80 Metres: cm long whip

Cat D-4310 **$44.95**

40 Metres: cm long whip

Cat D-4311 **$44.95**

20 Metres: cm long whip

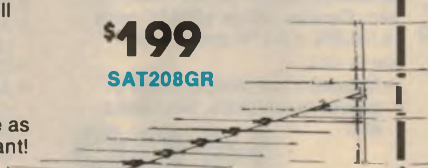
Cat D-4312 **$44.95**

The Ultimate 2m Beam

We defy you to better the performance of this 8 element beam! It is absolutely sensational — and even better when stacked! Precision made by RF Aerospace — exclusive to Dick Smith Electronics — and ready to assemble for the best 2m DX you'll ever find. Cat D-4700

$199

SAT208GR



And the Ultimate 70cm Beam

If you work the birds, you need this beam. We used it to find JAS-1 on its launch morning. The performance is nothing less than amazing: also made to extreme tolerances by RF Aerospace, it offers the UHF operator performance (even QRP) he's only dreamed of until now! Cat D-4701

$249

SAT7018GR

2m Colinear Mobile

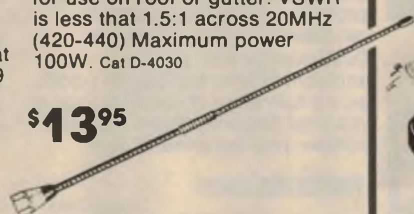
⅝ plus ⅜ wavelength gives 5.2dBi gain, with VSWR less than 1.5:1 at centre band (tunable with adjustable whip). Designed for side-of-roof mobile use, the PL-259 base suits huge range of mounts (our D-4035 SO-239 for example). Stainless steel construction

$79 Cat D-4320

Top performance Mobile 70cm

Co-linear with approximately 4.5dBi gain means your signal will pack a punch the others can't match. Solid brass ferrule has internal 5/16in, 26TPI socket (suitable for range of mounts/bases) and is suitable for use on roof or gutter. VSWR is less that 1.5:1 across 20MHz (420-440) Maximum power 100W. Cat D-4030

$13.95



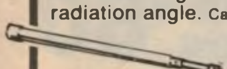
"Short" ⅞ wave for 2m

Capacitively loaded whip for two metres giving 4.2dBi gain — almost the same as a full ⅞ antenna! And even more: it's got an in-built foldover — ideal for low flying car parks. VSWR is less than 1.5:1 (less than 1.1:1 at band centre), adjustable. PL259 base terminated. Cat D-4325

$69.95

Vertical base antenna for 70cm

¾ wave end-fed vertical for the 70cm amateur band. No construction required — just bolt it to your mast and attach your co-ax! (SO-239/PL259 connection)
VSWR of less than 1.5:1.
Housed in non-contaminating PVC shroud for mechanical durability and life. C-Pole type antenna designed for low radiation angle. Cat D-4704



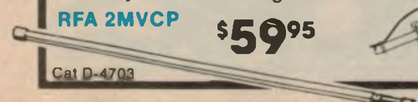
$59.95

RFA 70CMVCP

2m Vertical

Similar to above antenna, but designed for 2m (140-150MHz coverage). 175cm long, ready to bolt to your mast and go!

RFA 2MVCP **$59.95**

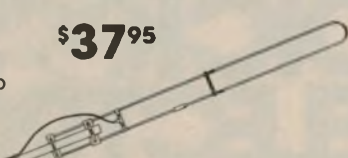


Cat D-4703

"J" Beam folded 2m vertical

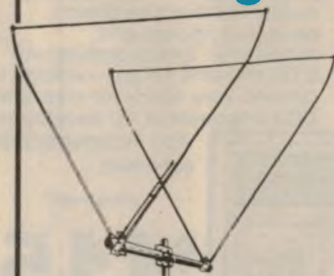
One of the most famous 2 metre amateur antennas in the world. Hundreds have been home-brewed — but almost everybody got into trouble bending the aluminium! We've done it for you — as well as supplying comprehensive, step-by-step instructions on how to put it together and how to get the most from it. A perfect antenna for those with a space problem (or an XYL problem!). Cat D-4211

$37.95



ANTENNAS

Turn your CB into a top of the line rig with DSE antennas!



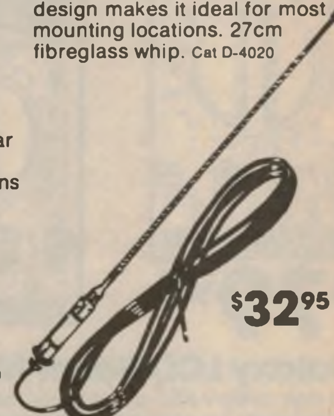
CB/10 metre V Quad

2 element V Quad giving similar gain to 3 element Yagi! Simple to construct (detailed instructions supplied) and suitable for horizontal, vertical and mixed polarity. Stack two for even greater gain. Designed for 27MHz CB use, only minor adjustments required for 10m amateur band. Everything supplied — including mast clamps and brackets. Cat D-4079

$129

Coax Dipole for UHF CB

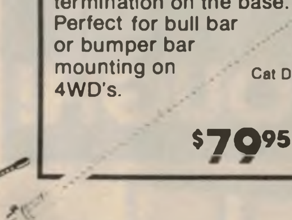
Coaxial dipole whip, complete with mounting base and co-ax. All you do is add the transceiver connector! Ground-independent design makes it ideal for most mounting locations. 27cm fibreglass whip. Cat D-4020



$32.95

For the big boys...

Computer designed fibreglass whip a massive 250cm long (yes, 2.5 metres!) Full ¼ wave on 27MHz, with PL-259 termination on the base. Perfect for bull bar or bumper bar mounting on 4WD's. Cat D-4081

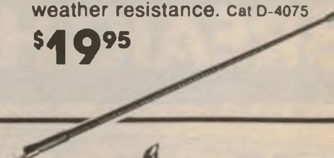


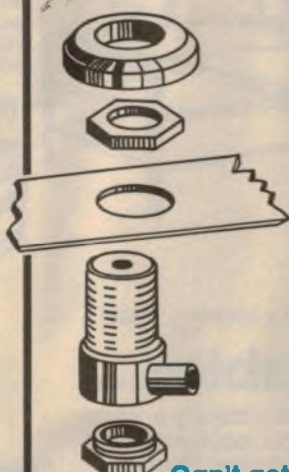
$79.95

Not quite as much room?

Try 100cm long. Suits roof or gutter mounting with a VSWR of 1.5:1 or less. PL259 terminated (in base of whip). Quality fibreglass construction with spiral and loading coil coated in polyolefin heatshrink for top weather resistance. Cat D-4075

$19.95

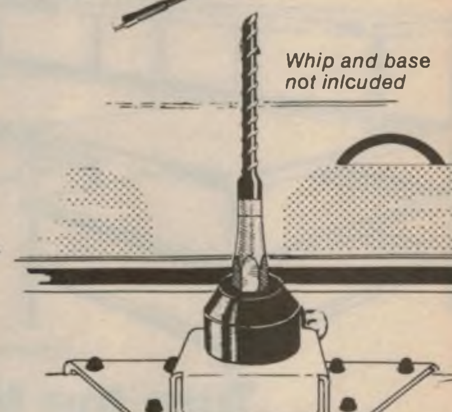




Can't get past first base?

Try this base: it's first! SO-239 type (mates with PL-259 antennas), perfect for use with RG-58 or similar co-ax. Complete with mounting hardware. Cat D-4035

$7.95



Look Mum: No Holes!

No holes — but it's strong enough to hold virtually any mobile antenna — without even scratching the paintwork. Stainless steel plate mounts on boot or bonnet lip — allen key adjustment with pips to prevent damage. Suits a huge range of bases and mounts. Cat D-4515

$24.95

Check our meters — they pass the test...

Multimeter Transistor/Diode Checker

3.5 digit LCD m'meter even has buzzer continuity and battery checker (checks under load). Plus current to 10A, transistor Hfe and Diode Vf. All at a bargain price!
Cat Q-1445

NEW!

$79.95

Digital Multimeter checks caps & semis too!

The latest and the best for Christmas. Imagine: for this low price you get a full 3.5 digit LCD multimeter that also checks capacitors, diodes and transistors! Switch between AC & DC on same range — voltage or current. Very handy for measuring DC component of AC waveforms. Also includes buzzer continuity.

Cat Q-1465

$115

NEW!

LCD Temperature/ Meter

What a combination! 3.5 LCD multimeter for current and voltage checking with override indicator, buzzer continuity and 0.1%/0.25% accuracy. Also takes thermal readings (F and C) for scientific and hobbyist measurements: check heatsinks, etc. **Covers -20 to 1370°C with +/-0.3% +/-1°C accuracy.**
Cat Q- 1512

- **Measure the temperature of power transistors, heatsinks, etc.**

$199

COMPLETE WITH PROBES AND THERMAL UNIT

4.5 Digit Bench Top Meter

Laboratory standard LCD multimeter priced for the hobbyist! All VOM functions, diode test and visual/audible continuity are included. Plus auto polarity and overrange protection in each range. Cat Q-1550

- **DC Voltage — 10uV to 100V**
- **AC Voltage — 10uV to 750V (50Hz-50 kHz)**
- **DC Current — 10nA to 10A**
- **AC Current — 10nA to 10A (50Hz-50 kHz)**
- **Resistance — 10m ohms to 20m ohms**

SAVE $66!

NOW ONLY **$199** WAS $265

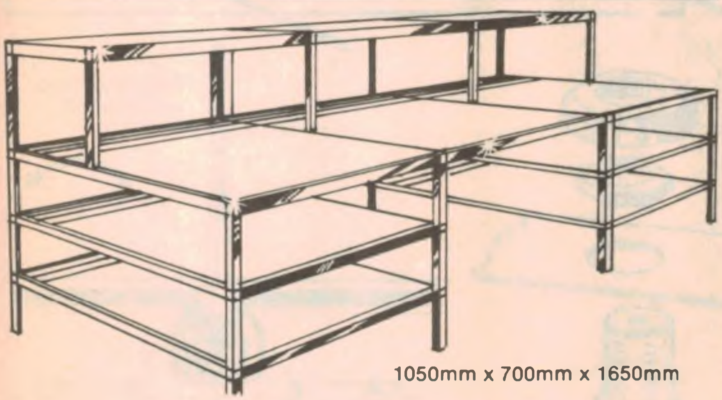
Galaxy LCD Panel Meter

3.5 digit, 200mV FSD panel meter makes an ideal replacement for analogue meters which are susceptible to movement. LCD display provides accurate readout and can be seen even under adverse light conditions. Cat Q-2200 **$54.95**

LCD panel meter 4.5 digit. Cat Q-2202 **$79**

WITH DATA/APPLICATIONS

BENCH BREAKTHROUGH!



1050mm x 700mm x 1650mm

Turn the tables...

Organise yourself with a new work bench. It's literally a 'snap' to assemble — no tools required! Store tools, equipment and enjoy a large work area. Set up amateur gear too! Sturdy aluminium frame and deep shelves for neat organisation.
Cat H-2480

** Requires optional shelves (below)*

$249

White laminate shelves. Cat H-2485

$119

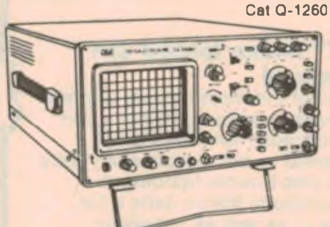
Unbeatable value for dual trace 20MHz CRO!

- **1mV Sensitivity**
- **+ and - Algebraic additions**

Sensational value! An affordable, professional standard 20MHz oscilloscope that's got the lot. Dual channel with algebraic addition, 20MHz bandwidth (-3dB), plus a full range of controls to give you total flexibility. Even includes probes: nothing extra to buy!

PROBES INCLUDED!

Cat Q-1260



$949

Multimeter/ Capacitance Checker

Get more than you bargained for: 100,000 ohms/volt multimeter PLUS transistor capacitance checker in one unit. Measure transistors Ico and Hfe for both NPN and PNP. In-built transistor oscillator for capacitance measurement. Also test diodes. DCV: 0.25 - 1000, ACV: 5 - 1000.
Cat Q-1140

35% OFF

SAVE $45!

WAS $125 NOW **$80**

DICK SMITH ELECTRONICS PTY LTD

GREAT AMATEUR BARGAINS from DICK SMITH ELECTRONICS PTY LTD

Yaesu FT-2700RH 2m/70cm
The 2-in-1 transceiver..

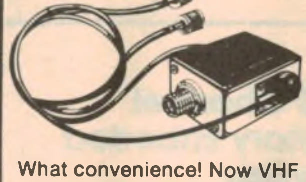
An amateur's dream come true: access to 2m AND 70cm bands without the expense of buying two rigs. Boasting typical advanced Yaesu features: • 10 memory channels • programmable memory scan • 25W continuous on both bands • full duplex crossbanding... and more! Cat D-3515

WAS $1199 **SAVE $500** FANTASTIC

NOW ONLY **$699**

LIMITED STOCK
ONLY ONE PER CUSTOMER
AT THIS PRICE!

2m/70cm Duplexer



What convenience! Now VHF enthusiasts can connect two transceivers to one antenna... saves time and trouble disconnecting and re-connecting. Cat D-3550

WAS $49.95 **SAVE $20** **$29**

6 m/2 m Duplexer

This 'Maldol' duplexer is ideal. Same principle... connect two transceivers to the one antenna. No fuss. Cat D-3555

SAVE $20 **$29**

Weltz 100W Dummy Load

100W continuous or 500W short term: that's the WELZ CT 530 Dummy Load. DC to 450MHz with SO239 socket termination and fan-forced air cooling. A must for the serious amateur. Cat D-7020

SAVE $35 **$90** WAS $125

FP757HD heavy duty power supply

The strength to take long qso's without getting hot under the collar. Truly a heavy duty supply for high power transceivers, rated at 13.8V, 20A continuous (20 mins tx, 30 mins rx). Cat D-2945

$489 WAS $689 **SAVE $200**

2m rig lacking oomph?

Give it a boost with our 2m linear amp... 30W output with just 3W in. • 13.8V Power supply (ideal for mobile use) • Dual time constant for SSB or FM operation • Reverse polarity protection.

Alinco All Mode Amp Cat D-2546

SAVE $50 **$115** WAS $164.95

HF Linear Amp

Adds power and performance to your mobile or base rig over the full HF band: 2-30MHz.
• Impressive 100W (plus) with only 4W input. • 3-Level RF power selection • over-voltage and over-drive protection • Specially wound ferrite transformers.
• Input/output impedance: 50 ohms nominal; SWR <2:1 recommended. Cat D-2547

Famous TOKYO HY-POWER Brand

$199 WAS $399 **SAVE $200**

STORE LOCATIONS

NSW		
Swift & Young Sts.	**Albury**	**(060)21 8399**
T55 Terrace Level	**Bankstown Sq**	**(02)707 4888**
Shop 1, 65-75 Main St	**Blacktown**	**(02)671 7722**
613 Princess Hwy	**Blakehurst**	**(02)546 7744**
Oxford & Adelaide Sts	**Bondi Junction**	**(02)387 1444**
Shop 2, 1B Cross St, Warringah Mall	**Brookvale**	**(02)93 0441**
Campbelltown Mall Queen St	**Campbelltown**	**(046)27 2199**
Shop 235, Archer St Entrance	**Chatswood Chase**	**(02)411 1955**
147 Hume Hwy	**Chullora**	**(02)642 8922**
164 Pacific Hwy	**Gore Hill**	**(02)439 5311**
315 Mann St	**Gosford**	**(043)25 0235**
4 Florence St	**Hornsby**	**(02)477 6633**
Elizabeth Dr & Bathurst St	**Liverpool**	**(02)600 9888**
450 High Street	**Maitland**	**(049)33 7866**
621-627 The Kingsway	**Miranda**	**(02)525 2722**
173 Maitland Rd, Tighes Hill	**Newcastle**	**(049)61 1896**
Lane Cove & Waterloo Rds	**North Ryde**	**(02)88 3855**
George & Smith Sts	**Parramatta**	**(02)689 2188**
The Gateway High & Henry Sts	**Penrith**	**(047)32 3400**
818 George St	**Railway Square**	**(02)211 3777**
125 York St	**Sydney City**	**(02)267 9111**
Treloar's Bldg, Brisbane St	**Tamworth**	**(067)66 1711**
263 Keira St	**Wollongong**	**(042)28 3800**
ACT		
96 Gladstone St	**Fyshwick**	**(062)80 4944**
VIC		
Creswick Rd & Webster St	**Ballarat**	**(053)31 5433**
145 McCrae St	**Bendigo**	**(054)43 0388**
Shop 46, Box Hill Central, Main St	**Box Hill**	**(03)890 0699**
Hawthorn Rd & Nepean Hwy	**East Brighton**	**(03)592 2366**
260 Sydney Rd	**Coburg**	**(03)383 4455**
1150 Mt Alexander Rd	**Essendon**	**(03)379 7444**
Nepean Hwy & Ross Smith Ave	**Frankston**	**(03)783 9144**
Shop 9 110, High St	**Geelong**	**(052)43 8522**
291-293 Elizabeth St	**Melbourne City**	**(03)67 9834**
Bridge Rd & The Boulevarde	**Richmond**	**(03)428 1614**
Shop 2, 141 Maroondah Hwy	**Ringwood**	**(03)879 5338**
Springvale & Dandenong Rds	**Springvale**	**(03)547 0522**
QLD		
157-159 Elizabeth St	**Brisbane City**	**(07)229 9377**
166 Logan Rd	**Buranda**	**(07)391 6233**
Gympie & Hamilton Rds	**Chermside**	**(07)359 6255**
Queen Elizabeth Dr & Bernard St	**Rockhampton**	**(079)27 9644**
2nd Level Western Entrance Redbank Shopping Plaza	**Redbank**	**(07)288 5599**
Gold Coast Hwy & Welch St	**Southport**	**(075)32 9863**
Bowen & Ruthven Sts	**Toowoomba**	**(076)38 4300**
Kings Rd & Woolcock St	**Townsville**	**(077)72 5722**
Cnr Pacific Hwy & Kingston Rd	**Underwood**	**(07)341 0844**
SA		
77 Grenfell St	**Adelaide**	**(08)232 1200**
Main South & Flagstaff Rds	**Darlington**	**(08)298 8977**
Main North Rd & Darlington St	**Enfield**	**(08)260 6088**
24 Park Terrace	**Salisbury**	**(08)281 1593**
WA		
Wharf St & Albany Hwy	**Cannington**	**(09)451 8666**
66 Adelaide St	**Fremantle**	**(09)335 9733**
William St & Robinson Ave	**North Perth**	**(09)328 6944**
Raine Square, 125 William St	**Perth City**	**(09)481 3261**
TAS		
Shop 40A, Lower Level Cat & Fiddle Arcade	**Hobart**	**(002)31 0800**
NT		
17 Stuart Hwy	**Stuart Park**	**(089)81 1977**

Visit our new Ringwood (Vic) store
— now open at:
Shop 2, 141 Maroondah Hwy,
Ph: 879 5338

Dear Customers,

Quite often, the products we advertise are so popular they run out within a few days, or unforseen 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.

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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 3d

January 1937

Missing products: there are plenty of good receivers and plenty of cheap recievers. There are receivers which have fine console cabinets, there are midgets with cabinets of wood, metal and moulded bakelite. There are sets with dials as wide as the cabinet can accommodate, but there is still room for two more types of receivers.

We need a receiver which we can recommend to the music lover as giving the best possible tonal quality from the local stations, yet selling at a reasonable price. The second type of receiver which we suggest is a large complicated and delicately tuned receiver , designed to sell to those short-wave and DX enthusiasts who are keen enough to spend their last shilling in order to get something really out of the ordinary.

Boom in litigation: (from our American correspondent) the radio industry has kept many patent lawyers and expert witnesses happy during its brief history. Recently two manufacturers went to bat in court, one charging patent infringement, the other charging restraint of trade. Both won, both lost to some extent. Probably money to the extent of 100,000 dollars has been taken out of the radio industry and put in the pockets of non-producers.

Electric clock: for the country resident, who has no AC power available, a battery-operated electric clock has now been introduced to the market. The clocks are of English manufacture, but are fitted with a 4-jewel Swiss movement.

RADIO. TELEVISION and HOBBIES

January 1962

Modern Slaves: automatic production and, in its ultimate form, "automation", are subjects very much in the news these days. They present social, economic and technical problems which are a unique challenge to man's ingenuity. If all these can be solved, we may well be on the threshold of a new era; an era of plentiful, high quality, low cost production which will raise our standard of living by a very marked degree.

Minutemen missiles: the United States' Minuteman, a solid-fuelled three stage intercontinental ballistic missile is currently one of that country's top projects in defence planning. One of the companies contributing research and production for it is the Allison Division of the General Motors Corporation. They are currently engaged in developing plastic rocket cases to replace the older steel variety.

Colour TV: the B.B.C.'s demonstration of colour television was a big attraction at Britain's National Radio Show late last year. Continuous closed circuit transmissions presented "live" colour television from a specially constructed glass walled studio.

Metal Film Resistors: greater flexibility in designing miniaturised electronic equipment and printed circuitry is claimed to be possible following the development of easy-to-apply, fired-on resistor compositions with varied resistance values.

The compositions are specially treated metal powders and glass particles dispersed in suitable organic solvent. They can be applied on glass or ceramic bases by the usual dipping, brushing, spraying or screen printing techniques.

Part 1: the nature of light and colour

Understanding colour television

This is the first in a series of eight articles dealing with the principles of colour television, with particular emphasis on the PAL system. Here, we examine the nature of light and colour.

by DAVID BOTTO

In order to grasp the principles of colour television we first need an understanding of light and colour. We'll define light as the natural medium by which objects are made visible to our eyes; i.e, that section of the electromagnetic spectrum to which our eyes respond.

Much remains to be discovered concerning the nature of light, but it is generally accepted that light consists of electromagnetic waves which travel in straight lines and can be measured in terms of wavelength. This wave theory explains why light bends when passed through water or glass, the operation of lenses, and why solid objects cast sharply defined shadows. However, it does not explain why light striking a metal plate causes the plate to emit a shower of electrons.

Further, the wave theory cannot explain the action of light in the case of solid-state optoelectronic devices. Here, light behaves as if it consists of particles which can be absorbed into semiconductor materials. So light seems to travel as waves, yet appears to consist of tiny particles!

The present understanding, known as the quantum theory, is that light travels in waves consisting of a number of tiny particles or packets of energy called photons. In a vacuum the velocity of all electromagnetic waves, including light, is 3×10^8 metres per second.

The electromagnetic spectrum covers a range from the cosmic, gamma and x-rays, through ultra-violet rays and the narrow band of visible light frequencies, down to the lower frequencies of infrared waves, television and radio waves (Fig.1). White light can be split into a spectrum of colours by passing it through a glass prism (Fig.2). The wavelengths of the various colours, measured in nanometres (10^{-9} metres), are approximately 630 to 760 for red, 590 to 630 for orange, 590 to 565 for yellow, 490 to 565 for green, 450 to 490 to blue, and 380 to 450 for purple and violet.

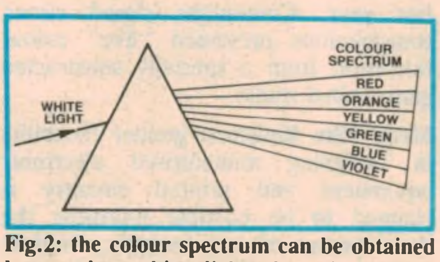


Fig.2: the colour spectrum can be obtained by passing white light through a glass prism.

How our eyes see light and colour

Because a colour television picture is produced by mixing several colours in order to reproduce as accurately as possible the colours of the transmitted scene, it's helpful to know how our eyes see light and colour.

When we view a scene, the curbed surfaces of the cornea, eye fluids, and lens of the eye focus the image onto the retina, a light sensitive layer of cells at the back of the eye. This image is fed to the brain by the optic nerve which consists of about 800,000 nerve fibres.

The retina contains two kinds of light sensitive cells. These are named 'rods' and 'cones', according to their shape. The rods, which number approximately

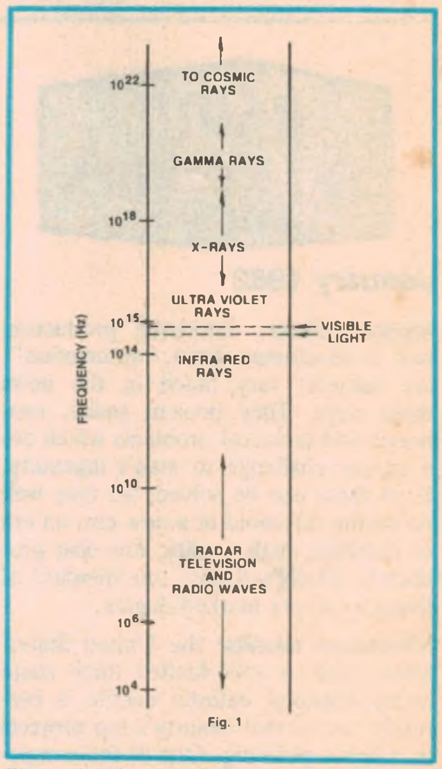


Fig.1: the electromagnetic spectrum.

twelve million, are very sensitive and are able to detect small amounts of light and very fine detail.

The cones, which respond particularly to colour, consist of three groups, each group having peak sensitivity to a different colour.

Thus some cone-cells have a peak response to yellow light, some to red light, and others to green light. The cone-cells total about seven million. When the right balance of colours are detected by the three types of cone-cells, the optic nerve sends the sensation of white to the brain.

The rod-cells seem to be mainly concerned with monochrome vision and vision in low light intensities. Our understanding of both rod and cone cells remains incomplete for the present.

Although various colours possessing the same radiant energy may be present, the response of our eyes is not the same for all colours. Fig.3 shows the response curve of what is known as the "standard" human eye possessing normal sight. Notice that green and yellow colours appear brighter to the eye than do red or violet shades.

When our eyes view a relatively large area in normal light, we easily distinguish between colours. However, as the size of the area decreases, the eye finds it harder to distinguish one colour from another. Blue and green become confused, and difficult to distinguish from grey. Blue and yellow appear grey. Reds remain fairly distinct, but tend to merge with greys as the colour area becomes smaller.

When the area is very small all our eyes can distinguish are changes in brightness; colour cannot be seen at all.

Colour television systems utilize these properties of our eyes by transmitting the detail of the picture in high-definition monochrome, and the colour information at a relatively low definition. A rough comparison is that of a child's painting book where the picture is drawn in black and white, and the colour painted in the blank areas.

Sending the fine detail in monochrome has the further advantage that the colour transmission can be received in black and white on a monochrome receiver.

Why objects appear the colour they do

An object takes its colour from the colour of the light it reflects. When, in white light, an object appears green to us, it is because all other wavelengths of light are absorbed, and only green light is reflected.

Similarly, a red object appears red because only red light is reflected, and the rest of the light absorbed.

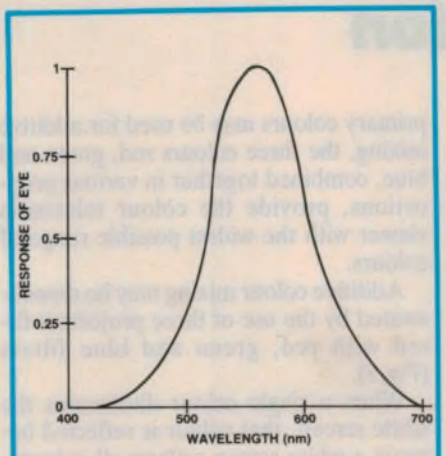


Fig.3: response curve of the eye to various colours.

If in a darkened room we shine a red light onto a green object, the object will appear to be black, because there is no green light available for the object to reflect. Similarly, if the object is red, with only green light illuminating it, it will also appear to be black, as again there is no green light to be reflected.

A dull black object is black in any lighting conditions because it reflects virtually no light of any colour.

However, an unpolished pure white object reflects every colour and seems to the eye to be the colour of the light illuminating it. Thus, if bathed in pure green light it will appear as a green object, while in pure red light it will appear as a red object. Hold your copy of Electronics Australia in a coloured light in a darkened room, and the white page appears that colour, but the black print remains black.

Some basic terms used in colour television are hue, saturation, brightness and chromaticity.

Hue is the colour of the light as it appears to our eyes — the wavelength of the light. ***Saturation*** is the measure of how deep the colour is — the deeper the saturation the less the amount of white light mixed with it. Thus deep red is highly saturated, but we say pink is less saturated because white light is mixed with the red colour.

Brightness is a term describing the intensity, or amount of light energy of a colour. ***Chromaticity*** is the quality of colour and is dependent on both hue and saturation, but not on its brightness. Achromatic light is light without colour ranging from white, through grey to black.

Colour mixing

Colour mixing, using three properly selected primary colours to obtain a wide range of colours, may be subtractive or additive.

Primary colours are those which mix together to produce a wide range of colours, but no two of these colours will combine to yield the third colour.

Subtractive colour mixing uses the principle of mixing primary colours in such a way as to absorb some colours, leaving only the required colours. This method of colour mixing is generally employed in modern colour photography systems.

If we subtract red light from white light we obtain the colour known as cyan. Subtract blue light from white light and the result is yellow. Removing green light from white light leaves magenta. These three colours — cyan, yellow and magenta — together form three primary colours.

Fig.4 demonstrates the use of three coloured filters placed in front of a white light.

The cyan filter absorbs all red light from the white light source, the yellow filter the blue light, and the magenta filter the green light. This subtractive action results in the colour sensations of cyan, yellow and magenta. Thus a colour filter allows only the colour light of its name to pass through it.

If we overlap the magenta and cyan

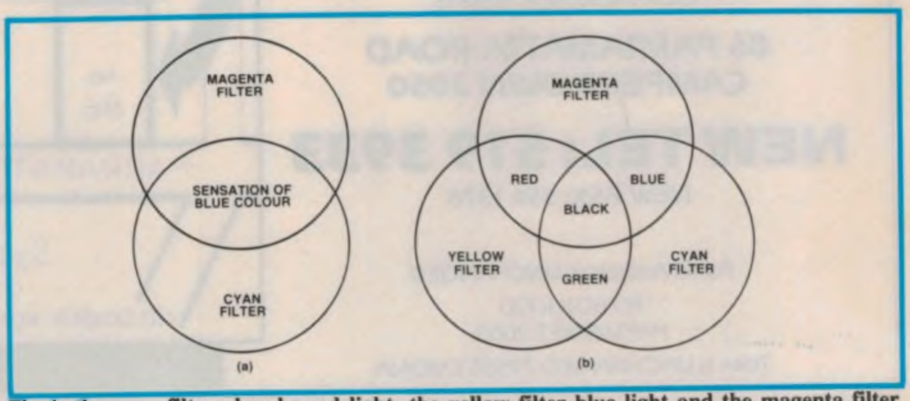


Fig.4: the cyan filter absorbs red light, the yellow filter blue light and the magenta filter green light.

Colour television

filters (Fig.4a), the magenta filter removes the green light and the cyan filter the red light, so that our eyes see a blue colour.

Overlap all three filters as in Fig.4b and the overlapping magenta and yellow filters remove green and blue light, leaving only red light. Similarly, the overlapping cyan and yellow filters stop the red and the blue light so that our eyes see a green colour.

Where all three filters overlap, no light at all passes and our eyes register a black colour.

The primary colours used in subtractive colour mixing are known as complementary colours because, as we have seen, to produce the primary colour another colour known as an additive primary was removed from white light to produce it. So the additive primaries of cyan, yellow and magenta are red, blue and green in that order.

Additive colour mixing

Colour television makes use of additive colour mixing. Although any three primary colours may be used for additive mixing, the three colours red, green and blue, combined together in various proportions, provide the colour television viewer with the widest possible range of colours.

Additive colour mixing may be demonstrated by the use of three projectors fitted with red, green and blue filters (Fig.5).

When a single colour illuminates the white screen, that colour is reflected because a white screen reflects all colours.

When both red and green light are projected on to the screen we see a yellow colour. This is because the cone-cells of our eyes are stimulated in the right proportions to produce a yellow sensation, even though no pure yellow spectrum light is present. Project green and blue and our eyes register a cyan colour. Red and blue projected together will appear magenta.

If we now project all three colours, red, green and blue, at the correct intensities (by adjusting the brightness control of each projector), the result will appear as white.

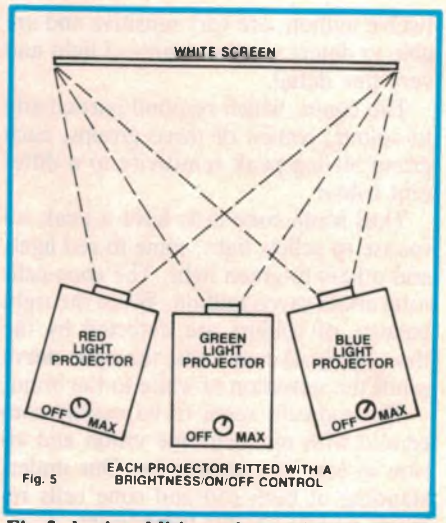


Fig.5: basic additive colour mixing scheme.

Note that the six colours produced match those generated by the standard colour bar generator used for television servicing.

By using the three brightness controls to produce red, green and blue light at various levels of intensity, a large range of colour sensations may be obtained. The proportions of the three primary colours used to form a wanted colour are known as ***Tristimulous*** values.

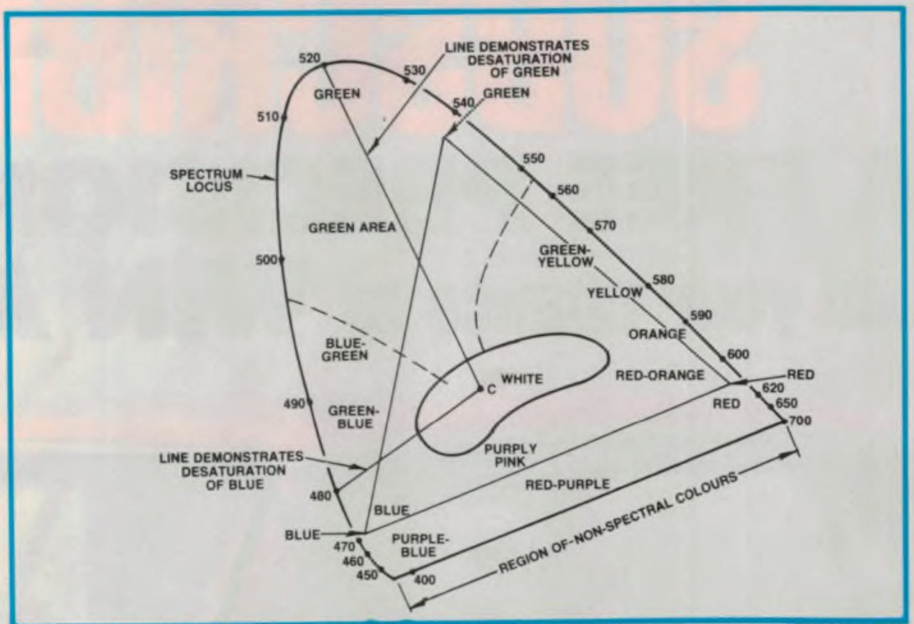


Fig.6: the horseshoe-shaped chromaticity diagram. The figures around the perimeter show the wavelengths of different hues of colours in nanometres.

The colour picture reproduced by a television picture tube makes use of red, green and blue light-emitting phosphers. These produce a wider range of colours than a photographic colour print using subtractive colour mixing. However, the colour photograph is able to reproduce heavily saturated blues and greens outside the range of colour television.

Fig.6 shows the well-known horseshoe shaped chromaticity diagram. Around the perimeter are figures that show the wavelengths of different basic hues of colours in nanometres. At the centre is a point labelled white. Sunlight at midday, daylight or light seen through a skylight all are white light, but with different energy levels over the entire colour spectrum of 400 to 700 nanometres.

Since there is no "standard" white, various "reference whites" are used, such as equal energy white light, Illuminant A, Illuminant B and Illuminant C. The Australian standard is based on a warmer reference white known as Illuminant D 6500. This contains less blue and slightly more green light than the white of Illuminant C.

If we draw a line from the point numbered 520 at the perimeter of the chromaticity diagram to the point marked "white", then at the edge of the diagram we have spectrum green at a wavelength of 520 nanometres.

As we move down the line towards the centre, more and more white light is added to the green, until at point C only white light remains. Thus the spectrum green has been gradually diluted to produce graduations of colour from green to white. The midpoint of the line represents spectrum green saturated 50% with white light.

Similarly, a line drawn from the point numbered 480 to point C begins at spectrum blue and is increasingly saturated with white light. The blue thus becomes paler in colour until only white light remains.

If you draw a straight line between any two points on the numbered perimeter of the chromaticity diagram you will see the various colours that can be produced by combining two colours additively in various amounts.

The perimeter line at the bottom of the diagram is known as the region of non-spectral colours, because no pure colours are present here. In this area all colours are formed from different mixtures of red and blue.

The triangle within the diagram — called an RGB triangle — shows the range of colours that can be displayed by the colour television receiver using three colours. These are red at a wavelength of about 610 nanometres, blue at 470 nanometres and green at about 540 nanometres.

Colours outside the RGB triangle cannot be displayed, a fact that might appear to limit the reproduction of the colour picture. However, the more saturated colours outside the RGB triangle are not essential to good colour reproduction.

Since red, green and blue light in the right proportions stimulate the eyes to see white, the correct balance of the three colours can be used to transmit the monochrome or brightness detail of the television picture. This is called the "Y" or luminance signal. The "Y" signal can be received by a monochrome receiver to provide a normal monochrome picture.

Because the eye is most sensitive to green, and more sensitive to red than to blue, the best balance of the three primary colours to form the "Y" signal is 59% green plus 33% red plus 11% blue. This is better expressed as

$$EY = 0.59\ EG + 0.33\ ER + 0.11\ EB$$

where E represents the relative voltages of the different signals, and G, R and B the colours.

It might at first appear that to obtain a colour picture we need to transmit the EY signal, to form the high definition detail of the picture, and three colour signals carrying respectively red, green, and blue colour information, in order to reproduce the colours of the transmitted scene. To do this would require excessive and unacceptable bandwidth in the transmitted television signal, and would result in unnecessary complexity of the colour television receiver, increasing the cost considerably.

Our study of additive colour mixing shows that it is not necessary to transmit three colour signals because all the colour information is contained in the "Y" signal. So all we need to transmit is the "Y" signal and two of the three colour signals, recovering the third by subtracting the two colour signals transmitted from the "Y" signal.

We could use any two of the three primary colour signals, and recover the third. The colour signals chosen are red and blue, sent in a form known as colour difference signals.

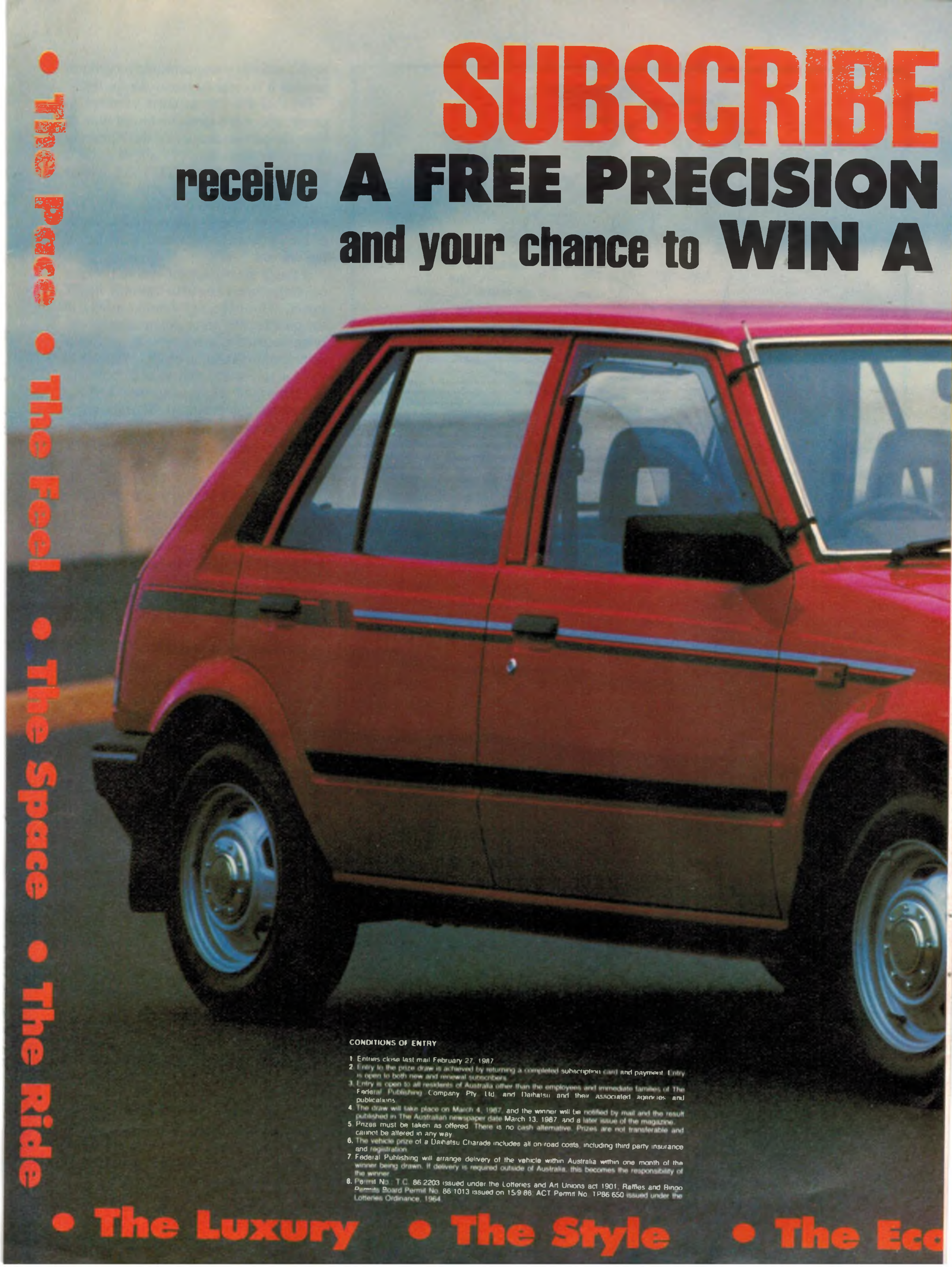
Green is not used to produce one of the two required colour difference signals because the maximum voltage of a green colour difference signal would be less than that of a red or blue colour difference signal, and would be more liable to distortion in transmission.

These colour difference signals are formed by inverting the "Y" signal (by means of an amplifier) to produce a "-Y" signal. By adding this "-Y" signal to the red signal (R), the red colour difference signal ER-EY is obtained, (usually referred to as the R-Y signal).

Similarly, by adding the "-Y" signal to the blue (B) signal, the B-Y colour difference signal is formed.

We now have the "Y" signal, plus the R-Y and B-Y colour difference signals, and from these we can recover the G-Y signal. How this is done will be discussed in a later article.

In part two of this series we'll consider the requirements of a modern colour television system and take a brief look at early systems. In addition we'll describe the PAL system and its advantages.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Building our new **Pt.2**

Low distortion audio oscillator

Building the Low Distortion Audio Oscillator involves installing the parts on a printed circuit board, wiring the board to the case hardware and making a few adjustments for optimum performance.

by JOHN CLARKE

The printed circuit board (PCB) for the oscillator measures 169 x 143mm and is coded 86ao11. It has been specially designed to fit into two plastic instrument cases supplied by Altronics. These measure 200mm wide by 70mm high by 160mm deep (Altronics Cat. H-0480/1) and 260mm wide by 80mm high by 190mm deep (Altronics Cat. H-0482/3).

Note that while the board can certainly fit into a variety of plastic and metal cases from other suppliers, the mounting holes have been positioned to match the integral mounting pillars in the Altronics cases.

As noted last month, the new oscillator can be built in two versions: with or without output level metering. This is why the PCB was made adaptable to two different cases. If the non-metered version is built, the saving should be about $25 or so. We think that most constructors will decide to go the whole hog and build the complete version in the larger case.

We have designed front panel artwork to suit both the Altronics instrument cases although again, it would be possible to adapt these labels to cases from other suppliers.

Note that regardless of which instrument case is used, it must have metal front and rear panels. These are necessary both to earth all the panel hardware and to provide a degree of shielding.

PCB assembly

You can start construction by assembling the PCB. To do this, you should refer to the printed circuit board overlay which is incorporated in the wiring diagram for the metered version of the oscillator. If you intend building the unmetered version, you should omit the components shown within the dotted lines on this diagram (adjacent to the power transformer).

Begin by inserting the PC stakes for all external wiring with the exception of the mains wiring connections. Now the links, resistors, diodes and ICs can be installed. Note that the 4049B integrated circuit, IC10, is oriented differently to the remainder of the ICs.

When soldering the ICs take care not to short the pins with excess solder. In particular, this may easily happen on IC11 and IC12 where tracks pass between the IC pins.

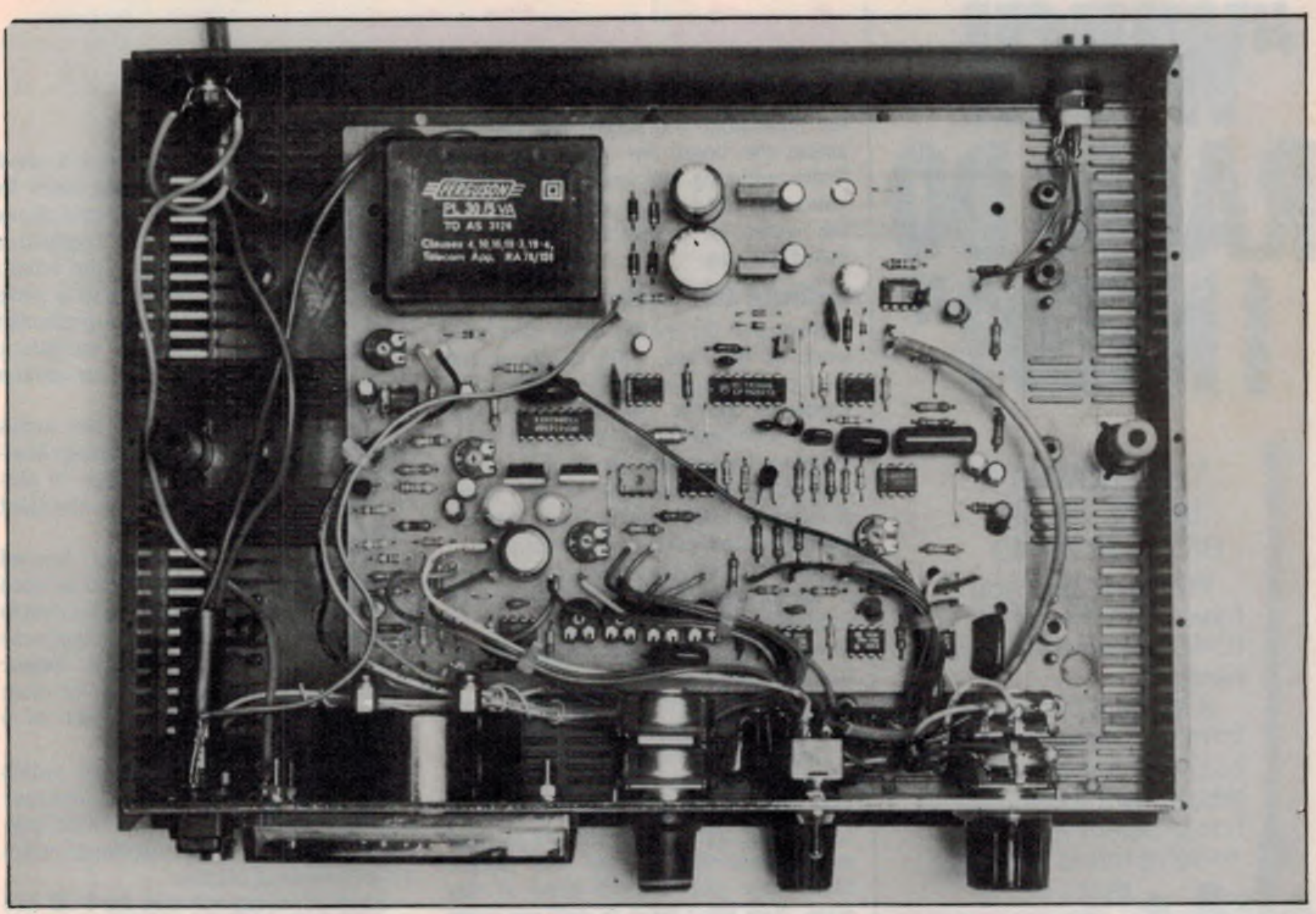
Next the capacitors, trimpots, transistors and regulators can be inserted and soldered in place. Electrolytic capacitors are polarised and need to be oriented correctly. The plus sign is indicated on the overlay diagram. Note that the centre lead for FET Q1 must be bent outwards by a few millimetres in order to fit the PCB.

The transformer is installed on the PCB and secured using 4BA nuts screwed on the integral plastic locating pillars. Alternatively, the plastic pillars can be melted over on the underside of the PCB using a hot piece of metal as a former. Do not rely on the transformer electrical pins to hold the transformer in position since they can pull out.

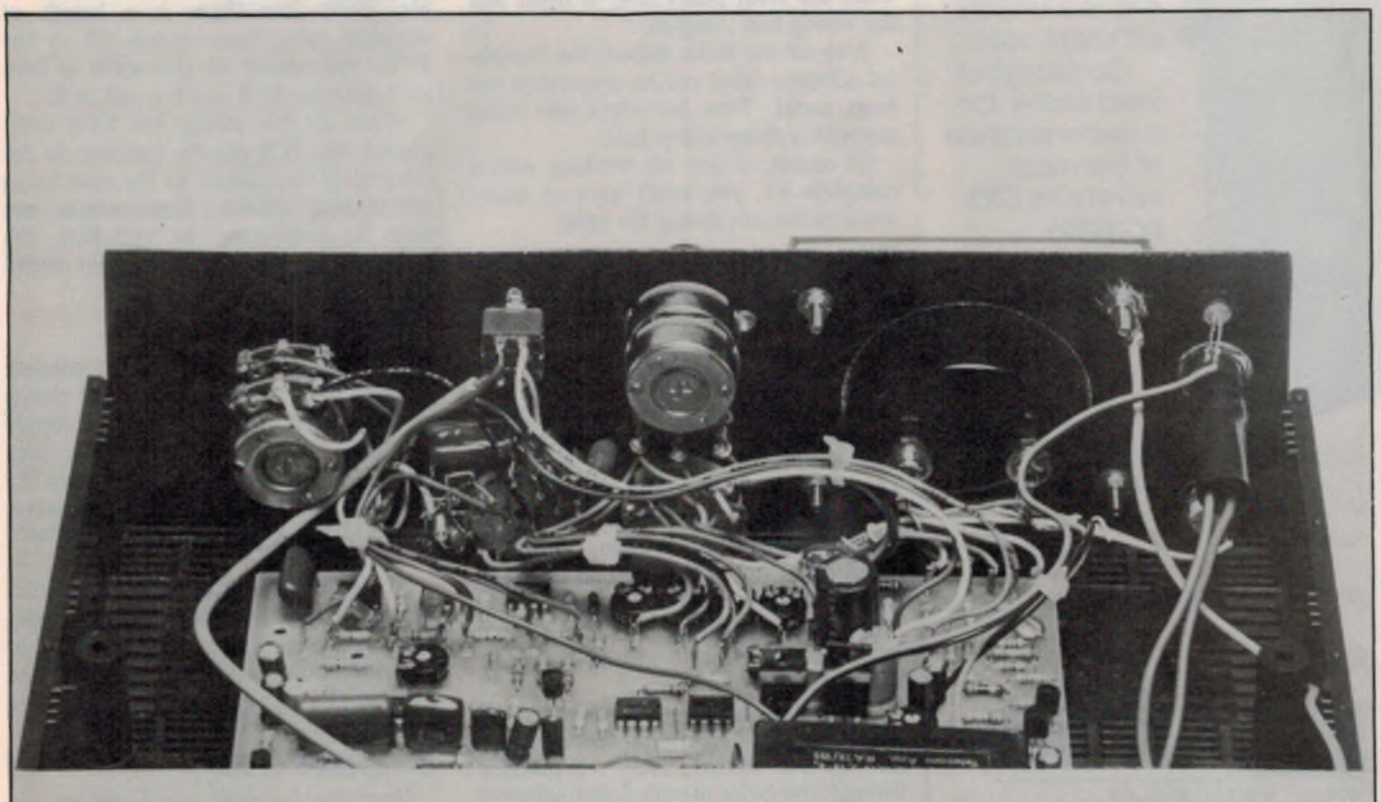
Incidentally, don't use your soldering iron to melt over the plastic locating pillars of the transformer. It makes a terrible mess of both the transformer and the soldering iron tip and is very hard to clean off. For that reason, we prefer our suggestion of using two 4BA nuts to secure the transformer.

Once all the components are soldered in place and their pigtails clipped from

The Altronics instrument case is ideal for the audio oscillator.



Here is an inside view of the completed project (metered version). Take care with the mains wiring.



This view shows the front panel wiring for the metered version. Note sleeving on mains switch.

Audio oscillator

the underside, you should carefully examine the board for wiring mistakes, faulty soldering and so on. It is important to do this job now rather than have the worry of a possible fault on the board later on.

Drilling the case

Now put the board aside and start work on the case. Both the front and rear panels require drilling before the hardware can be installed. The front panel Scotchcal label can be used as a template to position most of the controls with the exception of the meter (for the metered version only), but do not secure the label to the panel yet.

Supplied with the meter movement is a cardboard drilling template which should be used when working on the front panel. The large circular cutout for the meter body can be made by drilling many small holes around the circumference and filing out the hole.

Drill out the holes for all the potentiometers, switches, LED and output socket on the front panel and for the cord clamp grommet, sync socket and earth connection on the rear panel. Make sure you drill all holes at this stage. You don't want to drill any holes when the front panel label is fitted and the wiring half complete.

With all the holes drilled, the Scotchcal adhesive label can be secured to the front panel. Trim the edges and holes out with a sharp utility knife.

Of course, if you are working with a complete kit, you won't have to worry about drilling or fitting the label.

Wiring

The mains cord must be securely clamped with the cord clamp grommet so that it cannot be pulled out from the rear panel. The earth lead is soldered to the earth lug which is secured to the rear panel with a screw and nut. A further earth lead runs from this rear panel earth lug to an earth lug on the front panel.

For the metered version, the front panel earth lug is bolted to one of the screws securing the meter, while in the unmetered version the earth lug is secured by the nut used to fasten the output socket.

The active and neutral mains leads are terminated directly on the PCB (do not use PC stakes). They are inserted through the holes provided and soldered so that no bare wire is exposed on the top of the PCB.

In the interests of safety, it is a good idea to make up an insulating cover to prevent any possibility of electric shock (or shorts) from the main conductors running on the underside of the board. The cover could be made from a piece of insulating material such as presspahn or elephantide or you could use plastic from an icecream container or similar source.

In addition, the wires to the mains switch should be insulated using heatshrink tubing or insulation tape to prevent accidental contact and resultant shock.

Switch S1 has capacitors located around the body with one lead of each capacitor soldered to consecutive switch wipers. Note that the 390pF polystyrene capacitors each have a 68 ohm resistor in series. The remaining leads of these capacitors are soldered together as a common connection.

Note that the frequency range switch S1a should have make-before-break contacts. This is necessary to avoid possible latch-up of the oscillator when range-switching occurs.

Keep all wiring between the PCB and the switches and pots as short as possible. Note that there is a length of shielded cable from switch S2 to the PCB. The shield of this cable is connected at the PCB end but not at S2.

When all the wiring has been completed, the PCB can be fastened to the integral plastic pillars in the case using self-tapping screws. Construction can now be completed by installing the switch and pot knobs, but don't install the lid at this stage.

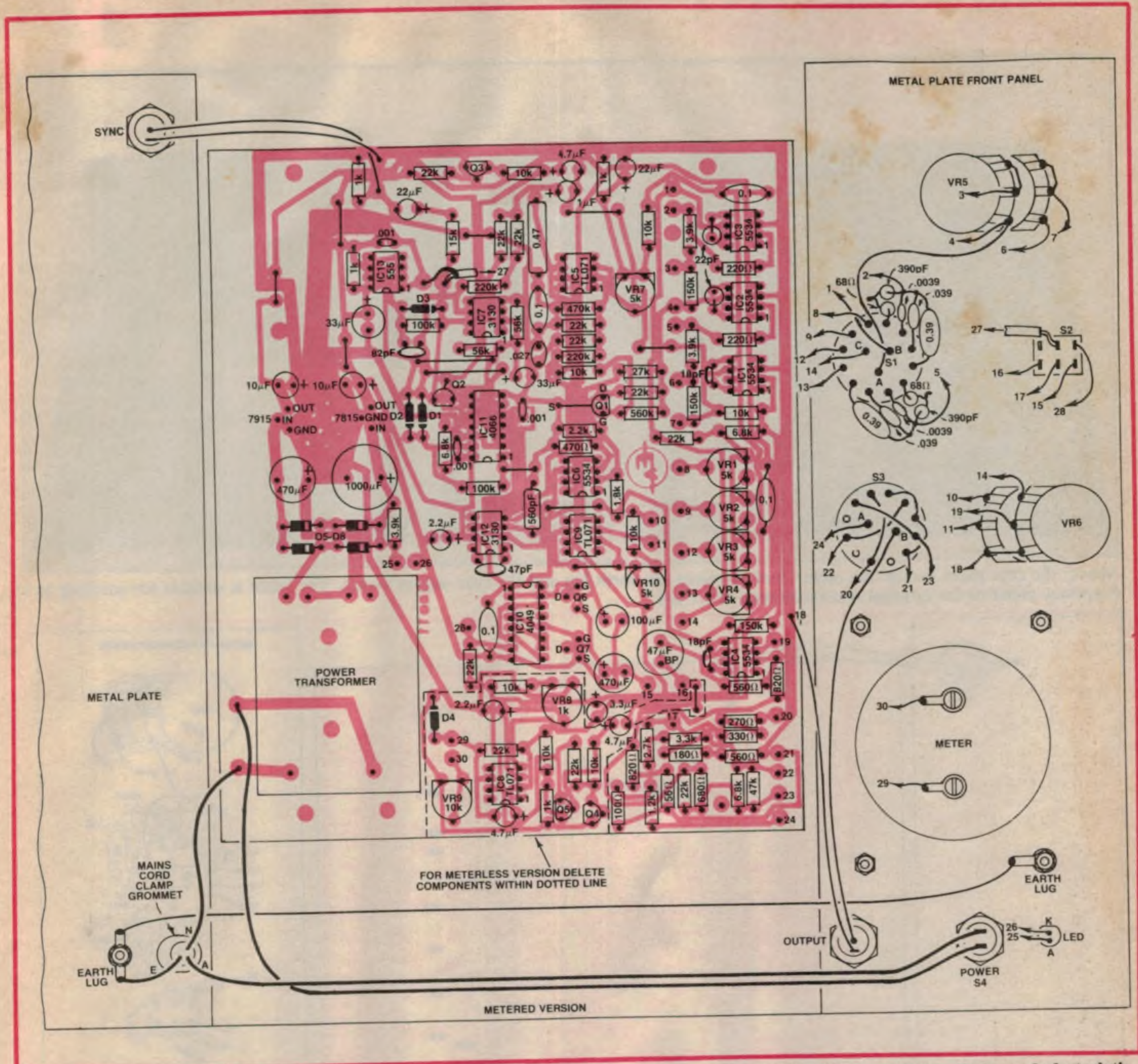
Testing

To test the oscillator, firstly connect the unit to the mains supply and switch on. Immediately check that the supply rails are correct. You should have close to +15V and –15V at the outputs of the 7815 and 7915 regulators respectively. These voltages should also be present on the supply pins to the ICs.

If the voltages are incorrect, switch off and locate the fault before proceeding further. The lack of any voltage at all could mean a shorted track on the PCB or a complete open circuit along one of the supply line tracks.

Sinewave level

Once the supplies are confirmed as correct, you can check and set the out-



This parts layout and wiring diagram is for the metered version. Make sure that you install the ICs, transistors, diodes and electrolytic capacitors correctly. The components within the dotted line are deleted for the unmetered version.

put sinewave signal. Make sure that the attenuator is set to 0dB and the fine level control is set fully clockwise. Measurement can be made with an oscilloscope or multimeter set to a low AC voltage range. With the sine/square switch set for sinewave mode, adjust VR7 for a 3V RMS reading.

Note that many digital multimeters have a very poor response above a few hundred Hertz. Check the specifications of your multimeter and make the level measurement below this frequency figure. If you don't have the specifications of your meter, set the oscillator to 100Hz, just to be on the safe side.

If you use an oscilloscope to set the sinewave output level, adjust VR7 to give a displayed waveform with a peak-to-peak amplitude of 8.5 volts. (The exact peak-to-peak value is 8.484 volts but 8.5 is as close as you can reasonably judge on an oscilloscope screen).

Meter setting

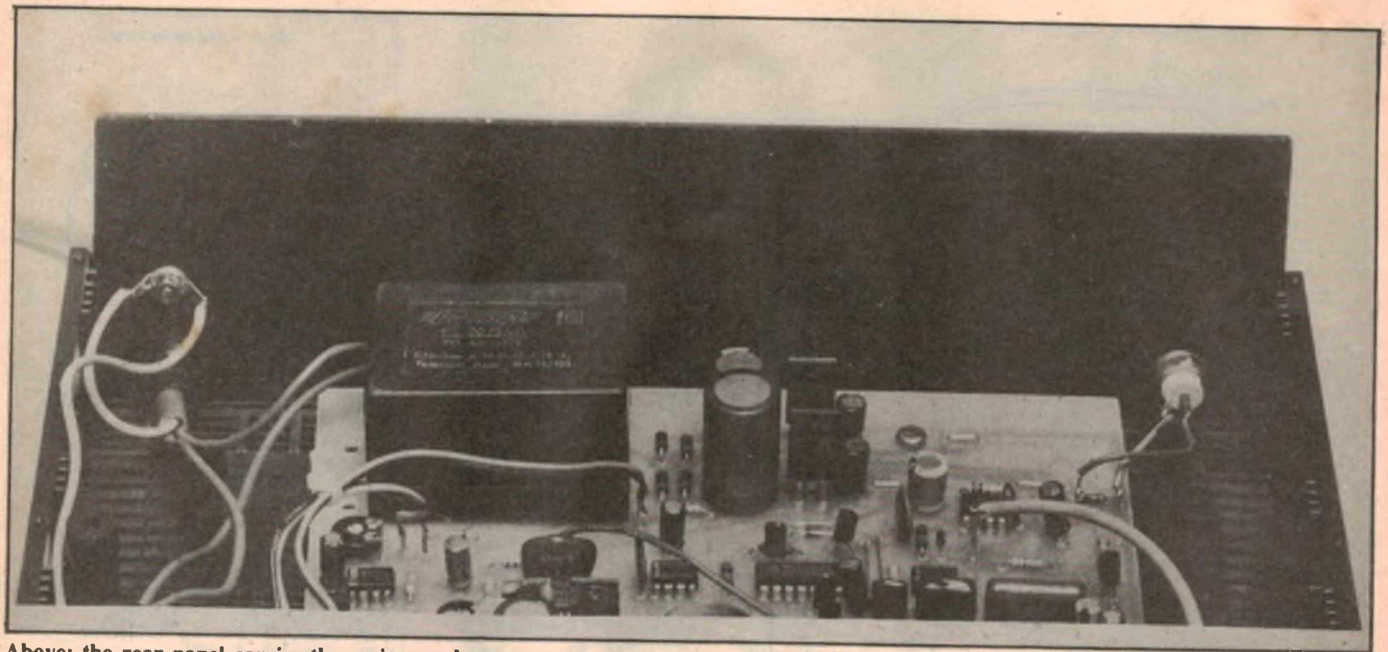
For the metered version, turn the fine attenuator control fully anticlockwise and adjust VR8 so that the meter reads zero. Now turn the attenuator fully clockwise and set the meter using VR9 to read 3V for the 0dB setting on the attenuator.

Square wave level

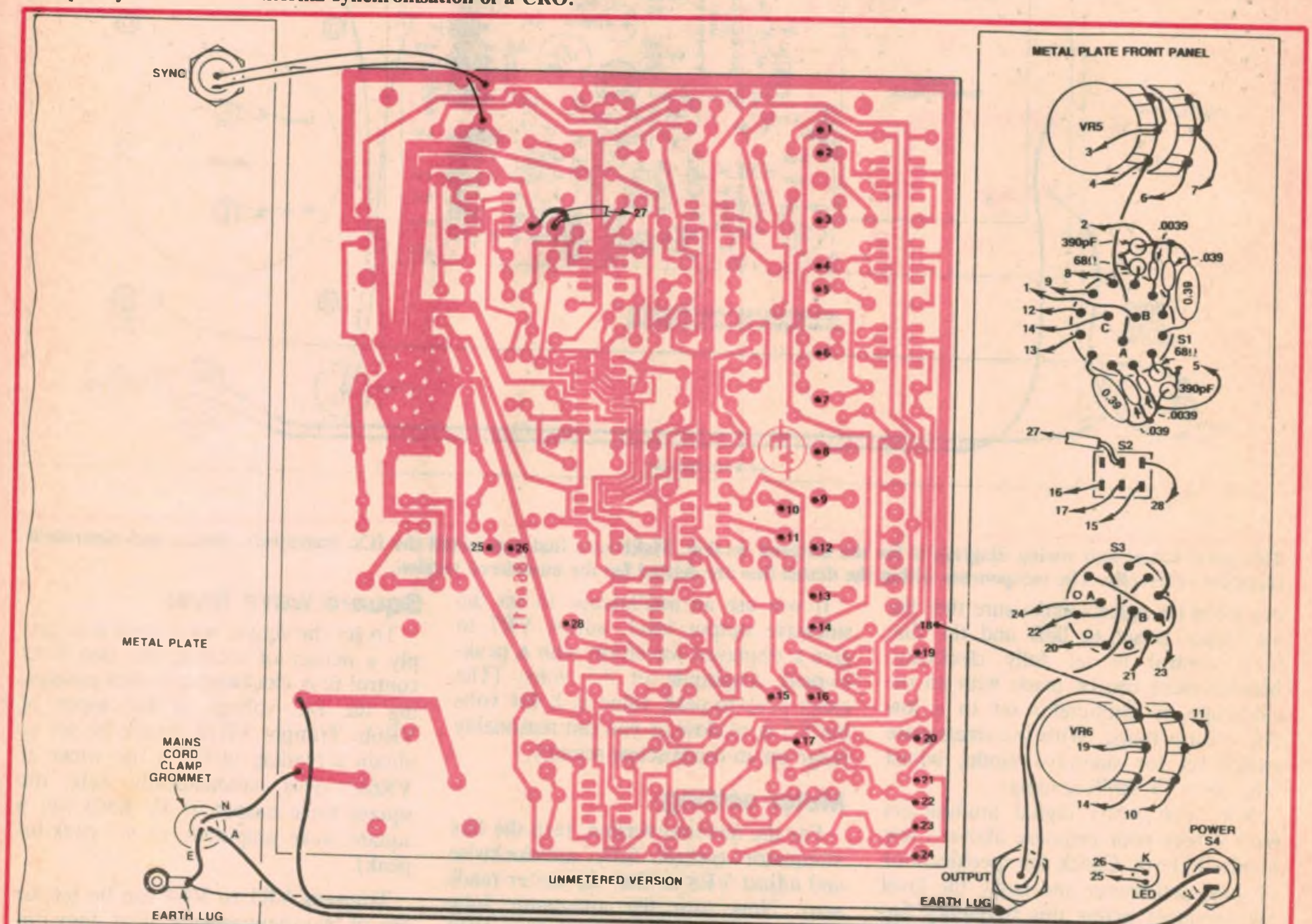
To set the square wave level it is simply a matter of rotating the fine level control fully clockwise and then measuring the DC voltage at the wiper of VR6b. Trimpot VR10 should be set to obtain a reading of 6V at the wiper of VR6b. This automatically sets the square wave output to 3V RMS (ie, a square wave amplitude of 6V peak-to-peak).

Trimpots VR1 to VR4 can be set for one of two requirements. First, they can be set so that there is equal output level for each frequency range. Alternatively,

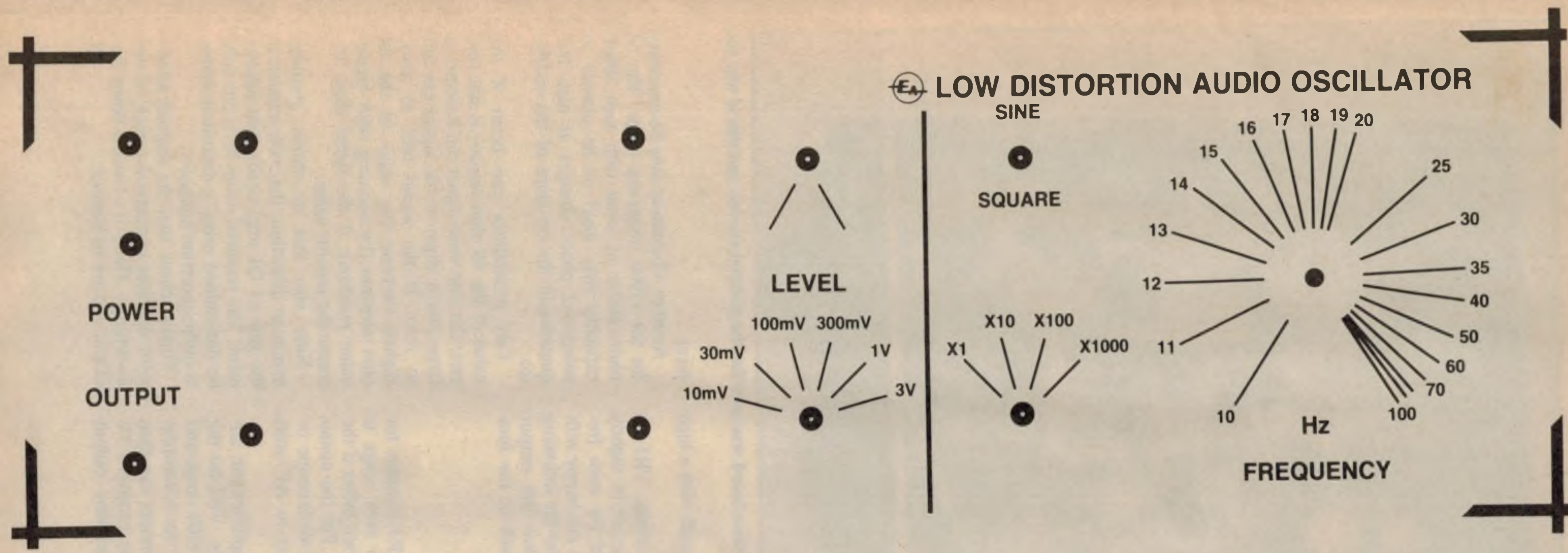
Audio oscillator



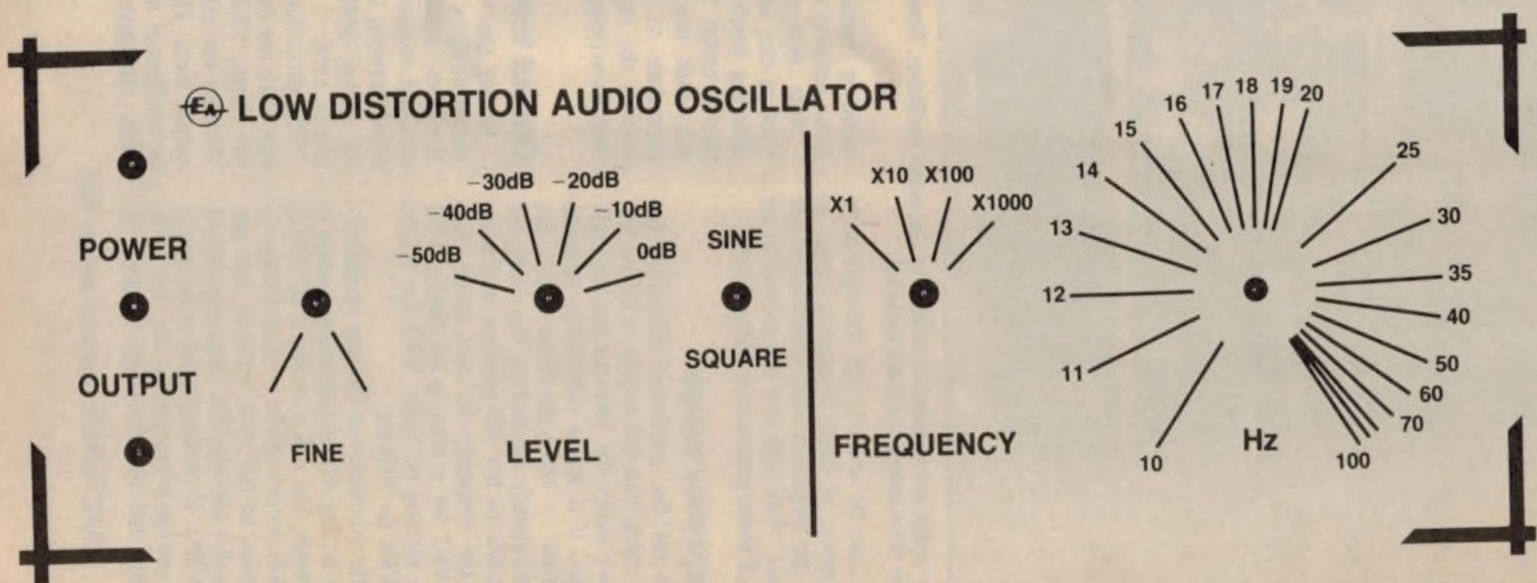
Above: the rear panel carries the mains cord grommet, an earth lug and the sync output socket. The latter is suitable for coupling to a frequency meter or for external synchronisation of a CRO.



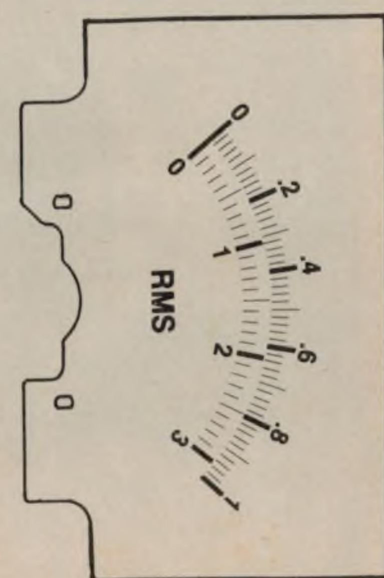
This wiring diagram is for the unmetered version. The parts layout for the PCB is the same as for the metered version but do not install the parts within the dotted line.



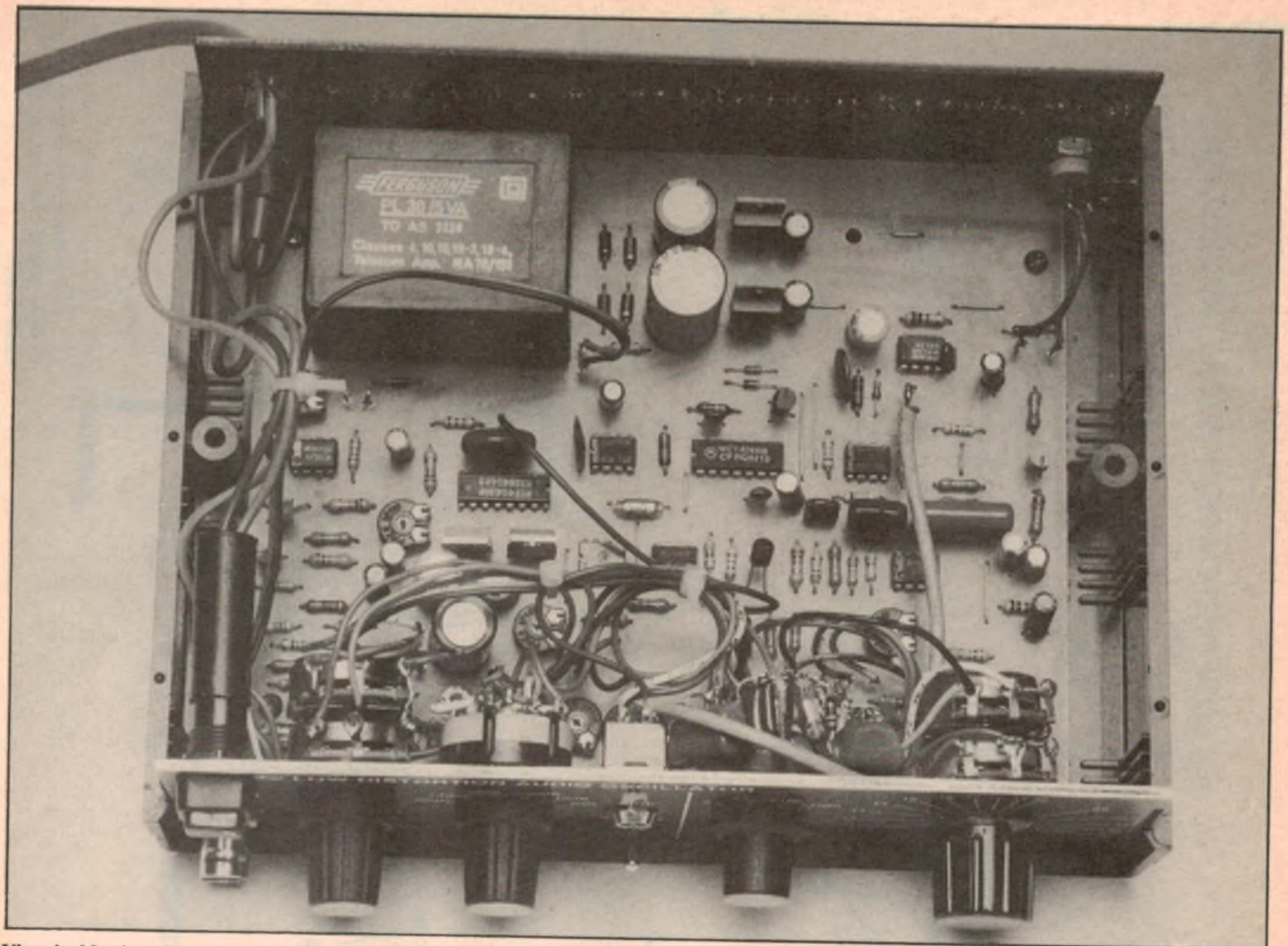
Above: actual size front panel artwork for the metered version of the audio oscillator.



This actual size front panel artwork is for the un-metered version.



Above: actual size artwork for the meter scale.



View inside the unmetered version of the audio oscillator. Note that the same board was used for the metered version and this is why the meter drive components are included.

they can be used to set the maximum frequency of each frequency range so that the frequency scale calibrations are correct. Note that you can choose to set one of these parameters but not both.

Frequency range

To set the maximum frequency for each range you will require a digital frequency meter (or you can use an oscilloscope if it has a reasonably accurate timebase — most do these days.) Set the frequency control of the oscillator clockwise to the 100 position and measure the frequency for each range. Adjust VR1 for a reading of 100Hz, VR2 for a reading of 1kHz, VR3 for 10kHz and VR4 for 100kHz.

If the frequency at the low (anticlockwise) setting of the frequency control is inaccurate (ie, not a multiple of 10Hz) you will need to make a small change to the value of the 150k resistors that are in parallel with the 50k frequency adjust pot (VR5). If the frequency at the minimum setting is marginally low, the 150k resistors can be effectively reduced in value by shunting them each with a high value resistor, say 2.2M.

Note that setting trimpots VR1 to VR4 in this way may result in slightly differing levels of signal for each frequency range. If you are not happy with this result, you may prefer the following procedure to ensure that the output level is the same for each of the four frequency ranges.

Output level

Setting the VR1 to VR4 trimpots for constant signal level on each range is best done using the internal meter if the metered version is built. For the unmetered version, either an oscilloscope or an analog multimeter set to AC volts can be used.

The procedure is straightforward: adjust VR1 for the x1 range, VR2 for the x10 range, VR3 for the x100 range and VR4 for the x1000 range for a constant output level. The VR7 trimpot can then be readjusted if necessary to give a 3V RMS sinewave at maximum output level.

Another adjustment may be necessary for the x1000 frequency range. The 68 ohm resistor in series with each 390pF capacitor may need to be altered to counteract phase changes at high frequencies in the op amps of the oscillator.

Two possibilities can occur if the value of the 68 ohm resistor is not correct: the sine wave signal can become so large that it clips; or the signal can fall to zero. If the signal falls to zero, slightly decrease the value of the 68 ohm resistors (by shunting with higher value resistors); if the signal clips, increase the resistor value.

Note also that to obtain absolute minimum distortion, the 560k resistor at the gate of Q1 may need slight adjustment. The required value here can only be determined using a distortion meter or audio spectrum analyser.

Finally, check that the stepped attenuator operates correctly for each of the six settings. That's it — screw down the lid and you are in business.

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An introduction to hifi, Pt.10.

Compact disc players — 1

Background; compact discs in close-up

Undoubtedly, the most notable feature of the home hifi scene in recent times has been the speed with which digitally based compact discs have taken over from the century-old "black" analog variety. In this the following chapter we take a closer look at compact discs and compact disc (CD) players.

by NEVILLE WILLIAMS

The distinction between analog and digital technology was explained in the two preceding chapters, along with reasons for the very evident swing to digital audio equipment during the past decade.

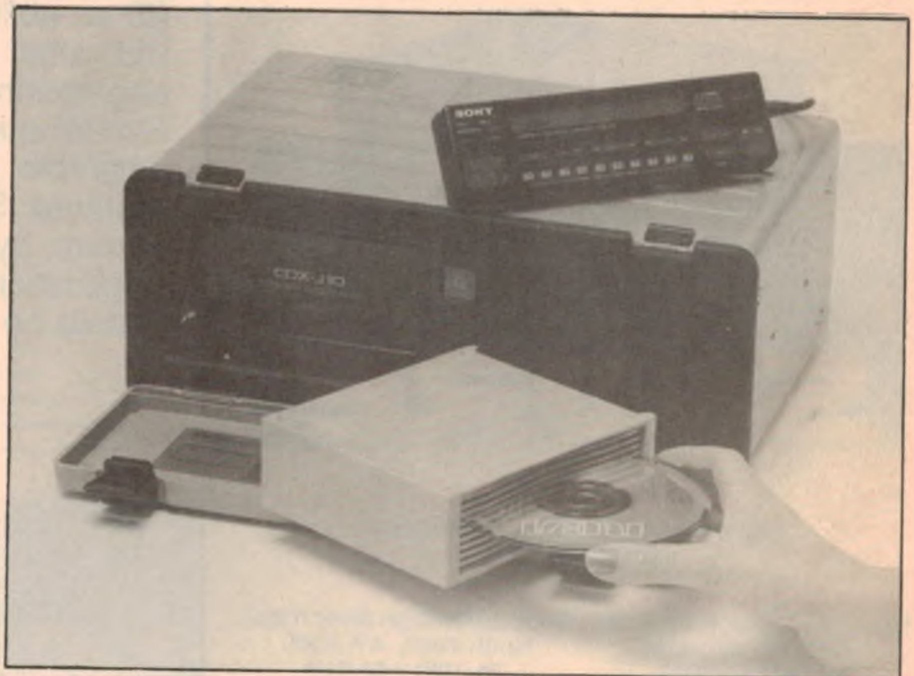
As noted, the analog disc system appears to have reached a practical limit to its logical development, with little prospect of it being able, any longer, to keep pace with the on-going performance specifications of other key audio equipment. It depends too heavily on critical, costly and somewhat precarious mechanical properties.

This has become increasingly apparent in a succession of special quality record players and components devised for the audiophile market over the years — often fragile and outrageously expensive, yet inherently subject to the limitations of a mechanical analog system.

While compact discs and players might also be seen as mechanical devices involving, what's more, incredibly small dimensions, there is a vital distinction in that the quality of the recovered audio is much less dependent on their mechanical properties.

Provided that the basic — and inherently "rugged" — digitised information can be recovered from the disc substantially intact, electronic decoding circuitry can reconstitute the original audio signal(s), virtually without loss of quality and without introducing extraneous components such as noise, hum, crosstalk, rumble, acoustic feedback, wow and flutter.

The bottom line is that mass produced CD players can undersell and outperform their most pretentious black disc counterparts by a considerable margin. There is no disc or stylus wear and, as a bonus, they can accommodate supplementary timing and cueing information to permit various programmed play modes and precise access to individual segments of the program.



A dream come true. Designed for use on cars, coaches, boats and aircraft, Sony's CDX-J10 CD player can be installed in any available space and remotely controlled from a small panel near the driving position. It can accommodate 10 discs for continuous play, with provision for memory preset for up to 10 selections per disc.

A spin-off from video

The CD system is essentially a spin-off from video disc research in the early '70s which, of necessity, had to provide for signal frequencies well up into the MHz (megahertz) range. The most ambitious approach was one pursued mainly by Philips, using a laser light beam to read a spiral pattern of microscopic indentations in a mirror-like plastic disc.

As it turned out, the market was captured by video cassette tape recorders and video discs were largely set aside. Manufacturers were aware, however, that the technology could be adapted in various ways for a new generation of high performance audio discs, creating a possible demand for compatible video/audio players.

For a while it looked as if three competing video/audio formats might emerge but fortunately Philips, in conjunction with Sony, were able to present a convincing case for a world standard audio disc that would be small rather than large — 12cm rather than 12 inches — to permit its ultimate use in cars and portable players.

It should employ laser optics and digital signal technology, they said, to obviate wear problems and encourage innovative development.

Their proposed "compact disc" system was formally demonstrated to the industry DAD (Digital Audio Disc) Committee in mid 1980, with most major hifi manufacturers subsequently taking out a licence for CD hardware and/or software. Prototypes were developed and problems sorted out during the next couple of years, with product being released from early 1983 onwards.

A universal medium?

What began in that year as a trickle has since developed into a flood, with CD players rapidly displacing analog decks in quality audio systems. In fact, the widespread adoption of the format is having a fundamental bearing on the content of compact disc catalogs.

Early on, hifi enthusiasts in particular tended to assume that, because of its advanced technical specifications, the CD format would be reserved mainly for modern hi-tech recordings. Older, indifferent recordings would survive only as analog pressings.

In fact, the consumer trend to equip — or re-equip — with CD facilities has generated a demand for popular, historic or notable performances to be re-issued on CD, as a matter of convenience and without undue emphasis on age.

Some see the trend as a backward step, on the basis that dated recordings from analog masters will compromise the standing of compact discs, especially if the source tape is indifferent or the playing time remains at the original 35-odd minutes.

On the other hand, it is possible that many notable analog recordings could benefit by being rearranged, reprocessed and remastered on modern equipment, even if they still fall somewhat short of modern, all-digital standards.

The moral is for hifi devotees to read the small print on the label, catalog or notes. They will have to accommodate to the fact that, if not specifically nominated as all digital — Philips and DG use the coding "DDD" — some shiny, new compact discs may have an analog master in their family tree!

Only the beginning...

One thing is certain, however: with the hifi industry fully occupied with two-channel stereo recordings carrying mainly basic information cues, compact discs are, as yet, far from being fully exploited. They have the potential for some form of surround sound and/or the inclusion of titles, lyrics, music scores or still pictures for simultaneous presentation on a video monitor.

Beyond that, Philips and Sony are promoting consultation to encourage industry compatibility as researchers explore the potential of the format for multimedia interactive audio/video applications (CD-I) such as education, information access and games. CD-ROM is also in the offing, with CD-style discs operating in conjunction with computers. (See EA, May '86 p92).

Details & specifications

A compact disc has little in common with a conventional 12-inch (305mm) album. It is much smaller (Table 1) and,

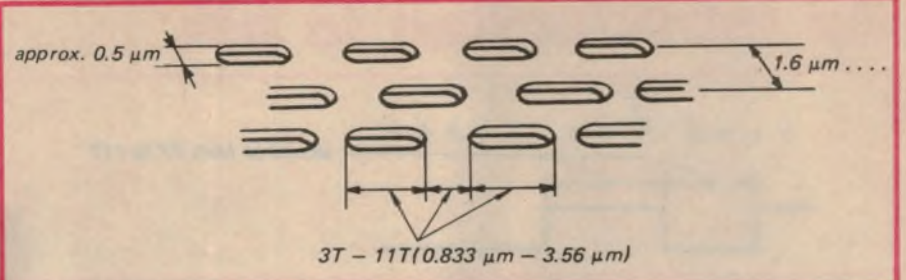


Fig. 1: Illustrating the pits (or bumps) in three adjacent spirals. CD players are able to track the bumps by sensing the "lands" on either side of the spiral.

PHYSICAL SPECIFICATIONS

Disc diameter	120mm
Disc thickness	1.2mm
Centre hole diameter	15mm
Recording diameter limits	46 to 117mm
Signal diameter limits	50 to 116mm
Rotation	Anticlockwise (referred to laser)
Signal path spiral	Inside start
Signal spiral pitch	1.6um
Lineal scanning speed	1.2 to 1.4m/sec
Playing time (one side)	Nominal 60 mins; max 74 mins
Minimum pit length	0.833um at 1.2m/sec (min speed)
Minimum pit length	0.972um at 1.4m/sec (max speed)
Maximum pit length	3.05 to 3.56um (depends on speed)
Pit depth	Approx 0.11um
Pit width	Approx 0.5um

Table 1: The principle physical specifications of compact discs. Because the system operates with a constant lineal track speed, the disc rotation speed varies continuously from about 500rpm for innermost track to about 200rpm at the outside.

An introduction to hifi

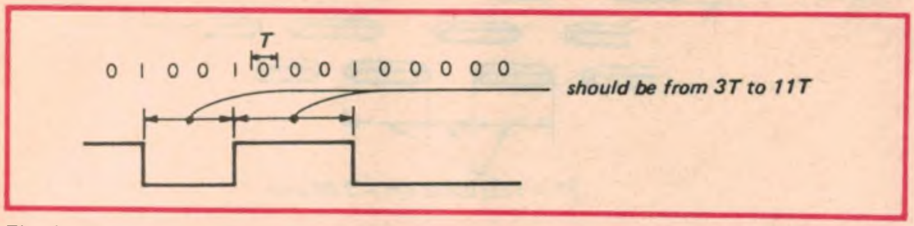


Fig. 2: The length of individual bumps and lands, expressed in time intervals "T", indicates a particular number of binary "0's" from 3 to 11.

for virtually the first time in a century of audio disc technology, lacks a continuous analog groove. Instead, the program information, processed into digital form, is recorded as a spiral sequence of incredibly small pits or bumps, intended to be scanned and read by a laser-beam optical system. (See microphotograph).

The pitch of the spiral — therefore the separation between adjacent spiral "tracks" — is also an incredibly small 1.6μm. (Fig 1).

Here a word of explanation: the terms "pits" and "bumps" are often confused in CD literature. As we shall see later, they refer to the one thing: a pit in a polished, transparent surface looks like a bump, if viewed from the other side!

The pits (or bumps) are about 0.5μm (micron) wide and between about 0.8μm and 3.6μm long, laid end to end in the spiral track but separated by small "lands" also measuring between 0.83 and 3.56μm.

Pit and land lineal dimensions vary continuously according to the distribution of "0's" and "1's" in the encoded information, with the land/pit/land transitions indicating binary "1's", and the intervening land and pit lengths representing specific numbers of binary 0's — between 3 and 11, as indicated in Fig.2.

It has been suggested that the pits in a compact disc are amongst the smallest entities ever to be deliberately manufactured. The dimensions may be more meaningful if it is pointed out that the track pitch is around 600 per millimetre, with 60-odd spirals, side by side, occupying about the same width as a single groove in an analog LP disc. They are invisible to the eye, even under a typical 300 magnification microscope.

Since the pits are only 0.5μm wide, or about one third of the spiral pitch, there will also be an uninterrupted strip of "land" about 1.1μm wide between each adjacent row of pits. As we shall see later, the laser light beam uses the adjacent unetched land to maintain accurate tracking.

About compact discs

Unlike a conventional analog record, compact discs do not rotate at a constant, critically controlled speed. Instead, the CD system re-introduces a desirable principle that was sacrificed, of necessity, in the historic changeover from Edison's cylinders to Berliner's discs, namely that of constant lineal track speed.

It has the advantage that the data packing density can be optimised and remain constant from the beginning to end of play, instead of varying inversely with groove diameter, as in an ordinary disc.

In fact, a compact disc player accepts digital data from the spinning disc at a rate basically determined by a crystal clock. The speed of the disc drive motor is electronically controlled, at all times, so that the required average bit rate is maintained into a buffer memory bank which acts as a kind of data reservoir.

The information is continuously "clocked" out of the memory bank again, for conversion back into analog form, but strictly at the crystal clock pulse frequency, thereby completely eliminating wow and flutter effects. (See previous article).

CD standards permit a lineal scanning speed ranging from 1.2m/sec (for maximum playing time) to 1.4m/sec. Recording starts from the inside at a diameter of 46mm (data) and 50mm (program) at a disc speed of about 500rpm. This reduces automatically and progressively to about 200rpm at the outer program/data recording diameter limits of 116/117mm.

Rotation is counter clockwise, when viewing the signal (non-label) read-out surface. Maximum available playing time is 74 minutes, suggested to Philips by Herbert von Karajan, so the story goes, as the time required to accommodate his version of the Beethoven Ninth Symphony!

As a standard bit rate of 4.3218 Mbits/sec, that adds up to possibly 19+ billion bits on a compact disc, of which (currently) 6+ billion are audio data.

Table 2 is a summary of performance specifications for a normal CD disc/player combination compared with what can be expected from a high quality analog record player. The difference between the two is plainly apparent.

Compact disc production

One of the natural advantages of the disc medium, evident from the time of Berliner (circa 1890) is that discs can be duplicated, relatively quickly and relatively cheaply, by mechanical moulding and stamping processes.

This holds true for compact discs but their processing calls for much greater precision and tighter tolerances than for analog pressings. Indeed, production problems in the early stages were such that promoters of the system must often have despaired.

One vital factor that compact discs have

A microphotograph of the pits or bumps in a typical compact disc. It has been calculated that, for the pits to be magnified to rice-grain size, the effective disc diameter would be around 800 metres! (By courtesy of Philips).

Possibly smaller than was forseen by the DAD committee in 1980, Sony's "Discman" CD portable measures only 126 x 126 x 27mm. It can be powered on the move from rechargeable or dry cells or used with a mains adaptor and coupled to a hifi system. It features search, repeat and any-order programming.

MASTERING PROCESS:

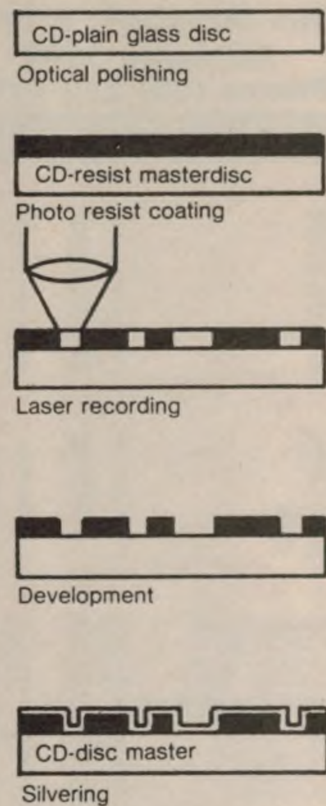


Fig. 3: Illustrating five major steps in the production of a compact disc master recording. The laser normally lays down the spiral track in "real time", i.e. operating at the normal bit rate and with the disc spinning at the normal playback speed.

going for them is that the digital system is inherently forgiving. If a fault (or damage) occurs in an analog recording, it is likely to be directly audible as such. With a compact disc, there is a strong chance that the fault will be ignored during digital playback or rendered inaudible by special error detection and correction circuitry — the first use of such technology in a consumer product.

The steps involved in digital recording and playback were outlined in the previous article and will be followed through again later in the context of CD players. At this juncture, we simply assume the existence of a master tape carrying audio and supplementary information encoded in accordance with CD signal format requirements.

The processes involved in mastering and duplicating compact discs parallel those for analog records, although calling for greater precision and quality control. What follows, based mainly on literature from Philips and Marantz, explains the basic steps.

The master recording

The starting point for a CD master recording is a plain glass disc of about 220mm diameter and 6mm thick, lapped and polished to rigid optical standards and scrupulously clean (see Fig.3). The side to be further processed is checked with a laser beam to detect potential "dropouts" in reflectivity.

If satisfactory, the side is spin-coated with a photo-resistive layer, commonly 0.11μm (110nm, nanometres) thick and critical, because it largely determines the ultimate pit depth. It is analogous to the photo-resistive coating on photographic film.

The sensitised disc is then mounted on a special computer controlled recording turntable and rotated through the precise required speed range (nominally 500-200rpm) while being simultaneously traversed by a laser "cutting" head, using one beam to "expose" the photoresist and another (to which the resist is insensitive) to monitor focus and tracking.

The exposure beam is intensity modulated by signals from a master tape, using an acousto-optic "shutter", to produce a spiral track of microscopic, photographically "exposed" areas.

This done, the disc is placed in an automatic developing machine and rotated, while a chemical solution etches away the exposed areas in the photoresist to create

DIGITAL, ANALOG SYSTEMS COMPARED

Parameter	CD Typical	LP Typical
Freq. response	20Hz-20kHz	25Hz-18/20kHz
Freq. tolerance	+/− 0.5dB	+/− 2dB
Channel balance	Complete	1.5dB (1kHz)
Channel sep.	90+dB (1kHz)	25dB (1kHz)
Dynamic range	90+dB	65dB
S/N ratio	90+dB	60+dB
Harm. dist.	0.005%	1-2%
Wow & flutter	Crystal lock	0.03% RMS
Rumble	Not applic.	−75dB DIN

Table 2: To date, the performance figures for CD players have been remarkably uniform from model to model. They rate well ahead of analog players although, in all cases, the ultimate sound still depends heavily on the excellence or otherwise of the particular recording.

An introduction to hifi

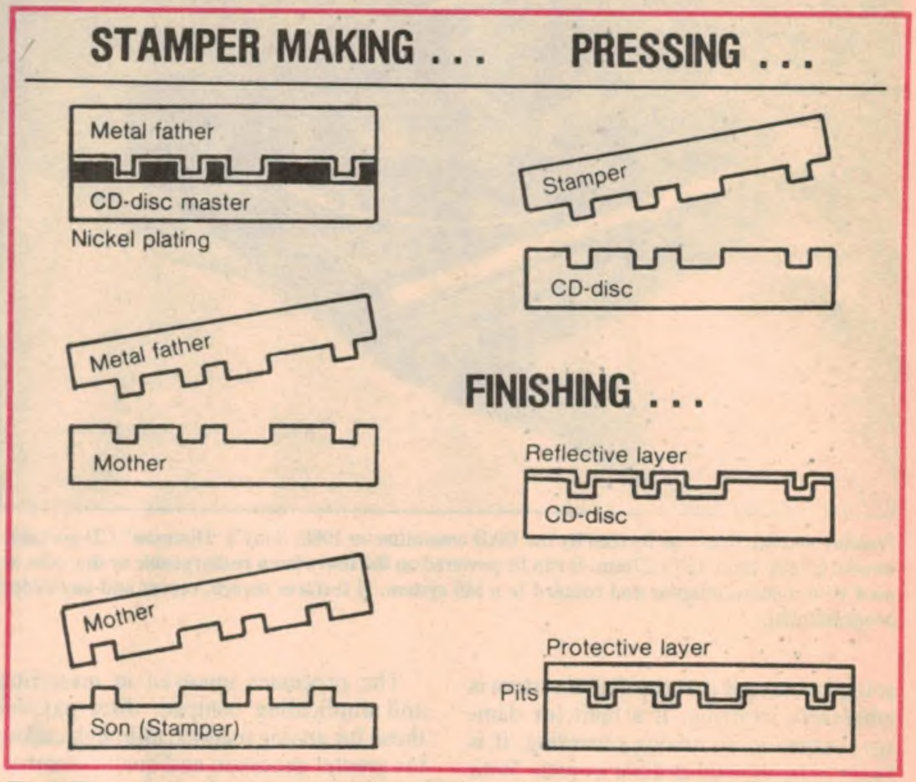


Fig. 4: The steps necessary to produce consumer copies of the master disc. The sequence is similar to that used for analog pressings but the level of precision required is far higher.

a spiral pattern of pits — in the true sense of the term.

At this state, a very thin conductive layer of silver is applied to the developed surface, which is later heavily plated with nickel. When this is stripped away from the original glass "master", it provides a tough "negative" or "father" disc, with a spiral of "bumps" instead of the original pits (Fig.4).

Duplication process

The "father" could actually be used as a stamper to make consumer copies but only for a limited production run. Normal procedure is to plate and strip the "father" recording to make a number of "mother" discs with, once again, a spiral of pits.

Each of these "mothers" can then be plated to make a number of "sons" or "stampers", which are then used in the

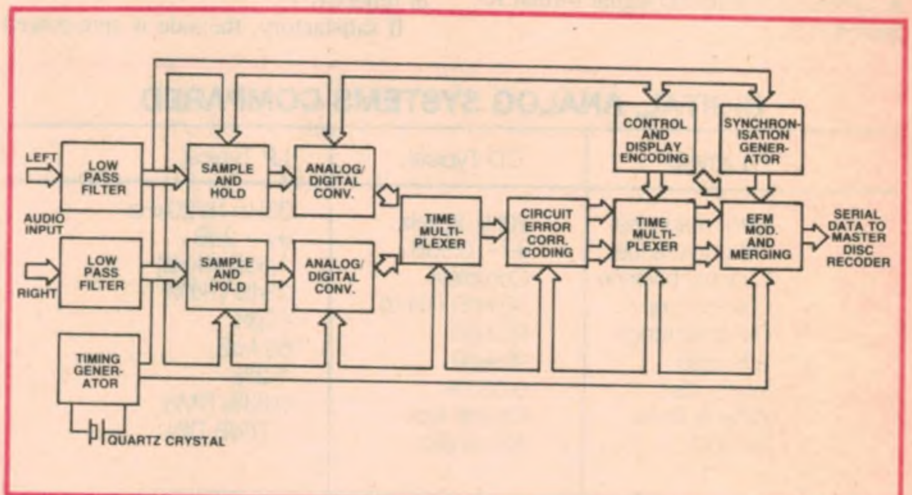


Fig. 5: Summarising the steps necessary to structure an analog signal for recording on a compact disc. For modern DDD recordings, much of the structuring would be done by studio engineers preparing a CD master tape.

presses to produce the consumer copies, using a special polycarbonate base material and compression and/or injection moulding techniques, as preferred.

After moulding, racks of polycarbonate pressings are placed in an evaporation chamber for about 15 minutes and a layer of aluminium about 0.1μm (100nm) vacuum deposited over the surface carrying the signal information. Viewed from the other side, the polycarbonate biscuit becomes a virtual mirror.

In a further process, the aluminium is spin coated with a layer of acrylic, which is subsequently cured with ultra-violet light. The label is printed on top of this and, if not already done, the centre hole is punched out with the highest possible precision.

To play back the disc, the information must be read from underneath, through the original polycarbonate biscuit. And, since the laser beam is reading the mirror-coated pits from underneath, they appear as bumps. In short, the recording laser produces pits but the replay laser reads bumps!

Compact discs are normally single sided. Double sided discs could be produced by cementing them back to back but the single-sided format is considered to be more practical.

Signal processing

So much for actual disc manufacture. It remains now to follow the audio signal from source to the point where, along with the supplementary data, it is ready to be etched into the master disc as a pattern of pits.

Digital signal processing was discussed in broad terms in the previous article but Fig.5, adapted from Marantz literature, should serve to illustrate the essential steps in formatting an audio signal for 2-channel stereo CD recordings.

The diagram assumes that the program material is in the form of an analog left/right stereo pair. As such, the signals must first be fed through low pass filters to remove any components above the 20kHz passband — necessary to prevent them from interacting with the sampling pulses and generating "alias" frequencies. (See previous article).

After filtering, the L&R signals pass to sample & hold circuits and to A/D converters, where they are "quantised" at precise intervals, dictated by a 44.1kHz crystal locked timing generator. The size of each successive sample is expressed as a 16-bit binary "word" which appears at the output of the respective A/D converters.

At that point, the "parallel" 16-bit presentation is rearranged into "serial" form in a "shift register" (not shown separately) with the bits being output in sequence, ready to feed into the recording circuitry.

(In the case of an all-digital "DDD" recording, the master tape from the recording studio would normally carry the stereo pair already mixed down into this form.)

To enable both stereo signals to be carried by a common channel, they are then "time multiplexed". One signal is passed through a delay line, to enable the pulse groups representing left and right samples to be interleaved, being handled separately and in sequence in the data stream.

Special encoding

At this stage, special logic circuitry checks the audio pulse groups and injects parity bits into the data stream to give effect to error correction measures, as outlined in the previous article.

As a further error correction measure, the composite signal passes through another multiplexer, which shuffles the data bits in a programmed way, on the assumption that all CD players will include provision to re-shuffle them back into the proper order.

The idea of this is to prevent reading errors from destroying whole blocks of information, leading to audible clicks, plops or dropouts. Scrambling and unscrambling tends to disperse misreadings into smaller, more easily correctable errors. The overall error correction system is described as "CIRC" meaning Cross Interleave Read-Solomon Code.

Because the data is to be recorded and read as physical pits or bumps in a disc, originators of the CD system had to ensure that it would not contain a pattern of '1's" (transitions) that would create pits or lands, either unduly short (difficult to read) or unduly long (likely to prejudice synchronisation).

In practical terms, it meant that at least three, but not more than eleven, "0's" had to appear between any two "1's". Clearly, a special "modulation code" was necessary to reconcile the data format to the medium. (See previous article).

An exercise in logic statistics led to the EFM (eight to fourteen) modulation code. It calls for the original 16-bit quantising words to be broken down into two parts of 8 bits each. These are then re-encoded using only those combinations of 14 bits which do not transgress the abovementioned requirements for pit/land length.

In fact, 14 bits can offer 267 unique and "acceptable" combinations of "0's" and "1's", which are typically stored in a ROM "dictionary" for purposes of EFM encoding and decoding. This compares with the 256 possible numbers represented by an 8-bit word. So, while EFM modulation increases the number of bits, it also ensures a readable optical pattern.

Frames & figures

At this same stage, various other timing and information signals are clocked into — or merged — with the audio, such that the data stream is transformed, in effect, into a continuous sequence of readily recognisable information packets or "frames".

Each frame commences with a unique 24-bit synchronising block, which a CD player can lock to its own timing clock and drive motor and can use to identify the bit contents of the frame. A new sync pulse occurs each 136μs, at an effective sync pulse rate of 7.35kHz.

The sync pulse is followed by a 14-bit "control" signal which started out, before EFM, as 8 bits, arbitrarily identified by the letters P to W. Only the P and Q bits are currently used in audio discs — being referred to as the PQ Code. They indicate such things as the number of selections on the disc, their beginning and end points, index points within selections, pre-emphasis on and off, and the end of the program.

(At the time of writing, the remaining code bits have yet to be firmly allocated but it is envisaged that, because they are accessed during each frame, they could be time-encoded into blocks with their own parity checks, &c. If used for video display, an hour-long compact disc could supplement the audio program with up to 700 still video images — one every five seconds).

Following the control signal comes a left/right audio data block, an error correction block, another L/R data block and a final error correction block.

As a point of interest, three passive merging bits are inserted between each 14-bit data signal so that, in effect, the original 8-bit data words become 17-bit words in the frame structure — accounting for the published data-to-channel bit ratio of 8:17.

The total number of bits per frame adds up to 588. Multiply this by the 7.35kHz frame rate and you get the channel bit rate of 4.3218 Mb/sec, which is 17/8 times the data bit rate of 2.0338 Mb/sec.

The 4.3218 Mb/sec data stream is the one which is ultimately imposed on the glass master disc. In the next article, we see how the signal processing is reversed to recover and reconstitute the original analog stereo pair.

To be continued.

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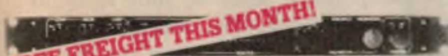

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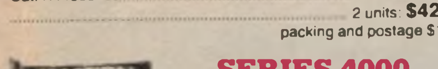

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Freq. Response: 1.2 - 20 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz
Cat. C10200 .... **$5.95**

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SPECIFICATIONS:
Sensitivity: 94dB
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Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz
Cat. C10202 .... **$6.95**

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Freq. Response: 650 - 15 kHz
Impedance: 8 ohms
Power RMS: 15 watts
Magnet Weight: 3.6 oz
Cat. C10204 .... **$11.95**

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Clothed edge surrounds.
SPECIFICATIONS:
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Freq. Response: 600 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz
Cat. C10206 .... **$14.95**

6½" WOOFER
Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 96dB
Freq. Response: 55 - 7 kHz
Impedance: 8 ohms
Power RMS: 15 watts
Magnet Weight: 5.4 oz
Cat. C10208 .... **$17.95**

8" WOOFER RIBBED CONE
Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 94dB
Freq. Response: 55 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz
Cat. C10210 .... **$20.95**

12" WOOFER RIBBED CONE
Cloth edge roll surround.
SPECIFICATIONS:
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Freq. Response: 32 - 4 kHz
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2 x P25 woofers
2 x pre-built quality crossovers

The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbond, grill clips, speaker terminals, screws and ports.

D19 DOME TWEETER SPEAKER SPECIFICATIONS
Nominal Impedance: 8 ohms
Frequency Range: 2.5 - 20kHz
Free Air Resonance: 1,700Hz
Sensitivity 1W at 1m: 89dB
Nominal Power: 80 Watts (fo: 5,000Hz, 12dB/oct)
Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2ohms
Moving Mass: 0.2 grams
Weight: 0.28kg

D75 DOME MIDRANGE SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 350 - 5,000Hz
Free Air Resonance: 300Hz
Sensitivity (1W at 1m): 91dB
Nominal Power: 80 Watts (fo: 500Hz, 12dB/oct)
Voice Coil Diameter: 75mm
Voice Coil Resistance: 7.2ohms
Moving Mass (incl. air): 3.6 grams
Weight: 0.65kg

P25 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 25 - 3,000Hz
Free Air Resonance: 25Hz
Operating Power: 5 watts
Sensitivity (1W at 1m): 89dB
Nominal Power: 60 Watts
Music Power: 100 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5.7ohms
Moving Mass (incl. air): 44 grams
Thiele/Small Parameters:
Qm: 3.15
Qe: 0.46
Qt: 0.40
Vas: 180.1
Weight: 1.95kg

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Cabinet Kit Cat.K16032 **$349**

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This exciting new speaker kit, designed by David Tillbrook (a name synonymous with brilliant design and performance) uses VIFA's high perfomance drivers from Denmark. You will save around $800 when you hear what you get from this system when compared to something you buy off the shelf with similar characteristics. Call in personally and compare for yourself!

The system comprises...
2 x P21 Polycone 8" woofers
2 x D25T Ferrofluid cooled dome tweeters with Polymer diaphrams
2 pre-built quality crossovers

The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbond, grill clips, speaker terminals, screws and ports.

D25T SPEAKER SPECIFICATIONS
Nominal Impedance: 6 ohms
Frequency Range: 2 - 24kHz
Free Air Resonance: 1500Hz
Operating Power: 3.2 watts
Sensitivity (1W at 1m): 90dB
Nominal Power: 90 Watts
Voice Coil Diameter: 25mm
Air Gap Height: 2mm
Voice Coil Resistance: 4.7ohms
Moving Mass: 0.3 grams
Weight: 0.53kg

P21 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 26 - 4,000Hz
Free Air Resonance: 33Hz
Operating Power: 2.5 watts
Sensitivity (1W at 1m): 92dB
Nominal Power: 60 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5.8ohms
Moving Mass: 20 grams
Thiele/Small Parameters: Om: 2.4
Qe: 0.41
Qt: 0.35
Vas: 80.1

Weight: 1.65kg

Complete Kit Cat.K16020 **$699**
Speaker Kit Cat.K16021 **$549**
Cabinet Kit Cat.K16022 **$209**

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The new Vifa/EA 60 + 60 loudspeaker kit has been designed to completely out perform any similarly priced speakers. This is a 2-way design incorporating drivers which give a deeper, more natural bass response and 19mm soft-dome ferro fluid cooled tweeters which provide clear, uncoloured sound reproduction.

These Vifa drivers are identical to the ones used in such fine speakers as Mission, Rogers, Bang & Olufsen, Monitor Audio and Haybrook just to name a few. Some of which cost well over $1,000 a pair!

The dividing network is of the highest quality and produce no inherent sound characteristics of their own; they simply act as passive devices which accurately distribute the frequency range between both drivers in each speaker.

The fully enclosed acoustic suspension cabinets are easily assembled. All you need are normal household tools and a couple of hours and you've built yourself the finest pair of speakers in their class!

D19 TWEETER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 2.5 - 20KHz
Free Air Resonance: 1,700Hz
Sensitivity 1W at 1m: 89dB
Nominal Power: 80 Watts (fo: 5,000Hz, 12dB/oct)
Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2 ohms
Moving Mass: 0.2 grams
Weight: 0.28kg
Cat. C10301 .... **$38**

C20 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 35 - 6,000Hz
Resonance Frequency: 39Hz
Sensitivity 1W at 1m: 90dB
Nominal Power: 50 Watts (12dB/oct)
Voice Coil Diameter: 25mm
Voice Coil Resistance: 5.5 ohms
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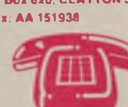

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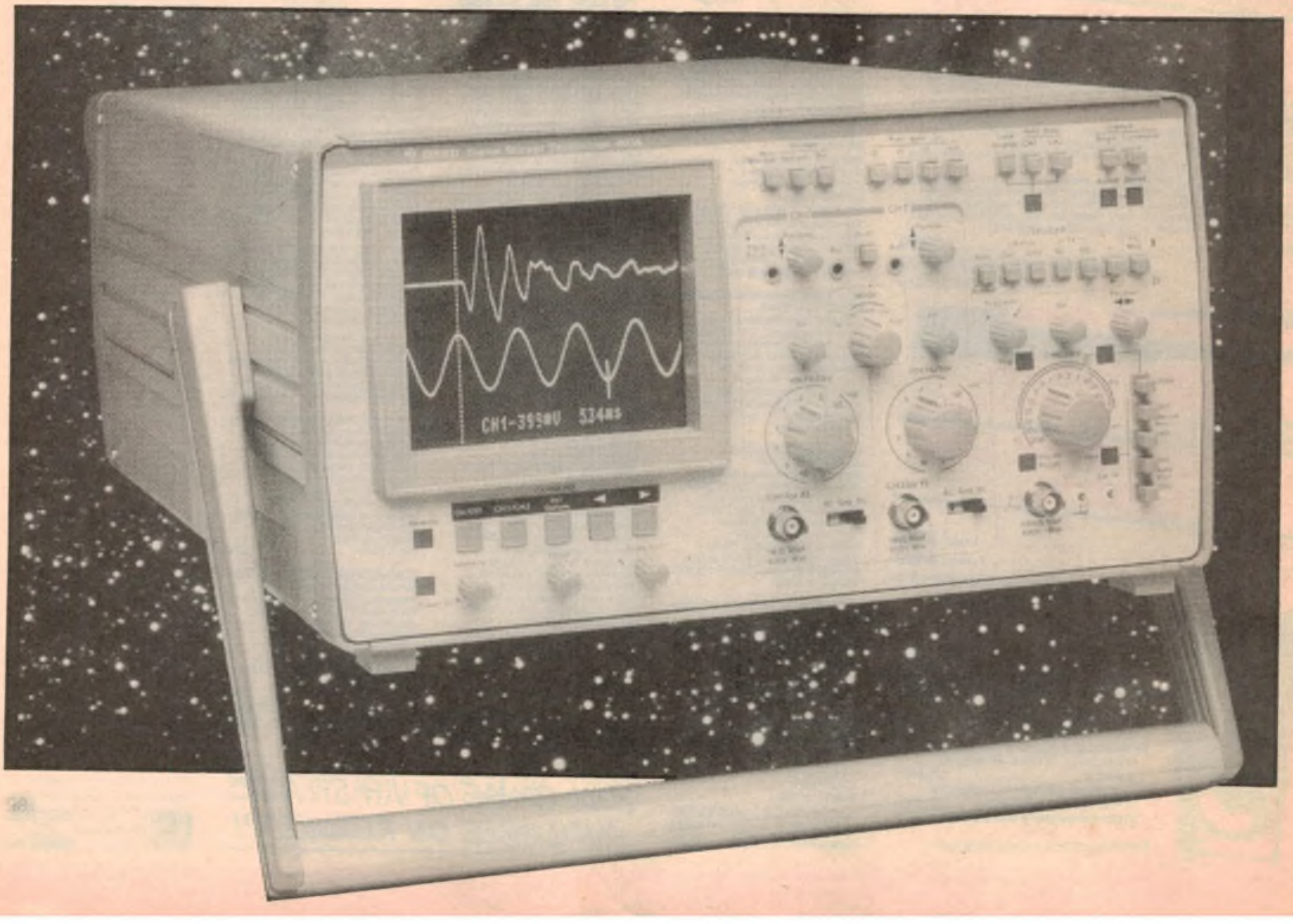
Gould 4035 digital storage oscilloscope

Hi-tech test equipment tends to get a little tiresome when it takes you days to figure out how to use it. As well as having all the features, real sophistication should mean that a machine is easy to use. Nowhere is this better illustrated than in the Gould 4035 digital storage CRO.

If you have ever sat down with a new CRO jam packed with all the features, you'll surely understand the disappointment of not being able to find the trace. An ancient screen storage CRO which collects dust in our lab is avoided fastidiously for this very reason. The mean time to finding the trace seems to be around ten minutes (that's after the ten minute warm up!).

In fact, this museum piece and the new Gould CRO were both made in England but that's where the similarity ends. The Gould machine is a sheer delight to use.

The front panel labelling is virtually self explanatory. In the absence of confusing abbreviations and awkward control groupings, it takes no time at all to familiarise oneself. The machine is off to a good start in this respect because it has a very large front panel. At 340 x 175mm, it has room to spare for all of



the controls and suitable labelling.

In fact, the 4035 is of rather generous proportions all round — it is 450mm long and quite heavy as well.

Large as it may be, few technicians would reject this machine. In the trend of recent up-market CROs, it has on-screen measurement of time and voltage. We can foresee the day when having a well equipped laboratory will not mean shelf upon shelf of test gear — rather, just a CRO with the 'works'.

Naturally, measurements for the on-screen readout are facilitated by moveable cursors. Positioning of the cursors could not be simpler — the five push button controls are located separately under the screen. Touch the "On/Off" button, locate the cursor on "CH1/CH2", and use the left or right shift buttons.

Only one cursor is controlled by this action — the other (the datum) is superimposed on this position when you touch "Set Datum" . The left/right controls have two speed operation. All very efficient, but not enough to surprise the hardened reviewer.

It is only after you select the storage mode that the cursor and on-screen readout really come into their own. With the waveform stored, left or right movement of the cursor cause it to track along the waveform. The voltage and time readings (from the datum) continually update. For a stored tone burst or ringing, the cursor "roller-coasters" along the screen. It looks most impressive to non-technical people visiting the lab, but it is also very practical and useful.

To illustrate the point, we used the machine to analyse a high voltage discharge circuit. We had previously tried the screen-storage CRO, which did not have sufficient writing speed, and a conventional CRO. In the latter case, the brightness was turned up to maximum so that the technician's eyes functioned as the storage medium. The only definite result from this approach was deteriorating eyesight for the technician.

With the waveform stored permanently, we were able to optimise the circuit in several aspects, as well as detecting some potentially troublesome spikes of only a few microseconds duration.

Because the Gould 4035 has dual analog to digital converters, it can store both channels simultaneously. Further, the sampling rate is 20MHz. For the application outlined above, this enabled the detection of transients that would otherwise have gone unnoticed. Each channel can store 1024 horizontal positions, with each position having a vertical resolution of eight bits.

Eager to see what device was capable of providing dual A/D conversion at 20MHz, we investigated the circuitry. The chip in question is a Sony device. Enquiries revealed that replacements for this chip can be had for around $110. While this sounds expensive, it's really quite reasonable in view of what the chip does.

Whilst the cover was off, we gave the CRO a perusal for layout and neatness. There is plenty of room for servicing inside. Access is excellent with the upper and lower halves of the case easily removable. This leaves only a backbone supporting the PCBs, along with the front and back panels. Full marks.

We also noticed that most of the interboard connections are soldered in place — no quick disconnects. No doubt this improves reliability but it would add to servicing time and creates the possibility of making a wrong connection.

In addition to time/voltage displays, the on-screen readout can be altered to any 16 character message, either by means of the GPIB bus or a special keypad. As expected, the GPIB bus can also be used to interrogate the CRO to retrieve stored data. The host computer can also be used to execute a limited number of controls for the CRO when the "Remote" mode is selected. This disables many of the front panel controls.

When in the Remote mode, a trace can be written to the memory. A number of interesting possibilities are created by this facility. You could, for example, keep a library of reference waveforms on disc and recall them as necessary for comparison.

A substantial part of the instruction manual is given to software syntax for the GPIB interface. We could not find a section describing operation of the miscellaneous I/O port on the back panel. Most interesting is an analog output on the back panel. This can be fed into a plotter, and the stored waveform for both channels plotted. A rate control is provided for this analog output to control the horizontal axis. As well as reading out the contents of both memories, the volts/div and timebase settings are also printed.

The graticule can also be plotted if required.

A pendant is available which can be used to process the stored waveform. Magnification (0.06 to 3.98), filtering, as well as display manipulation can be achieved.

One aspect of the front panel controls which is definitely not up to the generally high standard is the trigger mode switches. To select "Ext", both the "CH1" and "CH2" trigger buttons have to be pushed simultaneously. Once you understand this quirk, it seems obvious enough but it is confusing initially. We would much prefer to see a separate button for the external trigger selection.

"Refresh" and "Roll" storage modes are available. Refresh causes new data to overwrite old (from left to right). With timebase settings of less than about 200ms, the whole trace appears to be instantly updated. With the Roll mode selected, the old trace is pushed across the display as the new one is written. A "Pretrigger" of either 0%, 25%, 75% or 100% causes that proportion of the old display to remain (for the Roll mode).

To take full advantage of the storage capability, very slow timebase settings should be available. The Gould actually allows timebases of up to 50 seconds, which is most commendable.

Servicing instructions seem to be adequate. Each circuit diagram has a substantial block of text describing overall operation for various functions; eg analog to digital conversion.

Once the storage facility is available, its surprising how often you can use it. There are more and more applications which are suggested when the flicker free slow timebase is available. Additionally, there is the potential for interesting waveforms to be stored on or off screen so that several members of a technical staff can view them at their convenience.

For example, technicians working different shifts could analyse a problem without each having to make the measurements. This is especially useful for intermittent problems. Our only complaint is that our laboratory non-storage CROs seem very primitive by comparison.

The price of the Gould 4035 is $8,995, plus sales tax. For further information, contact Elmeasco Pty Ltd, 15 McDonald St, Mortlake. Telephone (02) 736 2888. (C.D.)

New Products...

Product reviews, releases & services

Close-field probe tracks down EMI

Hewlett-Packard's close-field probe is a calibrated, magnetic-field sensor that locates electromagnetic-emission sources and makes repeatable, relative measurements from 30MHz to 1GHz.

The unit is low in price and makes a convenient tool for anyone involved in monitoring electromagnetic interference (EMI), diagnostic testing and trouble-shooting operations.

Probes can often be sensitive to both the electric and magnetic field components of an electromagnetic field and stray capacitive coupling can create large errors in the probe's output signal. The HP 11940A overcomes this problem by using a dual-loop configuration and a balun to provide common-mode rejection of electric field components.

Because the probe is insensitive to the electric field, it yields very repeatable measurements. Calibration is accurate to plus or minus 2dB in a 337-ohm field impedance. With appropriate modelling, this allows the prediction of radiated signal strength at a specified distance from the equipment under test.

Unlike radiation monitors that rectify the RF voltage to produce a DC voltage, the HP 11904A probe provides frequency information. Its optimal use is with a spectrum analyser such as the HP 8567A, HP 8566B or HP 8568B.

For further information contact Hewlett-Packard Australia Ltd, 31-41 Joseph St, Blackburn, Vic. 3130. Telephone (03) 895 2895.

Hand-held digital thermometer

Five multifunction models from the Unitherm range of hand held thermometers have recently been released through Electromark Pty Ltd.

The basic thermometer is available with either an 8mm-high LED display or a "multi-data" LCD display. The LED model (HL500) includes an NiCd battery and charger as standard accessories.

Some of the common functions are Hold, Peak Hold (max), Valley Hold (min), Average, and degress Celsius or degrees Fahrenheit.

The temperature range is from −200 to +1200 degrees C, using type K thermocouple sensors.

The HL610 model has a calibration interface, alarm signal and Centronics output. The HL620 model is similar but has two input channels with differential indication and audible output alarm function.

For further information contact Electromark Pty Ltd, 43 Anderson Road, PO Box 184, Mortdale, NSW 2223. Telephone (02) 570 7287.

Low cost dual-trace 50MHz oscilloscope from BWD

A new Australian-designed 50MHz oscilloscope has been released by BWD. It has a MIX-MAG capability, enabling between 0 and 80% of the trace to be magnified by a factor of 10. This can be combined with the normal "x 10" magnification to give an extra 100 x magnification. With 75MHz triggering, the BWD 831 is claimed to be more than price competitive with machines of similar capability.

Other features include 7ns risetime at 5mV/div, 20ns/div maximum sweep speed, and the inclusion of 100MHz x1 and x10 dual range probes.

For more information contact Parameters Pty Ltd, PO Box 261, North Ryde, NSW 2113. Phone (02) 888 8777.

Get off to a good start in '87 with Ritronics Wholesale!

FREE 58 PAGE WHOLESALE PRICE LIST! Simply supply a Business Card!

IC's GALORE!

Desc.	1-9	10 -	100 -	250 -
8035	3.90	3.70	3.50	3.00
8085	4.00	3.90	3.50	3.00
8088	15.00	14.00	12.00	11.00
8155	3.90	3.75	3.50	3.00
8156	3.50	3.30	2.90	2.50
8212	1.80	1.70	1.50	1.00
8224	2.40	2.00	1.90	1.50
8226	1.90	1.70	1.50	1.00
8237A	35.00	31.00		
8253	3.90	3.70	3.50	3.00
8255	4.00	3.50	2.90	2.00
8257	3.90	3.50	3.00	2.50
8259	3.90	3.50	3.30	2.70
8237A	35.00	31.00		
8279	3.90	3.50	3.30	2.70

Plus 20% tax where applicable

MICRODOT 5¼" FLOPPY DISKS

Have a look at these prices! These are 100% certified, prime spec disks in labelled jackets. (not like our oppositions)

Description Cat.No.	1-9 boxes	10+ boxes	100+ boxes
S/S D/D C12440	$14.50	$13.90	$13.00
D/S D/D C12445	$16.50	$14.90	$13.50

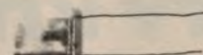
Plus 20% tax where applicable

Attention Schools, Government Depts etc FREE sample disk available on request! (Please send $2 to cover postage)

FANS

Cat.No.	Descript.	1-9	10+	100+
T12461	240V 4½"	10.50	10.00	8.00
T12465	240V 3½"	10.50	10.00	9.00
T12463	115V 4½"	10.50	10.00	8.00
T12467	115V 3½"	10.50	10.00	9.00

(Fan guards to suit also available)
Plus 20% tax where applicable



CRYSTALS

Cat No.	Frequency	Can	10+	100 -
Y11000	1MHz	HC33	4.75	4.00
Y11005	2MHz	HC33	1.95	1.70
Y11008	2.4576MHz	HC18	1.95	1.70
Y11015	3.57954MHz	HC18	1.20	.95
Y11020	4.00MHz	HC18	1.20	.95
Y11022	4.194304MHz	HC18	1.20	.95
Y11025	4.75MHz	HC18	1.20	.95
Y11026	4.9152MHz	HC18	1.20	.95
Y11042	6.144MHz	HC18	1.20	.95
Y11050	8.00MHz	HC18	1.20	.95
Y11055	8.867238MHz	HC18	1.20	.95
Y11070	12.00MHz	HC18	1.20	.95
Y11072	14.318MHz	HC18	1.20	.95
Y11080	16.00MHz	HC18	1.20	.95
Y11085	18.432MHz	HC18	1.20	.95
Y11090	20.00MHz	HC18	1.20	.95

Full range of crystals available on indent
Plus 20% tax where applicable

19" RACK MOUNT CASE

Tremendous value! Vented top panel
Dimensions: 480(W) x 134(H) x 250(D)mm

1-9	10 -
$32.00	$29.50

Plus 20% tax where applicable

TELEPHONE CABLE (200 METRE ROLLS)

Cat.No.	Description	1-9	10+
W11302	2 Pair	$30.00	$27.00
W11303	3 Pair	$39.00	$37.00
W11310	10 Pair	$120.00	$115.00

Per 200m Roll
20% Sales tax where applicable

TRANSFORMERS

Cat.No. & Desc.	1-99	100+	1000 -
M12851 2851 240V 12-6V CT 150mA	3.00	2.75	2.50
M12155 2155 240V 6-15V 1A tapped	5.50	4.95	4.50
M12156 2156 240V 6-15V 2A tapped	8.50	8.25	7.90
M12840 2840 240V to 9V C.T. at 150mA	3.20	3.00	2.70
M12860 2860 240V to 15V C.T. at 250mA	3.50	3.00	2.80
M16672 6672 240V 15-30V 1A tapped	8.50	7.95	7.70

Plus 20% tax where applicable

POLYESTER 100V "GREENCAP" TYPE

Cat No.	Description	1-99	100+	1000 -
R15131	.001uF	0.06	0.04	.03
R15137	.0012uF	0.06	0.04	.03
R15138	.0015uF	0.06	0.04	.03
R15140	.0022uF	0.06	0.04	.03
R15142	.0033uF	0.06	0.04	.03
R15143	.0039uF	0.06	0.04	.03
R15145	.0047uF	0.06	0.04	.03
R15146	.0056uF	0.06	0.04	.03
R15147	.0082uF	0.06	0.04	.03
R15148	.01uF	0.07	0.05	.04
R15150	.015uF	0.07	0.05	.04
R15152	.022uF	0.07	0.05	.04
R15154	.033uF	0.07	0.05	.04
R15155	.039uF	0.07	0.05	.04
R15156	.047uF	0.08	0.06	.05
R15157	.056uF	0.08	0.06	.05
R15158	.068uF	0.08	0.06	.05
R15159	.082uF	0.08	0.07	.05
R15160	.1uF	0.09	0.08	.07
R15162	.15uF	0.11	0.10	.09
R15164	.22uF	0.15	0.14	.13
R15165	.27uF	0.16	0.15	.14
R15172	1uF	0.70	0.55	0.50
R15176	2.2u	1.20	1.10	1.00
R15178	3.3uF	1.50	1.20	

Plus 30% tax where applicable

COMPUTER CONNECTORS

Cat No.	Description	1-99	100 -	1000+
P10900	DB25 Plug	1.30	1.20	0.80
P10901	DB25 Skt.	1.40	1.30	0.90
P10902	DB25 Cover	.80	.65	.55
P12210	Cent. Solder	3.50	3.15	2.50
P12200	Cent. Crimp	4.50	4.00	3.50
P10880	DB9 Plug	1.30	1.20	0.90
P10881	DB9 Skt.1.40	1.30	1.00	
P10882	DB9 Cover	0.60	0.55	0.50
P10890	DB15 Plug	1.30	1.20	0.90
P10891	DB15 Skt.1.40	1.30	1.00	
P10892	DB15 Cover	0.65	0.55	0.50

Plus 20% tax where applicable

75 OHM COAX CABLE IN 100M ROLLS

Cat No.	Descript.	1-4	5+	10+
W11222	3C2V	25.00	24.00	23.00
W11224	5C2V	30.00	29.00	28.00

(5C2V WHITE OR BLACK)
LINE LOSS PER 100 FEET (33M 200MHz)
W11222 3C2V 6.2dB (Approx.)
W11224 5C2V 3.9dB (Approx.)
Plus 20% tax where applicable

RITRON II MONITORS

Swivel base monitor in stylish case.

Desc/Cat.No.	1-9	10+	50+
Green Cat. X14506	$175	$165	$160
Amber Cat. X14508	$175	$165	$160

Plus 20% tax where applicable

500K DISK DRIVE FOR IBM*

12 months warranty!

1-9	10+	100+
$145	$135	$125

Plus 20% tax where applicable
*(*IBM is a registered trademark)*

10W P.A. SPEAKERS TWIN CONE

1-9	10+	100 -	300 -
$6.00	$5.75	$5.50	$5.00

Plus 20% tax where applicable

VOLTAGE REGULATORS

Descript.	10+	100+	1000+
7805uC	.45	.44	.43
7805KC	1.50	1.40	1.20
7812uC	.45	.44	.43
7815KC	1.50	1.40	1.20
7818uC	.50	.49	.48
7818KC	1.50	1.40	1.20
7905uC	.70	.60	.55
7912uC	.70	.60	.55
uA323KC	4.50	3.90	3.75

Plus 20% tax where applicable

DISK DRIVE FOR APPLE* (6502 SYSTEM)

1-9	10-24	25+
$175	$165	$155

Plus 20% tax where applicable
*(*Apple is a registered trademark)*

PRINTER RIBBONS

To suit CP80, BX80, DP80 etc.

Cat.No.	3+	25+	100 -
C22036	8.00	7.50	6.50

Plus 20% tax where applicable

RG CAN TYPE WITH LUGS

Cat.No.	Descript	1-99	100+	250 -
R?????	4,000uF 75V	5.00	4.50	4.40
R16585	8000uF 75V	6.00	5.90	5.80
R16587	10,000uF	7.00	6.50	5.90

Plus 30% tax where applicable

12V SEALED LEAD ACID BATTERIES

Description/Cat.No.		1-9	10+
1.2AH	S15029	$12.50	$11.75
2.6AH	S15031	$17.70	$16.50
4.5AH	S15033	$23.40	$22.00

Plus 20% tax where applicable

RESISTORS

¼ Watt E12 carbon
Bulk packed $5.25 per 1,000
Taped and boxed $5.25 per 1,000
$50.00 per 10K lots
¼ METAL FILM TAPED AND BOXED
$14.00 per 1,000 lot
$120.00 per 10K lot
SUPPLY E24 VALUE
Plus 30% tax where applicable

MEMORY PRICES!

"Check for the latest memory prices!"

	10-99	100 -	1000+	10K+
27512	$24.00	$22.00	$22.00	$22.00
4164-15P	$ 2.00	$ 1.70	$ 1.65	$ 1.60
41256	$ 4.00	$ 3.50	$ 3.40	$ 3.20
6116P-3	$ 3.00	$ 2.90	$ 2.20	$ 2.00
2716	$ 7.50	$ 7.00	$ 6.50	$ 6.00
27128	$ 7.00	$ 6.50	$ 6.00	$ 5.50
2532	$ 8.50	$ 6.50	$ 6.40	$ 6.30
2732	$ 7.50	$ 6.10	$ 5.90	$ 5.50
27256	$ 9.00	$ 8.00	$ 7.00	6.50
6264	$ 5.50	$ 5.00	$ 4.50	$ 4.00
2764	$ 6.00	$ 5.00	$ 4.50	$ 4.00

Plus 20% tax where applicable

HOOK UP WIRE

ALL PRICES PER 100 METRE ROLL

Cat. No. Description Colour
W11251 13/.12 TND BLK
W11252 13/.12 TLD BROWN
W11253 13/.12 TLD ORANGE
W11254 13/.12 TLD YELLOW
W11255 13/.12 TLD GREEN
W11256 13/.12 TLD BLUE
W11257 13/.12 TLD WHITE

PRICES PER 100 METRE ROLL

1-9	10 -
$3.50	$3.00

Plus 20% tax where applicable

W11260 14/.20 RED
W11261 14/.20 BLACK
W11265 14/.20 BLUE
W11268 14/.20 WHITE

PRICES PER 100 METRE ROLL

1-9	10 -
$9.00	$7.00

Plus 20% tax where applicable

W11270 24/.20 RED
W11272 24/.20 BLACK
W11274 24/.20 GREEN

PRICES PER 100 METRE ROLL

1-9	10 -
$11.00	$10.00

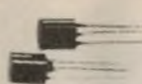
Plus 20% tax where applicable

W11280 32/.2 BROWN
W11282 32/.2 BLUE

PRICES PER 100 METRE ROLL

1-9	10 -
$12.00	$11.00

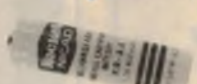
Plus 20% tax where applicable



TRANSISTORS

Desc	10+	100 -	Desc.	10+	100+
2SJ49	5.50	4.95	2SK134	5.50	4.95
PN2222A	.10	.08	PN2907A	.10	.08
PN3463	.15	.13	PN3565	.12	.11
PN3566	.15	.13	PN3567	.10	.08
PN3569	.18	.16	PN3639	.18	.16
PN3640	.18	.16	PN3641	.10	.08
PN3642	.10	.08	PN3643	.10	.08
PN3644	.15	.13	PN3645	.15	.13
PN4250A	.15	.13	PN4355	.16	.14
PN4356	.16	.14	MPSA42	.23	.20
MPSA43	.23	.20	MPSA55	.15	.14
MPSA56	.15	.14	MPSA92	.22	.20
MPSA93	.22	.20	SC1410	.85	.75
BU126	1.50	1.25	BUX80	2.75	2.55
BU208	2.50	2.20	2SD350	2.75	2.40
BU326	1.75	1.60	BC547	.07	.06
BC548	.07	.06	BC549	.07	.06
BC557	.07	.06	BC558	.07	.06
BC559	.07	.06			

Plus 30% tax where applicable



NICADS

Cat No.	Description	1-99	100+	250 -
S15020	AA .5AH	$2.00	$1.90	$1.70
S15021	C 1.2AH	$5.55	$5.45	$5.15
S15022	D 1.2AH	$5.75	$5.50	$5.25

Plus 20% tax where applicable

LEDS 5mm STANDARD

Desc	10+	100+	1000 -	10,000+
Red	$0.10	$0.09	$0.08	$0.07
Green	$0.15	$0.10	$0.09	$0.08
Yellow	$0.15	$0.10	$0.09	$0.08

Plus 20% tax where applicable

PANEL METERS

Cat.No.	Descript.	1-9	10+	100+
Q10500	MU45 0-1mA	7.50	6.95	6.75
Q10502	MU45 50-0-50uA	7.50	6.95	6.75
Q10504	MU45 0-100uA	7.50	6.95	6.75
Q10505	MU45 0-50uA	7.50	6.95	6.75
Q10510	MU45 0-5A	7.50	6.95	6.75
Q10518	MU45 0-1A	7.50	6.95	6.75
Q10520	MU45 0-20V	7.50	6.95	6.75
Q10535	MU45 VU	8.50	7.75	7.50
Q10530	MU52E 0-1mA	9.95	8.35	
Q10533	MU52E 0-5mA	9.95	8.35	
Q10538	MU65 0-50uA	11.50	9.35	8.95
Q10540	MU65 0-1mA	11.50	9.35	8.95
Q10550	MU65 0-100uA	11.50	10.35	9.95
Q10560	MU65 0 0-20v	11.50	10.35	9.95

Plus 20% tax where applicable

RITRONICS WHOLESALE Pty. Ltd.

56 Renver Road, CLAYTON, 3168, VICTORIA, AUSTRALIA. Phone (03) 543 2166 (4 lines). Telex AA151938

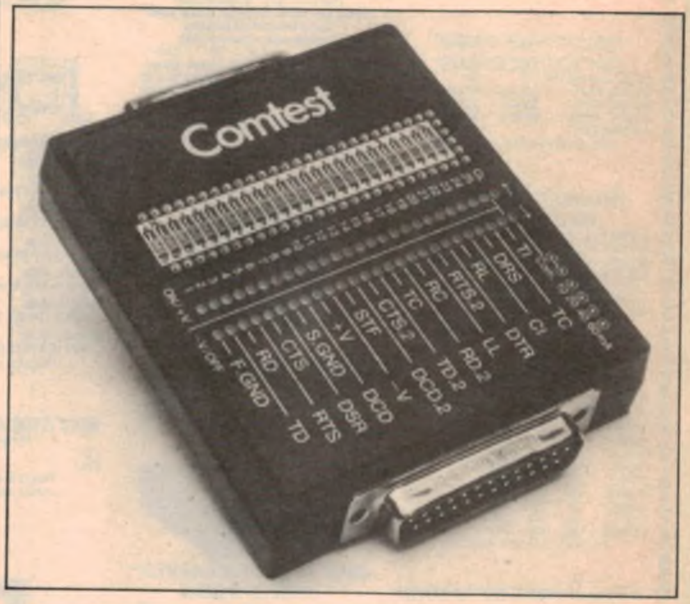
N.S.W. DISTRIBUTOR: Bill Edge Electronics Pty. Ltd. 76 Porters Rd, KENTHURST 2156. Phone (02) 654 2046

Minimum account order is $50, minimum cash sale is $25. Minimum post/pack $3.00 Minimum account post/pack $5.00. Comet Road Freight, bulky items and/or over 10kg is extra.

Bank Card, Visa and Master Card Welcome!

Errors & Omissions Excepted

New Products...



Low cost intelligent modem from Avtek

Avtek Electronics have produced what they claim is the most intelligent modem available at a cost of only $499. Called "Megamodem", it emulates both the Hayes SM300 and SM2400 standards, as well as having easy access to the menu mode. It is claimed to be compatible with the majority of PC software.

The modem also has the ability to recognise both outgoing and incoming baud rates automatically and adjust to these rates. Connection is claimed to be "idiot proof" — the Megamodem has autoanswer and complete V21/V22/V23 standards.

For further information contact Avtek Electronics, PO Box 651 Lane Cove. Telephone (02) 427 6688.

In-line RS-232/V24 interface tester

Motivation Plus have just released the Comtest, a complete in-line RS-232/V24 interface tester. Equipped with 25 pairs of LEDs, 25 dual-in-line switches and 25 pairs of DTE-DCE interface pins Comtest can perform the following functions: Tri-state monitoring of all 23 signals: break and redirect all 25 lines; cross-patch all 25 lines.

Comtest can also perform a two-level (>2V and >25V) test of open circuit voltages, as well as 4-level current loop measurements (10, 20, 40 and 60mA).

For more information contact Motivation Plus, 12 Fetherstone St, Bankstown, NSW 2200. Telephone (02) 707 1126.

4-channel oscilloscopes from Tektronix

The trouble with most sophisticated and powerful test equipment is that it is difficult to use until you have some familiarity. To shorten the familiarisation period, Tektronix have introduced a range of easy to use oscilloscopes.

The new range of CROs feature single button set-up, save/recall set-up memory, set-up sequencing and set-up transfers (without a controller). Bandwidths range from 100MHz for the 2445A to 350MHz for the 255A.

All four models are four channel oscilloscopes with dual, delaying timebases and on-screen measurement cursors. Bandwidth improvements include carrying the full bandwidth capability ot the probe tip, even at 2mV/div sensitivity.

For more information contact Tektronix, 80 Waterloo Rd, North Ryde, NSW 2113. Telephone (02) 888 7066.

Toroidal current transformer design software

To compliment the recently released software for designing C-core and toroidal power transformers, Maneng Pty Ltd has available a program for the design of toroidal current transformers.

The software is suitable for use on either IBM MS-DOS systems or Apple IIe (64k + 80-column card). The program has been specifically written to comply with Australian Standard AS1675-1986, and will design metering current transformers of M or ME type and protection current transformers of P or PL type.

For further information contact Maneng Pty Ltd, 64 Brisbane Water Drive, Koolewong, NSW 2256. Phone (043) 41-1940.

Digital storage oscilloscope

Gould UK has announced a new digital storage oscilloscope which provides a range of automatic measurement and data processing facilities. It is intended for use in areas such as transducer-based mechanical and physiological testing and low-frequency electronic measurements.

The Gould 1604 is a 4-channel instrument incorporating two 20MHz, 8 bit A/D converters, plus large (10K) words for each channel. A built in digital colour plotter provides hard copies and there is an optional waveform processing keypad.

For more information contact Elmeasco Instruments Pty Ltd, PO Box 30, Concord, NSW 2137. Telephone (02) 736 2888.

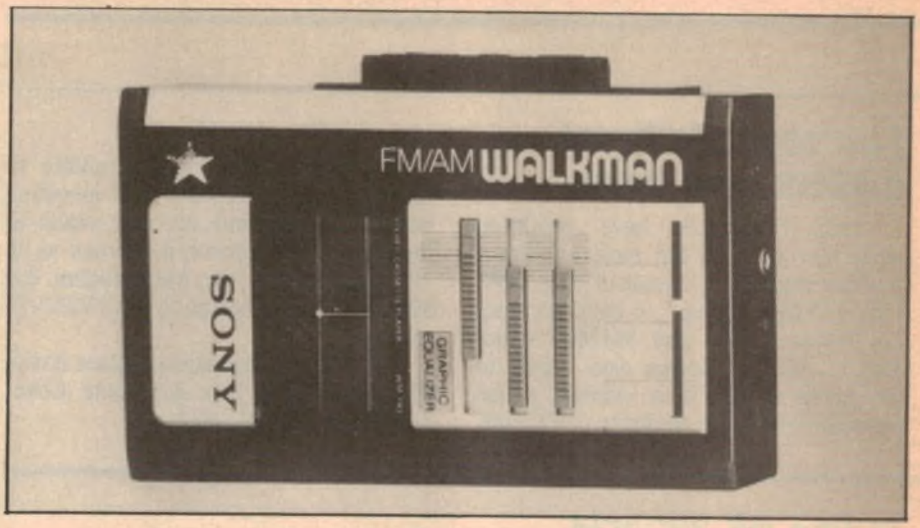
New Edition of Electronics Directory

The 1986-87 edition of the Australian Electronics Directory is now available. Listings include over 600 local suppliers representing 2,000 worldwide manufacturers. Overseas principals (4,000) and trade names are cross referenced to local suppliers. There are over 1900 product categories. The name and address section shows the head office, branches and contact numbers.

For further information contact Technical Indexes Pty Ltd, PO Box 98, Cheltenham, VIC 3192. Telephone (02) 981 5666.

New Products...

New Walkman players from Sony



Sony have released three new Walkman cassette players models to add to their already impressive range. The WM-31 is a small, lightweight (200g) stereo cassette player featuring metal tape capability and auto shut-off. It is supplied with headphones.

The WM-33 stereo cassette player has all the features of the WM-31 but also has a three band graphic equaliser so that users can tailor the sound to their liking.

And to top it all off, there is the Sony WM-F33 which combines all the features of the WM-31 and WM-33 together with an AM/FM stereo tuner while still managing to keep the weight to only 200 grams. Suggested retail prices are $69 for the WM-31, $89 for the WM-33 and $129 for the WM-F33.

For more information contact Sony (Australia) Pty Ltd, 33-39 Talavera Road, North Ryde, 2131. Telephone (02) 887 666.

Substitute for 7-segment displays

Another substitute for the FND500 7-segment display has just been introduced by Rod Irving Electronics. Designated the Senior SEC5011, it is a 12mm-high, pin-for-pin compatible and has a display brightness of 3.4mCd per segment. It does, however, lack the built in filter of the FND500 device

Also available is an equivalent for the FND507 common anode display. Retail price is $1.95 per display.

For further information contact Rod Irving Electronics 425 High Street, Northcote, 3070. Vic. Telephone (03) 663 6151.

Heat sinks for plastic transistors and regulators

If you only have a small PCB and a plastic case, how do you get around the problem of heatsinking small TO-220 and TO-202 transistors and regulators? The answer is to use a TO-220 heatsink from Rod Irving Electronics.

The fluted matt black heatsinks are small enough not to interfere with other components on the PCB and can really make a difference to hard working devices. The cost is only 30 cents each.

For more information contact Rod Irving Electronics, 425 High Street, Northcote, Vic. 3070. Telephone (03) 663 6151.

Phase measuring oscilloscope

Parameters Pty Ltd, the marketing arm of BWD Precision Instruments, has announced the release of the BWD model 881 Powerscope II. This instrument, which is designed and manufactured by BWD in Australia, can measure voltage, current, power, phase and time. It is the only instrument available in the world today that will display multiple in-circuit high-voltage power control measurements safely, simply and accurately.

Main features of the Powerscope II are as follows: 25MHz bandwidth 20mV sensitivity, external trigger view, CH1 x CH2DC — 10MHz multiplier, a rise time of 14nsec, phase angle measurements with pushbutton control, and the ability to display power measurements. The device can in fact display four completely independent signals with levels from 20mV to 2kV from equipment operating directly in single or multiphase power lines or at high DC levels.

For further information contact Parameters Pty Ltd, Centrecourt, 25-27 Paul Street North, North Ryde, NSW 2113. Telephone (02) 888 8777.

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

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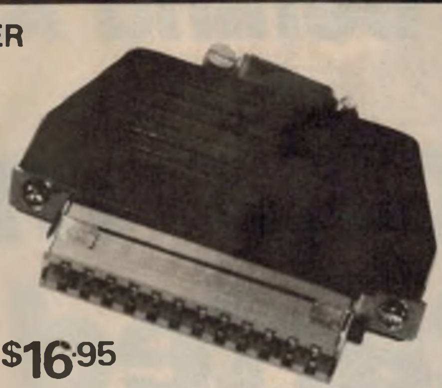
COMMODORE COMPUTER EDGE CONNECTOR

Geoff is actually putting these connectors together himself because no one can supply a proper connector for the Commodore expansion port. Yes this connector has the two polarising keys so you can't plug it in the wrong way round and blow things up!! Also has a posh U.S. made back shell. Needless to say the two rows of 12 contacts are gold plated and of the correct pitch. The polarizing feature alone makes it well worth $16.95.



$16.95

MODULAR DIP-SWITCH SUPER SPECIAL 60c

What would you expect to pay for quality EECO rocker DIP switches? Would you believe 30cents per actuator? We've secured a quantity of two pole switches which can be stacked to get any even number of switches you like on the same PCB pitch - yes a 20 SPST gang or more if you like.
They're rated at 1Amp, 28V non-switching or 125mA switching. Gold over copper alloy switch contacts and tin-lead over copper alloy terminals. Rugged sealed construction. Actuators can be locked against accidental actuation. 60 cents each (twin actuators blocks) but hurry.

NEW RANGE OF HIGH QUALITY TEST LEADS

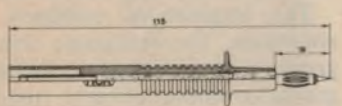
Sick of those stiff plastic test leads that come with most multimeters? You know the ones that kink and produce pungent smoke when you touch them with a soldering iron? Well we've done something about it and proudly introduce the HCK range of quality silicone leads.
It's impossible to describe how flexible they are. You wouldn't believe that a 1000V/16Amp rating cable could be so er, floppy (?). Cable has soldering-iron proof silicon rubber insulation with 512 strands of copper inside, -100 C to 300 C temperature range. Plugs are stackable, extremely hard-wearing. Choice of black, red, blue, yellow, green and violet.

4mm Test Leads
Stackable with special cracking protection grid. Laminated cage spring contact with virtually no contact resistance. Available in three lengths - 500mm **$5.66**, 1.0m **$7.21** and 1.5m **$8.66** with exposed plug on each end.

4mm Safety Shrouded Leads
Available with straight or 90 plugs. Available in 1 metre length only. Straight **$9.43** 90 **$9.99**

4mm Safety Prod Leads
Available with straight or 90 plug. Available in 1 metre length only. Straight **$10.15** 90 **$10.60**

4mm Plug-On Test Prods



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Accepts 4mm plug and features quality steel hook **$9.43**

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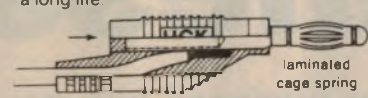
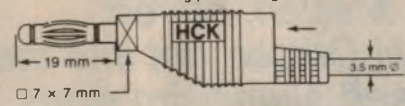
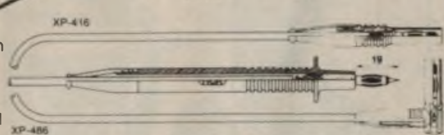
No exposed parts. Fully epoxy-resin insulated. Grips down to 1mm and won't fall off **$10.54.**

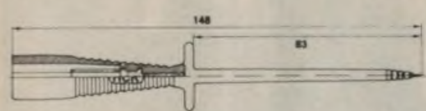
We will also be stocking the cable cut to length. Not cheap but an investment in real quality and a long life.



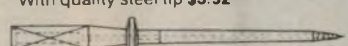
16 A Universal Test Lead with cracking protection grid



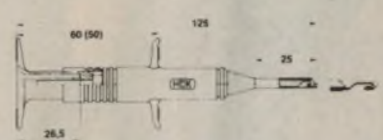


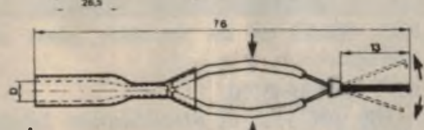


With quality steel tip **$3.92**

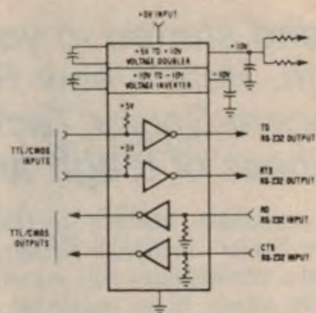


250V rated 130mm with steel tip **$2.66**





Prices are for single items only.



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The story behind Armsign

How one man got started in business

Getting started in your own business can be tough. Here's how Russ Maslen, retired Telecom Senior Technical Officer, got into the business of tough anodised aluminium signs.

The connection between a retired Telecom Senior Technical Officer, a park and a revolutionary new system of signs may appear to be somewhat obscure. The three have, however, combined to produce a new product in the form of anodised aluminium labels, plaques and signs for engineering applications, botanical specimens, town signs, marine uses and a host of other applications in virtually any type of environment.

Russ Maslen retired from the position of Senior Technical Officer at Mullumbimby in the far north coast of NSW during 1981 and, being a keen conservationist, was deeply involved in the formation of the local Brunswick Valley Heritage Park. The park was originally a leased horse paddock and it was proposed that an area of some four hectares be developed as a long term leased caravan park.

Because it was situated along the banks of the Brunswick River, a large number of objections were received by Council. The Byron Flora and Fauna Conservation Society, to which Russ belonged, proposed that the area should be a botanic park containing one specimen of each tree which originally grew in the district, in addition to picnic tables, seats and normal park equipment. The first tree was planted in June 1980 and since then some 270 species have been planted.

Russ Maslen at the anodising plant of Armsign.

The problem of identification labels for the trees was immediately apparent. They had to be cheap since all finance was raised from street stalls, they had to be readable in sunlight or shade and they needed to last "for ever". Many ideas were tried but none satisfied the requirements. Then one day, a flash of inspiration: "why not anodised aluminium?"

No information was available locally other than that a direct current passed through an acid bath with the aluminium as anode resulted in an oxide coating being formed. But with perseverance and the help of the Richmond-Tweed Regional library, technical books from all over the state were procured. Russ soon became an expert on the theoretical aspects of anodising.

Using plastic refrigerator dishes, a modified battery charger and his wife's frypan, Russ then experimented for about six months until finally an acceptable sign appeared in the dish. Turning it over in various lighting situations it was immediately apparent that it was better than anything else around.

The implications suddenly became enormous. The realisation that durable graphics of all types, including photographs of various colours, could be produced had immediate commercial attractions.

What to call the system was the next question. Since Russ's initials are ARM, Armsign — "The Armoured Sign" — was born.

Getting started

Due to medical reasons Russ could not undertake the problems of producing the signs on a commercial basis, so his son, Alan, a painter and decorator, gave up that business and they undertook the task of getting Armsign off the ground. Alan handled the business side whilst Russ carried on with research and development. The system was submitted to patent and trademark attorneys and Armsign was registered.

Since their capital was virtually nonexistent the raising of finance to buy power supplies, tanks and refrigeration equipment was the first objective. The power supply necessary to produce a 1-metre square sign must be capable of producing a variable output voltage up to 18V DC and have a current rating of some 300 amps. This equates to a power rating of about 5kW.

Refrigeration was necessary in order to keep the anodising tank temperature at an optimum figure, with 300 amps passing through the sulphuric acid solution. Since the signs were a new product, all equipment had to be designed to suit and was manufactured locally with the exception of the printing table and associated items.

Approaches to various finance institutions resulted in a kick in the teeth on every occasion. Government authorities, development sections of the banking world, finance brokers etc all gave the same answers. The conversation went something like this:

"We need finance for this new sign."

"Yes it really is a good product. What are your last two months sales figures?"

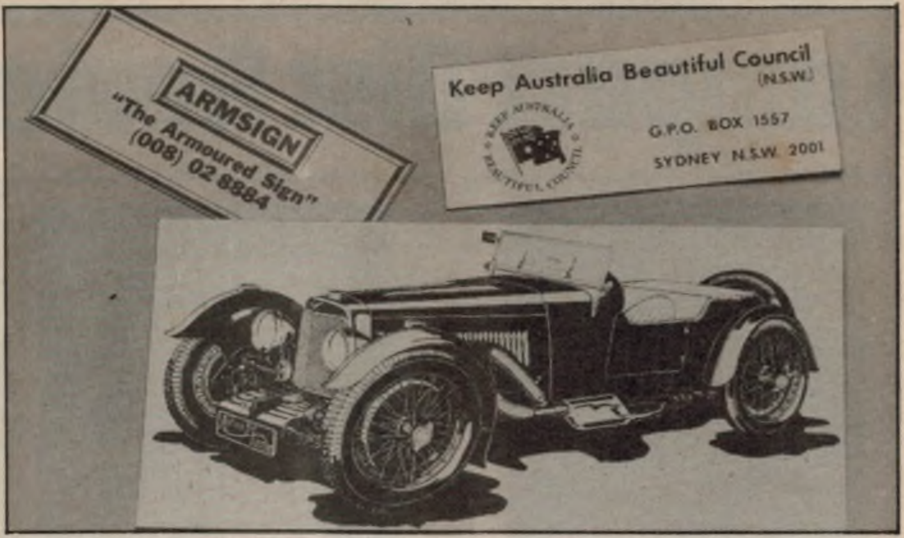
"We haven't sales figures because we haven't the finance to buy the equipment which is why we are here."

"Well, we can't let you have finance without knowing sales figures".

It was the proverbial Catch 22.

Despite this, small signs were being produced in plastic dishes and frypans with home built 25 amp power supplies. Several engineering companies ordered labels for diverse items inlcuding water treatment plants, mechanical equipment and electrical items, some of which were exported. Endorsements started to roll in, the main one being the Keep Australia Beautiful Council (N.S.W.) who had seen Russ's hand written signs in the Brunswick Valley Heritage Park.

Eventually, the decision was made to form a Pty Ltd company financed by relatively small amounts of money from friends and acquaintances, all of whom were "little people" in a financial sense. So finance was available and the necessary items were purchased — some $45,000 worth in all. The factory was set up, phones and offices organised and the new plant switched on in August 1986.



The Armsign process can produce both text and graphics.

Wrong phase

And then the new power supply only gave out 10 volts. A visit by an engineer from the company that manufactured the supply soon established that one phase of the 415V supply to the plant was open circuit at the isolating switch. So it was working on only two phases. After repair, it worked.

Then the production problems began. Applied voltages, current densities, temperature, solution concentration and the presence of impurities in the aluminium alloy all affected the resultant quality of the sign and stretched Russ's high school chemistry. But the problems have now been solved and signs are being produced.

A marketing organisation was set up and the sales team is now receiving orders from as far afield as Perth and Brisbane. Hence the development of Armsign has resulted in employment opportunities being created in a currently depressed situation. Research and development is undertaken each time someone requests a new application.

Armsign is located at 50 Diadem Street, Lismore (PO Box 3, Lismore Heights, 2480). The telephone number is 008 02 8884.

Alan Maslen checks a newly produced anodised aluminium Armsign.

Compact Disc Reviews by RON COOPER

JULIAN WEBBER

Pieces
Playing Time: 41 min 5 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

This is one of those recordings which I find hard to categorise. I feel it is either high-brow pop or classical slop. Probably it is somewhere between, perhaps good background music when non-musical friends come for dinner. A more apt title would be "bits and pieces" which either appeal or don't

Whilst Julian Lloyd Webber is obviously a most accomplished cellist and produces a superb tone, I was most unimpressed with his sloppy version of the beautiful cor-anglais solo from Dvoraks "New World" Symphony.

These are very modern arrangements with an obvious plethora of electronic instruments and effects including a ghastly sounding electronic piano (couldn't they borrow a "Bosendorfer"?).

The balance of the orchestra and cello are very good and where the effects don't override this, the sound is rich and well balanced albeit electronically; but with some of the overmiking electronic reverberration and mixing you end up at times with two channel mono.

Polydor are not very generous with their playing time either and there are no cover notes, just times and titles. Definitely not for me but no doubt it will appeal to some. (R.L.C.)

COPPELIA

Delibes
Playing Time: 1. 45 min 33 sec
2. 45 min 34 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

In 1867, Leo Delibes was given a commission to write a ballet score for the Paris Opera. At this time he was at the threshold of his career, not actually having written a ballet score but proving his natural gift in this area by collaborating with Ludwig Minkus in the ballet "La Source" which was performed by the opera company in 1866.

Delibes was obviously well schooled, having studied composition under Aldolphe Adam, the composer of Giselle.

For most people this music needs little introduction; it is simply ballet music at its best — bright, colourful, rythmic and full of great orchestral effects.

Just looking at the label, from previous CDs of Decca and, with this music directed by Richard Bonynge, my attitude was almost ho-hum; I felt this one had to be good. I was not disappointed. This is a 1986 all-digital recording, and it is simply stunning.

There is an excellent sound stage, with an eerie silent background, apart from the atmosphere of musicians in front of you.

All up, this version is tops. And it has excellent notes on how Coppelia came to be written and of the people associated with the first performance. (R.L.C.)

NEVILLE MARRINER

Scandinavian Music
Playing Time: 73 min 24 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

This is a most interesting disc as it features popular classical music from romantic and modern composers of Scandinavian music.

The Holberg suite was transcribed by Greig from music by other Norwegian composers and has become a popular concert work. Similarly, the Elegiac Melodies are also transcriptions for string orchestra but with the originals being two songs published in Copenhagen in 1881 by Aasmund Olavson Vinje.

The Sibelius piece "Valse Triste" can only be described as a popular evergreen and is from the incidental music to a play by his brother-in-law Arvid Jarnefelt.

Nielsen's "Little Suite" is a lesser-known modern work and has a pleasant freshness about it, while the "Serenade" composed by Dag Wiren in 1937 was an immediate success. The last movement of this work was used n the popular TV series "Dr Finlay's Casebook".

The overall mixture is another superb disc from Neville Marriner and the Academy, in both musical direction and sound quality. There is just a hint of background noise from this analog recording but that is all. The disc is excellent value too with 73 minutes of playing time. (R.L.C.)

Back by Popular Dem

DATA & REFERENCE

DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS
A. Michaels **BP0140**
Shows equivalents and pin connections of a popular user-orientated selection of European, American and Japanese digital ICs. Also includes details of packaging, families, functions, manufacturer and country of origin.
$18.00
256 pages (Large Format)
(Available February 1987)

LINEAR IC EQUIVALENTS AND PIN CONNECTIONS
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Shows equivalents and pin connections of a popular user-orientated selection of European, American and Japanese linear ICs. Also includes details of functions, manufacturer, and country of origin.
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INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE
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CHART OF RADIO, ELECTRONIC, SEMICONDUCTOR AND LOGIC SYMBOLS
M. H. Babani, B.Sc.(Eng) **BP0027**
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$4.00
Chart

RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART
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Covers many colour codes in use throughout the world, for most radio and electronic components. Includes resistors, capacitors, transformers, field coils, fuses, battery leads, speakers, etc.
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Chart

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BUILD YOUR OWN SOLID STATE HI-FI AND AUDIO ACCESSORIES
M. H. Babani **BP0220**
An essential addition to the library of any keen hi-fi and audio enthusiast. The design and construction of many useful projects are covered including: stereo decoder, three-channel stereo mixer, FET pre-amplifier for ceramic PUs, microphone pre-amp with adjustable bass response, stereo dynamic noise filter, loud-speaker protector, voice-operated relay, etc.
$6.00
96 pages

AUDIO PROJECTS
F. G. Rayer **BP0090**
This book covers in detail the construction of a wide range of audio projects. The text has been divided into the following main sections: Pre-amplifiers and Mixers, Power Amplifiers, Tone Controls and Matching, Miscellaneous Projects.
All the projects are fairly simple to build and have been designed around inexpensive and readily available components. Also, to assist the newcomer to the hobby, the author has included a number of board layouts and wiring diagrams.
$8.50
96 pages

COMPONENT SPECIFIC

MODERN OP-AMP PROJECTS
R. A. Penfold **BP0106**
Includes a wide range of constructional projects which make use of the specialised operational amplifiers that are available today, including low noise, low distortion, ultra-high imput impedance, low slew rate and high output current types. Circuits using transconductance types are also included.
All of the projects are fairly easy to construct and a stripboard layout is provided for most of them so that even constructors of limited experience should be able to build any of the projects with the minimum of difficulty.
$8.50
112 pages

MODEL RAILWAY PROJECTS
R. A. Penfold **BP0095**
The aim of this book is to provide a number of useful but reasonably simple projects for the model railway enthusiast to build, based on inexpensive and easily obtainable components.
The projects covered include such things as controllers, signal and sound effects units, and to help simplify construction, stripboard layouts are provided for each project.
$8.50
112 pages

AERIALS

AERIAL PROJECTS
R. A. Penfold **BP0105**
The subject of aerials is vast but in this book the author has considered practical aerial designs, including active, loop and ferrite aerials which give good performances and are relativley simple and inexpensive to build. The complex theory and mathematics of aerial design have been avoided.
Also included are constructional details of a number of aerial accessories including a pre-selector, attenuator, filters and tuning unit.
$8.50
96 pages

25 SIMPLE AMATEUR BAND AERIALS
E. M. Noll **BP0125**
This concise book describes how to build 25 amateur band aerials that are simple and inexpensive to construct and perform well. The designs start with the simple dipole and proceed to beam, triangle and even a mini-rhombic made from four TV masts and about 400 feet of wire.
You will find a complete set of dimension tables that will help you spot an aerial on a particular frequency. Dimensions are given for various style aerials and other data needed for spacing and cutting phasing lengths. Also included are dimensions for the new WARC bands.
$6.50
80 pages

25 SIMPLE SHORTWAVE BROADCAST BAND AERIALS
E. M. Noll **BP0132**
Fortunately good aerials can be erected at low cost, and for a small fractional part of the cost of your receiving equipment.
This book tells the story. A series of 25 aerials of many different types are covered, ranging from a simple dipole through helical designs to a multi-band umbrella.
$6.50
80 pages

25 SIMPLE INDOOR AND WINDOW AERIALS
E. M. Noll **BP0136**
Written for those people who live in flats or have no gardens or other space-limiting restrictions which prevent them from constructing a conventional aerial system.
The 25 aerials included in this book have been especially designed, built and tested by Mr. Noll to be sure performers and give surprisingly good results considering their limited dimensions.
$6.00
64 pages

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E. M. Noll **BP0145**
Shows you how to build 25 simple and inexpensive aerials for operation on the medium wave broadcast band and on 60, 75, 90 and 120 metre tropical bands. Designs for the 49 metre band are included as well.
$6.00
64 pages

FAULT-FINDING

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
R. A. Penfold **BP0110**
The aim of this book is to help the reader overcome problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.
Chapter 1 deals with mechanical faults such as tracing dry joints, short-circuits, broken P.C.B. tracks, etc. The construction and use of a tristate continuity tester, to help in the above, is also covered.
Chapter 2 deals with linear analogue circuits and also covers the use and construction of a signal injector/tracer which can be used to locate and isolate the faulty areas in a project.
Chapter 3 considers ways of testing the more common components such as resistors, capacitors, op amps, diodes, transistors, SCRs, unijunctions, etc., with the aid of only a limited amount of test equipment.
Chapter 4 deals with both TTL and CMOS logic circuits and includes the use and construction of a pulse generator to help fault-finding.
$8.50
96 pages

AUDIO AMPLIFIER FAULT-FINDING CHART
C. E. Miller **BP0120**
This chart will help the reader to trace most common faults that might occur in audio amplifiers. Across the top of the chart are two "starting" rectangles, vis Low/Distorted Sound Reproduction and No Sound Reproduction: after selecting the most appropriate one of these, the reader simply follows the arrows and carries out the suggested checks until the fault is located and rectified.
$4.00
Chart

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112 pages

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112 pages

MISCELLANEOUS

COIL DESIGN AND CONSTRUCTION MANUAL
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$10.00
144 pages

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$12.00
192 pages

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and... Babani Books!

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This book covers in detail, the construction of a wide range of test equipment for both the electronics hobbyist and radio amateur. Included are projects ranging from a FET amplified voltmeter and resistance bridge to a field-strength indicator and heterodyne frequency meter.
Not only can the home constructor enjoy building the equipment but the finished product can also be usefully utilised in the furtherance of his hobby.
$8.00
96 pages

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O. Bishop **BP0073**
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$9.50
176 pages (Available February 1987)

ELECTRONIC GAMES
R. A. Penfold **BP0069**
Contains a number of interesting electronic games projects using modern integrated circuits. The text is divided into two sections, the first dealing with simple games and the latter dealing with more complex circuits thus making the book ideal for both beginner and more advanced enthusiast alike.
$8.00
96 pages

IC 555 PROJECTS
E. A. Parr **BP0044**
Every so often a device appears that is so usefull that one wonders how life went on before without it. The 555 timer is such a device. Included in this book are basic and general circuits, motorcar and model railway circuits, alarms and noise-makers as well as a section on the 556, 558 and 559 timers.
$9.50
176 pages (Available February 1987)

HOW TO DESIGN AND MAKE YOUR OWN P.C.B.s
R. A. Penfold **BP0121**
Chapter 1 deals with the simple methods of copying printed circuit board designs from magazines and books and covers all aspects of simple P.C.B. construction as comprehensively as possible. Chapter 2 covers photographic methods of producing p.c.b.s and Chapter 3 deals with most aspects of designing your own printed circuit board layouts.
$6.50
80 pages

POWER SUPPLY PROJECTS
R. A. Penfold **BP0076**
The purpose of this book is to give a number of power supply designs, including simple unstabilised types, fixed-voltage regulated types, and variable-voltage stabilised designs, the latter being primarily intended for use as bench supplies for the electronics workshop. The designs provided are all low-voltage types for semi-conductor circuits. This book should also help the reader to design his own power supplies.
$7.50
96 pages

HOW TO DESIGN ELECTRONIC PROJECTS
R. A. Penfold **BP0127**
The aim of this book is to help the reader to put together projects from standard circuit blocks with a minimum of trial and error, but without resorting to any advanced mathematics. Hints on designing circuit blocks to meet your special requirements where no "stock" design is available are also provided.
$9.00
128 pages

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Many people associate the term "security device" with only burglar alarms of various types, but in fact, any piece of equipment which helps to protect people and property against any form of danger could be termed a "security device".
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$9.50
112 pages

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Information centre

Speed sensor for cruise control

I have a request concerning the Cruise Control for Cars described in EA June 1984. I would like to build this project but cannot buy the speed sensor equipment. I would appreciate your advice on the availability of this item.

By way of interest, I became interested in cruise control on a recent trip to Adelaide. Prior to that I just hadn't realised how flat Australia is!

I have tried several in my car but all were of Taiwanese origin. None worked and I finally opted for getting my money back. The next price bracket is $300-400. (J.B., Blaxland, NSW).

● The speed sensor is no longer available commercially but you can easily make up your own by winding about 300 turns of 0.4mm enamelled copper wire on a 4mm steel bolt. The coil should be about 12 to 15mm long.

You should be able to buy small magnets from hobby shops and department stores.

Varicap diode for tunable whip antenna

I wish to buy into the discussion on parts availability for projects which you describe in your magazine, with a difference. Your July '86 edition featured a constructional article on a tunable whip antenna.

Did you people investigate parts availability for the critical item — the BB212-2 varicap diode? It took me about 15 phone calls before I could even find out who manufactures them. Initially, even Philips denied that they were theirs! Then the final crunch was that there are none available in Australia. Expected delivery: end of August! So much for your fine project. (G.H., Wembley Downs, WA).

● The BB212-2 varicap diode is available from Geoff Wood Electronics, 229 Burns Bay Rd, Lane Cove West, NSW 2066. The same diode was used in the Playmaster AM/FM Stereo Tuner which is sold by Jaycar Pty Ltd. In other words, the part was available and in stock from at least two suppliers when the article went to press.

Parts for 50V/5A power supply

I am currently building the 50V/5A Laboratory Power Supply described in your May 1985 issue. My problem is that I cannot locate the toroids specified in the article here in New Zealand, nor can amateur friends in Australia locate a source. What source did you use for your unit?

I would also like to mention that I have built a number of EA projects and have had no problems at all in getting them to work. My thanks to your team. (A.S., Christchurch, NZ).

● The Neosid toroids used in this power supply (type 17-143-10 and type 17-146-10) are available from Phoenix Industrial Pty Ltd, 68 Alexander St, Crows Nest, NSW 2065. Alternatively, you can buy them from Altronics Pty Ltd, 151 York St, Subiaco, WA 6008 (catalog numbers L5120 and L5130 respectively).

Blinking digital capacitance meter

I recently purchased a kit for the Digital Capacitance Meter which was published in the August 1985 issue of *Electronics Australia.* Unfortunately though, I am having some difficulties with it.

It will not give a measurement for capacitance values below 100pF and the last two digits blink from one reading to another. For example, when measuring a test capacitor which has a value of 288pF, the indicated value varies from 285 to 290pF; when measuring an 8.3nF capacitor the reading blinks from 8.3 to 8.4nF and so on.

I have built a lot of EA projects over the years, starting with a bench-type vacuum tube voltmeter and valve tester from the 50's, and would like to compliment you on your projects. I hope you can help me with these present difficulties. (C.B., Gillieston Heights, NSW).

● The digital capacitance meter will measure values below 100pF quite reliably provided the correct Schmitt trigger is used for IC1. This should be a 74C14 or 40106, as specified in the article. Some kitset suppliers have been supplying the MC14585 type which is unsuitable.

The last digit of the display is liable to jitter by plus or minus one, particularly on the pF range. This is a characteristic of most digital instruments. If you don't like it, it can be improved in this circuit by using a separate Schmitt trigger oscillator in place of IC1c. This is done by mounting a second Schmitt trigger IC on top of the existing one in piggyback fashion, and soldering their supply leads (pins 14 and 7) together.

It's then simply a matter of wiring connections for the gating oscillator directly to the piggyback IC.

The reason why this cure would appear to work is that, by having a second Schmitt trigger IC, there is less oscillator interaction via the supply rails.

Playmaster 60/60 confusion shock/horror

My Playmaster 60/60 has the problem of over-heating referred to in the errata published on page 125 of the November 1985 edition but there is disagreement between the text and the diagram. The text refers to an MJ340 transistor while the diagram shows an MGE340. I hope I have made the correct interpretation by ordering MJE340s.

Presumably, bad thermal contact by the BC547s is the real cause of the problems as these clips are a bit "Heath Robinson". I note you advise changing the value of the 470 ohm resistor between collector and base of Q12 to 1k. Will it still be within the range of VR1 which presumably needs to balance it? (R.V., St Georges Basin, NSW).

● Our staff member with the specially hardened posterior has been made to pay for this compounded error. Your interpretation of the type numbers is correct. While MJ340 sounds plausible, as a power transistor, say, there isn't any such beastie and neither is there any such device as an MGE340.

As far as BC547s are concerned, their thermal contact with the heatsink would not have been a problem if an anodised aluminium chassis had been used by kitsellers instead of a steel chassis with (smaller ventilation slots) which does not dissipate the heat as well.

In any case, it is not the thermal contact but the "tracking" of the temperature-dependent parameters of Q12 with the output transistors which is crucial. By specifying MEJ340s (oops, er, MJE340s. Yep, Got it right this time . . . Ed.) instead of BC547s, the degree of thermal tracking is better and hence the tendency to overheat is eliminated.

Fancy waves and op amps

I have read the EA publication *Op Amps Explained* and found it very interesting, even if the mathematics did go a bit beyond me. The section I found most interesting, and the reason I am writing this letter, is about analog computers.

What kind of system would it take to generate all possible (or a wide variety at least) waveshapes, given that you had, say, five variable inputs or feedback paths? If such a circuit is possible, what would its characteristics be; ie, output frequency, voltage, current, etc? If you could give a description of such a circuit, I would be most grateful. (J.J., Bondi Beach, NSW).

● When you think about it, the number of possible waveshapes from a generator is limited only by the complexity of the circuit. A simple analog circuit might generate one or two waveforms, such as square and sawtooth waveforms (as described in the *Op Amps Explained* book) whereas a more complicated circuit can generate more.

If you just want a circuit to generate sine, square and sawtooth waveforms, the simple answer is to use the XR2206 waveform generator IC. This was featured in the EA Function Generator published in the April 1982 edition.

Wire trap for amplifier builders

Builders of the Playmaster 60/60 amplifier kits should be warned of a trap into which I fell and which cause failure if not spotted. I received, in my Jaycar kit, what was by all appearances, a metre of clean bright tinned copper wire which turns out to be clear plastic coated.

As a keen amplifier builder since the 1930s and now in my 78th year I have never before seen wire with an invisible coating. Needless to say, I installed it for the shorter wire links without finding out that it needed to be stripped. Joints were difficult to make and did not look perfect.

It was not until my son condemned my work and started to replace the links that the cause was found. Others may not be so lucky unless warned in time.

I am looking forward to being able to report completion of what I expect to be the best sounding amplifier of a lifetime. (E.R., Mt Rumney, Tas).

● In this sort of case, we would be tempted to say that this clear-coated wire was a trap for young players but perhaps that would not be right. Thanks for bringing the problem to our notice. It turns out that the staff at Jaycar have become aware of the problem and are now putting an explanatory note about the need for stripping in with the kits.

Wants radio-control circuit modifications

I built the speed control circuit for radio-controlled cars which was published in the Circuit & Design Ideas pages of the December 1985 issue of EA. I managed to get the circuit working after correcting some minor errors (pins 2 and 8 reversed on IC1a and the 1k and 220 ohm resistors interchanged).

The motor draws about 4 amps from the 7.2V NiCd battery and although reversing and speed control is OK under no-load conditions, the unit does not provide enough power from the battery to operate the car satisfactorily under load.

Could you suggest any changes that could be made to allow full battery power at full throttle and also to increase the output over the speed control range of the received signal?

The speed control unit supplied with the car is just a two-stage resistive load with full throttle a direct connection of motor to battery. This provides a jerky speed control with wasted battery power for braking and slow speeds. The unit as constructed above will run the car but acceleration and hill-climbing ability are very poor. (B.D., Caringbah, NSW).

● We think that the TIP31 and TIP32 transistors specified in the December 1985 circuit are probably not up to the task of driving the car's motor. We note that the motor draws 4 amps (presumably when directly connected to the battery). The TIP31 and TIP32 are rated at 3 amps continuous or 5 amps peak. They might just squeak in but it is also likely that the 27 ohm base current limiting resistors for Q3 and Q5 stops them from saturating and thus prevents full power delivery.

We suggest you try substituting higher-rated transistors such as the TIP41 (NPN) and TIP42 (PNP). At the same time, try reducing the R3 and R4 values to 10 ohms. That should be a fair compromise between power loss in the transistors and power loss in the current-limiting resistors.

Radio Australia reception problems

On a recent trip to Europe I took a moderately expensive multiband receiver of the type made for travellers, small and light enough to slip into a backpack (Sony 7600A), and a copy of Radio Australia's time/frequency schedule. This was in the hope that I could keep in touch with news from home. Despite the fact that I augmented the radio's aerial with a length of hook-up wire, often clipping to a larger metallic body, I was not successful.

Not once in two months was I able to receive Radio Australia at any time during the day or night. The radio itself is an excellent performer and I don't blame it. Undoubtedly, the crammed frequency spectrum and the high background noise in Europe contributed, as did the fact that Europe is not Radio Australia's prime target area. But I did at least expect to be able to hear something from Australia sometimes.

I wonder if any of your readers have experienced the same problem and if anyone has overcome it, short of going to a communications receiver and full aerial array?

Though I'm not as old as your magazine I've read every issue since Vol 1 No 1 and still find it fascinating. Cheers. (M.A., Young, NSW).

● It would seem that most of the reasons for not being able to pick up Radio Australia have been covered in your letter but we have included it in case some reader can throw some light on the topic.

Notes and Errata

SCREECHER CAR BURGLAR ALARM (August 1986, File 3/AU/49): there is an error in the errata published in November 1986. The emitter of Q3 should connect to the emitter of Q2, not the base of Q2.

PLAYMASTER 60/60 STEREO AMPLIFIER (May-July 1986, File 1/SA/75): Q12 should be an MJE340 transistor (not MJ340 or MGE340 as specified on errata for November 1986).

EA marketplace EA marketplace

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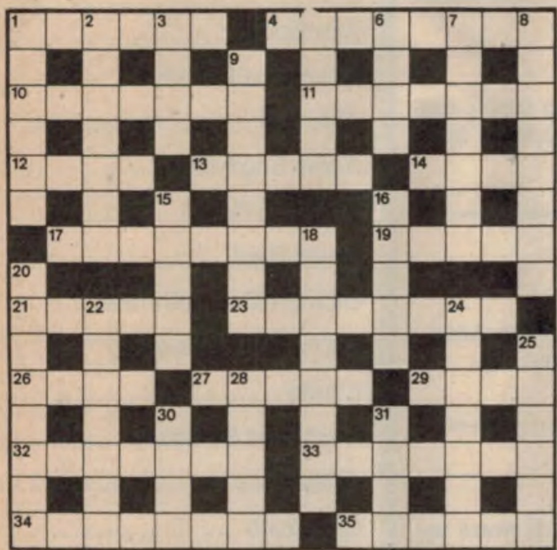
ACROSS

1. Silicon-based mineral. (6)
4. Area for constructive activity. (8)
10. Above threshold of hearing. (7)
11. Prepares soldering bit. (4)
13. Plenty of drive. (5)
14. A small DC voltage. (4)
17. Multi-electrode valves. (8)
19. Electronic musical instrument. (5)
21. George ——— gave rise to current logic. (5)
23. Type of memory. (4-4)
26. Parts of a drive system. (4)
27. Diesel-electric loco maker, ——— Engineering. (5)
29. Nils Bohr was a great - (4)
32. Solidify. (3,4)
33. Having more spurious signals. (7)
34. Recent variant of AM. (1,1,6)
35. Mechanical contrivance. (6)



DOWN

1. Packets of electromagnetic energy. (6)
2. Musical tempo. (7)
3. Term for a valve. (4)
5. Amplifying circuit module. (2,3)
6. Flying object. (4)
7. One of the five senses. (7)
8. A record. (8)
9. Break a joint. (8)
15. Control direction. (5)
16. Business computing language. (5)
18. Type of wave. (8)
20. The x-coordinate. (8)
22. Logic devices. (2,5)
22. Means of renting. (7)
25. Committed to memory. (6)
28. Oliver ———, discoverer of radio tuning. (5)
30. One of a batch of recordings. (4)
31. Natural insulator. (4)

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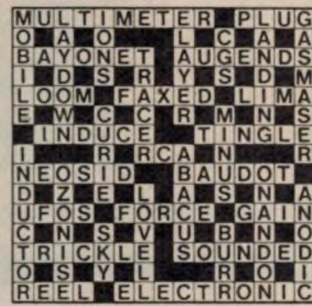

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Dual-tracking power supply

Based on readily available components, this new dual-tracking power supply can provide voltages from 0 to ±21V at currents of up to 2A. It also features foldback current limiting and a fixed regulated +5V output.

A ride on the Bond Airship

What's it like to fly in the Bond Airship which will be used to cover the America's cup races next month. Our intrepid reporter hitched a ride to find out.

Digital sound recorder

We really do promise to run this unique audio recorder next month. It stores up to 15 seconds of audio in RAM (random access memory) for instant replay at the press of a button — just the shot for use with a shop display or as a novel doorbell.

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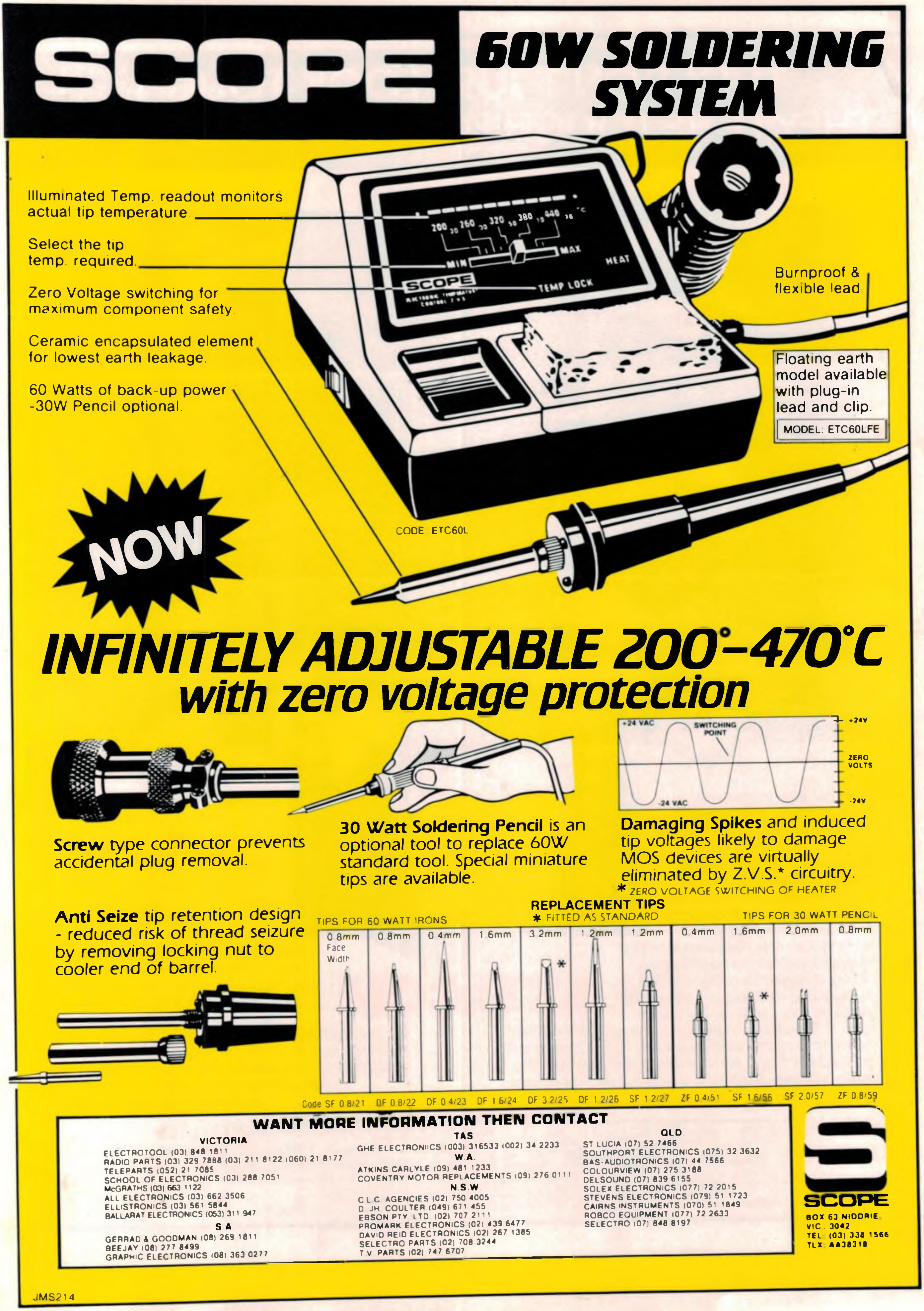
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