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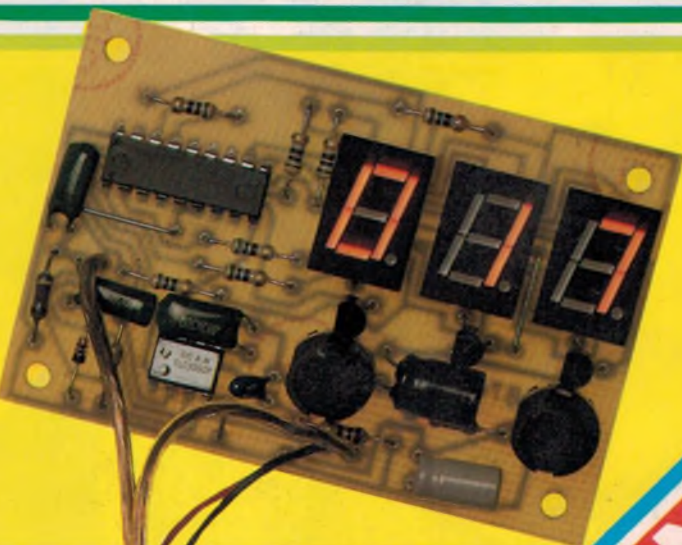

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Volume 49, No.3

Electronics Australia

March 1987

THIS MONTH'S COVER

Get ready for the next deluge by building our very clever electronic rain gauge. It even empties itself to save you from getting wet. Details page 58.

Features

Entertainment Electronics

Projects and Technical

News and Comment

Departments

Deep cycle nicad battery charger

This nicad battery charger will make a dramatic difference to your nicad cells. Unlike most other chargers, it correctly discharges each cell to its end point so that it can then be charged to full capacity. Details page 80.

Price rise:

We apologise for having to raise the price yet again to cover our increases in costs. We thank all our readers for their continuing loyalty.

TV booster and distribution amplifier

Got problems with your TV reception? This simple unit can be employed either as a masthead amplifier or as a distribution amplifier so that you can run signals to several points in your house. See page 28.

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Letters to the editor

In defense of vinyl records

I was very disturbed reading the "Editorial Comment" (December, 1986) in which Leo Simpson described hifi dealers and distributors promoting vinyl discs as superior to CD as either misinformed or liars.

I have no commercial interest in audio equipment. I do however take great pleasure in listening to music and for 25 years have owned and endeavoured to enjoy music through many items of audio hardware. The hardware is only a means to an end and has no purpose for me other than to provide the best possible source of music in a domestic environment within my available budget.

The advent of CD was welcomed as a likely superior signal source, taking away some of the variables and inconveniences of vinyl discs and turntables. Unfortunately the promise of "perfect sound forever" has yet to be achieved by any CD player I have heard. Mr Simpson states that anyone with functioning ears can hear the superiority of CD due to lack of cracks, pops, surface noise, etc with CD. What about the music Mr Simpson?

A competently engineered turntable will reduce record imperfections to a neglible level. Unlike CD it will also produce music with which one can easily achieve a feeling of involvement — an emotional involvement if you like. It's hard to measure with test equipment but very apparent to music lovers with "functioning ears!"

I find that CD sounds flat, lacking in true dynamics and depth. Early model CD players had such harsh unpleasant treble characteristics that manufacturers quickly had to replace them with so called second generation machines. I am also amazed how difficult it is on some CD recordings to identify individual instruments that can be plainly recognised on the vinyl version.

Any hifi retailer worth dealing with should be able to demonstrate the merits of CD against an adequate turntable. The customer can then decide which is preferable. Unfortunately, most people purchase audio equipment without the benefit of proper a proper demonstration. They rely on what is read in adverts or magazines. Who then is misleading or lying to them?

I. Stevenson,
Nth. Balgowlah, NSW.

Health effects of solder

With reference to the query from K.O. in EA, I have gathered some information on possible health effects of working with solder.

The major recognised effect is one of occupational asthma which seems to be due to sensitivity to colophony (pine resin) fumes. There have been several reports documenting this type of effect.

There has been a suggestion that there may be an increased risk of spontaneous abortion in women working with soldering.

In a study of cancer morbidity of tele-

Special Notice to EA Readers

Control appliances by telephone: Following publication of our article entitled *Control Appliances by Telephone* by John Clarke in our June 1986 edition on pages 42 to 48, we have been informed that the project described therein falls within the scope of a pending Australian patent filed by T.M. Kenny. Under the provisions of the Australian Patents Act, any manufacture, use, exercising or vending of the apparatus constructed in accordance with the project directions could constitute an infringement of a Patent issued in respect of the application.

Therefore, we would recommend that any readers who have a sufficient interest in this article should refrain from engaging in any of the communications workers there was no overall increase in total cancer morbidity. An excess risk of malignant melanoma of the skin was detected, which seemed to be particularly associated with soldering.

Dermatitis has also been associated with soldering flux.

I should point out that the above effects were found in a literature search and the authors' summaries used without critical appraisal.

N.H. Stacey, PhD,
Senior Lecturer In Toxicology,
University of Sydney.

NRMA requirements for a good alarm

We refer to your car burglar alarm projects in the August 1986 edition of *Electronics Australia* and take this this opportunity to advise you that the "NRMA 10 Minimum Requirements for a Good Alarm System" were revised in July 1986.

The revised list is as follows:

1. Protect all doors, bonnet and boot.
2. Isolate the (A) starter, (B) fuel or (C) ignition.
3. Have glass breakage protection.
4. Have a separate siren.
5. Have a rechargeable inbuilt battery.
6. Have a warning lamp and/or window stickers.
7. Alarm set (A) automatically or (B) manually from inside the vehicle or (C) by a coded electronic key.
8. Alarm operate instantly the bonnet or boot is opened.
9. Door entry delay between 5 to 10 seconds.
10. Alarm duration up to one minute with automatic cut-out and reset.

D.W. Mulder,
Technical Research Engineer,
NRMA, Sydney, NSW

continued on page p110

aforementioned possibly infringing acts and look at purchasing a similar unit, if required, fully constructed from Sentron Limited of Unit 3, Node 500, 11 Brodie Hall Drive, Technology Park, Bentley, Western Australia, 6102. Any queries concerning this matter should be directed towards the Marketing Manager of Sentron Limited who can be contacted on (09) 470 1800.

Editorial Viewpoint

Complacency and electricity don't mix

This morning I caught my daughter just about to poke a knife into the toaster. I shouted at her to stop, made her pull the plug out of the socket and then proceeded to give a lecture on the dangers of poking anything into a toaster. Naturally, my daughter became upset at this but better to have a daughter who is upset than one who is dead.

In a subsequent, calmer discussion with my daughter I said that it was absolutely essential that she be aware of the danger of such an action as poking a knife into a toaster. I also emphasised the extreme pain and mortal danger of electric shock. Her replay was, "But Dad, I already have had an electric shock." It was from an electric fence at Waratah Park (a popular Sydney attraction where animals are on display). Then I knew just how much difficulty I was up against in telling her (or anyone else) of the dangers. Anybody who has experienced a shock from an electric fence could be deluded into thinking that that's all there is to it.

The point about electric fences is that they are designed to be safe. Certainly they give a nasty shock but the purpose is to discourage further contact not to kill. Since the high-voltage pulses are at a rate of about one a second, there is ample time for the brain to regain control of the muscles and for the victim to move away. With mains AC voltage there is no such safety element. Depending on how you make contact and your skin resistance, your first electric shock from the mains could well be your last.

Poking a knife into a toaster is probably the most dangerous scenario. Because the toaster is hot, your hands are likely to be sweaty and therefore your skin resistance will be very low. Second, the knife is likely to have metal handle and you will probably have your other hand on the metal exterior of the toaster as you peer inside. Thus the electric path is a low resistance one through both arms and via the heart. In less than a second, you could be dead.

I'll be frank. I'm terrified of electricity. I've had quite few electric shocks in my time and I'm still here to tell the tale. But unlike many electricians, I am not the least bit blase because I know that in many instances I have been lucky. Lucky that I wasn't also touching an earthed metal object or lucky not to have had a lower skin resistance or whatever.

In many ways, the very high safety standards of today's electrical appliances have allowed complacency to develop. As an example, virtually all new power tools today are double-insulated which allows them to be used in damp situations which yesterday's tradesmen would not dream of considering.

The danger still lurks though, ready to strike at any time. Every year, some 50 to 100 people are electrocuted in Australia.

Have a look around your home. Are all the power cords up to scratch,

continued on page 118

News Highlights

IBM GETS SET TO LAUNCH THE CLONE CRUSHER

IBM seems ready to strike back with a series of new products in a move to counteract the sales it lost last year, due largely to Apple Computer Inc and makers of IBM PC lookalikes or "clones".

These rivals were mainly responsible for cutting IBM's share of the PC market to 22 percent of total units shipped in 1986 from 27.5 percent in 1985, according to market researchers International Data Corporation.

Market analysts are predicting that IBM may move into such areas as powerful desktop computers and operating systems that would be difficult for clones to copy.

Intel Corp., the California-based semiconductor maker, is reported by trade publications to be producing a new set of chips which will allow IBM to make smaller and faster PCs. Intel recently signed an exchange technology pact with IBM.

While many analysts predict that IBM will not surrender without a fight, IBM's chairman, Mr John Akers has said the company will disengage from the PC battle if it cannot make money.

The first salvo IBM is expected to launch will be aimed at the home, educational and retail markets. It is based on the Intel 8086 chip. Most analysts think this "clone crusher" will sell for about $US1,000 though they say retailers could sell it for as low as $US600 to make it even more competitive.

To keep production costs to a minimum, it's possible that the clone crusher will be made offshore. Japan's Matsushita has been named as a possible manufacturer but IBM refuses to comment.

Ambitious plan for national fibre optic network

Telecom Australia recently opened the first leg of the high capacity optical fibre cable network which will eventually link all Australia's capital cities.

At a completion cost of $13 million, the Sydney-to-Canberra link was formally opened by the acting Minister for Communications, Mr Jones, during a video conference hook-up between the Deakin telephone exchange in Canberra and the Newtown exchange in Sydney.

The 300 kilometre link, which passes through Campbelltown, Bowral and Goulburn, is the first stage of the $40 million, 900-kilometre Sydney-Canberra-Melbourne link which is expected to be completed later this year.

Telecom is investing about $40 million in the creation of a national optical fibre highway which will form Australia's major trunk communications route when it is completed in the early 1990s.

With the completion of this project Australia will rank alongside the US, the UK, Canada, Japan and France as one of the largest users of advanced optical fibre communications systems.

Optical fibre cables transmit using laser light impulses over hair-thin strands of glass at speeds of up to 565 million pulses per second.

In everyday terms, this means that the new route can handle up to 61,000 separate voice circuits simultaneously compared with about 9,000 voice circuits on the present Sydney-Melbourne link.

Cable for the new trunk route is being manufactured in Australia by Austral Standard Cables and Olex, while the 140-megabit line systems and transmission repeaters are being supplied by NEC Australia. Plessey will supply 565 megabit transmission systems later in the project.

In addition to voice communications, the optical fibre cable will also pave the way for the introduction of a greater number of services for video and data transmission.

Volvo's new face for accident research

Volvo Car Corporation has developed a synthetic "face" for evaluating driver and passenger head injuries resulting from major impact damage.

The culmination of its American research program, the dummy "face" is sensitive to pressure and indicates the stresses applied to the human skull during a vehicle crash.

Data provided by the "face" indicates the exact point of impact, when it occurred during the accident, how long it lasted and the extent of the pressure.

This data is transmitted from a thin piezo electric polyurethane film containing 52 different pressure sensors.

When subjected to pressure, the film emits a weak electric current which increases as the pressure rises. Each sensor is linked to a computer which monitors the readings and process the results.

Injury to an occupant depends on the force of the impact plus the duration of that force. According to Volvo, the new "face" will enable engineers to accurately redesign potentially dangerous parts of a car's interior.

Electronic publishing – the high end

Plenty of hoopla has surrounded the introduction of personal computer-based desktop publishing. But, according to a new 170-page research report from consulting firm International Resource Development Inc., while the personal computer manufacturers are fighting for each $10,000 sale of "low-end" electronic publishing systems, Xerox Corporation is quietly bagging orders for "hundreds of millions of dollars worth" of its high-end 9700-based and 8700-based electronic publishing systems, each selling anywhere from $200,000 to $800,000.

Most, according to the IRD report, are going to the in-plant market where technical manuals are the principal application.

According to the IRD study, most of the computer-based technical electronic publishing systems currently on the market are deficient in output resolution; many applications require at least 1,000 dots per inch (dpi), rather than the 300 dpi typical of today's laser printers. But better "back ends" will be available soon, able to produce typeset-quality output at an affordable price.

This technology gap is expected to create a split market. The low end will consist mostly of typical office automation customers who will gladly rely on 300-400 dpi laser printers. The high end will consist of companies for whom printing is not a cost factor. These will be the customers who invest in expensive, high-resolution electronic printers as they come to market.

"Thus," says IRD's Buffham, "instead of being threatened by electronic publishers, as so many analysts predict, phototypesetting companies will actually benefit from the introduction of electronic back ends!"

Clamp down called for on bugging devices

A leading Australian electronics company, Vicom Australia, has called for a concerted Government clamp down on the availability of listening devices and has recommended the registration of companies and private investigators to ensure their competence in debugging.

Vicom's Managing Direct, Mr Russell Kelly, said that while it was illegal in all states to advertise listening devices, publications were freely available that flagrantly disregarded the law.

Listening devices were also available commercially, ranging from cheap and simple devices at around $20 to more complex devices such as the latest laser beam receiver that transmits conversations from window vibrations straight onto a tape recorder. This device is valued at around $30,000.

Mr Kelly warned organisations and companies who believe they may be bugged to be careful of calling in so-called specialists, saying that they often used crude equipment under the control of unqualified personnel. "Organisations could, therefore, be under the false assumption that their premises are clean", he said,

It was also possible that bug sweeping could be used as a front for in fact planting bugs in a client's premises.

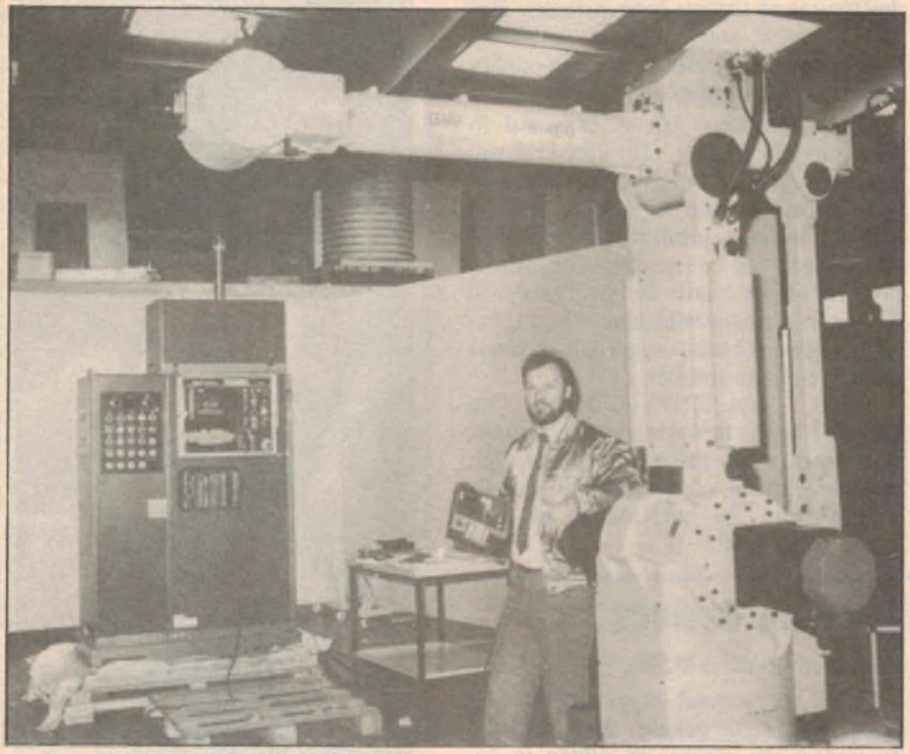
To safeguard individual privacy, Mr Kelly suggested that it should be an offence to incite people to build, sell or use listening devices outside strictly enforced parameters.

Crazy Watches

Want a watch that can be played like a piano? No? Well how about one that "runs" off water? Or one that also functions as a cigarette lighter?

The Water Watch comes from Hong Kong company Shing Cheong Electronics Ltd and runs off a permanent "tank type" energizer that uses only a few drops of ordinary tap water to create electrical energy. Mamona Enterprises Limited, also of Hong Kong, produces the piano watch while the cigarette light watch comes from Cirby Ltd. Believe it or not, all three can actually tell you the time.

News Highlights



Karel: the brains behind the brain

Australia currently has more than 600 industrial robots and current trends show that this figure is likely to grow at an increasing rate.

One Australian company which is placing much of future success on robotics is John Hart Pty Ltd of Clayton, Vic. Three years ago, the company became the exclusive Australian distributor for General Motors Fanuc (GMF), the world's largest producer of industrial robots.

GMF says that the the introduction last year of its *Karel* programming language has changed the course of factory automation.

Karel was specifically created for robotics and vision systems and has the capability of a true robotic programming language, while still being easy to use and understand.

It was purposefully designed to allow flexibility of operations and is not restricted to specific applications such as spot welding or other repetitive tasks.

The Karel language is similar to Pascal. Like Pascal, Karel is intuitive, lends itself well to structured programs and is easy to program, read and modify. It is also IBM PC compatible.

GMF delivered 1310 robots last year, realising $187 million in sales revenue.

MaGraths move to Preston

Rifa subsidiary, MaGraths, has moved out of the inner city area of Melbourne to new premises at the corner of Bell Street and Lahinch Street, Preston (just down the hill from Panch hospital).

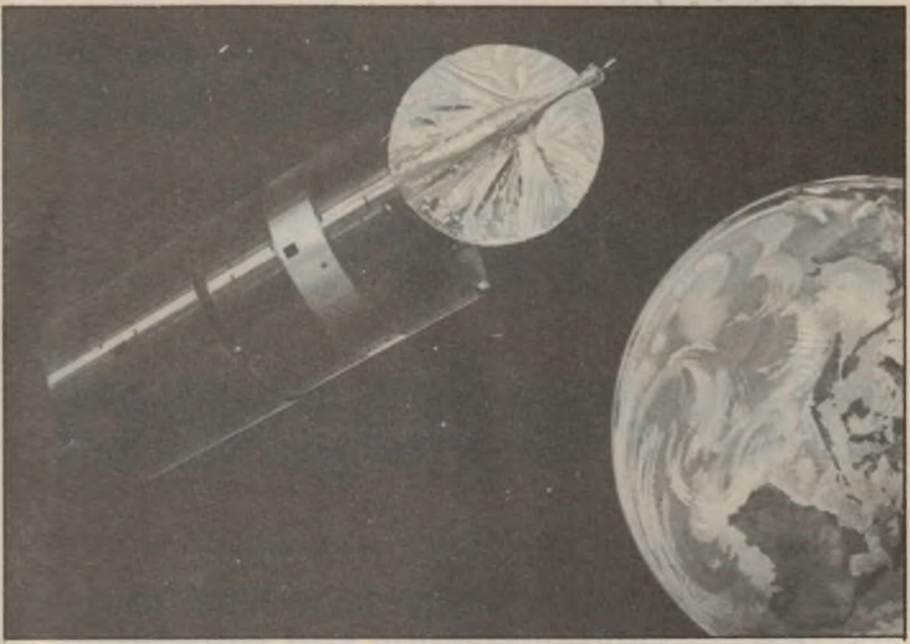
As well as being more conveniently located, the new venue will also offer more efficient telephone sales, a quicker mail delivery service and much larger stock holding.

Emona moves house

Emona Instruments has moved to larger premises at 86 Parramatta Road, Camperdown NSW 2050 (opposite St. John's College). Telephone: (02) 519 3933.

The new conveniently located premises has a larger showroom with more products on display than ever before, with plenty of off-street and customer parking.

Kiwis sign up for Aussat



Aussat will now provide satellite services to New Zealand. Mr Derek Rose, Assistant Director-General, New Zealand Post Office (NZPO) and Mr Graham Gosewinckel, Managing Director off Aussat Pty Ltd, recently signed a five year contract in Sydney.

The contract provides for the use by New Zealand of a 30 watt transponder and part of a 12 watt transponder, giving the NZPO satellite communications capability for domestic purposes within New Zealand.

Welcoming New Zealand's participation in the Aussat satellite System, Mr Gosewinckel said the contract undertaken by the two organisations will give New Zealand the benefits of satellite communications technology, such as point to multi-point communication and the ability to provide enhanced telecommunications and broadcasting services to remote areas and offshore islands.

"The Aussat capability, which will enable NZPO to provide satellite communications for New Zealand will become available with the launch of the third satellite, by the European rocket system Ariane, now scheduled for March 1987," Mr Gosewinckel said.

The third satellite will carry special antennas which will provide a footprint covering the South West Pacific, including New Zealand. It is expected that the NZPO will use the satellite for television distribution, video conferencing, high speed data transmission and other telecommunication services.

First solar trip from Darwin to Adelaide

The first solar powered crossing from Darwin to Adelaide (a distance of 3,200km) was completed on Friday, 19th December, 1986 by *The Spirit of Adelaide.*

It took Trevor Berry, Director of Pecan Engineering (Adelaide), and three of his employees five months to build the vehicle which he claims "looks a little like a Lamborghini and drives more like a Morris Minor". During the trip, the vehicle reached speeds of 55km/h and covered up to 148km per day.

The vehicle was designed to promote the use of photovoltaics. Pecan Engineering are agents for Solarex panels, 17 of which are used on the vehicle to provide up to 765 watts of power.

The vehicle was designed to look like a familiar road vehicle with comfortable "Formula 1" style seating and conventional driver controls.

It features a tubular steel frame with fibreglass and Kevlar body, independent suspension, and rack and pinion steering.

The body was tested in "The Levels" University wind tunnel. It was also run at speed on dirt roads and the dust pattern examined to optimise aerodynamics.

The drive system employs a 7.5kW printed circuit motor (ex Flinders University) coupled to a four speed gear box. Four 50A.h deep cycle batteries are connected to the solar panel and motor via a simple but effective control system.

For further information contact Trevor Berry, Director of Pecan Engineering, Natural Energy Centre, 147 King William Road, Hyde Park, SA 5061. Telephone: (08) 272 8536.

EA/Texas Instruments Contest Winners

The winners of the EA/Texas Instruments Digital Signal Processing Contest are Carlo Manfredini (right) and Alfred Breznik (centre). The pair have won a complete Texas Instruments Digital Signal Processing Development System valued at $10,000 and are shown here receiving congratulations from TI Product Marketing Engineer David Cartwright. Details of the winning entry will be published in a future issue.

How electronic warfare developed

The success or otherwise of military operations is increasingly dependent upon the use of communications and electronics. Disrupt the enemy's control over his electronics systems by interferring with his use of the electromagnetic spectrum and one disrupts control of his weapons systems and personnel.

by J.S.BELL

MARCONI demonstrated the feasibility of radio communications in 1901 and it was not long before the military recognised the advantages. The early transmitters and receivers were relatively crude affairs but the introduction of the triode valve and tuned circuits entrenched radio as a practical communications medium prior to the commencement of the Great War of 1914-18.

Both land and sea-based communications systems were widely used during the war, and signal interception and analysis provided both sides with valuable intelligence. In fact, the great naval battle of Jutland in 1916 took place only because the British intercepted German radio signals and were able to deduce the whereabouts of the German fleet.

Of course, these early developments in radio were relatively unsophisticated. Frequencies were low and the principles of super-regeneration (feedback) and of the superheterodyne receiver were still to be implemented. There were, however, many ideas and experimenters: indeed so much parallel work was being conducted that it is still difficult to establish who was responsible for some of the major breakthroughs.

What is clear is that basic radio communications systems were well established by the end of the First World War and that some attempt had been made to provide mobile and airborne systems.

In parallel with the development of communications systems for military use, other experiments were also in progress. For instance, the British were experimenting with ASDIC, an elementary electroacoustic system with which to detect German U-boats. Clearly, the infant science of electronics was being actively harnessed to assist in particular types of military action some seventy years ago.

Between the two world wars, the fledgling electronics industry developed at a pace and direction largely dictated by major commercial interests. In the 1920s, perceived requirements were associated with the establishment of regular broadcasting services while the 1930s saw the demonstration of several television systems and the introduction of the first regular service from Alexandra Palace, London.

Associated with this explosion in radio communications, a number of other key devices were developed: the cathode ray tube was available in production quantities, the klystron valve had made the generation of frequencies in the 1GHz range possible, and both tetrode and pentode valves were in quantity manufacture.

These advances were not lost on the military, particularly in the UK, USA and Germany. By 1939, for example, the British had established a viable ground based radar (Chain Home) system operating at between 22 and 30MHz and capable of detecting hostile aircraft at a range of 200km. And in Germany, a radio navigation system called Knickebein had been deveİeped by 1940. This used crossed beams operating at 30MHz and allowed German bomber aircraft to drop bombs with a theoretical accuracy of 1km in any weather.

To counter these threats both sides were forced to take appropriate countermeasures, leading to what is known today as *E*lectronic *W*arfare (EW).

During the early days of the German invasion of Russia during WW II, the Russian communications system broke down with disastrous results for their armies. Nearly one million Russian soldiers were captured. Today, much more attention is given to ensuring that communications can be maintained in the face of hostile action.

It is recognised that a prime element for success in the field is an ability to provide two-way communication between the field commander (who would normally be stationed away from the main battle zone) and the men at the front. This is known as Command, Control, Communication and Intelligence — C^3I for short. Obviously. if one side can interfere with the other's C^3I system there is a significant advantage to be gained.

Thus, C^3I comes under the general

Aircraft such as the FA/18 Hornet would not survive for long above the modern battlefield without inbuilt electronic navigation and ECM equipment. Seventy-five Hornets are being purchased for use by the RAAF.

umbrella of EW, as military use of the electromangetic spectrum is involved (ie, EW is concerned with the control of operations as well as with weapons systems).

With that background, let's define what is meant by EW and discuss what practical steps are required to implement it.

A standard definition of EW is "military action to prevent or reduce the enemy's use of the electromagnetic spectrum, and action which retains the friendly use of the spectrum". Although in general use, it is thus seen that the term Electronic Warfare is somewhat of a misnomer. Because the ramifications of EW go beyond simple electronics, some authorities now call it Radio Electronic Combat or Information Warfare.

Know thy enemy

Before being able to deal with a threat posed by the enemy's use of some part of the electromagnetic spectrum in an efficient manner, one must know as much about the threat as possible. It's a matter of 'know thy enemy' or perish.

In this case, the necessary information is gathered using Electronic Support Measures (ESM): data on potentially hostile systems are gathered, recorded and analysed and an appropriate countermeasure. If this action is electromagnetic in character it is called Electronic Counter Measure (ECM).

To counter the German Knickebein system, for example, the British first identified the threat, its mode of operation, frequencies and the locations of supporting transmitters. By then monitoring the transmitters, the British were able to deduce the probable bomber path and the target.

Although powerless to intercept bombers at night (their night fighters did not then possess radar), the British eventually managed to disrupt the beams using assorted diathermy equipment — an early example of ECM. The Germans, in turn, quickly countered by producing new systems operating at higher frequencies and by using different modulation frequencies — ie, the Germans employed Electronic Counter-Counter measures (ECCM).

So there we observe the EW cycle: new threat, ESM, ECM and ECCM. Clearly, with the introduction of each new threat, the advantage tends to be with the attacking force until such time as the defenders are able to nullify it. The cycle then repeats itself.

Fig.1 indicates how the X-Gerat system was used by the Germans to accomplish pinpoint bombing of selected targets. A Knickebein transmitter located near Cherbourg (point A) directed two narrow overlapping beams, one modulated with dots, the other with dashes, at the target. When a bomber flew along the midpoint of the beams, on-board receivers would present a continuous tone to the navigator as the dots and dashes were interleaved.

If, on the other hand, the bomber strayed from the centre line, either dots or dashes would start to predominate and the pilot would then be instructed to take corrective action.

From point B, near Calais, three signals were beamed to intercept the Knickebein beam just south of the target. When a bomber arrived at point X, some 50km south of the target, the crew were automatically warned to prepare for the bombing run. At point Y, 30km nearer to the target, the second signal instructed the bomb aimer to activate a special timing clock whose first hand was stopped when the third beam was

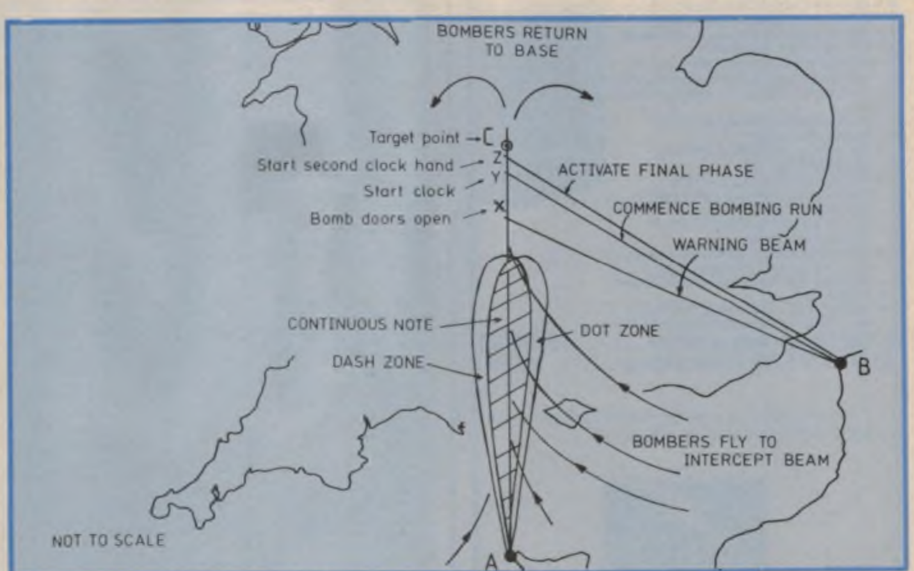


Fig 1: operational principles of the German X-Gerat system used to bomb a selected target in World War 2.

intercepted at point Z.

Because the distance between points Y and Z was known to be 15km, the first hand position gave an indirect measure of ground speed near to the target. At point Z, some 5km from the target, a second hand was started and when this intercepted the first one an automatic release mechanism was activated to drop the bombs on the target with a mean accuracy of 200 metres.

The Britsh soon countered this sytem by simply activating jammers which radiated "dots and dashes" near to all targets on a direct line from Cherbourg, and jamming the cross beams with noise.

Passive & active jamming

Before proceeding further let's look at some of the principles behind two types of ECM, namely passive jamming using chaff and active jamming using an airborne device.

Chaff is used to conceal potential targets from the enemy's radar system and to cause confusion and delay at the same time. Chaff clouds consist of the large numbers of air-dispersed metallic dipoles cut to the half-wavelength of the enemy's radar.

Fig. 2 illustrates how chaff could be deployed to screen an incoming bomber stream and to confuse the defences by laying a false trail. Two aircraft are used to deploy chaff in our example; in practice, any reasonable number may be used.

The left hand diagram illustrates that, without chaff, the incoming bomber force has been detected and its numbers and positions displayed on the plan-position-indicator (PPI). The right hand side indicates what would happen if chaff (or *window* as it was first called by the British in WWII) is deployed. Not only does the chaff in front of the bomber stream hide them from view but the chaff distributed to the west also returns radar echoes.

Thus, without further information, the radar operator cannot establish from which direction the threat is being mounted or indeed whether he is being hoaxed. It will be seen that much of the PPI display is quite useless to the operator as it is filled with false returns.

Fig.3 illustrates the use of an onboard jammer by a single hostile aircraft approaching a defence system radar. Without the use of the jammer (which could also be used to hide other aircraft), the aircraft's position is readily determined and displayed on the PPI. In the second case, the pilot has switched on his jammer which severely interferes with the receiving circuits of the radar system, thus effectively blotting out the PPI display with unwanted signals.

The invention of the first practical cavity magnetron in 1940 enabled high power generation of wavelengths of 10cm to become reality. This, in turn, allowed Britain and the USA to produce more sophisticated radar systems which could, because of the small antenna size, also be fitted to aircraft for both navigation and air-interception purposes.

To counter this new threat, the Germans, using captured magnetrons from bombers shot down over their territory, soon worked out how the new radar

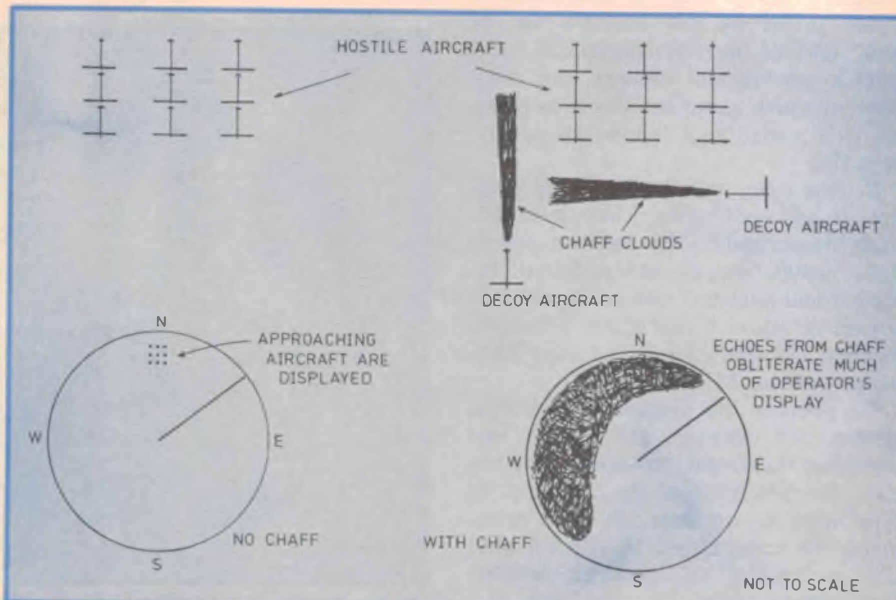


Fig 2: how chaff may be used to obscure approaching aircraft.

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systems worked. They were then able to apply some degree of ECM and to develop similar equipment themselves.

During the Second World War, electronic warfare was almost exclusively concerned, apart from the German-based aircraft navigation systems, with the development of various radar systems and the resultant ESM, ECM and ECCM. It was only later that EW branched out to embrace other technologies such as infrared.

This fight for electronic supremacy was not restricted to air combat alone. Naval forces, including the pocket battleship Graf Spee, were equipped with elementary gun laying radar as early as 1939.

As in the air, both sides used elaborate hoaxes to deceive the other. For example, the Germans masterminded the escape of some of their trapped warships, including the *Scharnhorst* and the *Gneisenau*, through the English Channel, right under the noses of the watching British radars. What the Germans did was to jam the British radars each morning at sunrise, thus convincing the British that it was a natural phenomenon associated with the rising Sun. Then, at dawn on February 12, 1942, units of the German fleet made their historic escape.

The post war period

With the cessation of hostilities in 1945, military interest in EW languished. There were some developments, however. In particular, improvements to the cavity magnetron and klystron led to the use of wavelengths of about 3cm for high definition radar. The travelling wave tube amplifier also became available in the 1950s. But it was the development of the transistor that rekindled military interest in EW and led to the vast range of computer controlled systems now present on the battlefield.

How does one utilise electromagnetic energy to deal with a threat using some part of the electromagnetic spectrum? One easily understood way is just to to simply create enough noise, whether over a broad band or in a narrow band, to make the received signals unintelligible. Narrow band or spot jamming is more efficient if the threat frequency is known.

Another technique is to confuse the other system or operators by providing false information. A good example of this occurred during the Second World War when the British used German-speaking fighter controllers on the Luftwaffe frequencies to direct the German aircraft to the wrong destinations — just imagine the arguments which took place with the pilots as each ground controller insisted he or she was the genuine one!

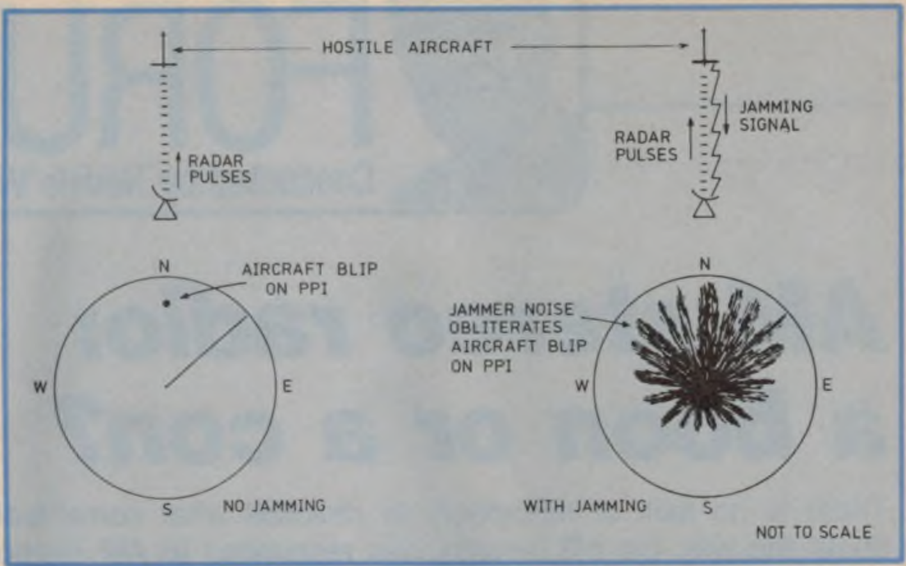

Fig 3: how an airborne jammer may be used to confuse a defensive radar system.

Other ways of confusing enemy radar systems, apart from the release of "chaff" as outlined above, include the use of radar absorbent material (RAM) and the release of decoys by potential targets. Summarising all this, it is seen that an ECM activity must use an active noise jammer, an active deception jammer which can initiate or manipulate signals, or a passive device. In turn, a prepared defense will endeavour to respond with some form of ECM which must be anti-ECM or anti-ESM.

When the conflict in Vietnam commenced, for example, US aircraft were threatened by radar controlled anti-aircraft fire, including surface-to-air (SAM) missiles for which they were unprepared. To avoid these hazards, the bombers tried flying low but this in turn exposed them to other threats, including short range, heat-seeking missiles.

Eventually, to minimise losses, the USAF was forced to develop additional EW systems.

The Israelis were confronted with their own particular problems during the Yom Kippur War in 1973, in which their air force initially suffered grievous losses. This was because their EW capability was not able to deal with new ground-to-air missiles used by the Egyptians and Syrians. In this case, the Israelis were able to survive and win the war by changing tactics and by quickly updating their EW systems.

Even so, it wasn't until Israeli ground forces overran Egyptian radar positions on the west bank of the Suez Canal, that the situation eased.

A similar problem, highlighted by the sinking of the warships *Exeter* and *Sheffield* by Exocet missiles, was experienced by the British during the Falklands War. To protect their fleet from a potentially disastrous situation the British were forced to introduce immediate electronic counter measures, including the use of chaff and helicopter decoys. Again, as in the First and Second World Wars, Vietnam, and the Yom Kippur War, the initial advantage lay with the side mounting the threat.

For the British, the Falklands War quickly demonstated the need for naval forces to have sensors capable of detecting missile-carrying aircraft at as long a range as possible. It also demonstated all too clearly the need for ECM equipment to counter Exocet type missiles.

It is a simple statement of fact that no field of human endeavour can be separated from use by the military if there is a perceived advantage to be gained by one side or the other. Electronics is no exception. Indeed, such are the uses of communications and electronics in the modern military armoury that the difference between victory or defeat will become increasingly dependent upon the control the adversaries have over the electromagnetic medium.

More precisely, the battleground now and in the future will increasingly include battles between competing and highly complex EW systems.

Further reading

Most Secret War, R.V. Jones, Hamish-Hamilton 1978.

The Secret War, B. Johnson, Book of BBC TV Series.

Instruments of Darkness, Alfred Price, MacDonald and James, 1978.

FORUM

Conducted by Neville Williams

AM stereo radio: a boon or a con?

There is no lack of metaphors to describe what some feel about the way the hifi industry has responded to AM stereo broadcasting. It's been left lamenting, they suggest, the iron still unstruck, while the horse has bolted! So much time has been wasted pushing barrows that it's missed the boat, &c!

It could be, of course, that enthusiasts who subscribe to the above are simply being impatient; are expecting to happen overnight what is likely to take considerable time in the current economic conditions. Let's examine the situation and see where we get to.

The broad background to stereo AM broadcasting was covered in the March 1986 issue and is referred to again in the series "An introduction to hifi". Briefly, however, FM stations were the first to exploit the stereo mode as part of their hifi image and it was adopted as standard when the current Australian FM services began operation in 1976.

Initially, Australian AM stations were in no hurry to follow suit, especially in view of the technical difficulties involved. They spent years arguing about rival systems but finally, in the continued absence of a definitive lead from overseas, they took the initiative, in collaboration with the Federal Government, by endorsing Motorola C-QUAM as the method to be used in this country.

All Australian AM broadcasters were automatically licenced for stereo on February 1 1985 and about 30 commenced the service immediately, with others following suit as the new equipment was commissioned.

However, hifi enthusiasts wanting to buy a suitable tuner or receiver have been somewhat disappointed. Equipment suppliers who, in other circumstances, would have been competing for their custom, seemed either not to know about AM stereo or not to want to! Here's how one Victorian reader describes the situation:

Dear Mr Williams,

Your erudite treatment of CD player comparisons prompts me to put to you a matter which has bothered me for some months. If my discussions with most of Melbourne's leading hifi shops have been at all typical, many people must be pondering the same question.

I refer to the introduction of stereo AM transmissions in this country. One could almost believe that we've been the victims of some kind of hoax.

Stereo transmissions have been with us for many months now and most of the stations have not only been reminding us that their music is coming to us in stereo, but that the improvement in their transmissions makes their station the obvious choice for enjoyable listening.

I recently took myself along to about a dozen of this city's hifi outlets with the intention of purchasing the wherewithal to enjoy these new, improved stereo transmissions — but that is where things started to go wrong.

About half the sales people I spoke to assured me that there was very little equipment available to receive AM stereo and they did not stock any. Nor were the responses from the rest very encouraging. Some had car radios and small portable equipment but only two had equipment intended for use as part of a stereo music system in the home.

It was not just the lack of equipment that I found irritating. It was the generally apathetic attitude of even the senior sales staff that left me incredulous:

"We don't have what you want", they said; "we're not really interested". Quite a few of them attacked the very idea of stereo AM with comments like: "It isn't what it's cracked up to be" or "it sounds dreadful; forget about it".

One sales manager criticised my interest in wanting to play AM stereo through a hifi system. I was told that the transmissions were not of a hifi standard and were not suitable source material for home stereo. He (and others) quoted all sorts of figures to assure me that one should forget about AM stereo.

But having (as they thought) so convinced me, what should they then proceed to do but to try to sell me a new tuner or receiver with an AM MONO capability!

It was at this stage that I decided to seek your opinion. There seems to be two distinct unanswered questions relating to the introduction of AM stereo:

(1) Why is there such a shortage of receiving equipment on the market; and

(2) What can we really expect from these new transmissions?

The first question undoubtedly invites speculation about market forces, supply and demand, &c. One dealer rather cynically suggested that the major suppliers would not release AM stereo receivers until stocks of mono models have been sold.

Be that as it may, I would be pleased if you would pursue the second question. There was an implicit assertion in the advice of hifi experts that AM stereo transmissions are actually inferior to mono.

We have been willing, for years, to play mono broadcasts through our sound system, using front ends that haven't even taken advantage of the available mono signal quality. Then why not play stereo transmissions using suitable receiving equipment? Does stereo equipment actually degrade the signal and how good is the end result, assuming the receiver to be of reasonably high quality?

J.K., Blackburn South, Vic.

J.K. tends to play down the fact that a range of AM stereo equipment is indeed available, although not necessarily in the brand or style that best suits individual vendors or buyers. However, after having canvassed a dozen hifi equipment outlets in Melbourne, I would judge that J.K.'s reactions would typify those of other readers in other cities.

When I discussed the letter with a sales executive with one of the large equipment suppliers, his response was entirely pragmatic. He saw the introduction of stereo AM as an interesting development but not one likely to galvanise personnel in the sales area.

Stereo AM had become a reality, he agreed, it was here to stay, but its acceptance by the listening public would be a gradual process, not an overnight phenomenon.

His casual response caused me to wonder how very different his attitude might have been, had AM stereo been introduced when it first became practicable, rather than now, lending credence to those up-front suggestions about the industry having "missed the boat".

In the late 1970's and early 1980's, hifi manufacturers were busily involved in updating their tuners, replacing manual models with synthesised circuitry. It would have been an opportune time to go a step further and provide wideband AM stereo in their up-market models.

Their potential attraction as a signal source would have been much greater then than now and, in those prosperous days, the few extra dollars would have been of little consequence.

But the situation has changed drastically since then. Faced with a falling dollar, hifi suppliers are having to trim costs rather than invent ways of adding to them. CD players are competing for a place in new systems, even at the expense of the once standard phono deck. A more elaborate and more costly stereo AM tuner is something they can do without — especially as AM stations no longer dominate broadcasting in the major centres.

With the hifi markets elsewhere in similarly indifferent shape, it is not really surprising that major manufacturers are in no hurry to commit themselves to a new range of possibly slow-moving tuners.

Then does the delay add up to a hoax or a con?

Not really. Australian AM stations have changed, or are currently changing over to stereo, with an eye not only on the domestic but on the automotive market. They'll keep plugging away and the message will gradually get through to all concerned: your new tuner or receiver should be equipped for stereo AM as well as stereo FM.

It probably won't happen in a hurry but at the rate at which enthusiasts routinely turn over their equipment in the quest for a new look and a new sound.

Stereo AM quality

And that brings us to the central question in J.K.'s letter: What can we rightly expect from these new transmissions? To find an adequate answer to that question, it's necessary to go back to the basics of high (audio) quality AM radio reception:

The bandwidth or "selectivity" of an AM tuner (or receiver) has always been a compromise:

(1) The bandwidth must be sufficiently narrow to discriminate adequately against broadband electrical and atmospheric noise and against interference from stations broadcasting on adjacent or nearby channels.

(2) It should not be so narrow as to discriminate against the outer sidebands of the wanted carrier to the extent that the recovered signal becomes unacceptably muffled because of attenuation of the higher audio frequencies.

In practice, the vast majority of tuners and receivers, including those in domestic sound systems, end up with an AM bandwidth narrow enough for most reception situations but with an audio frequency response falling well short of even modest hifi expectations.

Response through the tuner may typically be 6dB down at around 3kHz and 20dB down at 5kHz — nowhere near wide enough to accommodate the range of high audio frequencies actually broadcast by AM stations.

While it would be easy, at this point, to call for an effective bandwidth of at least ±10kHz, majority opinion in broadcast engineering circles favours ±7kHz, or 14kHz overall, as a more appropriate figure for Australian conditions, offering a worthwhile increase in perceived audio response without unduly exacerbating problems of noise and interference.

Even at that figure, wide/"normal" bandwidth switching becomes a desirable provision, to cope with situations where noise and interference renders reception of particular stations unacceptable in a wider band configuration.

In fact, during the conversation mentioned earlier, the sales executive nominated failure to understand such problems as a reason why wide-band AM tuners have, in the past, received less than their due in hifi stores. Said he: "What can you expect when they try to demonstrate them without an adequate aerial, in congested shopping centres,

"BUT SIR! THIS WAY YOU GET TO LISTEN TO TWO DIFFERENT STATIONS AT THE SAME TIME..."

surrounded by fluorescent lights and a tangle of electrical wiring?"

Relevant to AM stereo

This whole matter is relevant to stereo AM, because stereo is only half the package which could increase the appeal of AM broadcasting to hifi listeners. The other half is a subjectively clean, open signal, free from obvious background interference. Indeed, the two belong together, because the stereo effect is subjectively more apparent with a wide-band tuner.

In part, therefore, the answer to J.K.'s question about what to expect of stereo AM depends on:

(a) His choice of a suitably specified tuner: wide/normal bandwidth switching, C-QUAM only decoding, crystal-locked tuning;

(b) The availability of a reasonable level of signal from the wanted stations at the listening location;

(c) His readiness, if necessary, to take a little extra trouble with the antenna.

The rest is up to the station. Most are quite fussy about the quality of their basic equipment but, as explained in the March 1986 article, AM stations tend to "doctor" their signal to achieve higher effective carrier modulation and a brighter sound through ordinary narrow band receivers.

Unfortunately, this sort of processing can be perceived as distortion — which it is — in a wide-band receiver, becoming even more objectionable when operating in stereo mode.

C-QUAM was chosen because it has the capacity to produce a totally compatible stereo/mono signal which, while falling short of FM specifications, is nevertheless subjectively clean and quiet, with good left-right separation — provided the station operators observe good audio practice and C-QUAM recommendations regarding signal processing.

So, to the provisions a,b & c above we can add:

(d) Recognition by the station operators that they are now catering not just for the 0-3kHz brigade, but for a new audience listening in wide-band stereo.

Summing it all up . . .

As a lover of silence, I am not an avid listener to radio. However, my limited experience of the AM stations, as heard on an otherwise ordinary crystal-locked mono tuner, does not support the suggestion that their quality in that mode has been compromised by the provision of stereo.

However, listening to their signals, on headphones, through a near equivalent stereo tuner is very informative. With normal (narrow) bandwidth, the stereo effect is quite apparent, with music no longer concentrated in the centre of one's head and with voices surrounded by a genuine dimensional ambience. Switch back to mono and the difference is immediately apparent.

C-QUAM certainly works!

In the wider band setting, voices gain sibilants, violins acquire strings and the stereo effect is emphasised.

In some cases, the sibilants may be rather too prominent, indicating that the station is still using too much pre-emphasis in the upper midrange — an effect that may not be so obvious with loudspeakers and that can be offset, anyway, with the help of the treble tone control.

My firm conviction is that stereo AM is here to stay and that, in the course of time, it will be accepted as routine.

Right now, I can understand hifi dealers knocking AM stereo if they don't have their own pet brand of tuner to offer. What else can they say? If they recommend it without having product available, they'll have done a selling job for someone else!

If the object is to knock stereo AM, one can certainly quote figures to back any criticisms. Frequency response, distortion, signal/noise ratio, dynamic range and channel separation all suffer by comparison to FM.

Why then would anyone bother to listen to AM? For the same reason that J.K. — along with a lot of other people — listen to AM through narrow band mono tuners: because, from time to time, the program content appeals to them. No matter what the figures say, if you choose, on occasions, to listen to narrow band mono, the change to wide-band stereo will almost certainly multiply the satisfaction in so doing.

One other point: if you're one of those who likes listening to stereo radio in your car, you've probably been exasperated on occasions with the "picket fence" effect with FM signals. You'll be glad to sacrifice a few Hertz and a few decibels to get rid of those adjectival pickets!

Fancy enjoying that!

In the accompanying panel we reproduce, in precis form, a letter to hand from electronics serviceman and fellow contributor Jim Lawler who, in his spare time, is obviously a lover of classical music. It has nothing to do with AM radio but it bears out my own remark as above.

Why on earth, in this day and age, would anyone want to listen to something that was originally recorded on an old 78rpm mono system? The answer: because the contents happen to appeal for reasons other than technological excellence. If it had been possible, the same performance captured on a better medium would obviously have been preferred.

Equally, if there's any merit at all in what the AM broadcasters are presenting, it makes sense to hear it to better advantage.

Low fidelity — high enjoyment

The State Library of Tasmania has a fine collection of LP discs and cassettes, available on loan to registered borrowers.

At present I have a thing about Mahler and I visited the library recently to select three symphonies to listen to during the following couple of weeks. All three are reasonably new versions (one is from a digital master) and all three are excellent examples of phono recording.

The library files its discs under the composer's surname and, just behind Mahler, I noticed Mendelssohn. The first record under that heading happened to be an HMV Treasury Series recording by pianist Moura Lympany. It carried the Concerto No.1 in G, the Rondo Brillant in E and the Capriccio Brillant in B by Mendelssohn, the Symphonic Variations by Cesar Franck and the Scherzo from the Concerto Symphonique by Litolf.

The original version of the Litolf recording, on two sides of a 12-inch 78, was at one time the world's most popular classical recording. I borrowed the Mendelssohn record just for old times sake, to see if the Litolf was still as good as it used to be.

According to the sleeve notes, the Concerto and the Rondo, recorded respectively in 1948 and 1952, were transcribed from "surviving metal masters". The Capriccio (1953) and the Franck Symphonic Variations (1949) were recorded on tape and this was the source of the present recording. The Litolf Scherzo (1948) had the unhappiest origin, being dubbed from a commercial pressing — the same one I had treasured all these years.

To play the discs, I used our medium-fi domestic system and a pair of Sennheiser HD-40 headphones, allowing me to turn the wick up a little higher than would be politic to do using loudspeakers.

So what am I getting at?

The Mahler was sonically superb — every note of every instrument clearly audible. But, musically, it was unimpressive.

By contrast, the Mendelssohn Concerto, although suffering a little from restricted frequency range and a degree of surface noise, was a lively, well balanced and satisfying performance.

The Rondo and Capriccio were pleasing performances, not exactly exciting but truly workmanlike and quite listenable. The Franck was pianistically sound but I've heard better versions.

The Litolf was the last item on side 2 and it was halfway through when I had a sudden, terrible thought: For nearly an hour, I had been absorbed in the music and had never once given a thought to the fact that it was plain old-fashioned hole-in-the-wall mono!

After a confession like that, I'm afraid that I will have blown any chance of gaining admission to the "Golden Ears" club. The more so when I also confess to treasuring old 78s like the magnificent Schoor-Parr-Melchoir-Schmann-Williams Quintet from "Die Meistersingers", the Schwarzkopf version of "O Tannenbaum" and the McMillan/Toronto Symphony version of Fitzwilliam's "The Bells".

These discs are old and worn but the performances are, to my mind, the best ever recorded and will be treasured in my collection for as long as I can take an interest in recorded music.

Jim Lawler, Geilston Bay, Tas.

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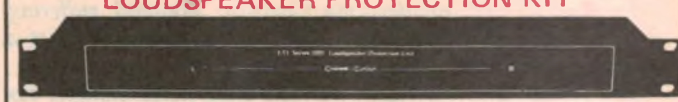

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Cradle Relay Sockets Includes Retaining Clip

S 4058 for DPDT Relays (S 4067/8) **$2.40 Now $1.50**

S 4059 for 4PDT Relays (S 4070/1) **$2.40 Now $1.50**

240V Mains Power From Your 12V Battery

K 6752 Complete Kit **$229.00**

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 6754 Fully built & tested **$289**

Don't Miss Out! Reserve Your Order Right Now — Phone STD Free On 088 999 007

Temperature Controlled Soldering Station

(EA Sept.'86)

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. K 6400**

$35.00

TOROID TRANSFORMERS

30% OFF

M 3075

PRIM	240V
SEC 1	40V 2A
SEC 2	40V 2A

M 3100

PRIM	240V
SEC 1	40V 3.7A
SEC 2	40V 3.7A

M 3080

PRIM	240V
SEC 1	45V 1.8A
SEC 2	45V 1.8A
WERE	~~$55~~
NOW	$38 ea

M 3105

PRIM	240V
SEC 1	45V 3.3A
SEC 2	45V 3.3A
WERE	~~$69~~.95
NOW	$48 ea

W/PROOF PA SPEAKERS

PVC 5 WATT 8 OHM

C 2010 . . . ~~$11~~.75

NOW $8.50 ea

PVC 10 WATT 8 OHM

C 2015 . . . ~~$12~~.50

NOW $9.50

ALUMINIUM 15 WATT 8 OHM

C 2025 . ~~$29~~.95

NOW $25

ALUMINIUM 15 AND 30 WATT FITTED WITH LINE TRANSFORMER

15W Taps 660/15W, 1K/10W, 2K/5W 4K/2.5W

C 2030 . . . ~~$79~~.95

NOW $65

30W Taps 330/30W 660/15W, 1K/10W, 2K/5W 4K/2.5W.

C 2033 . . ~~$99~~.95

NOW $80

Warehouse Moving Sale

To 174 Roe St. Perth (same Phone Numbers) End of March '87

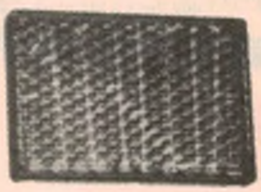
We're Desperate to Dramatically Reduce Stock Levels — You Save Up To 50%

Price Break Through Solar Cell Array 18V @ 7 Watt

Brilliant New Solar Array at an amazing price. Yes, for less than $90 we now have just the handiest Solar Modules available (Why pay our competitors $239 for a measly 3 additional watts?? Superb for Powering or Charging 12 - 15 Volt circuits - Now there's now excuse for that flat Car, Boat or Caravan Battery. Solar Cells are fixed to a fibre board, front covered with tough EPS and rivetted into stainless steel frame. **Cat No. A 0220**

Amazing Price Break Through

$89.95



Solar Cell Module .4V at 450mA

Great experimenters Solar Module. Connect in parallel or series as you wish. Terminal strap enables easy interconnection to other cells. **A 0210**

Value $4.50

10 cells or more $3.98ea

SOLAR CHARGER

For 4AA Nicads

A 0230

~~$12.~~ **$10**

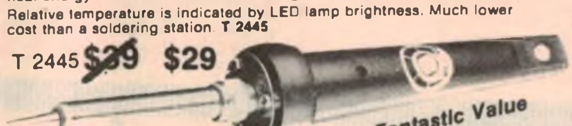
Save a Bundle on these Fantastic Micron Soldering Irons

Temperature Adjustable 250°C to 450°C

Excellent new iron, screwdriver temperature adjustable between 250°C and 450°C enabling very delicate soldering on low settings with surprising heat energy reserve on maximum setting.

Relative temperature is indicated by LED lamp brightness. Much lower cost than a soldering station. **T 2445**

T 2445 ~~$39~~ **$29**



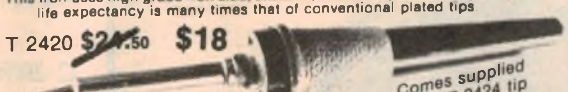
Fantastic Value

Professional Temperature Fixed Soldering Iron

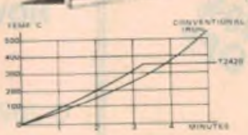
• 370 deg. Fixed Temperature • High efficiency patented heating element • Iron clad, chrome plated, long life interchangeable tips.

This iron uses high grade iron clad, chrome plated and pretinned tips. Tip life expectancy is many times that of conventional plated tips.

T 2420 ~~$24.50~~ **$18**

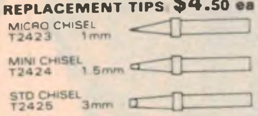


Comes supplied with T 2424 tip



HEAT UP AND RECOVERY

REPLACEMENT TIPS $4.50 ea



Professional Megaphone PA

A 1990

~~$109.50~~ **$99**

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

Refer to Our 1987 Catalogue for full Specifications on These Fine Quality Products

MICRON T2440

Electronic Temperature Controlled Temperature Selectable Soldering Station

The MICRON T 2440 soldering station, offers the ultimate in controlled temperature hand soldering. 320°C, 350°C, 380°C, 410°C (608°F 662°F, 716°F, 770°F and 824°F) fixed temperatures are selectable by rotating the detained rotary switch freely without changing heater or tip.

Heat Capacity Full 48 Watts • Temperature Control +or - 3 deg.C • Zero Voltage Switching • Grounded Tip • Low Voltage Element 24V • Chrome Plated Tip. T 2440

Normally ~~$119.95~~

This Month **$99.00**

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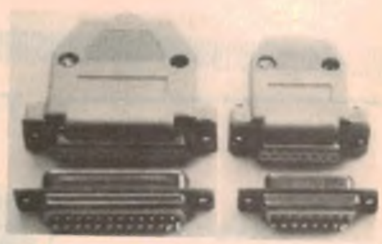
Save Up To 50% On Top Quality D Series Connectors!

Fantastic Value

D Series Computer Connectors. Gold Plated Professional series



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P 3010	Female 9 Pin	3.25	2.35
P 3020	Male PCB Rt/L	3.75	1.85•
P 3030	Fmale PCB Rt/L	4.50	2.20•
P 3040	Male PCB mnt.	2.95	1.95
P 3050	Fmale PCB mnt.	3.95	2.25
P 3090	Backshell cover	1.95	.95
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P 3100	Male 15 Pin	3.25	2.25
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P 3120	Male PCB Rt/L	4.35	2.10•
P 3130	Fmale PCB Rt/L	5.50	2.95
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P 3150	Fmale PCB	4.85	2.40•
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P 3200	Male 25 Pin	4.95	2.47•
P 3210	Fmale 25 Pin	5.50	2.74•
P 3220	Male PCB Rt/L	4.95	3.50
P 3230	Fmale PCB Rt/L	6.90	4.95
P 3240	Male PCB mnt.	4.95	4.95
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P 3290	Backshell cover	2.20	1.10•

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See Review Electronics Australia March '86

BRILLIANT AUTO RANGING DIGITAL MULTIMETER

$99.95

Autoranging with Memory Function for Relative Measurements

SPECIFICATIONS:

DC VOLTAGE	
Ranges	5 (200mV, 2V, 20V, 200V, 1000V)
DCV Accuracy	0.5% + 1DGT
AC VOLTAGE	
Ranges	4 (2V, 20V, 200V, 750V)
ACV Accuracy	0.75%+5 DGTS
Input Impedance	10M Ohm Min.
DC CURRENT	
Accuracy	20mA—0.75%+1DGT 10A-1.50%+5DGTS

Free Select either a Carry Case or Holster this month with your Q 1075 at no charge

Carry Case

Keep your **Labtech** DMM looking like new for years!

Q 1076 **$9.50**

Holster Q 1077 **$9.50**

What's this? For want of a better name we've named this thick rubber "Cliparound" protector a "Holster". Great protector for field use, dropping on concrete floors etc. —

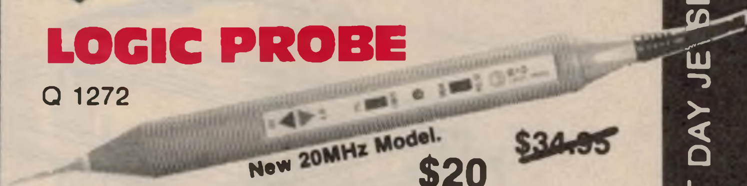
Now Only ~~$98.00~~ **$75**

UV EPROM ERASER

Erase your EPROMS quickly and safely. This unit is the cost -effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety in about 40 minutes for 9 chips (less for less chips). **• Erase up to 9 chips at a time** • Chip drawer has conductive foam pad • Mains Powered • High UV intensity at chip surface ensures thorough erase • Engineered to prevent UV exposure • Long Life UV tube • Dimensions 217 x 80 x 68mm • Weight 670 grams

LOGIC PROBE

Q 1272



New 20MHz Model. ~~$34.95~~ **$20**

Max. Input Frequency 20MHz. Input Impedance 1M ohm. Operating supply Range 4 volt minimum. TTL Logic 1 Hi LED greater than 2.3 volts. Logic 0 Lo LED less than 0.8 volts. CMOS Logic 1 Hi LED greater than 70% Vcc. Logic 0 Lo LED less than 30% Vcc. Minimum Detectable pulse width 30 nano seconds. Maximum signal input 220V AC/DC (for 15 secs.)

Check Appliances And Electrical Wiring

Build This 1000V Megohm Meter

(1985 Successor to the "Megger")

It uses a transistor inverter to produce a regulated 1000V DC supply which is applied to the insulation under test. Insulation resistances between 2M Ohm and more than 2000 Ohm can be measured. **K 2550** (See EA July '85)

JUST $55

Don't Miss Out! Reserve Your Order Right Now — Phone STD Free On 008 999 007

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.

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.

'Sixty-Sixty' Integrated Amplifier Kit

(EA May, June, July '86)

Features:

• 60 watts per channel into 8 ohm loads • Very low noise on all inputs - better than CD performance • Very low distortion • Excellent headroom • Tape monitor loop • Tone controls with centre detent and defeat switch • Mono/stereo switch • Toroidal power transformer • Easy-to-build construction • Very little wiring.

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.

K 5060 **$299**

"This New Amplifier offers a standard of performance far ahead of anything we have previously published and ahead of most commercial integrated Stereo Amplifiers".

"It is half to one third of the cost of an imported Amplifier with equivalent power output and performance". *Says Leo Simpson Managing Editor Electronics Australia Magazine.*

Beginner constructors can Build this Amplifier Kit — It looks terrific and will last you a lifetime.

Save $200 or more on comparable performance commercial units

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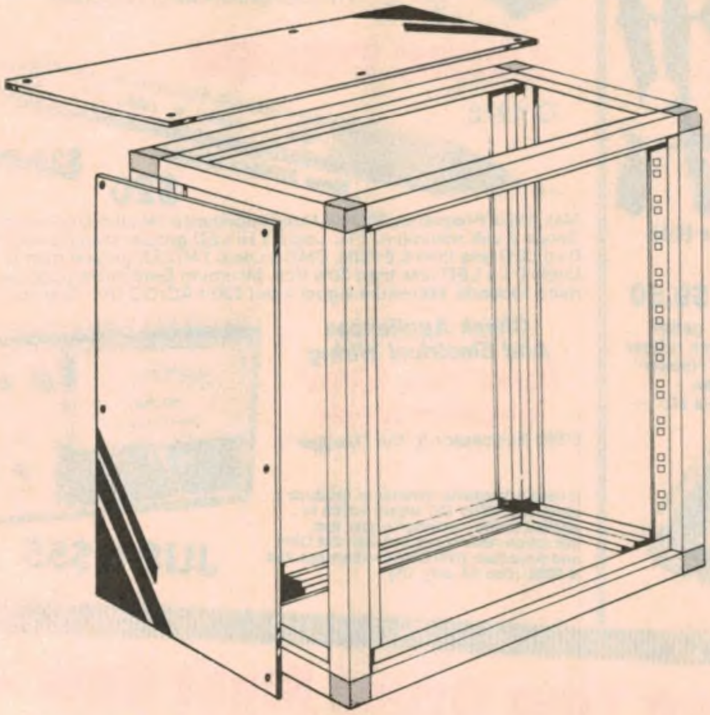
To 174 Roe St. Perth (same Phone Numbers) End of March '87

We're Desperate to Dramatically Reduce Stock Levels — You Save Up To 50%



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

Both at Low Low Altronics Prices

AVAILABLE IN TWO FORMATS

(1) **Racking Frame Only** Fantastic for neatly housing your home Hi Fi 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 Equipment 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 M6 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.

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

All 450mm Deep

	Normally	Now
H 0365 Rack Frame 6 unit (370MM)	89.50	$79.00
H 0367 Panel Set for H 0365	49.00	44.00
H 0370 Rack Frame 18 unit (907MM)	119.50	99.00
H 0372 Panel Set for H 0370	89 00	79.00
H 0375 Rack Frame 30 unit (1450MM)	149.50	135.00
H 0377 Panel Set for H 0375	129.00	109.00
H 0380 Rack Frame 38 unit (1804MM)	189.50	169.00

	Normally	Now
H 0382 Panel set for H 0380	149.00	135.00
H 0385 Rack screw M6 PK12 Natural	2.95	2.50
H 0386 Rack screw M6 PK100 Natural	19.95	15.00
H 0390 Rack screw M6 PK12 Black	2.95	2.50
H 0391 Rack screw M6 PK100 Black	19.95	15.00
H 0395 Rack captive nuts M6 PK12	3.95	3.00
H 0396 Rack captive nut M6 PK100	25.00	19.00

Supplied In Flat Pack Form They Snap Togetgher In Minutes

These High Grade Rack Cabinets cost less than 1/2 that of purpose made sheet metal Racks.

Hundreds are now in use with Universities, TV Stations, Govt. Departments and Private Industry. They are extremely sturdy and beautifully finished with natural anodised Aluminium frames and super durable "Electron Grey-Blue" powder coat enamel panels.

DISPLAYED HERE IN SEQUENCE LEFT TO RIGHT ARE —

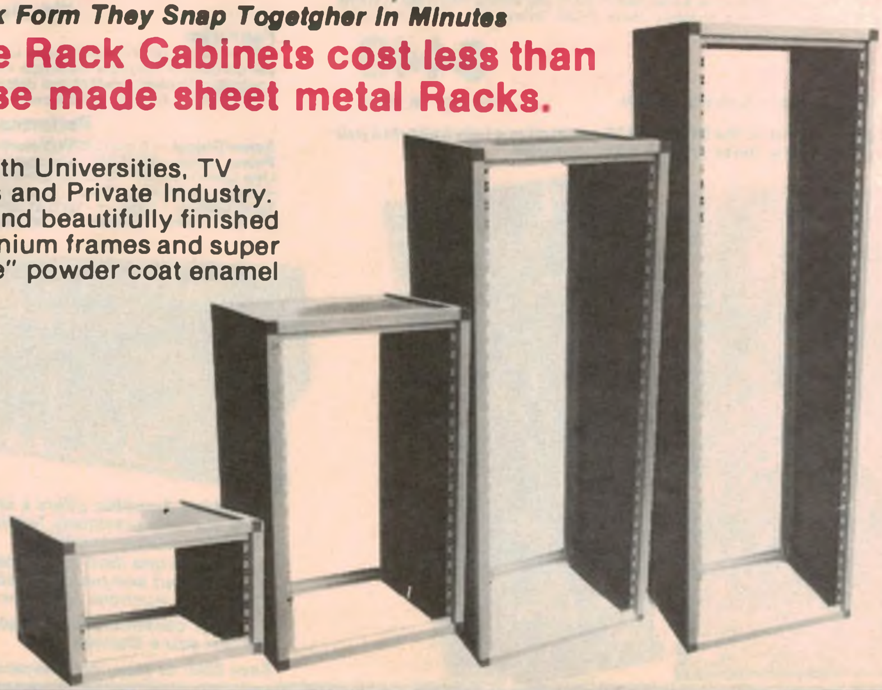
(A) H 0365 with H 0367 307mm High (267mm of Panel Height)

(B) H 0370 with H 0372 907mm High (800mm of Panel Height)

(C) H 0375 with H 0377 1450mm High (1333mm of Panel Height)

(D) H 0380 with H 0382 1804mm High (1690mm of Panel Height)

AUSTRALIAN MADE



Microphone Super Sale

BIG SAVINGS THIS MONTH

For Professional 2 way Radio's on Aircraft, Boats, Vehicles and also for Industrial PA Systems.

Noise Cancelling Microphone

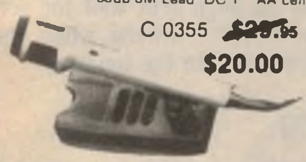
Fantastic voice clarity and absence of feedback and background noise with this microphone, a great addition to the Altronics microphone range. Frequency Response 400-8KHz impedance 160 Ohms Sensitivity -65 (5cm from Sound Source)

C 0304 ~~$25.50~~ **$19.00**

Stereo Microphone

Superb for Stereo recording of vocal or music. Includes stand. Fantastic performance **Frequency Response** 50-18KHz 1000 Ohm -68db 3M Lead DC 1 AA cell

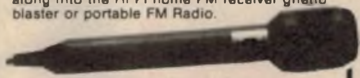
C 0355 ~~$28.95~~ **$20.00**



Electret Condenser Microphones
One for the Kids

Low Cost Wireless Mic

Absolutely the "Bees Knees" for the kids to sing along into the Hi Fi home FM receiver ghetto blaster or portable FM Radio.



Great Fun for all the family

Transmitting **Frequency:** 88-108MHz FM, tough ABS, powered by one AA penlight battery.

C 0315 ..... ~~$17.50~~ **$12.00**

A Great Present for that Budding "Star"

Two Function Cardioid Microphone

Wireless or Electret operation (simply swap over the antenna and output lead)

Frequency 88-108MHz 3M Lead supplied DC 2 x AA Penlight

C 0320 ... ~~$29.50~~ **$19.00**

Lavalier (Lapel)

Superb little microphone. Clips to tie, shirt etc. Ideal for lecturers, religious speakers, stage work etc. Uses 1.5V alkaline manganese LR44 battery (supplied). Includes tie clip.

C 0353 ~~$32.50~~ **$24**

ALC Wireless Microphone

Superb roving entertainment microphone. Our incredible ALC Microphone is one of the most exciting products. We all know how handy it is to operate a microphone without trailing cable— of course, wireless mics suffer from overmodulation distortion with too higher input sound level making them totally unsuitable for high grade vocal entertainment.

C 0400 **Only** ~~$79.00~~ **$65.00**

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$3.00 DELIVERY AUSTRALIA WIDE We process your order the day received and despatch via Australia Post. Allow approx. 7 days from day you post order to when you receive goods. Weight limited 1Kg

$6.00 OVERNIGHT JETSERVICE We process your order the day received and despatch via overnight jetservice Courier for delivery next day. Country areas please allow additional 24-48 hours. Weight limti 3Kgs.

$6.00 HEAVY MAIL SERVICE For deliveries exceeding 3Kgs and less than 10Kgs - allow 7 days for delivery

$10.00 HEAVY HEAVY SERVICE - All orders of 10Kgs or more must travel Express Road - Please allow 7 days for delivery

INSURANCE — As with virtually every other Australian supplier, we send goods at consignees risk. Should you require comprehensive insurance cover against loss or damage please add 1% order value (Minimum charge $1). When phone ordering please request "Insurance".

TOLL FREE PHONE ORDER

Bankcard Holders can phone order toll free up to 6pm Eastern Standard Time. Remember with our **Overnight Jetservice** we deliver next day.

Altronics Resellers

Chances are there is an Altronics Reseller right near you — check this list or phone us for details of the nearest dealer.

Blue Ribbon Dealers are highlighted with a ■. These dealers, generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

Don't forget our Express Mail and Phone Order Service—for the cost of a local call, Bankcard, Visa or Mastercard holders can phone order for same day despatch.

Please Note: Resellers have to pay the cost of freight and insurance and therefore the prices charged by individual dealers may vary slightly from this Catalogue — in many cases, however, Dealer prices will still represent a significant cost saving from prices charged by Altronics Competitors.

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Ortofon's new series of moving magnet cartridges

Ortofon has released a new series of moving magnet cartridges which has versons for conventional headshells or the newer P-mount arms. The OM series of cartridges have removeable stylus assemblies which are interchangeable for upgrading.

by LEO SIMPSON

For many years Ortofon was well-known for its moving coil cartridges but in recent years it has also produced moving magnet cartridges. This latest series of cartridges is based on the moving magnet principle which gives a higher output voltage than moving coil types and can be connected to the standard phono input on stereo amplifiers.

The OM series (OM stands for Optimum Match) of cartridges all have the same body and the various styli are interchangeable so that the buyer can have several strategies when approaching the purchase. You could buy the cheapest, the OM10, and upgrade to one of the three higher performing models at a later date.

Alternatively, you could buy the top-of-the-range OM 40 and also buy the styles from the OM 10 for use at parties. You can also buy a stylus to play 78rpm records should that be your desire.

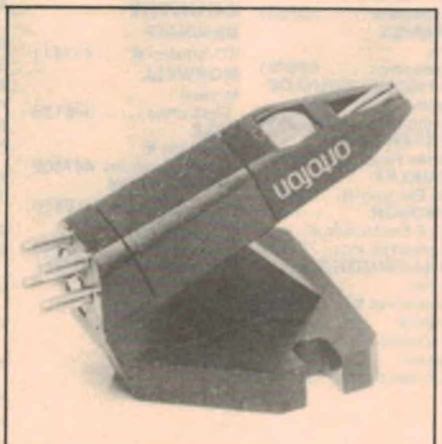
There are also P-mount versions of the OM series, so that people with T-4P tonearms (first introduced by Technics) are not left out. Common specificatisons to all cartridges are 450 millihenries inductance and 750 ohms resistance. Recommended load impedance is 47kΩ shunted by 200 to 500pF capacitance.

The OM series have a very slim body and would have to be one of the smallest and lightest cartridges available at the present. The basic cartridge together with its stylus assembly weighs a mere 2.5 grams but this is increased to 5 grams with the inclusion of a metal insert into the mounting foot.

The overall weight of 5 grams is more desirable as far as most tonearms are concerned because many arms could not balance a cartridge weighing only 2.5 grams.

We reviewed the top-of-the-range model, the OM-40. This has the Van del Hul biradial stylus which is specially designed for very good tracing of the record groove, especially the innermost tracks, while keeping surface deformation forces very low. The stylus assembly is also claimed to have particularly good tracking ability.

The OM-40 comes well packed in a bright red and white box within internal polystyrene foam packing. Inside, the cartridge itself is securely mounted in a perspex and aluminium presentation case. Included with the cartridge is an assortment of mounting screws, a miniature screwdriver, a stylus cleaning brush and a set of coloured cartridge terminating leads.



Ortofon's new OM range is available in versions to suit conventional tonearms or the new T-4P mounts.

Also included was a neat plastic stylus pressure gauge calibrated from 8 to 30 milliNewtons (equivalent to 0.8 to 3 grams), and an alignment tool for setting up the stylus overhang when the cartridge is installed in the tonearm.

Mounting

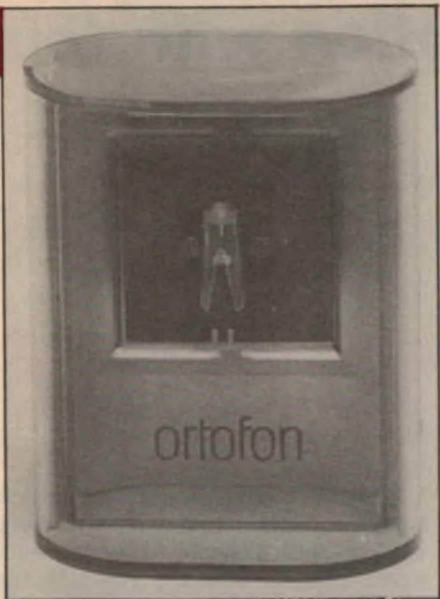
Mounting the cartridge in a typical headshell is reasonably easy, especially since the mounting holes in the cartridge foot are slots. However, the tapered body shape does present a small problem in that the lack of parallel sides makes it harder to get the correct alignment in the headshell.

We also prefer the flip-down stylus guards found on other more conventionally styled cartridges. The stylus guard supplied by Ortofon is effective enough when it is on but liable to be lost when it is removed for playing.

Having mounted the cartridge in the headshell, it is then a matter of using the Ortofon alignment gauge to minimise the tracking error. The alignment gauge is a strip of perspex which has one end drilled to fit over the turntable spindle. It has a grid of parallel lines marked on it and two stylus positions, at 65 and 120mm.

The suggested procedure is to put the stylus at point A, note the angle between stylus and the grid lines and then do the same at point B. The cartridge is then twisted slightly within the headshell to make the angles at points A and B equal.

In practice, it is not possible to see the angle between the stylus and the grid lines and so you have to do the next best theng which is to note the angle between the cartridge body and the grid lines. As noted above, because the cartridge body is tapered and angled to the record surface, this makes it a



This view of the Ortofon OM-40 in its presentation case also shows the removable stylus guard.

matter of eye-balling the cartridge and then guesstimating the angles — a tricky business which some users may find hard to grasp.

Once you get the general idea though, it is not too hard to do and is a better procedure than attempting to measure and adjust the stylus overhang. The latter process is not possible with many automatic turntables since the headshell cannot be positioned over the turntable spindle.

Having set the arm balance and the tracking force to Ortofon's suggesting setting of 1.25 grams, we checked the supplied plastic stylus force gauge and found the calibrations to be within 10% of the actual values. It really is a nifty little gauge and one which other cartridge manufacturers will probably copy in the future.

Performance

Our first objective tests concerned tracking and we put the cartridge through a battery of test records. The first was our old favourite, the drum test tracks on the W&G 25/2434 record. The Ortofon sailed through all tracks, including the most difficult at +16dB. Very few cartridges have been able to do that in the past.

On the Shure Audio Obstacle Course, TTR-110, the Ortofon also did very well, handling all five levels of the Bells and Sibilance tracks without problems, up to level four of the Violin tracks and with just slight mistracking of the level five drum track.

On the CBS STR-110 disc, the Ortofon played the +15dB sinewave track without distortion and handled the very difficult +18dB track with some mistracking.

Overall then, the Ortofon must be regarded as one of the best tracking cartridges available.

To check the frequency response and cartridge separation, we used the CBS STR-100 test disc. With a load of 50kΩ and 200pF in parallel which is fairly typical of most amplifier and turntable/tonearm combinations, the frequency response was within ±1dB over the range 20Hz to 10kHz. Above 10kHz, there is a rise to a small resonance of about +4.5dB at 14kHz, dropping away thereafter to about -1dB at 20kHz.

This is quite a good result, typical of many moving magnet cartridges. In fact, it can be argued that the small resonance at 14kHz is desirable, giving, as it does, a slight lift to the response right at the hearing limit of most people. This has the effect of "sweetening" the strings while not emphasising record surface noise.

Separation between channels was commendable with the minimum reading being -16dB at the 14kHz resonance. Elsewhere it was quite symmetrical at -27dB in the midrange and even -18 and -21dB at 20kHz. Again, a good result.

Waveform on sinewave is very good, comparable with the best cartridges we have seen. That is to say, at some frequencies, typically between 8kHz and the resonance, the waveform can be distorted (in some cartridges it becomes very much like a sawtooth waveform) but overall it is quite good.

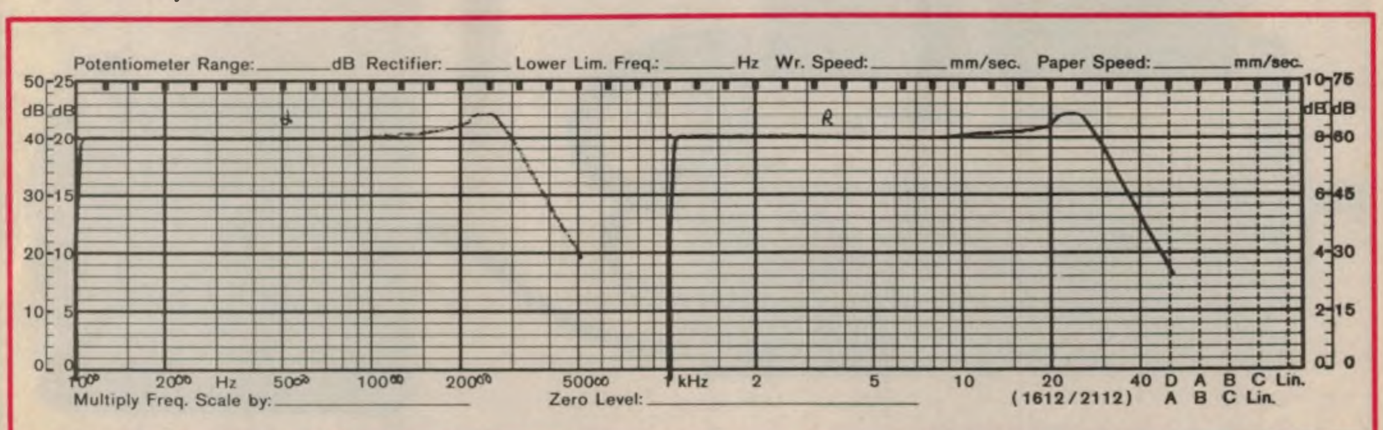
Square waves are also good, with very little overshoot and only slight high frequency ringing. Sensitivity of the cartridge is about average, producing 4mV at 5cm/sec signal amplitude.

Listening tests confirmed the very good objective results. If you had to define the sound quality, it would involve terms like crisp and analytical. The bass is tight while the upper treble is a little on the bright side.

Conclusion

In summary, it's a beauty. It would have to be one of the best performers available at the asking price and in this reviewer's opinion, it's probably the best available regardless of price, particularly when the tracking performance is taken into account.

Recommended retail price of the Ortofon OM 40 is $329, including sales tax. The OM 10 model retails for $89, the OM 20 $159 and the OM 30, $249. For further information, contact your hifi dealer or the distributors for Ortofon cartridges, Scan Audio Pty Ltd, 52 Crown St, Richmond, Victoria 3121. Phone (03) 429 2199. (L.D.S.)



The supplied frequency response plot for the OM-40 was substantially in line with our test results.

Boost your TV and FM reception with this dual-purpose unit

TV booster & distribution amplifier

This simple amplifier circuit can improve TV and FM reception in fringe and metropolitan areas. It can be employed as a masthead amplifier or distribution amplifier, and is easy to build and install. The unit is relatively inexpensive when compared to commercial equivalents with similar performance.

by BRANCO JUSTIC

Even though Australian television and FM transmission standards are as good as, if not better than, anywhere in the world, it is surprising just how many people are missing out on good reception. In many cases, the good signal which may be available at the antenna terminals is dissipated by losses in the transmission line (coaxial cable), splitters and terminations.

The solution is to amplify the signals before they are attenuated in the distribution system.

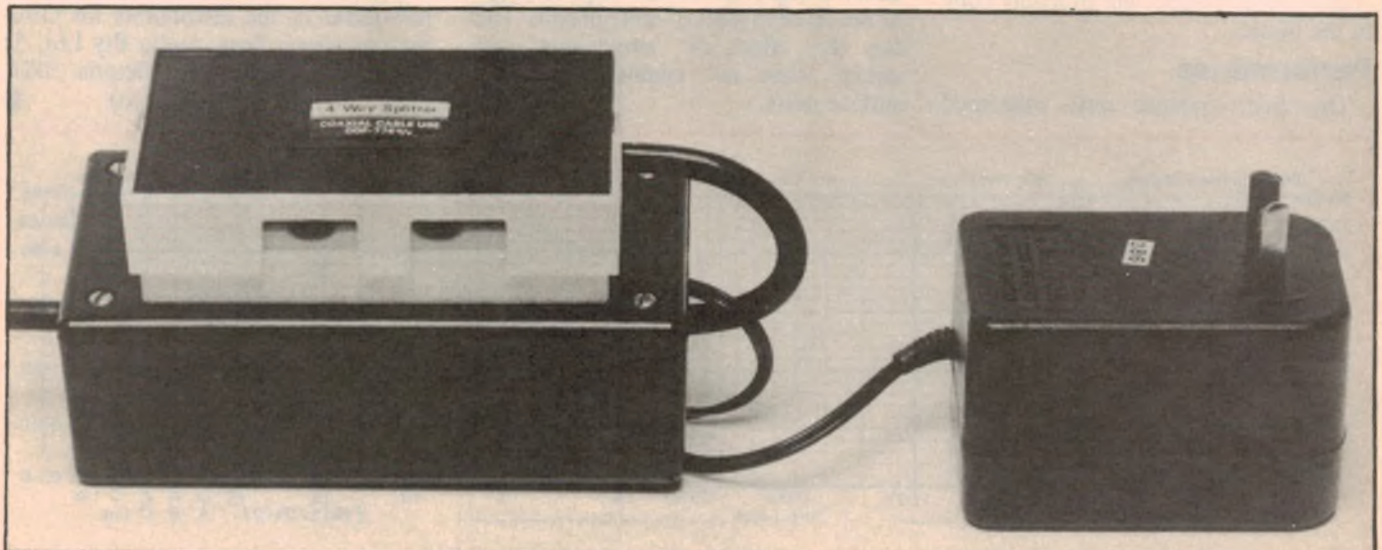
At first one may hesitate at the cost and time needed to build and install a booster amplifier for TV or FM reception. But if you want to have good signals at more than one point in your home, the chances are that the extra losses brought about by the need for signal splitters will make an amplifier necessary. By the time you invest in cable, splitters and other hardware for a multipoint TV/FM signal distribution system, you might as well do the job properly and install an amplifier as well.

With this amplifier you can have as many as 16 signal outlets, all with a signal level 9dB higher than the incoming signal from the antenna. You may also find that some channels that presently give poor (snowy) reception will show a big improvement because because of a better overall signal-to-noise ratio.

Masthead or distribution amplifier

Let's compare the two possibilities. The overall gain of an amplifier in a properly terminated distribution system is independent of its position along the transmission line. However, the noise performance (signal-to-noise ratio) is best if the amplifier is placed at the antenna terminals.

Consider the two situations depicted in Fig.1 where the amplifier input noise is assumed to be 20μV and the signal level at the antenna is 200μV. For the purpose of this explanation the amplifier gain is 20dB but the principle is the same for any gain figure.



In this version, a 4-way splitter has been mounted on the back of the amplifier case. Power comes from a 12V AC plugpack.

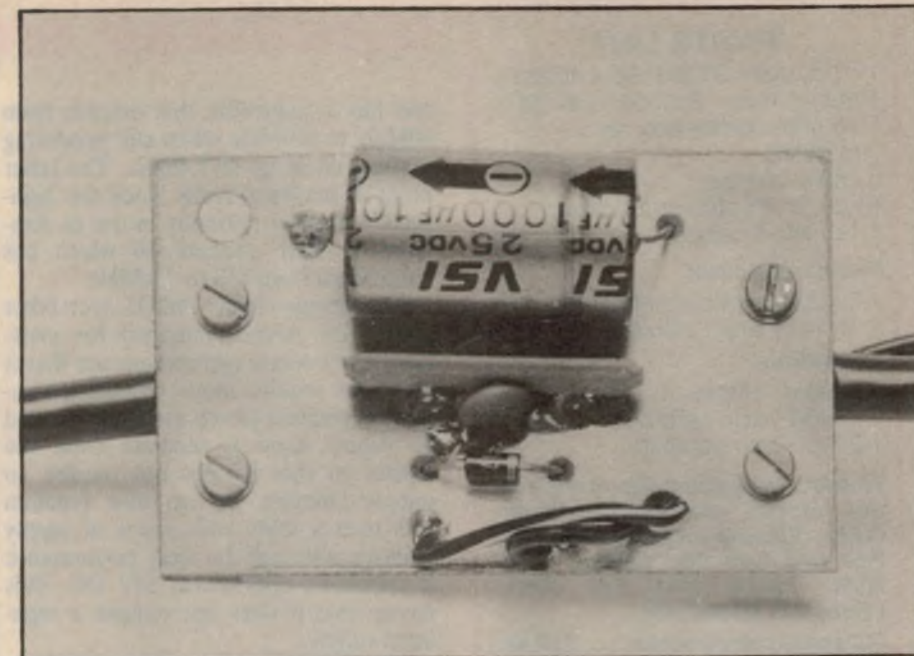
In the first case, Fig.1a, the amplifier's input terminals are connected directly to the antenna so that there are no losses in a cable between antenna and amplifier. The amplifier amplifies its input noise and the signal by the same amount, so that the S/N ratio is the same at the output of the amplifier.

The output cable from the amplifier is shown as having a loss of –6dB but since the loss effects signal and noise equally, the S/N ratio at the output cable end is the same as the input; ie, 200:20 or 10:1, or in decibel terms, 20dB.

In the second case, Fig.1b, there is a –6dB loss in the cable between antenna and amplifier, so the antenna signal is attenuated by half by the time it reaches the amplifier input. This means that the amplifier input signal is now 100μV while its input noise is still 20μV. So in this case, the signal-to-noise ratio has deteriorated by 6dB to 14dB. That is a pretty serious loss in signal quality.

Best performance can thus be expected with the amplifier placed at the antenna terminals. But masthead amplifiers are difficult to install, need waterproofing and need DC feed on coaxial cable. These problems are enough to discourage many people from the project but there is a good compromise.

Good quality low-loss cable can be used to connect the signal from the antenna to the first convenient point of entry (in the ceiling, in the garage, under the house etc), where the amplifier can be installed. From there, the signal can be distributed using less expensive but higher-loss cable. Good quality cables have losses as low as 2dB per 10 metres (at 600MHz), so you won't notice the signal loss produced by a short run between antenna and amplifier.



The masthead amplifier employs only a few parts and these are mounted on a double-sided printed circuit board.

After the amplifier you would have signal to burn, so you could then use the cheaper cables to distribute to other points in your home and not worry about the higher losses causing any noticeable signal degradation.

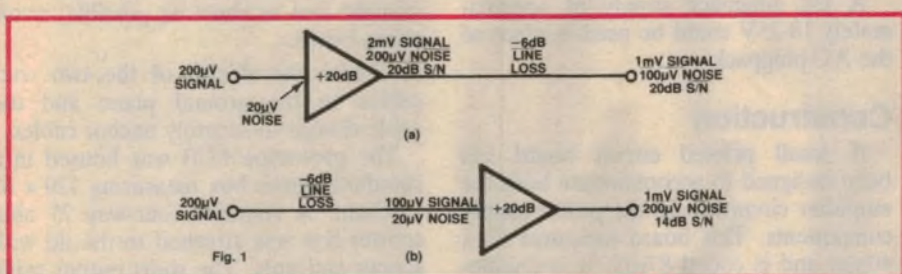


Fig.1: best performance is obtained if the amplifier is installed close to the antenna and connected to it via good quality coaxial cable.

Fig.2: this diagram shows the general arrangement for a distribution system.

The beauty of using the compromise approach is that the amplifier does not have to be weatherproofed and is much more accessible if you want to check the state of the cables and connections.

However, if you decide to take the masthead amplifier approach you could encapsulate the whole amplifier assembly to waterproof it and feed it with a separate AC power lead which could be inexpensive figure-8 twin-wire cable.

Before you decide on either approach though, there are a couple of points to consider. If you live fairly close to the transmitter towers, say within 10km or so, then you really should not need an amplifier at all. The signal from your antenna should be very strong and should more than cope with the losses expected in any normal distribution system.

The other point is that if your existing reception on all stations is presently noisy or snowy, then there is a good chance that an amplifier alone will not improve matters. You would be better off first investing the money necessary to install a higher gain antenna system, perhaps on a taller mast than you may already have. The reason for this is that an amplifier by itself will not improve matters where reception on all channels is noticeably snowy.

Circuit description

The amplifier is based on a thick-film hybrid RF amplfiier IC type OM335, made by Philips. This device produces an overall gain of approximately 27dB

Masthead amplifier

PARTS LIST

1 PCB, code 87sp3, 63 x 40mm
1 plastic box, 120 x 65 x 39mm
1 75 ohm splitter box, as required
2 cable clamps
40 cm of 75 ohm coax cable
1 12V AC plugpack

Semiconductors

1 OM335 hybrid amplifier IC
1 1N4004 silicon diode

Capacitors

1 1000μF 25V electrolytic
1 1000pF disc ceramic
1 270pF disc ceramic

Where to buy the parts: parts for this project are available from Oatley Electronics, 5 Lansdowne Pde (PO Box 89), Oatley, NSW 2223. Phone (02) 579 4985. Prices are as follows:

PCB plus components	**$32.95**
Plastic box	**$2.60**
12V AC plugpack	**$11.00**
4-way splitter	**$8.30**
Complete kit, as above	**$54.85**

Note: copyright for the PC artwork for this project is owned by Oatley Electronics.

and has a bandwidth that extends from 40MHz to 860MHz whilst still producing useful gain at up to 1.4GHz. The latter point is academic really since the highest TV channel presently in use in Australia is UHF channel 59 which has band limits from 743 to 750MHz.

Advantages of the OM335 over other hybrid RF devices intended for masthead and booster applications are that it does not require input or output coupling capacitors (these are internal) and its supply input is separate from the output so that it does not require an output inductor. It can also function well over a fairly wide range of supply voltages although for best performance it should be operated at 24V DC. This means that it does not require a regulated supply.

Characteristic source and load impedance of the OM335 is 75 ohms. That and the fact that there are no external input and output coupling capacitors means that the input and output shielded cable may be directly connected to the device.

The power supply employs a half-wave rectifier diode (D1) and a 1000μF filter capacitor (C1). C2 and C3 provide RF decoupling for the supply rail. Note that a 12V AC plugpack has been specified for the project and this will result in a DC supply of around 21V or so, which is sufficient to ensure good performance.

A DC plugpack supply of approximately 18-25V could be used in place of the AC plugpack.

Construction

A small printed circuit board has been designed to accommodate both the amplifier circuitry and the power supply components. This board measures 63 x 40mm and is coded 87sp3. It is double-sided, with the component side pattern being a ground plane.

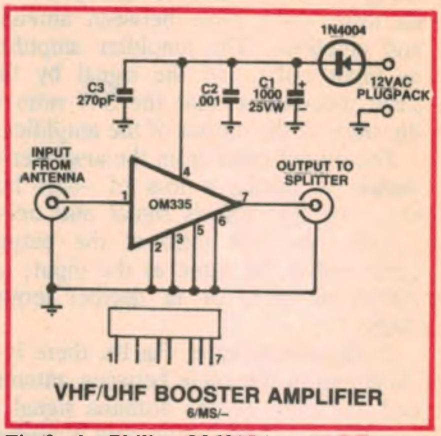


Fig.3: the Philips OM335 hybrid RF amplifier provides about 27dB of gain.

Do not attempt to build this project without this printed circuit board. Unless correct construction techniques are followed you could finish up with an oscillator or an amplifier with reduced bandwidth. You must observe the following instructions:

1. Mount the hybrid IC close to the ground plane.
2. Mount C2 and C3 close to the ground plane.
3. Solder all the negative connections of C1, C2, C3 and the IC. The relevant leads do not have the copper etched away from the holes, so that soldering is straightforward.
4. Keep the centre conductors of the input and output coaxial cables as straight and as short as possible; avoid sharp bends.
5. Solder the shields of the two coax cables to the ground plane and use cable clamps to securely anchor cables.

The prototype PCB was housed in a standard plastic box measuring 120 x 65 x 93mm. A standard four-way 75 ohm splitter box was attached to the lid with screws and nuts. The short output cable from the PCB was then terminated at the input of the splitter box.

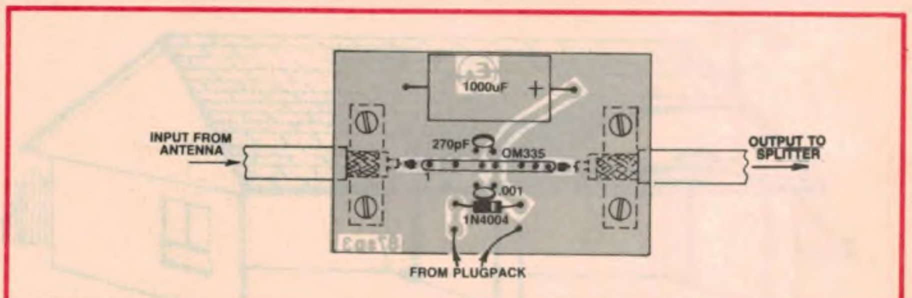


Fig.4: parts layout for the PCB. Note that the negative connections for C1, C2, C3 and the OM335 must be soldered to both sides of the PCB.

Audio Audio Audio Audio Audio

TOLL FREE MAIL ORDER NUMBER 008 33 5757 (STRICTLY ORDERS ONLY) INQUIRIES TO (03) 543 7877

VIFA/AEM 3 WAY SPEAKER KIT!

This superb 3 way speaker kit competes with systems that cost 2 - 3 times the cost of these units! (which may even be using VIFA drivers etc.) Never before has it been possible to get such exceptional value in kit speakers! Call in personally and compare for yourself!

The system comprises...
2 x D19 dome tweeters
2 x D75 dome midrange
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

Complete Kit Cat.K16030 **$1,199**
Speaker Kit Cat.K16031 **$949**
Cabinet Kit Cat.K16032 **$349**

VIFA/AEM 2 WAY SPEAKER KIT!

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: Qm: 2.4 Qe: 0.41 Qt: 0.35 Vas: 80.1
Weight: 1.65kg

Complete Kit Cat.K16020 **$799**
Speaker Kit Cat.K16021 **$649**
Cabinet Kit Cat.K16022 **$209**

SUPERB NEW VIFA/EA 60 + 60 SPEAKER KIT!

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
Moving Mass: 15 grams
Cat. C10322 **$89**

Cat. K86092 (speakers only) **$379**
Cat. K86091 (complete kit) **$449**

SENNHEISER HEADPHONES!!

The worlds best headphones are now available from Rod Irving Electronics!! 3 models to choose from, other models are available on request! (Phone Tony DiPaolo on (03) 543 2166)

SENNHEISER HD 40

The HD40 is feather light, at just 60g! This HiFi stereo headphone is uncommonly convenient to use. Its systems can be rotated so it can fit into any drawer. It is also available as a TV headphone.
SPECIFICATIONS:
Frequency Range: 22 - 18,000Hz
Impedance: 600ohm
Distortion Factor: Approx. 1.5%; pressure on ear; approx. 1.3 N
Weight: Approx. 60g
Length of lead: 3 metres
Cat. A10515 **$49.95**

SENNHEISER HD 410 SL

The HD 410 SL embodies all the advantages of the new "Slim-line" concept: brilliant sound characteristics with an optimum of sound volume combined with high wearer comfort.
SPECIFICATIONS:
Frequency Range: 20 - 18,000Hz
Impedance: 600ohm
Distortion Factor: Less than 1%; pressure on ear; approx. 2.5 N
Weight: Approx. 82g
Length of lead: 3 metres
Cat. A10518 **$74.95**

SENNHEISER HD 540 REFERENCE

The HD 540 reference headphones are open dynamic stereo headphones. They are among the best ever made. Designed according to latest findings in acoustics, their reproduction is of extraordinary transparency and the highest transients fidelity. The test with a CD player shows: their acoustic properties are outstanding. The ear cushions play a major role. They provide a completely resonance-free treble reproduction up to 25 KHz and assure an impressively clear bass reproduction down to 16 Hz.
SPECIFICATIONS:
Frequency Range: 16 - 25,000Hz
Impedance: 600ohm per capsule
Harmonic Distortion Factor: Less than 0.4%
Contact Pressure: Approx. 3 N
Weight: Approx. 250g
Length of lead: 3 metres
Cat. A10519 **$199**

1" DOME TWEETER SPEAKER

Mylar diaphragm
SPECIFICATIONS:
Sensitivity: 96dB
Frequency Response: 2-20 kHz
Impedance: 8 ohms
Power RMS: 15 watts RMS
Magnet Weight: 5.4oz
Size: 96mm diameter
Cat. C10234 **$10.95**

2" HORN TWEETER SPEAKER

Mylar diaphragm, aluminium voice coil
SPECIFICATIONS:
Sensitivity: 95dB
Frequency Response: 1.5-20 kHz
Impedance: 8 ohms
Power RMS: 10 watts RMS
Magnet Weight: 2.5oz
Cat. C10232 **$8.95**

5" MIDRANGE SPEAKER

Sealed back, foam edge, black cone, silver dust cap
SPECIFICATIONS:
Sensitivity: 98dB
Frequency Response: 500-8 kHz
Impedance: 8 ohms
Power RMS: 10 watts RMS
Magnet Weight: 5.4oz
Cat. C10230 **$12.95**

6½" TWIN CONE FULL RANGE SPEAKER

Foam edge, black cone, black whizzer cone
SPECIFICATIONS:
Sensitivity: 89dB
Frequency Response: 60-15 kHz
Impedance: 8 ohms
Power RMS: 10 watts RMS
Magnet Weight: 5.3oz
Cat. C10222 **$14.95**

8" TWIN CONE FULL RANGE SPEAKER

Foam edge, black cone, black whizzer cone
SPECIFICATIONS:
Sensitivity: 98dB
Frequency Response: 45-16 kHz
Impedance: 8 ohms
Power RMS: 30 watts RMS
Magnet Weight: 13oz
Cat. C10224 **$23.95**

8" WOOFER HIGH POWER SPEAKER

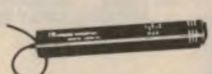
Cloth edge, dark grey cone, rubber mounting seal, cloth dust cap
SPECIFICATIONS:
Sensitivity: 90dB
Frequency Response: 60-4 kHz
Impedance: 8 ohms
Power RMS: 50 watts RMS
Magnet Weight: 20oz
Cat. C10226 **$34.95**

10" WOOFER HIGH POWER SPEAKER

Cloth edge, dark grey cone, rubber mounting seal, cloth dust cap
SPECIFICATIONS:
Sensitivity: 93dB
Frequency Response: 50-2.5 kHz
Impedance: 8 ohms
Power RMS: 100 watts RMS
Magnet Weight: 30oz
Cat. C10228 **$59.95**

12" WOOFER HIGH POWER SPEAKER

Cloth edge, dark grey cone, rubber mounting seal, cloth dust cap
SPECIFICATIONS:
Sensitivity: 97dB
Frequency Response: 28-4 kHz
Impedance: 8 ohms
Power RMS: 50 watts RMS
Magnet Weight: 30oz
Cat. C10229 **$69.95**



OMNI-DIRECTIONAL WIRELESS MICROPHONE

Tuneable: 92 - 104MHz
Freq. Response: 50 - 15kHz
Range: Over 300 feet in open field
Modulation: FM
Power Source: 9V Battery
Type: Electret Condenser
Dimensions: 185 x 27 x 38mm
Weight: 160 grams
Cat. A10450 **$19.95**

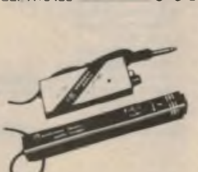
PHILIPS SPEAKERS

This month we are offering 20% off these prices! But, you'd better be quick as this offer is limited.

Description	Cat.No.	Price
AD01610T8	(C12030)	$24.95
AD02160SQ8	(C12040)	$69.95
AD80652W8	(C12042)	$69.95
AD070620M8	(C12045)	$69.95
AD12250W8	(C12050)	$129.00

WIRELESS MICROPHONE RECEIVER WA100

Made by Piezo (Azden) of Japan this device will turn any microphone fitted with a Cannon Type male socket into a wireless microphone. The receiver will plug into any 6.35mm microphone input. Both transmitter and receiver can be tuned from 76 - 81MHz.
Freq. Response: 50 - 16kHz
Tunable: 76 - 81MHz
Field Strength:
Transmitter 10uV/100 metres
Receiver 15mV (100%)
Battery: Transmitter LR44 (1.5V)
Receiver 3 x UM4 (4.5V)
Instructions: Japanese (English not available!)
Cat. A10520 R.R.P. $199
Our price, only $189



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

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**

rie

Rod Irving Electronics
48 A Beckett St, MELBOURNE
Phone (03) 663 6151
425 High St, NORTHCOTE
Phone (03) 489 8866
Mail Order and Correspondence:
P.O. Box 620, CLAYTON 3168
Telex: AA 151938

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
(STRICTLY ORDERS ONLY)

LOCAL ORDERS & INQUIRIES
(03) 543 7877

POSTAGE RATES:

$1 - $9.99	$2.00
$10 - $24.99	$3.00
$25 - $49.99	$4.00
$50 - $99.99	$5.00
$100 - $199	$7.50
$200 - $499	$10.00
$500 plus	$12.50

The above postage rates are for basic postage only. Road Freight, bulky and fragile items will be charged at different rates.

Certified Post for orders over $100 included free!
Registered Post for orders over $200 incuded free!

All sales tax exempt orders and wholesale inquiries to: RITRONICS WHOLESALE, 56 Renver Rd, Clayton. Ph. (03) 543 2166 (3 lines)

Errors and omissions excepted

*Apple and IBM are registered trade names

Something for everyone

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

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

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

SPECTROL MULTIDIALS

Model 16-1-11 (.9")
Cat R14400 **$26.95**
Model 18-1-11 (1" x 1.75" Rect.)
Cat R14405 **$45.95**
Model 21-1-11 (1.82")
Cat R14410 **$46.95**

FERRITE AERIAL ROD

200mm x 9mm
Cat. L11401 Normally $2.75
SPECIAL, ONLY $1.50

COUNTER

Cat. **$12.95**

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**

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

10 TURN WIRE WOUND POTENTIOMETER

Spectrol Model 534 1/4" shaft.
Equiv (Bourns 3540S, Beckman 7256)
Dials to suit 16-1-11, 18-1-11, 21-1-11.

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

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

ELECTROLYTIC CAP SPECIALS

(LUG MOUNTING)

Description	1-9	10+
1,000 uF 16V	$0.40	$0.30
1,000 uF 25V	$0.50	$0.40
2,500 uF 16V	$0.60	$0.50
2,500 uF 25V	$0.80	$0.70
4,000 uF 75V	$5.50	$5.00
8,000 uF 75V	$9.00	$8.00

DB STAND OFFS

At incredible prices! No need to pay absurd prices because we import them direct and pass on the savings to you!
2 Pack P10930 .... **$1.00**
10 Pack P10932 .... **$3.95**
100 Pack P10934 .... **$20.00**

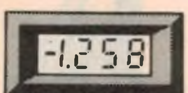
DC/DC CONVERTER

- Fail safe circuit protects against short circuit or wrong polarity
- Under dash mounting
- 13.8V DC input
- 7.5/9/12V DC output
- Current: 7.5V (900mA); 9V (1.2 amp); 12V (1.2 amp)
- 2 metres cord with 4 plug adaptor

Cat. A15054 .... **$21.95**

CANNON TYPE CONNECTORS

	1-9	10+
P10960 3 PIN LINE MALE	$3.90	$3.50
P10962 3 PIN CHASIS MALE	$3.00	$2.50
P10964 3 PIN LINE FEMALE	$4.50	$3.90
P10966 3 PIN CHASIS FEMALE	$4.95	$3.95



3 1/2 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**

SEMICONDUCTORS!

Always check with us before you buy!

	1-9	10+	100+
2716	$9.95	$9.50	$8.95
2732	$8.95	$8.50	$7.95
2764	$7.95	$7.50	$6.95
27128	$6.95	$6.50	$6.25
27256	$11.50	$10.50	$10.00
4116	$3.95	$3.50	$2.95
4164	$2.95	$2.75	$2.50
41256	**$4.95**	**$4.50**	**$3.95**
555 8pin	$0.50	$0.40	$0.35
6116	$3.95	$3.75	$3.50
6264	$6.50	$5.50	$5.25
6802	$5.00	$4.00	$3.75
6821	$2.00	$1.80	$1.70
6845	$5.00	$4.00	$3.75
7406	$0.40	$0.30	$0.25
8250	$29.95	$27.95	

NE5534AN

SCOOP PURCHASE!!!
1-9 **$1.95** 10+ **$1.85**

WORLD MODEM CHIP

Cat. U21614 ...... Normally $49.50
Save $25, SPECIAL $24.95

MEL9501

Have you blown up your Apple drive by plugging it in backwards or not turning off the power while changing boards? We have the MEL9501 chip!
SPECIAL, ONLY $29.95

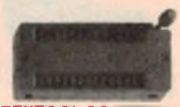
8087

Genuine Intel chips with manual and data sheets packed in boxes!

8087-3 (4.77MHz)	**$299**
8087-2 (8MHz)	**$399**
8087-1 (10MHz)	**$649**
80287-3 (6MHz)	**$499**
80287-7 (8MHz)	**$699**
8087-3 (4.77MHz)	**$299**

SPEECH SYNTHESISER CHIPS!

SPO256A-AL2: Speech synthesiser chip, needs programming to work **$16.95**
CTS256-AL2: Contains the code recognition circuit to enable the project to plug directly on the printer port, or into an IBM PC **$29.95**
A SET OF EACH $44.95



TEXTOOL SOCKETS

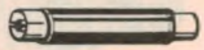
P17016 16 pin	$14.50
P17024 24 pin	$14.50
P17028 28 pin	$19.50
P17040 40 pin	$22.50

SPRING RETURN TOGGLE SWITCHES

		WAS	NOW
S.P.D.T.	Cat S11012	$2.25	$1.95
D.P.D.T.	Cat S11022	$2.50	$2.25

QUALITY LEDS

Cat. No.	Description	Price
Z10140	3mm Red	$0.20
Z10141	3mm Green	$0.30
Z10143	3mm Yellow	$0.30
Z10145	3mm Orange	$0.30
Z10150	5mm Red	$0.15
Z10151	5mm Green	$0.30
Z10152	5mm Yellow	$0.30



TV INTERFERENCE FILTER

Cuts CB/Ham signals interference
Cat. L11048 **$5.95**

10dB IN-LINE COAXIAL AMPLIFIER

Reduces loss from splitters and long cable runs. Suitable for use with antennas, coaxial feed lines and VCR's. A/C adaptor included.
SPECIFICATIONS:
Frequency Range: 5-900MHz
Gain: 10dB
Power Requirements: 12V A/C Adaptor (included)
Input Impedance: 75 ohm
Output Impedance: 75 ohm
Cat. L15043 **$44.95**

PLASTIC BODY CO-AXIAL CONNECTORS

Plug Cat. P10401 **$0.50**
Socket Cat. P10408 **$0.60**

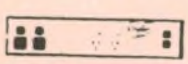
10W HORN SPEAKERS

White durable plastic, 8 ohms
Cat. C12010 **Normally $11.95**
SPECIAL, ONLY $9.95

PROGRAMMABLE 24 HOUR TIME SWITCH

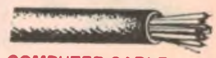
- 48 switching possibilities per day
- 240V AC, 2400 watt, 10 amp
- Suitable for turning on Heaters/Coolers, pool filter, electric blankets, cooking appliances, waking you, even making the coffee! lights etc for security while you're away from home!
- Bargain Price!

Cat. M22002 **only $19.95**



MAINS MUFFLER

Sudden mains disturbances can seriously affect your computer equipment, and stored data. So why risk it when you can have a Mains Muffler, particularly when the cost of one failure is likely to be greater than the purchase price! So vanish those dangerous clicks and voltage spikes forever with the Mains Muffler!
SPECIFICATIONS:
Maximum total load: 1000W 4 AMP 250V 50Hz
Outlet Sockets
Attenuation: 150KHz - 47dB, 500KHz - 68dB, 10MHz - 66dB
Dual T Section:
VDR Transient suppression
Surge capacity 200 Amp 8 x 20uS
2 WAY Cat. X10089 **$199**
4 WAY Cat. X10090 **$299**



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**

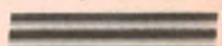
CIC12 12 conductor computer interface cable. Colour coded with mylar shielding. 12 x 7/0.16mm.
1-9 metres **$2.70/m** 10+ metres **$2.50/m**

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**

CIC25 25 conductor computer interface cable. Colour coded with mylar shielding. 25 x 7/0.16mm.
1-9 metres **$4.90/m** 10+ metres **$4.40/m**

BULK CABLE 100M ROLLS

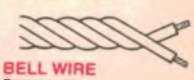
Cat. W11222 3C2V 75 OHM **$22**
Cat. W11224 5C2V 75 OHM **$35**
Cat. W11219 4 Core Shielded **$49**



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**

UV EPROM ERASER

Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less for less chips).
Features include:
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineered to prevent UV exposure
- Dimensions 217 x 80 x 68mm

WITHOUT TIMER
Cat. X14950 Normally $119
Special, $89

WITH BUILT-IN TIMER
Cat. X14955 $139
Special, $119

ROD IRVING ELECTRONICS "YOUR KIT SPECIALISTS!"

POWER AMPLIFIER

WHY YOU SHOULD BUY A "ROD IRVING ELECTRONICS" SERIES 5000 POWER AMPLIFIER

- 1% Metal Film resistors ...

SPECIAL, ONLY $399 SAVE $50

... ELECTRONICS and is being supplied to other kit suppliers

SPECIFICATIONS: 150 W RMS into 4 ohms (per channel)
POWER AMPLIFIER: 100W RMS into 8 ohms (+ - 55V Supply)
FREQUENCY RESPONSE: 8Hz to 20Hz +0=.0 4 dB 2 8Hz to 65KHz +0=3 dB. NOTE: These figures are determined solely by passive filters.
INPUT SENSITIVITY: 1 V RMS for 100W ouput
HUM: 100 dB below full output (flat)
NOISE: 116 dB below full output (flat, 20KHz bandwidth)
2nd HARMONIC DISTORTION: 0.001% at 1 KHz (0.0007% on Prototypes) at 100W ouput using a + = 56V SUPPLY rated at 4A continues 0.0003% for all frequencies less than 10KHz and all powers below clipping.
TOTAL HARMONIC DISTORTION: Determined by 2nd Harmonic Distortion (see above)
INTERMODULATION DISTORTION: 0.003% at 100W (50Hz and 7KHz mixed 4:1).
STABILITY: Unconditional.

Cat. K44771 .... **$389**

Assembled and tested $549

packing and post $10

PREAMPLIFIER

THE ADVANTAGES OF BUYING A "ROD IRVING ELECTRONICS" SERIES 5000 PREAMPLIFIER KIT ARE

- 1% Metal Film Re...

SPECIAL, ONLY $359 SAVE $40

... available that sounds as

SPECIFICATIONS:
FREQUENCY RESPONSE: High-level input: 15Hz = 130KHz +0 = 1dB Low-Level input-conforms to RIAA equalisation + = 0.2dB
DISTORTION: 1KHz 0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation)
S/N NOISE: High-Level input, master full, with respect to 300mV input signal at full output (1.2V) 92dB flat 100dB A-weighted. MM input, master full, with respect to full output (1.2V) at 5 mV input 50ohms source resistance connected 86dB flat/92dB A-weighted MC input master full, with respect to full output (1.2V) and 200uV input signal 71dB flat 75dB A-weighted.

Cat. K44791 .... **$359**

Assembled and tested $599

packing and postage $10

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS:
BANDS: 28 Bands ...

SPECIAL, ONLY $209 SAVE $30

Cat. K44590 .... 1 unit: **$239**
.... 2 units: **$429**

packing and postage $10

SERIES 4000 SPEAKERS

8 Speakers .... only $549
8 Speakers with Crossovers ... $795
Speaker Cabinet Kit (complete) $395
(Please specify cabinet to suit 7" or 8" mid range woofer)
Crossover Kits $295
Complete kit of parts (speakers, crossovers, screws, innerband boxes) $1,095
Assembled, tested and ready to hook up to your system ... $1,295
(Approximately 4 weeks delivery)

Errors and Ommissions Excepted

EA AM STEREO DECODER

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

Cat. K84100 .... **$26.95**

DIGITAL SAMPLER KIT

Digital sampling is at the core of many of the special sound effects used by modern musicians. A trigger input (usually a contsruction drum pad) triggers a prerecorded sound from the digital sampler. This sound has been recorded into the 4K of onboard memory and can be digitally manipulated so that it sounds completely different on playback. The unit has controls for gain, regeneration and mixing. It also gives a choice of a number of different triggering methods. (ETI 1402, May-July '86)

Cat. K41420 .... **$119**

50 W AMPLIFIER MODULE (ETI 480)

Cat. K44880 .... **$29.50**
(Heatsink optional extra)

100 W AMPLIFIER MODULE (ETI 480)

Cat. K44801 .... **$34.50**
(Heatsink optional extra)

HUMIDITY METER

This project can be built to give a readout of relative humidity either on a LED dot-mode display or a conventional meter. In addition it can be used with another project as a controller to turn on and off a water mist spray in a hothouse, for example. (ETI May 81) ETI-256 (Includes humidity sensor $19.50)

Cat. K42560 .... **$49.95**

1W AUDIO AMPLIFIER

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

Cat. K84111 .... **$9.95**

COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER KIT

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

Cat. K47550 .... **Normally $135**
SPECIAL, $99

ELECTRONIC MOUSETRAP

This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again! (ETI Aug '84) ETI 1524

Cat. K55240 .... **$39.95**

DELUXE CAR BURGLAR ALARM

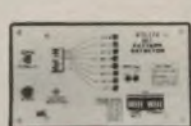
Stop your car from being one of the 70,000+ stolen cars stolen each year with this "state of the art" car burglar alarm. Features include key switch operation, delayed entry and exit, automatic reset, and provision for an auxiliary battery. Further more, of the 10 most important features listed by NRMA, this EA Deluxe Car Alarm has 9 of them! (84ba5, EA May 84)

Cat. K84050 .... **$99.50**

AEM DUAL SPEED MODEM KIT

The ultimate kit modem featuring 1200/300 baud, case and prepunched front panel. Exceptional value for money! (AEM 4600 Dec '85)

Normally $169
SUPER SPECIAL, ONLY $139



BIT PATTERN GENERATOR KIT

In applications where you are required to look for a particular byte of information in a serial or parallel data path, short of a logic analyser or a storage oscilloscope, there is not a lot to help you. However, this Bit Pattern Generator gives you a simple and economical way to detect and display specific bytes of data. It may be used on both parallel and serial data paths. (ETI 172, May '86)

Cat. K41720 .... **$54.95**
(Serial/Parallel Kit)

MULTI SECTOR ALARM STATION

Protect your home and possessions from burglars with this up to the minute burglar alarm system. It's easy to build, costs less than equivalent commercial units, and features eight seperate inputs, individual sector control, battery back up and self-test facility.

Specifications:

- Eight sectors with LED status indication.
- Two delayed entry sectors.
- Variable exit, entry and alarm time settings: entry delay variable between 10 and 75 seconds, exit delay variable between 5 and 45 seconds; alarm time variable between 1 and 15 minutes.
- Resistive loop sensing: suits both normally open and normally closed alarm sensors.
- Battery back-up with in-built charger circuit.
- Built-in siren driver.

The RIE kit includes a superb printed and prepunched metal case and inside metal work, plus a gell battery! Unbeatable VALUE!

Cat. K85900 .... Normally $169
SPECIAL, $159

ZENER TESTER

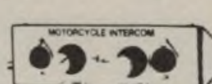
A simple low cost add-on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes. (ETI May 83) ETI 164

Cat. K41640 .... **$11.95**

30 V/1 A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current metering is provided. (ETI Dec. 83) ETI 162

Cat. K41620 .... Normally $69.50
SPECIAL, $59.50



MOTORCYCLE INTERCOM

OVER 500 SOLD!

Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build! (EA Feb. 84) 84MC2

Cat. K84020 .... **$49.95**

MICROBEE SERIAL-TO-PARALLEL INTERFACE

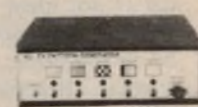
Most microcomputers worth owning have an 'RS232' connector or port, through which serial communications (input/output) is conducted. It is a convention that, for listing on a printer, the BASIC LLIST or LPRINT command assumes a printer is connected to the RS232 port. Problem is, serial interface printers are more expensive than parallel 'Centronics' interface printers. Save money by building this interface. (ETI Jan. '84) ETI 675

Cat. K46750 .... **$39.50**

PARALLEL PRINTER SWITCH KIT

Tired of plug swapping when ever you want to change from one printer to another? This low-cost project should suit you down to the ground. It lets you have two Centronics-type printers connected up permanently so that you can select one or the other at the flick of a switch. (ETI 666, Feb. '85)

Cat. K46660 .... **$79.95**



CRYSTAL CONTROLLED TV PATTERN GENERATOR

Anyone wishing to obtain the maximum performance from a colour TV reciever needs a pattern generator. Why not build this superb unit which provides five separate patterns: dot, crosshatch, checker board, grey scale and white raster? **Note:** The RIE kit includes a large ABS type case! (80pg6, EA June '80)

Cat. K80033 .... **$97.50**

LOW BATTERY VOLTAGE INDICATOR

Knowing your batteries are about to give up on you could save many an embarrassing situation. This simple low cost project will give your early warning of power failure, and makes a handy beginner's project. (ETI 280, March '85)

Cat. K42800 .... **$9.95**

PH METER KIT

Build this pH meter for use with swimming pools to fish tanks to gardening, this pH meter has many applications around the home. This unit features a large 3 1/2 digit liquid crystal display and resolution to .01 pH units, making it suitable for use in the laboratory as well. (EA Dec. 82) 82PH12

Cat. K82123 .... **$199**

What's new in car sound systems?

These days more people are spending big dollars on their car sound systems. With compact disc players, the sound in your car can be every bit as good as that in your home. To get high quality sound though, you have to spend your money carefully.

by LEO SIMPSON

In 1987, the big interest in car sound systems is still the compact disc. Even though the listening environment of a car is not ideal in that the background noise is nowhere near as low as it can be in the home, the medium is still extremely attractive, for a number of reasons.

First, even though cars are more noisy than the average living room, the sound of a compact disc player fed through a top amplifier and speakers is spectacularly better than the FM reception or cassette reproduction in most cars.

Second, many people already have a CD player in the home and are entranced by the sound quality. Naturally, they wish to play the same CDs in the car. At the moment, few cassette players can satifactorily transfer CDs to tape, so using the car cassette player for the same music is generally not on. It comes back to CD.

Another reason for the attraction of CD in the car is the ease of handling and the reduced concern about dust and grime. Nor do you have to worry about rewinding tapes and you can repeat any musical selection as often as you want, at will.

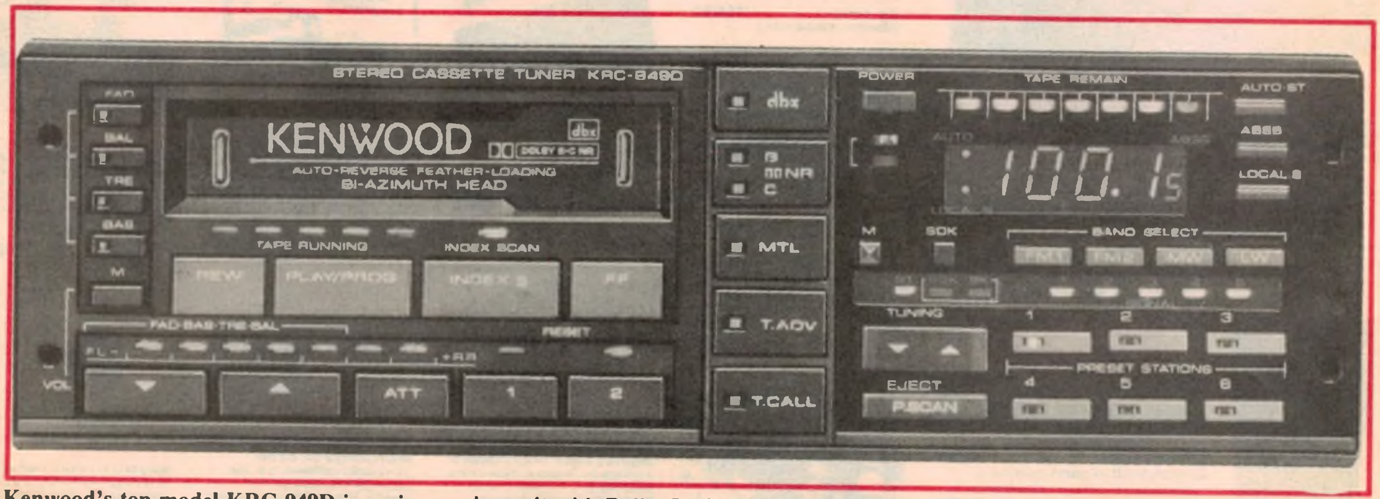
Car CD players have also proven to be reliable and not at all prone to mistrack because of the high vibration and shocks in a moving car. There is still an element of caution about leaving compact discs in direct sunlight because of the danger of warping but this applies more to the CD cases than then to the discs themselves.

Car security

In any case, no one in their right mind would leave compact discs in clear view in an unattended car; the risk of theft would be too great. And inevitably, risk of theft is the biggest drawback of having a CD player in a car. Car radio-cassette players are vulnerable enough to theft and CD players are much worse.

Unfortunately too, the theft of a car sound system is usually not the full extent of the loss. The damage to the car's bodywork and interior often has to be seen to be believed. The repair cost can often be considerably in excess of the replacement cost of the sound gear itself.

We have seen thousands of dollars of damage done to Commodores just to remove the standard Eurovox



Kenwood's top model KRC-949D is an impressive unit with Dolby B, C and dbx noise reduction.

The Nakamichi TD-1200 has excellent performance specs. and is one of the few to have inbuilt security coding.

radio-cassette player. In this context, "rip-off" is the operative word as thieves have absolutely no respect for mere property.

On the other hand, as the above evidence illustrates, even if you have a relatively standard sound system in your car, it can still be burglar bait. So how do you go about installing good sound in your car, preferably including a CD player.

Sony is one manufacturer who has addressed this problem and they have come up with what they believe is a solution with their DiscJockey CDX-10 CD player for the car. Instead of being installed in the car dashboard, as are other CD players (including the CDX-5 and CDX-R7 systems from Sony), the CDX-10 is mounted in the boot of the car. It takes up to 10 compact discs which can then be programmed for play by a remote-controlled unit which plugs into the dash.

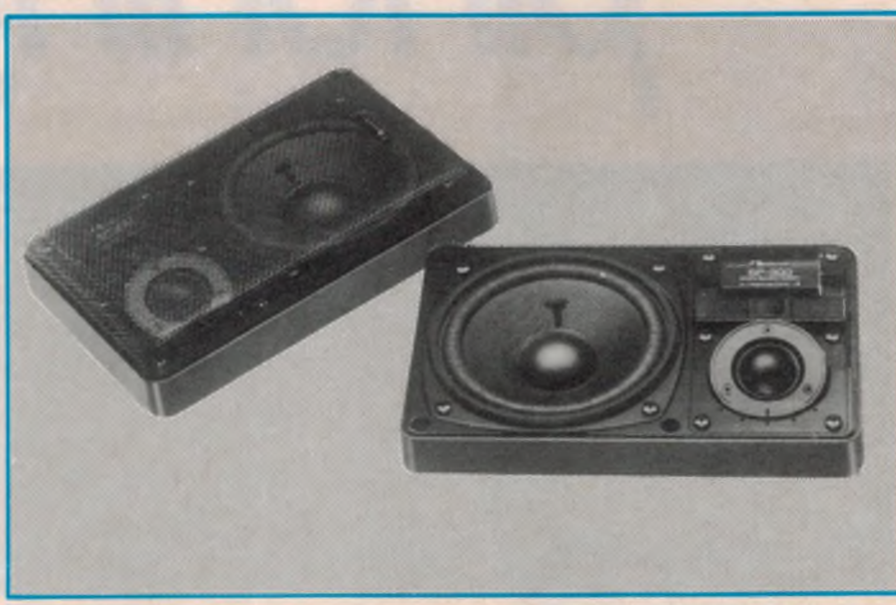
The beauty of this system is that there is no evidence of a CD player, even to a person who looks intently at the interior of the car.

Whether this idea will catch on with other manufacturers remains to be seen but for the moment it is exclusive to Sony. The price is exclusive too, at $1999 just for the player, to which must be added the cost of the rest of the sound system.

While the Sony DiscJockey may be too pricey for your wallet, virtually all car CD players cost $1000 or more. That may be disheartening but remember that the first home CD players were over $1000 and they can now be purchased for under $400 in some cases. Car CD players will eventually come down too.

Portable players

In the meantime, CD enthusiasts are taking another way out — use a portable CD player and plug it into the car's



The tweeters in Nakamichi's SP-300 car speaker system can be angled for best treble dispersion.

Stereo amplifiers such as these from Nakamichi require inbuilt DC/DC inverters to be able to deliver high power.

It's not worth pinching!

NOW, EUROVOX INTRODUCES A CODED SECURITY SYSTEM*

At last, car sound with its own in-built anti-theft system! The new Eurovox AM stereo/FM stereo radio cassette actually stops thieves in their tracks – thanks to a special pre-determined code which must be punched-in for the radio to operate. And, not only is it impossible for the new Eurovox to work unless the correct code is known, it sets off an alarm the moment the unit is tampered with. So you see, it's not worth pinching!

But there's more, Eurovox gives you great sound because it's loaded with features, like long range reception ... switchable wide/narrow band AM stereo ... micro processor controlled tape evaluation system ... Dolby noise reduction. Eurovox is the one system you won't beat.

*The security coded system is available in model MCC2459E (illustrated) and MCC2460E.

SC SECURITY CODED

A Dash of Aussie Brilliance

eurovox

EUROVOX AUSTRALIA
P.O. Box 345, Clayton 3168
Please send me details of the Eurovox Security Coded System and the name of my nearest dealer.

Name: ______________________

Address: ______________________

______________________ Postcode: __________

GNA/EU7286/FPC

The two top models from Eurovox have a microprocessor controlled tape system and inbuilt security coding to reduce the risk of theft.

existing sound system. This can work very well and has the distinct advantage that not only can the player be removed from the car but it can be used elsewhere.

A number of manufacturers of car radio-cassette players are now coming round to providing sockets for the connection of portable CD players and we expect it to be a feature of most systems before too long.

DC power

As an alternative, where a car sound system is being installed with a separate power amplifier, it would not be difficult for the installer to provide input facilities for a portable CD player (more on this subject later). Providing DC power though, is not quite as easy.

The Technics SLP-X7 portable CD player is perhaps the most difficult to power from a car's electrical system. It requires balanced supply rails of ±6V with the 0V line needing to be connected to chassis if it is also to be connected to the car sound system. Clearly, running the player from the car's battery is desirable since the player's internal rechargeable batteries only last for two to three hours.

As with most CD manufacturers, Technics do make a DC adaptor for cars but it is quite expensive. It would necessarily involve a DC to DC inverter. Other portable CD players, such as the Sony CD-10, are much simpler to run from a car's electrics but the demand has yet to be anticipated by the manufacturers. (*Electronics Australia,* on the other hand, has designed an inverter to suit any portable CD player. Details will be published in the April 1987 issue.)

One point which should be noted about using portable CD players in the car is that in spite of their noted resistance to vibration and shock, they should not just be sat on the car seat while in use. If the car has to stop suddenly or goes around corner rapidly, the player may well end up on the floor and the playing mechanism could be damaged.

The solution to this is to make up a foam cradle which will hold the player securely, perhaps in or on the centre console, while still being able to be removed at a moment's notice.

Alternative security

Coming back to the theft angle again, it must be admitted that where determined thieves are concerned, no car sound system is safe, even it is installed entirely in the boot. Again, with no repect for property, it is only a moment's effort for a thief to jemmy open the boot of a car, to snitch the contents.

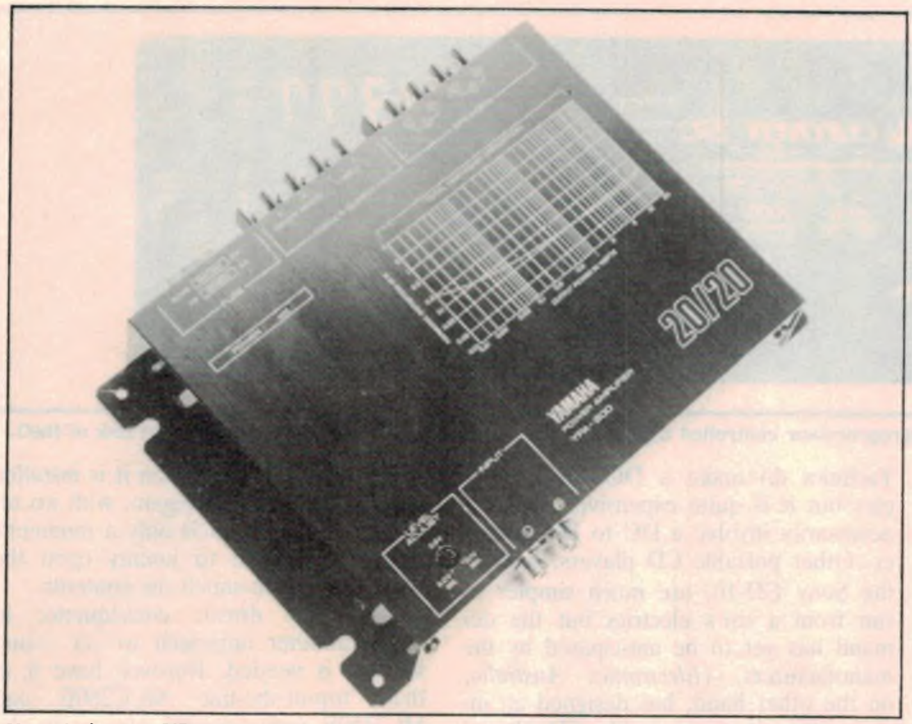
With that drastic consequence in mind, another approach to car sound security is needed. Eurovox have it in their top-of-the-line MCC260E and MC2459E radio-cassette players in the form of "security coding". It makes the units "not worth pinching". Originally introduced by Eurovox, security coding involves the radio's internal custom microprocessor and its read only memory (ROM).

When the unit is installed or whenever the car battery has been disconnected, a unique code must be fed in via the radio's pushbuttons in order for the system to work. The owner has details of the code on a card which is supplied at purchase. Thus, if the radio is stolen there is no way of getting it to work unless you have the code and so it is "not worth pinching".

Nakamichi's top-of-the-line TD-1200 radio-cassette player also has security code protection which is essential for this deluxe unit costing a cool $2600.

An interesting additional feature of the Eurovox MCC2459E (which has to

Yamaha's car CD player features a cartridge loading system to protect the disc. It has full playing facilities.



Yamaha's neat YPA-200 offers adjustable sensitivity and 20 watts per channel.

be used with an external stereo amplifier) is that the company can supply interface boards to suit any car CD player and some portables too.

Some manufacturers, notably Kenwood, have taken a simpler approach to the theft problem. Some of their models can be removed from the cradle when the owner leaves the car while other models come with a special cover which hides them from view when they are not in use.

Incidentally, if you are interested in really good car sound, you will have to pay for it. There are not too many installations which can be regarded as having reasonable performance which cost much under $1000. Many installations will be much more than this and may easily run up to $5000 or more.

Power amplifiers

These days, few dyed-in-the-wool car sound enthusiasts are satisfied with the stereo amplifier built into their radio-cassette player. There are good reasons for this. The first is insufficient power and the second is sound quality. Relatively few players are capable of more than ten watts per channel and the harmonic distortion performance is generally poor, especially when compared with domestic hifi systems.

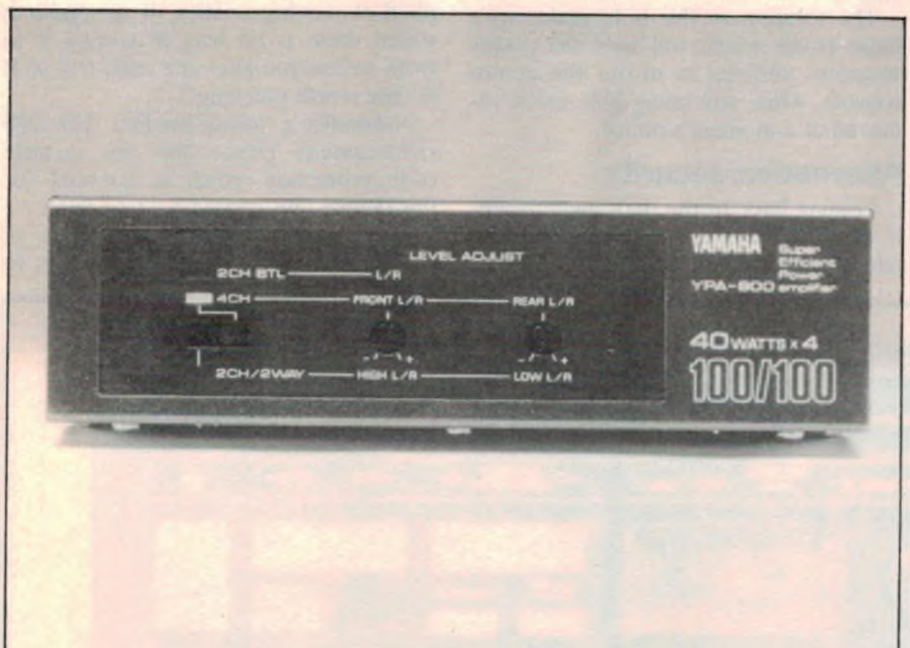
In view of this, separate power amplifiers are becoming more common in the better car sound installations. Made by the top manufacturers, such as Nakamichi, Sony, Pioneer, Yamaha and Kenwood, these amplifiers can offer power and distortion performance which is comparable with very good quality domestic hifi systems. As an example, consider the Nakamichi PA-300. It has a rated power output of 70 watts per channel at a total harmonic distortion of less than .003% at 1kHz.

Another good example is the Kenwood KAC-9020 which is rated at 100 watts per channel at a total harmonic distortion of .004% at 1kHz. These amplifiers offer superb sound quality, every bit as good as conventional mains powered amplifiers.

The usual load impedance of car loudspeakers is four ohms but even with this low impedance, it is not possible to obtain this high level of power and performance from an amplifier running at between 12 and 13 volts DC. The designers overcome this problem by building DC-to-DC inverters inside the amplifiers, to give them balanced supply rails of ±50V or more. This enables high power and low distortion to be obtained relatively easily although it is no easy achievement to reduce the inverter's electrical hash to a very low level.

The reason why such high power is necessary is that the better quality car loudspeakers tend to be relatively insensitive and thus require a lot of drive power. The consequence of using such higher power is that the car's battery is required to deliver very high peak currents when the amplifier is flat out.

To give an example, a high power amplifier with inbuilt inverter can be expected to be no more than 50% efficient. This means that a stereo power amplifier of 100 watts per channel rating will have a power draw of at least 400 watts total when at full power. At 12.5 volts, the equivalent battery current drain is over 32 amps. For average



For high power needs, the Yamaha YPA-800 has 100 watts per channel for stereo or 4 x 40 watts for four channel mode.

music signals, with the volume setting well up, the typical current drain of such an amplifier will be around 10 amps.

Ideally, the car sound system should be run from a separate battery so that there is no danger of running the battery down to the point where it will not start the car. The better installations do have a separate battery with relay or diode isolation to allow charging by the alternator.

Connecting leads

Whether or not a separate battery is used, the high current drain of higher power amplifiers means that resistance in the supply leads is of paramount concern. Even a commendably low resistance of 0.1 ohms is sufficient to cause a supply voltage drop of 3.2 volts for the above example and that would cause a serious power loss as well as degrading the sound quality.

Clearly, the supply leads must use very heavy cable and employ heavy-duty connections if the performance of the system is not to be degraded. For similar reasons, the connections to the loudspeakers must be of the highest quality, if the best sound quality is to be obtained. In fact, it is more important for the loudspeaker cables in a good car installation to be of high quality than in an equivalent domestic hifi installation. The reason is that most domestic loudspeakers have a nominal impedance of eight ohms and so the potential voltage losses are halved.

To be absolutely sure on this point, some installers go so far as to use high quality loudspeaker leads such as Monster Cable for both the loudspeakers and the supply leads. This may be gilding the lily but at least the buyer can be sure that he has a good installation.

Cassette players

Even the most basic car sound systems have a cassette player these days but that is by no means the end of the story. The player should have Dolby B noise reduction as a standard feature since virtually all music tapes these days have Dolby processing. The better players also have Dolby C processing and some even have dbx noise reduction.

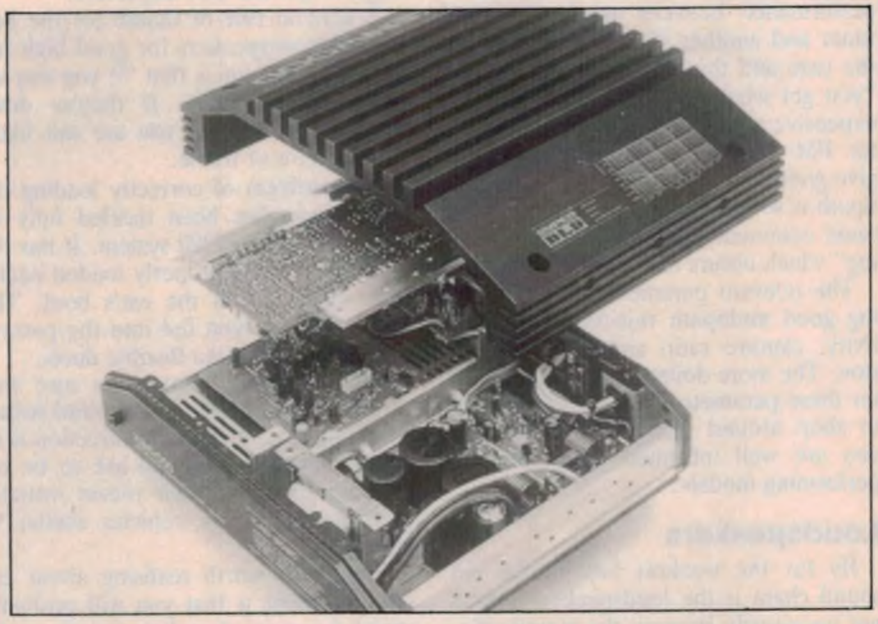
One or other of the latter features are desirable if your domestic hifi cassette deck has Dolby C or dbx, so that you can play your good tapes in the car. dbx noise reduction also has a very good dynamic range which should accommodate most compact discs without problems.

Other features, such as auto reverse at end-of-play are attractive too but not essential. More desirable is auto-eject when the ignition is turned off (to protect the tape and the heads) and the ability to play metal tapes.

One of the cheapest CD portables available, the Technics SLP-X7 can be used in a car but needs a DC adaptor.

Tuners

While AM stereo caused a lot of interest when it was introduced two years ago, it has been slow to catch on with the customers. Partly this is because relatively few manufacturers have offered the AM stereo option and those models which have included it have been the most expensive. This need not be the case since most good radio-cassette players now incorporate a synthesised tuner (you can forget most



One of the most popular high power car amplifiers on the market, the Kenwood KAC-9020 puts out 100 watts per channel.

Sony innovation strikes again with the DiscJockey which can store and play 10 compact discs in any order.

of the rest — they're not worth having). This is important for good oscillator stability, a requisite for effective AM stereo.

Until the manufacturers make more AM stereo models available at a lower price, most buyers will be content to wait and see. At the moment most AM stereo models being sold are original equipment in cars such as the Commodore Calais.

As far as FM is concerned, it may be thought that there is little difference in performance between one synthesised tuner and another. That is certainly not the case and this is one instance where "you get what you pay for". The most expensive models not only offer far better FM sensitivity but their ability to give good reception in areas where multipath is severe can be a revelation. The same comment applies to "picket fencing" which occurs in weak signals areas.

The relevant parameters in determining good multipath rejection are sensitivity, capture ratio and AM suppression. The more dollars you pay, the better these parameters usually are. It pays to shop around though, to make sure you are well informed about the top performing models.

Loudspeakers

By far the weakest link in the car sound chain is the loudspeaker. This is not necessarily because the manufacturers are not making high quality drivers. It has more to do with the difficult environment of the car passenger compartment and limited number of places to install the speakers. This means that it is difficult to aim the speakers for optimum sound dispersion and almost impossible to correctly baffle the bass speakers for extended bass response.

A partial answer to the problem of correctly aiming the high frequency drivers has been produced by Nakamichi. Their SP-300 mobile speaker system has a tweeter which can be clicked to a number of different physical settings, to get the best dispersion.

A general rule of thumb for the best mounting of speakers for good high frequency dispersion is that "if you can see them, they're OK". If they're down around your ankles, you are not likely to hear a lot of treble.

The problem of correctly loading the bass drivers has been tackled fully by Kef with their GT200 system. It has the bass drivers in a properly loaded enclosure which sits in the car's boot. The bass energy is then fed into the passenger compartment via flexible ducts.

Unfortunately, there is no sure way of obtaining a really good sound installation. A step in the right direction is to talk to the installers and ask to be referred to some of their recent installations, preferably in vehicles similar to your own.

One point worth realising about car sound systems is that you will probably spend far more time listening to music in your car than at home. On that basis alone, it is wise to carefully consider your options before making a purchase.

Some of the mind-numbing technical details that conclusively prove why Sony ES compact disc players are second to none.

Our engineers were last seen doing somersaults.

No doubt they're more than pleased about developing the world's best compact disc players.

The Sony ES Series.

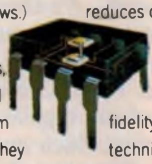
But they became ecstatic when we asked to borrow the technical manual.

Instead of resorting to tiresome adjectives, we thought it best to substantiate this bold, much bandied-about claim.

With facts and proof, and lots of it.

Sony's state-of-the-art technology will take some explaining. (Although what state you'll be in after reading it all, who knows.)

For the purposes of flow and to minimise the risk of repeating ourselves, the words breathtaking, staggering and mind-boggling have been edited from the original technical report where they occurred no fewer than 174 times.



(Much to our engineers' dismay, we're currently editing all superlatives from the ES Series amplifier, tuner, cassette deck, speakers, graphic equaliser and surround-sound-decoder technical manuals.)

Naturally, not all features are available on some models.

The Digital to Analog Converters. A true test of your powers of concentration.

Not one, but two Digital to Analog Converters are used for each independent channel to obtain accurate sound separation.

(Buy one, get one free!)

NOT ONE BUT TWO D/A C's

Together with twin monaural construction, the result is the best sound quality available in the world today.

That's being modest, of course.

Now, the way these little devils work is pretty obvious once you know how.

(This next bit is really dry, so we suggest you grab yourself a glass of water.)

The serial data recorded on a CD cannot be simultaneously reproduced into

A COMPLICATED GRAPH

L-channel and R-channel audio by a single D/A Converter no matter how hard it tries, creating a slight time-lag between the left and right channels.

Although this time-lag can hardly be sensed by the human ear, we eliminated it anyway.

Theoretically speaking.

By adopting independent D/A C's for L- and R-channel, the signal of both channels is converted simultaneously.

Which simply means, of course, that sound from both the left and right speakers reaches the listener at the same time.

Obvious. Isn't it?

The Optical Transfer System will bring tears to your eyes.

By incorporating an Optical Transfer System for music signal transfer from the Digital Circuit to the D/A Converter, digital noise is prevented from entering the analog circuits. Thus, clear sound is maintained.

In other words, Optical-Transfer reduces distortion that causes harshness in the high frequencies, and produces a rich solid bass resulting in pure, clean high-fidelity sound, as they say in the technical manual.

A wireless Remote Commander for the chronically lazy.

The full function wireless Remote Commander allows total control of all major features including 20 key Direct Music Select.

Even line-out level control is possible without moving from your seat.

The only time you get up is to get a beer out of the fridge, but we're working on it.

The mechanics of the Linear Motor Tracking Mechanism.

Incorporated in this sophisticated unit is the Linear Motor Tracking Mechanism.

Instead of using gear linkages, the pick-up is mounted directly along a pair of rails.

It thus assures high reliability and ultra-quick access within one second.

The New Tracking Servo Control Circuit incorporates Envelope Differential Detection and Servo Voltage Hold circuits.

With this System, Error Signals Caused ... sorry, caused by dust, smears, etc., or defects in the disc itself, are detected and corrected at high-speed.

Before they cause tracking error.

Unstable tracking is detected at the input of tracking error voltage to the window comparator.

The window... comp... aratz z z z z z
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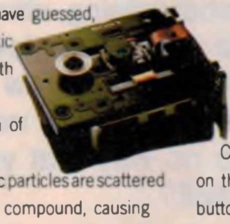
z z z z z z z z z z z z z z ... oh ... sorry... where were we... ah yes .. well so much for the Servo Voltage Control circuit.

What a little marvel.

The Cerasin Chassis. Famous for its quick attenuation to vibration.

The new Cerasin chassis (Ceramic & Resin) is reinforced with ceramic outserts that absorb mechanical vibrations and unwanted resonance.



As you may have guessed, the main characteristic of the plastic resin with ceramic powder is its quick attenuation of vibration.

(Small ceramic particles are scattered amongst the plastic compound, causing friction between ceramic particles and the plastic, resulting in attenuation. Phew.)

Do the Harlem Shuffle with our Shuffle Play.

Use the Shuffle Play to automatically playback the entire disc in continuous random order.

Although no amount of shuffling will make a Burl Ives disc seem fresh.

A 20-key Direct Music Select function allows you to play your favourite selections anyway, anytime, even with one arm tied behind your back. And the RMS random programming system will memorise the playback order of up to 20 selections.

Use the Index Search or two-speed manual search with the AMS (Automatic Music Sensor) to play any particular selection.

Five repeat functions allow you to repeat one selection/all/A-B/RMS or Shuffle Play. Now the RMS comes with an additional memory back-up for convenient timer play.

The unique Unilinear Converter System. Try saying that five times fast.

The Unilinear Converter System is the "heartbeat" of the player.

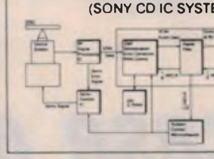
Operating from one masterclock, the EFM demodulator, Digital Filter and the D/A Converter are combined into a single synchronised system, eliminating beat noise jitter from the digital processing circuits.

THE CDP-502ES II

The rhinoceros is a much misunderstood animal. (Don't worry. Just checking to see if you're still with us. Plough on.)

The 16 bit Digital Filter with 2 times oversampling and high-speed D/A C raises the noise component of the digital signal above 20KHz, allowing the use of a gentle slope Low Pass Filter to reduce distortion

UNILINEAR CONVERTER SYSTEM (SONY CD IC SYSTEM)



and time-lag.

Have we converted you yet?

The Music Calendar & 6-mode time-keeper function. (Or the M.C.6-M.T.K.F.)

The large FL display has all of the information you need to know, the Music Calendar shows the number of selections on the disc or programmed. And a check-button gives instant confirmation of the program order. The selections are "checked off" as they are played.

The 6-mode Time Keeper function gives you complete time information of the total playing time and remaining time of the total disc, programmed selections, time elapsed and remaining time of the selection in play, time after time.

We've thrown in everything, including the oxygen-free copper heat sink.

Sony has loaded the ES series with more power than you need, to assure powerful bass sound reproduction.

This is thanks to the use of large capacitance power transformers, high-speed diodes and large filter capacitors.

Over-simplifying it, clean sound is enhanced by separating the power supplied from the digital and analog blocks so that interference is eliminated.

The audio circuitry uses noiseless carbon resistors that were especially designed for audio components.

THE SINK.

Non-inductive styrol condensers and ...um ... palyprip ... polypropylene film capacitors assure low distortion in the high-frequency range.

In addition, a non-magnetic Oxygen-Free Copper heat sink and copper screws are carefully selected.

If you want more information, please contact the Sony Technical Department.

And we'll refer you to a psychiatrist.

SONY®

THE LEADER IN DIGITAL AUDIO.

SSB(S) SNY 001

The Serviceman

A case of Rank carelessness

One of the most embarrassing situations which any serviceman can face is the set which develops a second fault the day after it has been serviced. How do you convince the customer that the second fault has nothing to do with the first one? Or that there is no way that you could have foreseen it while fixing the first fault?

The truth is that many customers simply do not trust repairmen of any kind — and, I must concede, with good reason in some cases. Fortunately, most of my regular customers have come to trust me, but there is always the odd one, particularly among new customers, who greets one's explanation with stoney silence, or a disdainful sniff, which clearly indicates that they don't believe you.

In fact, in social circles where I have mixed incognito, I have heard it stated as "a well known fact" that repairmen always create a second, latent fault designed to appear after a short period and thus ensure an additional service call and fee. Unfortunately for the credibility of that theory, I have never been able to find anybody who could explain exactly what mechanism one would employ to create such a time-delayed fault.

So how does one handle such situations? As I say, most of my regular customers trust me and will accept my word that it is pure coincidence and the luck of the game. If anyone protests, or even if I sense that they are dissatisfied, I will waive my usual fee and charge only for any parts involved — and I'll even chuck those in if they are minor ones. Anything for good customer relations and a quiet life.

... IN SOCIAL CIRCLES WHERE I HAVE MIXED INCOGNITO...

So how did this all start? The set was a Rank C-2606 which belonged to one of my regular customers. This model is one which evolved from the first Rank colour set of this size, the C-2601 and 2602, being the same chassis in different cabinets. This was followed by the 2603, 04, 05 and 06 models, all being basically the same circuit but with minor additions and modifications.

The customer's complaint was simple; the set had performed perfectly at a previous session but, at the last switch-on, had simply gone completely dead. Having confirmed the make and probable model number, I loaded the most likely spares into the van and listed them for the afternoon rounds.

When I finally faced up to the set in the customer's lounge room, and switched it on, it behaved more or less as had been described, except that, at the moment of switch-on, I was sure I detected the line circuit in operation and also a brief burst of sound. Then it shut down.

Protector circuit

From previous experience I immediately suspected the high voltage protector circuit; one of the additions which first appeared in the 2603 and continued in subsequent models. I first encountered this circuit back in 1983 and described a fault in it in the October notes for that year, with some additional (contributed) data in the June 1984 notes. Since then I have learned to recognise the symptoms as indicating an almost certain failure of one or other of the two transistors (TR2001 and TR2002) in this section.

In fact, once having satisfied myself that the protector circuit is at fault, as distinct from a genuine overvoltage condition, I simply change both transistors as a matter of routine. This invariably fixes the fault and is quicker and cheaper than pulling each transistor out and testing it individually.

But one must avoid jumping to conclusions on this basis. There can be a genuine overvoltage condition and a likely possibility is a short circuit in the power supply pass transistor, TR691. Such a failure will naturally take the main HT rail above its normal 120V. This, in turn, can produce excessive EHT, trigger the protector circuit, and shut down the horizontal deflection circuit. Which is exactly what is intended.

On the other hand, the mere fact that the HT rail is above normal — 140V is a typical condition — does not necessarily indicate that the power supply is at fault. When the horizontal circuit is shut down the reduced load creates just such a condition. My appproach, if I find this order of overvoltage, is to check the pass transistor and, if it is not at fault, to replace TR2001 and TR2002 as already described.

This is a fairly simple exercise in the 03, 04, and 05 models. In these, the protector circuit is accommodated on a small printed board mounted on the centre front of the chassis (ie, towards the front of the cabinet) where it is readily accessible. This mechanical arrangement is undoubtedly the result of the board being something of an afterthought, but it makes servicing relatively simple.

But not so with the 06 model. In this set, the protector circuitry has been made an integral part of the "Deflection Out" board, which carries most of the horizontal and vertical deflection circuitry and, in this new form, is designated PWC-525. In all sets in the C-26 series this board is mounted vertically, parallel with the left hand side of the cabinet (from the front), and with the print side towards the cabinet.

In greater detail, it is part of a subassembly consisting of a metal frame which supports the board, plus the horizontal output transformer, the tripler, and sundry associated components. These latter are mounted on the metal frame adjacent to the component side of the board, and fairly close to it. And the protector circuitry occupies the bottom right hand corner of the board when looking at the print side; ie, it is towards the front of the cabinet.

All of which adds up to a mechanical situation which is awkward to say the least, particularly when it is the protector circuit which needs attention. My approach is to first undo the two screws holding the main chassis to the cabinet, thus allowing the chassis to be moved

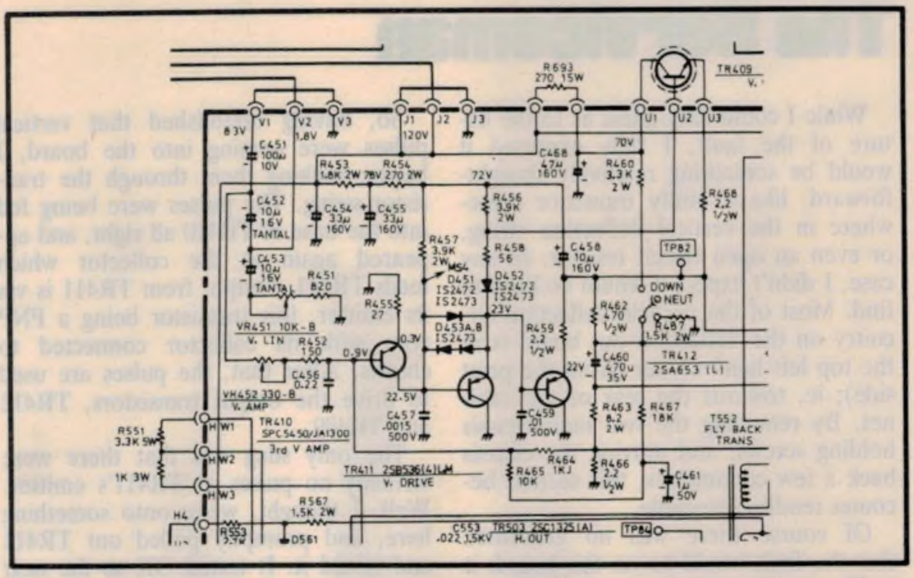


Fig.1 vertical drive circuit of the Rank C-2603. Note plug connection (U1, U2, U3) to vertical output transistor TR409.

back a short distance, the main limitation being various leads and cables to the tuner, picture tube, etc. These can be disconnected if necessary, but I prefer to avoid this additional complication if possible.

Next, the screws securing the sub-assembly to the main chassis are removed and this allows this section to be moved back a little further, the restriction again being various cables attached to it. Some of these are easily disconnected, and this allows a few more centimetres to be scored. Finally, about eight screws which hold the board in the frame are removed and this allows the board to be moved back far enough to reveal the copper print in the bottom right hand corner.

Dainty mitts

The next step calls for considerable dexterity and, preferably, an undersized double jointed left hand. Fortunately, my hand is not overly large, but is not really double jointed, other than by brute force. Nevertheless, I can manage to get it down between the horizontal transformer, tripler, etc and the component side of the board and grasp each of the suspect transistors. Then, by applying the sucker iron to the print side, the transistors can be withdrawn — along with a badly cramped hand!

But that is only half the story. Replacing the transistors is much more difficult because it is virtually impossible to see the three holes into which the leads have to be introduced. So it is very much a trial and error process, and getting all three leads into their correct holes, at the same time, is something of an achievement. Nevertheless, having done it on a couple of previous occasions, I managed it this time with somewhat less effort.

And that was the answer as far as the fault was concerned. The set came good immediately, and all that remained was to put everything back together, give the set a routine check and minor touch-up for height, linearity, colour balance, fine tuning etc, make out the account, and take my leave. And at that point I virtually wrote the job off as a successful if somewhat awkward exercise.

No room for complacency

Unfortunately, my complacency didn't last long. The lady of the house was on the phone first thing the next morning, with the news that the set had run for only a short period after I left and then, when switched on again in the evening, had failed again. My heart sank. I suddenly had visions of an intermittent overvoltage condition which had simply chosen to lie doggo after I had replaced the two protector transistors. And a fault like that could prove very nasty indeed.

Fortunately, a little discreet questioning revealed that the symptoms were not the same as before. They now had sound, but no picture; the only image on the screen was a bright white line across the centre. Well, that was a relief. It was a clear case of frame collapse, and nothing to do with the previous fault.

I explained this to the lady, but happily as it turned out, I didn't labour the point. Time enough for that, I felt, after I had found out what was actually wrong.

The Serviceman

While I could only guess as to the nature of the fault, I fully expected it would be something relatively straightforward, like a faulty transistor somewhere in the vertical deflection string, or even an open circuit resistor. In any case, I didn't expect it would be hard to find. Most of the vertical deflection circuitry on the deflection out board is in the top left hand corner (from the print side); ie, towards the rear of the cabinet. By removing the two main-chassis holding screws, and moving the chassis back a few centimetres, this section becomes readily accessible.

Of course there was no guarantee that the fault would be on this board; it could easily be on the "Deflection Board", PWC-367, which feeds the deflection out board and which is much less accessible. But the deflection board was a good place to start; time enough to start digging into less accessible parts of the set when the deflection out board was cleared of suspicion.

I started with a few routine voltage measurements, including the main vertical output transistor (TR409) and so on, but could find nothing wrong. At this point I remembered that I had the portable CRO in the van, which I had brought along for another job, and decided it might be quicker to employ this to track down exactly where the vertical pulses were being lost.

The easiest place to check was where the pulses from the deflection out board, PWC-367, come into the deflection out board via plugs V1 and V2. Both sets of pulses were normal here, so that cleared PWC-367. (The V2 line carries feedback pulses as part of the linearising process.) So it looked as though the fault must be on the deflection out board. The vertical portion of this board consists of three transistors: TR410, 3rd vertical amplifier; TR411, vertical drive; and TR412, one of two vertical output transistors.

The other vertical output transistor, TR409, is located some distance away from this board, on the main chassis, and connected to the board via a three-wire cable and three-pin plug and socket, U1, U2, and U3, located at the top of the board. It's an unusual arrangement, presumably designed to provide adequate heatsinking for TR409 which, apparently, does most of the work. And although TR409 is not directly accessible, it is easy enough to test via the plug and socket.

So, having established that vertical pulses were coming into the board, I began tracking them through the transistor string. The pulses were being fed into the base of TR410 all right, and appeared again at the collector which feeds TR411. Output from TR411 is via its emitter, this transistor being a PNP type with its collector connected to chassis. After that, the pulses are used to drive the output transistors, TR412 and TR409.

The only snag was that there were virtually no pulses at TR411's emitter. Well, I thought, we're onto something here, and promptly pulled out TR411 and tested it. It tested OK so the next step was to check TR412. I fully expected to find some kind of internal short, but no — it tested OK as well.

Looking more closely at the circuit I realised that a short on TR409, the remote transistor, could also produce similar symptoms, so I pulled the plug off the board and checked it. And again I came up with an all clear. This was all somewhat discouraging, so I refitted TR411 and went back to making more detailed voltage checks, the first check having been strictly limited. I also checked four diodes in this part of the circuit, D451, 452, and 453 "A" and "B".

The diodes checked out OK, but a voltage check on the emitter of TR411, where I had first missed the pulses, told a different story. The emitter is fed from a 72V rail via two resistors (R456 and R458) and diode D452, and normally sits at 22V. Instead it was down to zero. By now I was sure it had to be one of the two resistors, the diode having already been tested. A further check showed that there was no voltage at the junction of R456 and R458 — which is also the base of TR409 — and placed suspicion squarely on R456.

So I lifted the end of R456 at its junction with R458 and measured it. That was another set-back because it measured spot on. I was beginning to feel rather desperate now; if the resistor was intact, why no volts at the other end of it? Thus it was that I made a resistance measurement from the junction of R456 and R458 to chassis — and came up with a dead short!

This junction connected to one point only; the base of TR409, which had already been tested without showing any signs of an internal short. Nevertheless, when I removed the plug, U1, U2, U3, the short vanished from the board, while a measurement from the U2 plug connection (TR409 base) to chassis confirmed that the short was somewhere between the plug and the transistor.

So what was wrong with the transistor? If it had no internal shorts why was the base showing a short to chassis? It is a TO-3 package, and while I could understand a faulty insulator providing a path between the case (collector) and chassis, I just couldn't visualise how the base pin could be involved in a similar fault. And, from a purely practical point of view, I wasn't particularly happy about having to find out, because it would mean withdrawing the chassis completely.

Fools rush in

Fortunately, I didn't rush in. Instead I began tracing the lead between the board and the transistor. This runs along the top of the frame holding the board, then down the front of the board (ie, close to the front of the cabinet) to the main chassis level and across to the main chassis and the transistor.

Where it turns over to run down the front of the frame it is held by a simple plastic tie, which is also used to dress several other leads. This plastic tie measure about 35 x 35mm and has a central hole through which leads can be passed. There is also a slot leading into the hole, to facilitate feeding cables into it, and the tie is secured to the metal frame by means of two self tapping screws, one each side of the slot.

Thus, by undoing one screw one side of the plastic can be lifted and cables withdrawn. And that was what I had done during the first exercise, to allow the sub-assembly to be moved back as far as possible. Then having finished the

" I WAS BEGINNING TO FEEL RATHER DESPERATE NOW. "

The Serviceman

job, I had threaded all the cables back into the hole and replaced the self tapping screw.

And that was the catch. In replacing the screw — which is an awkward job at best — I had pinched the base lead to the transistor under the head of the screw. Even so, the screw did not penetrate the insulation immediately and the set had run for some time while I carried out routine checks and adjustments, and for sometime after I left.

It was only sometime after this that the pressure, probably helped by heat generated by the set, finally broke down the insulation and brought the edge of the conductor in contact with the screw. Naturally, it was easily fixed, and I was relieved at not having to pull the chassis out. But what a way to be trapped. In hindsight, of course, it can only be described as carelessness, my only defence being the awkward location of the self tapping screw.

Fortunately, I did not have to reveal all the sordid details to the customer. Instead, I simply described the fault as "something I overlooked", and let it go at that. But I was down the drain by an hour or so of working time, plus travelling, and a badly disrupted day's schedule, because there was no way I could make any kind of charge in the circumstances. The best I could hope for was that the customer would overlook — and perhaps forget — the inconvenience of missing a favourite TV show the previous night.

It was only later, while still kicking myself, that I realised I had done exactly what some smart alecs accuse all servicemen of doing; leaving a delayed fault to ensure another service job. Well, it had worked all right, but a fat lot of good it had done me. What's more, I doubt whether I, or anyone else, could pull the same trick again, and make it work reliably.

Fuse trouble

To change the subject, here is a brief comment about fuses. Some years ago (October 1981) one of my stories carried the heading: "We'd be better off without fuses — if we didn't need them so much!" The heading wasn't my idea — it was dreamed up by some facetious member of the editorial staff, though I had to admit that it summed up that story pretty well.

This was to the effect that, while fuses are very necessary devices in many pieces of equipment, they are not without their own faults, and can sometimes create as many faults as they prevent. Nor is the situation any better now, some five years later. In fact, I get the impression that it could be worse.

This all started when I paid a social visit to an amateur friend. Upon arrival, I was directed to "the shack" by his long suffering wife only to find him having a right proper go-crook; so much so that it was several moments before he realised that I was there.

When he calmed down a little, he explained that the reason for his outburst was one of the aforementioned devices; a glass cartridge fuse, automotive type, which he had just pulled apart.

It transpired that he had recently built himself a regulated power supply, designed to deliver 13.8V at up to 10A to power his two metre transceiver and its associated afterburner. This was to replace a rather clumsy arrangement consisting of a discarded car battery and battery charger.

More precisely, the new power supply was the *VK Powermate* described in this magazine in December 1983. And although he had taken some liberties with the power transformer, the chassis, and the heatsinks, the end result was at least as good as, if not better than, the original specs.

Naturally, he was highly delighted and immediately put the unit into service, where it performed faultlessly for several weeks. Then one day, in the middle of a contact, the supply suddenly died. Some frantic bashing of the front panel plus several cycles of the on-off switch eventually restored the power for long enough to complete the contact.

But he obviously had a problem and at the first opportunity he pulled the unit out of its case, set it up on his bench, and began probing. Naturally, it stubbornly refused to misbehave at first and then, when it did, the effect was so fleeting that it was impossible to make much sense of it. This went on for several hours and led my friend up several blind alleys, but to cut a long story short, he eventually tracked it down to the fuse which now lay in separate pieces on the bench.

The pieces consisted of the glass tube, the two end caps, and the fuse element itself, which was stamped from thin sheet metal. When my friend had realised that it was the fuse which was at

fault — just before I arrived — he had looked around for a spare, only to realise that he did not have one. Nor could he find any 10A fuse wire with which to improvise a repair.

So he had tugged at the two end caps in an effort to find out just what had caused the fault. One of the end caps came away quite readily, and with it the fuse element, which was supposed to be soldered to the other end cap. And a gentle tug on the element was enough to detatch it from the second end cap.

Careful examination inside both end caps revealed blobs of solder, each with a gutter or channel formed by the fuse element, but with typical rounded edges where the element had penetrated. Both joints were as dry as a bullocky in the Pub With No Beer!

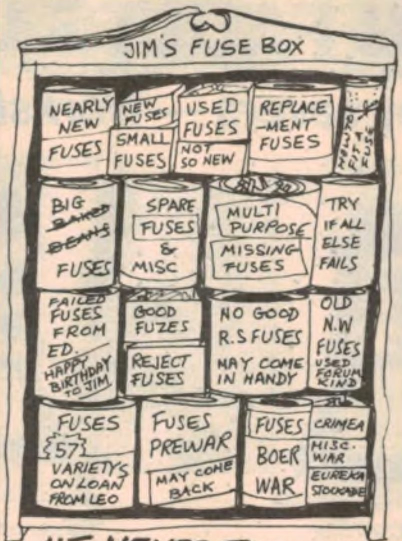
That set us both to wondering as to just how these fuses are made in the first place. Since there is no sign of any soldering action on the outside of the end caps, it would appear that each end cap is loaded with a blob of solder and, hopefully, some flux and the whole thing assembled in more or less its final form but with the end caps being held under pressure against the ends of the fuse element.

Then, presumably, the whole thing is heated, probably by induction, until the solder melts, and the end caps move into their final position. And, if everything is just right — the amount of the solder, flux, heat, and pre-tinning — the result is two perfect joints. Unfortunately, there is no way to check this. The joints are totally concealed, making visual inspection impossible, while an electrical check would be meaningless.

So what has happened to the old fashioned glass fuse with a length of fuse wire though it, brought out through holes in the end caps, and clearly soldered? I imagine it has succumbed to the ever increasing pressure to eliminate the production worker and replace him with a more economical automated process. Which is all very well — though tough on the worker — but at least we have a right to expect that the new product will be at least as good as the one it replaces.

As far as my friend's immediate problem was concerned, I was able to assist with a scrap of 10A fuse wire from the van. When I left him he was madly drilling holes in the end caps of discarded fuses — he never throws anything away — and preparing to make himself some "proper fuses". It's a pity industry didn't do likewise.

And finally, here is an interesting letter from a reader. Earlier I complained about how awkward it was to service the Rank 2606, but having just read this letter again, I wonder what I have to complain about. The letter is from P.H. of Macleay Island, Qld. This is how he tells it:



— HE NEVER THROWS ANYTHING AWAY —

A serviceman's watery tale

With this job, diagnosis was no problem; I knew exactly what was wrong — a severe case of salt water immersion. It was 21 years ago when I sailed my little schooner from America via Hawaii, Canton Island, Fiji, New Hebrides, and eventually home to Sydney — after many years in US aerospace & computers.

Well, after careers like that I should have known how to package a sailing boat as a "Zero-Defect-Project". And I did — almost — because nothing untoward ever happened. Well, almost nothing. The exception involved a superb multiband radio, a sort of poor man's version of those grand Zenith sets of the sixties.

In preparing for the journey, I must have noted down every vital piece of advice in every sailing book and magazine I could lay my hands on. The only one I overlooked was not to place critical items anywhere near a hatch or companionway in case a rogue wave misbehaved itself — which it did after thousands of kilometres of safe tradewind sailing. Then suddenly all the music went blank.

How could I possibly fix such a sorry case of drowning with minimal tools, a stove heated soldering iron, no parts or workbench, and all on a violently pitching yacht? Fortunately, as in all aerospace engineering, I had tried to package plenty of redundant systems — in this case an incredible war disposals pedal valve transceiver. At least this would provide me with WWVH navigation time ticks until repairs were figured out for the other radio. I simply strapped the pedal generator to the mast (which extended into the cabin), lay on the bunk, and pedalled.

Somewhere I read that, to get water out of electronic equipment, one should dunk the works in fresh water, dry over a stove then dunk again in increasingly strong concentrations of alcohol followed by drying. Rubbing alcohol (isopropyl), which we had on board, seemed ideal.

Fortunately, the cloth had protected the loudspeaker so my main task was to remove the printed circuit board from the cabinet, which involved snipping numerous wires to switches, meter, speaker, and batteries. But could all those preset and plastic capacitors survive the ordeal? It was an almost impossible task trying to dunk the board in water etc, in the pitching yacht, then drying it, only to repeat the process. Luckily our stove was a super, yet rarely seen, kero wick type that can be turned down to a safe heat.

Well after ages of hanging on for dear life, the operation was finally over, with the patient ready for soldering back into the cabinet. And what a mess it looked; all those plastic dielectric RF trimmers bent out of shape. Precision soldering with a heavy, stove heated, copper bit is no easy feat on the high seas. Still, with considerable anxiety, the job was completed, albeit with plenty of burnt spaghetti and fingers.

To our amazement that radio finally worked as well as ever — and never died on us later. Naturally I was careful from then on to place it somewhere far removed from a hatch.

Well, that's P.H.'s story. Among other things it emphasises that it is always worthwhile "having a go" even when all the odds seem stacked the wrong way. It's surprising how often the gamble pays off.

Another point I found interesting was the reference to the stove heated soldering iron. It reminded me of the days when we did all our home building using a plumber's iron heated on a Primus stove. Electric irons, if they were available at all, were far too expensive. When I could finally afford one it was only by reason of a remarkable stroke of luck. But that's another story — one I might tell one of these days.

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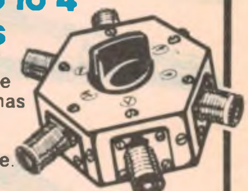

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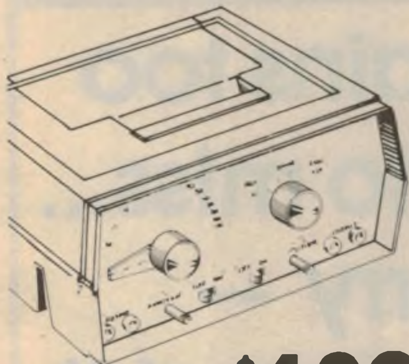

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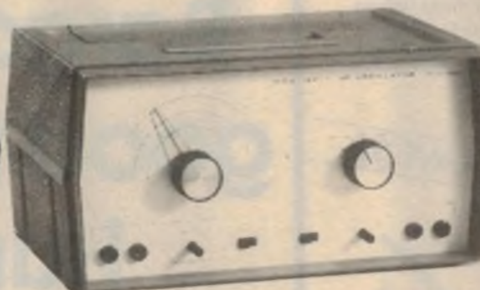

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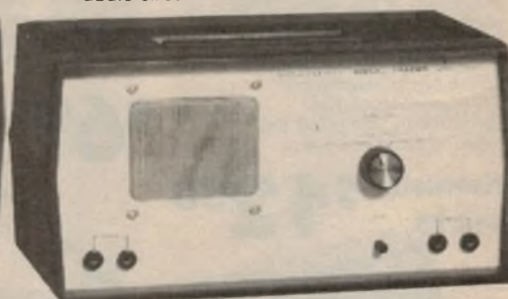

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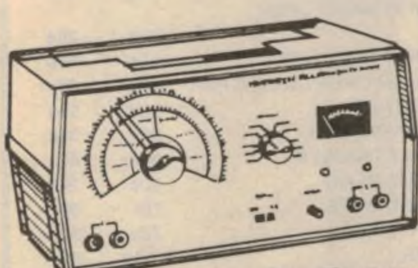

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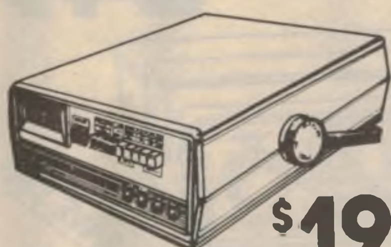

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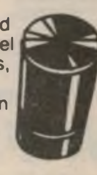

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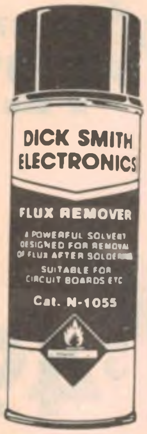

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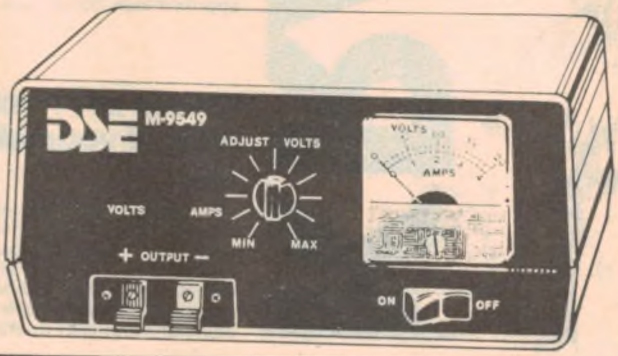

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Books & Literature

IC and transistor substitution manuals

IC SUBSTITUTION MANUAL. Published by Tech Publications, Singapore. Soft covers, 262 x 190mm, 358 pages. Recommended retail price $39.95.
UP-TO-DATE WORLD'S TRANSISTOR COMPARISON TABLE. Soft covers, 145 x 110mm, 789 pages. Recommended retail price $29.95.

Printed in Singapore, these two books give a comprehensive list of IC and transistor equivalents from virtually all the world's semiconductor manufacturers. The transistor handbook is particularly useful as each type listed also has its main specifications.

Both books are available from Jaycar Electronics. (L.D.S.)

1987 ARRL Handbook

THE 1987 ARRL HANDBOOK for the Radio Amateur. 64th edition published by the American Radio Relay League. Soft covers, 276 x 206mm, 1173 pages, illustrated with photos and diagrams. ISBN 0 87259 O64 6. Recommended retail price $42.95.

This is another monster edition of the ARRL which at 50mm thick is now the size of a telephone book. It has 40 chapters, most of which are reproduced from past issues of the ARRL magazine, *QST*. As we have said in past years, if you don't have recent copy of the ARRL handbook, it is certainly worth buying. As a reference book on a wide range of electronics, albeit with an emphasis on RF topics, it is unsurpassed.

Of particular interest these days are the chapters on Modulation Methods. These cover Voice Communictions, Digital Communications (RTTY, AMTOR, packet radio and modems), Image Communications (fast and slow scan TV, facsimile and weather satellites), and Special Modulation Techniques (radio control, telemetry and spread spectrum techniques). Naturally, there is also a chapter on Space Communications which covers transmission via satellites and moon bounce, also known as Earth-Moon-Earth (EME). In addition, these chapters have excellent glossaries and bibliographies.

Indeed, the more you use the ARRL handbook, the more you realise how good a reference it is. Make sure you have a copy. Our copy came from Technical Books & Magazine Co Pty Ltd, 289-299 Swanston St, Melbourne, 3000. (L.D.S.)

Engineering and the Japanese way

JAPANESE ELECTRONICS TECHNOLOGY, Enterprise and Innovation, by Gene Gregory. Second edition, published 1986 by John Wiley & Sons, New York. Hard covers, 220 x 155mm, 458 pages. ISBN 0 471 91038 4.

Gene Gregory is Professor of International Business at Sophia University, Tokyo and has been a respected writer for many years on the subject of high technology. Some of his articles have been published in this magazine. As such, Gene Gregory is very well qualified to tell the story of the Japanese ascendancy and in particular, to indicate how the Japanese have taken the opportunities offered by markets in the western world.

His book is a collection of essays and articles published around the world in journals such as the *Far Eastern Economic Review, Euro-Asia Business Review, Scientific American, New Scientist, Management Today* and *Communications International*. The essays have been arranged by the author to give a cohesive overview of Japan and the factors shaping its economic development.

In all, there are thirty chapters, under nine broad headings: The Japanese Electronics Industry, Technology, Consumer Electronics, Semiconductors, Computers, Computer Services, Factory Automation, Communications, and Regional Integration.

In reviewing a text which paints such a finely detailed picture of its subject, it is difficult to focus on any chapters which are more relevant than the others but a couple do seem particularly significant to the overall story. Chapter 6, entitled "The Great Engineering Gap", is one example. It highlights the difference between the vast number of engineers who graduate each year in Japan and the relative paucity of graduates in Western countries.

Chapter 12, entitled "The Brave New World of Microelectronics", is about the Japanese drive for superiority in memory products and their endless quest for device reliability. A previous chapter on consumer electronics also talks about the same quest for reliability, stemming from the Japanese internal market's expectation of quality. It was the quality aspect, combined with the initiative of western companies to import products from Japan, that so damaged the consumer electronics industries of most western countries.

Frankly, taken on its own, Gregory's book is depressing. It tends to give the impression that the Japanese are unstoppable. Only in the closing chapters is there an indication of recent developments where the rise of the Japanese currency has at last begun to stem the tide.

Aspects which are not given full weight include the Japanese policy of deliberately keeping the yen undervalued for as long as possible, of keeping Japanese markets as closed while taking full advantage of the low import barriers in most other countries, and the wholesale efforts of a great many western companies in taking advantage of cheap Japanese labour while running down their own manufacturing skills.

Even so, this book is a must for anyone who wishes to gain a detailed insight into the Japanese way of doing things. Gene Gregory is a most compelling writer and his book should be read by all Australin managers.

Our copy came direct from the publisher. (L.D.S.)

Get ready for the next deluge

Build this electronic rain gauge

Have you always wanted a rain gauge but could never be bothered going out to empty it? Our electronic rain gauge automatically empties itself, has a remote display which can be indoors, and measures up to 999mm rainfall with 1mm resolution. Best of all, it uses cheap and readily available parts.

by JOHN CLARKE

Are you often frustrated when the rainfall reports come over the radio? You know that the rain in your area was a veritable deluge but the overnight report says only 15mm.

"What rot!" you say but you don't have the evidence to satisfy yourself that the report is wrong or that the rainfall in your area was much heavier than the official report. Well now you can have the evidence of an electronic rain gauge.

Of course, you don't need an *electronic* rain gauge to know what the rainfall is. You can rely on the good old-fashioned rain gauge consisting of a transparent funnel shaped collector with graduations down the side but consider the disadvantages. You have to go outside to read and empty the thing. That means, horror of horrors, you might get wet.

Our Electronic Rain Gauge has all the features of a standard rain gauge with the following advantages:

- It can be read without ambiguities from the digital display which has 1mm resolution.
- Maximum reading of 999mm.
- The remote display can be located in a convenient position within your home. Battery operation means no need for mains power.
- It automatically empties the collected water.
- Resetting the display is done with the press of a button.

The rain collector for our electronic gauge is a rectangular box which incorporates a funnel shaped collector. This feeds the rain water into a measuring gauge which generates a pulse for each 1mm of rainfall.

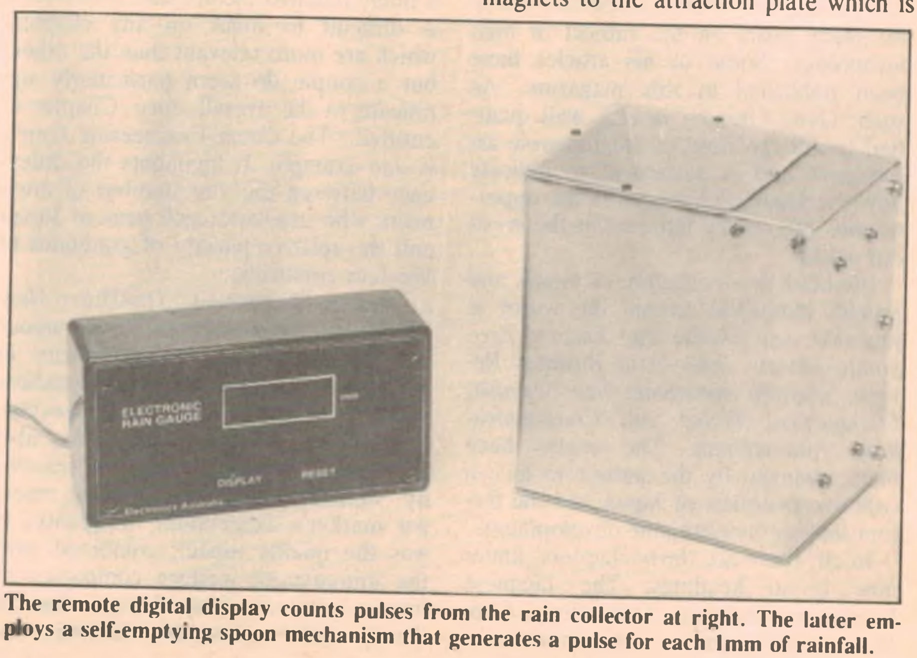
The digital display is housed in a small plastic case. It contains three 7-segment LED displays plus two push-button switches. One switch activates the display while the second switch resets the counter.

For each pulse from the measuring gauge, the digital display increments by one and it can count up to 999mm of rainfall.

Rain gauge operation

As mentioned above, the rain gauge includes a funnel which feeds water into the measurement mechanism. Fig.1 shows an exploded diagram of the mechanism which comprises a measuring spoon pivoted on a spindle and counter-balanced with small magnets. The contacts of an adjacent reed switch close whenever the magnets swing past.

As the spoon fills with water, its mass eventually overcomes the counter-balance mass and the attraction of the magnets to the attraction plate which is



The remote digital display counts pulses from the rain collector at right. The latter employs a self-emptying spoon mechanism that generates a pulse for each 1mm of rainfall.

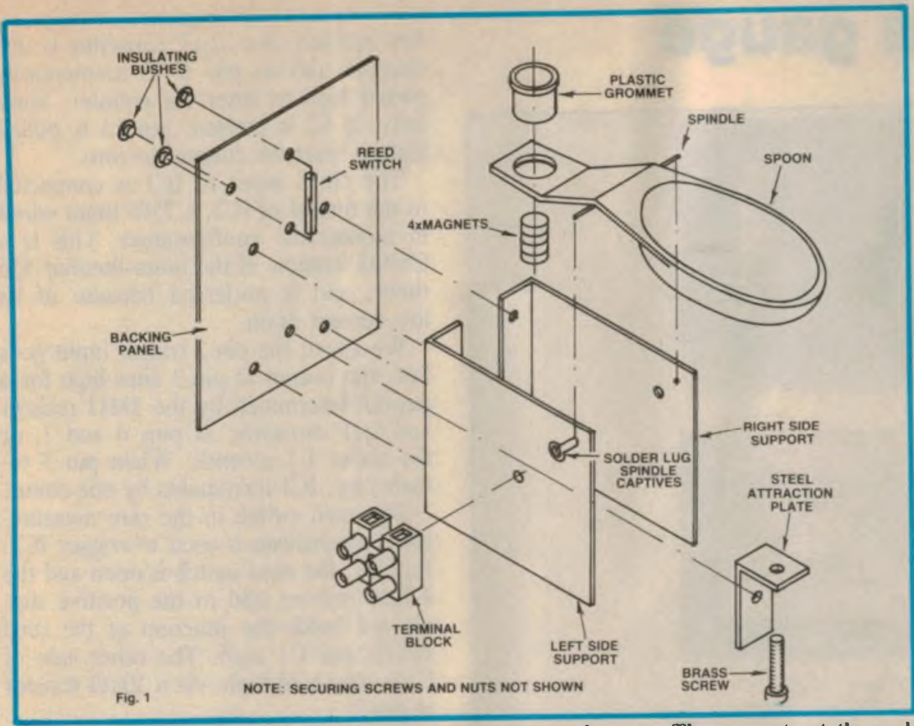


Fig.1: exploded diagram of the self-emptying spoon mechanism. The magnets at the end of the handle trigger a reed switch each time the spoon tips.

just below the reed switch. The spoon then tips forward to release the water in the spoon. The magnets then return the spoon to its normal resting position as set by the brass screw.

Note that the steel attraction plate and brass screw are vital to the correct operation of the mechanism. When the spoon is in its natural rest position, the spoon handle is supported on the brass screw.

The spoon normally stays in this rest position for two reasons: (1) because of the weight of the magnets; and (2) due to the magnetic force between the magnets and the attraction plate. The brass screw sets the distance between the attraction plate and magnets to adjust the amount of magnetic attraction.

Note that a brass or aluminium adjustment screw must be used here so that the magnets are not attracted to it.

As the spoon fills with water, the total mass eventually becomes sufficient to overcome the gravitational pull and magnetic attraction.

The spoon begins to tip and this moves the magnets away from the attraction plate. Since the magnetic force varies inversely to the square of the distance from the plate, the spoon does not need to tip far before the magnetic attraction becomes very small. Thus the spoon tips suddenly and empties its contents before reverting to the normal position, ready to be filled again.

Since the force between the magnets and the attraction plate is set by the distance between them, the amount of water required to tip the spoon is set by adjusting this distance. The further the magnets are from the attraction plate the less the amount of water required to tip the spoon.

The reed switch is located in such a position that when the spoon is in its rest position, the reed contacts are open. When the spoon tips, the magnet passes to close the reed contacts. Thus there are two closures of the reed switch, once when the spoon tips forward and again when it returns to the rest position.

Counter circuitry

The rain gauge circuit comprises a 4-digit counter, three 7-segment displays and a timer. Fig.2 shows the circuit details.

IC1 is a 74C926 4-digit counter made by National Semiconductor. It is a complicated device which contains a 4-digit decade counter, four 4-bit latches and multiplexed display drivers. In our circuit, only three of the internal decade counters are used and thus only three 7-segment displays are required.

Current limiting resistors between IC1 and the commoned display segments set the brightness of the displays. Separate transistors, Q1, Q2 and Q3, drive each display independently from the B, C and D outputs of IC1.

Note that the emitter connections of the display driver transistors are connected to ground via Display switch S1. This turns on the display whenever the switch is pressed. The display is normally left off to keep the battry drain low, typically around 140 microamps or so.

The reset and clock inputs control the operation of IC1. The reset (pin 13) is normally held low by the 2.2kΩ resistor connected to ground. When power is

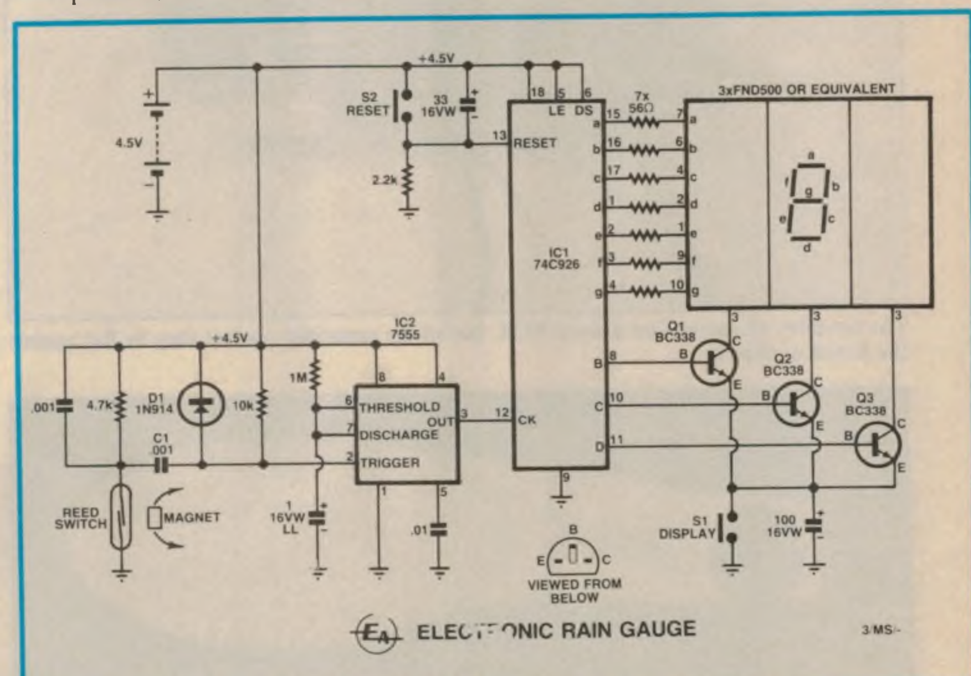
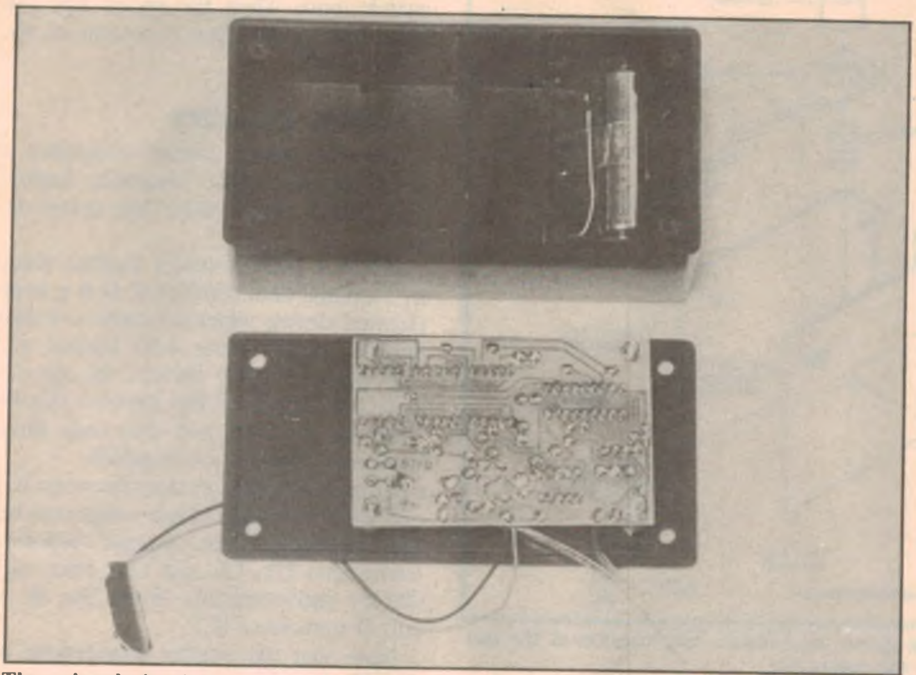
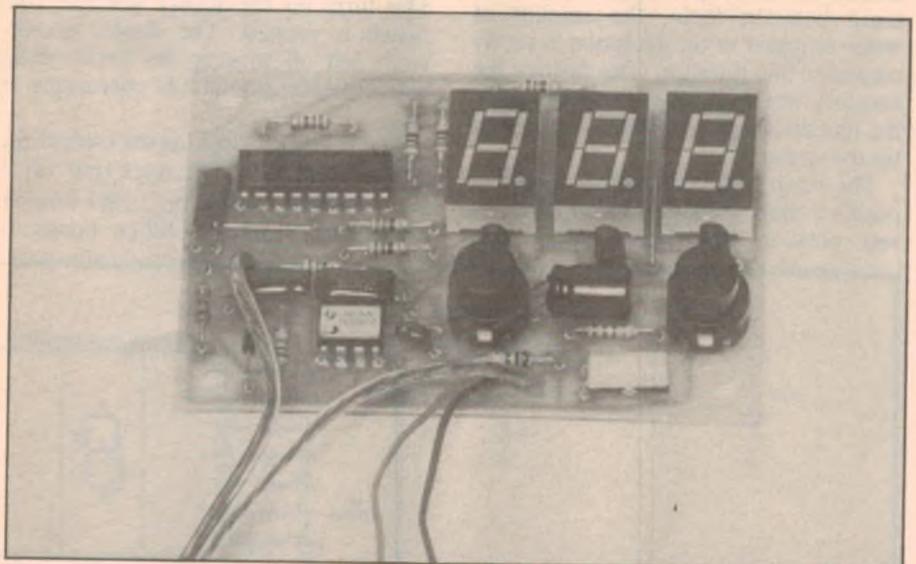


Fig.2: the circuit is based on a 4-digit counter (IC1), a 7555 timer (IC2) and three 7-segment displays. Power comes from a 4.5V battery.

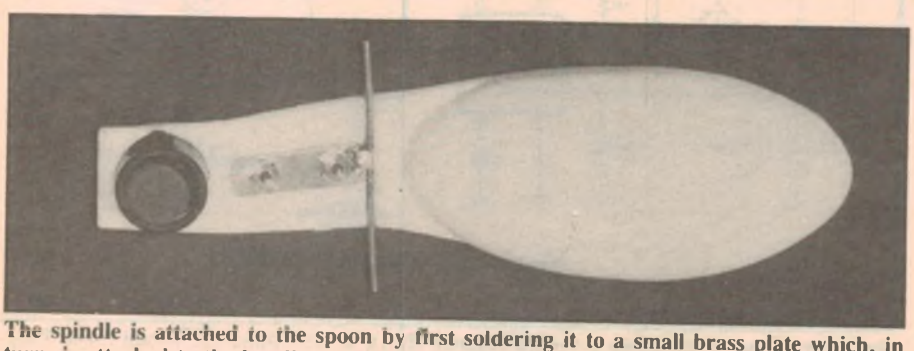
Electronic rain gauge



The printed circuit board is secured to the case lid using standoffs and machine screws and nuts. Note shorting link across one of the battery compartments.



The circuitry all mounts on a small PCB. Install the capacitors so that they lie flat against the board as shown.



The spindle is attached to the spoon by first soldering it to a small brass plate which, in turn, is attached to the handle using screws and nuts.

first applied, the 33μF capacitor is discharged and so pin 13 is momentarily pulled high to reset the counter. Similarly, if S2 is pushed, pin 13 is pulled high to reset the counter to zero.

The clock input to IC1 is connected to the output of IC2, a 7555 timer wired in monostable configuration. This is a CMOS version of the more-familiar 555 timer, and is preferred because of its low current drain.

Whenever the pin 2 trigger input goes low, the output at pin 3 goes high for a period determined by the 1MΩ resistor and 1μF capacitor at pins 6 and 7, or for about 1.1 seconds. When pin 3 returns low, IC1 increments by one count.

The reed switch in the rain measurement mechanism is used to trigger IC2. Initially, the reed switch is open and the 4.7kΩ resistor tied to the positive supply rail holds the junction of the reed switch and C1 high. The other side of C1 is also held high, via a 10kΩ resistor at pin 2.

When the reed switch subsequently closes, the left hand side of C1 (as viewed on the circuit diagram) is pulled to ground. This pulls pin 2 low until C1 charges up to the positive supply rail via the 10kΩ resistor at pin 2.

When the reed switch opens again, the left hand side of C1 is pulled to the postive supply rail via the 4.7kΩ resistor. At the same time, the resulting voltage on the right hand side of C1 is clamped to 0.6V above the positive rail by D1.

Since the output pulse from IC2 lasts for 1.1 seconds, each emptying of the spoon generates only one pulse, even though the reed switch closes twice for each event. It is interesting to note that we could have made this time-constant much longer, without prejudicing the rain gauge operation. Even in a tropical downpour which could be at the rate of 250mm per hour, IC2 would generate only one pulse every 14.4 seconds.

Note that a 0.001μF capacitor is connected between the reed switch and positive supply rail. This is used to remove any radio frequency noise which may be picked up by the long line between the reed switch and the counter circuitry.

Power for the circuit is derived from three AA-size cells which provide a nominal 4.5V supply. The current drain with the display off is typically about 140μA. With the display on, the current drain rises to around 100mA or so, depending on the number actually being displayed. With normal intermittent use of the display, the battery life for alka-

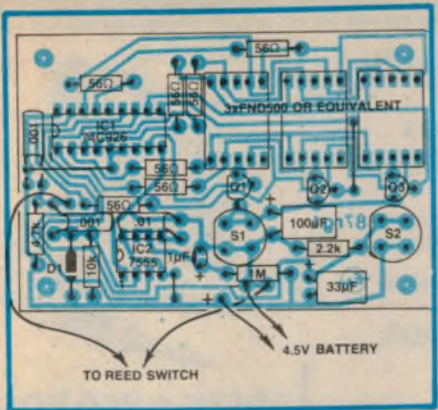


Fig.3: parts layout for the PCB. Don't forget the three wire links and take care when installing the polarised components.

line cells should be about a year or so.

We did consider the possibility of a 240VAC mains supply with a regulated 5V DC output but since the circuit has such a low current drain with the display off, we deemed it not worthwhile.

Construction

The electronic display unit of the rain gauge is housed in a plastic case measuring 130 x 67 x 43mm. A Scotchcal label measuring 127 x 64mm is used for the front panel. All electronic components, with the exception of the reed switch, are mounted on a printed circuit board coded 87rg1 and measuring 82 x 55mm.

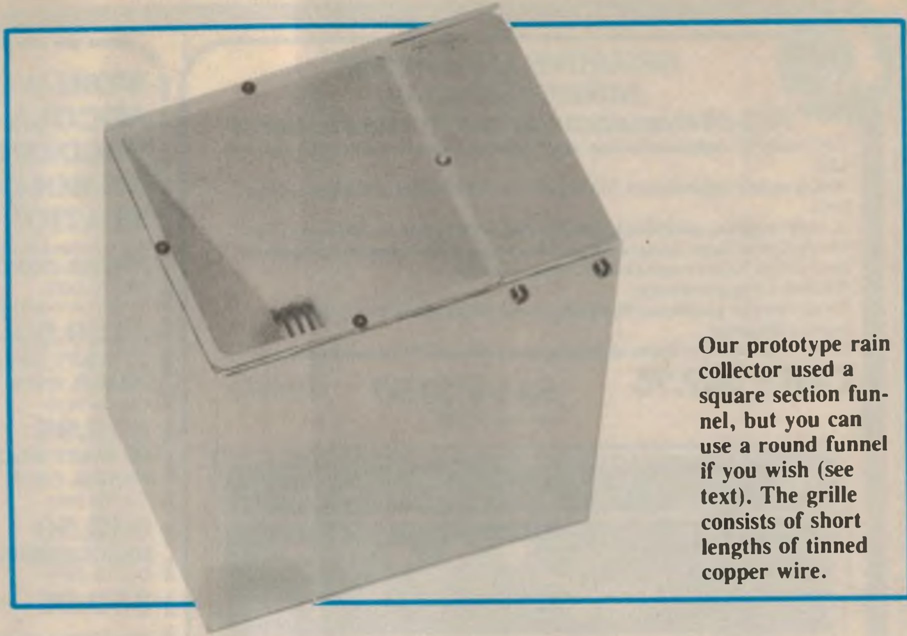
Start construction by installing the parts on the PCB as shown in Fig.3. It is a good idea to install the three wire links first, followed by the resistors, diode and ICs. This done, the three LED displays and the pushbutton switches can be installed.

Make sure you orient the displays correctly — ie, with the decimal point towards the bottom of the PCB. Similarly, take care with the orientation of the ICs and the diode. The pushbutton switches must be installed with the flat side of each switch facing left as shown in Fig.3.

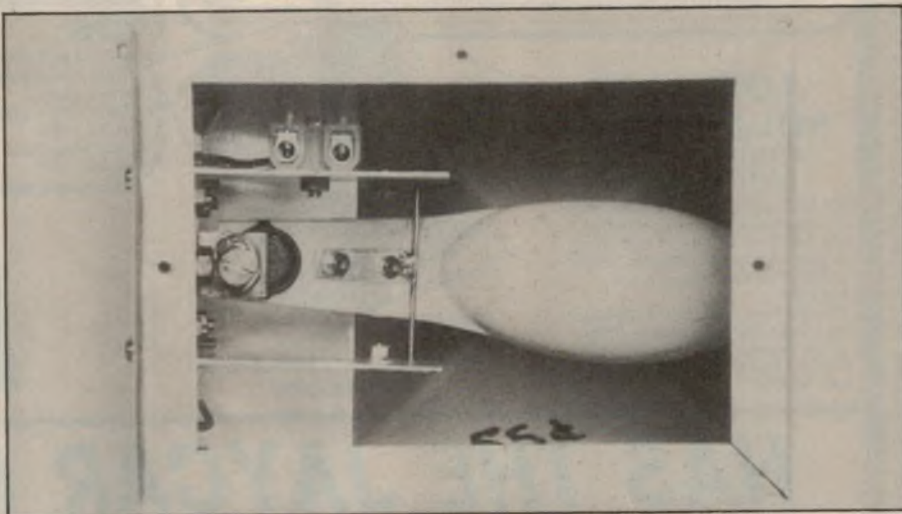
The three transistors can be installed next. Orient them as shown in the diagram and push them down onto the PCB so that they sit below the displays.

Assembly of the PCB can now be completed by installing the capacitors. These must all be mounted flat against the PCB as shown, otherwise they will later foul the front panel. Be careful with the electrolytic capacitors — they are polarised and must be oriented correctly.

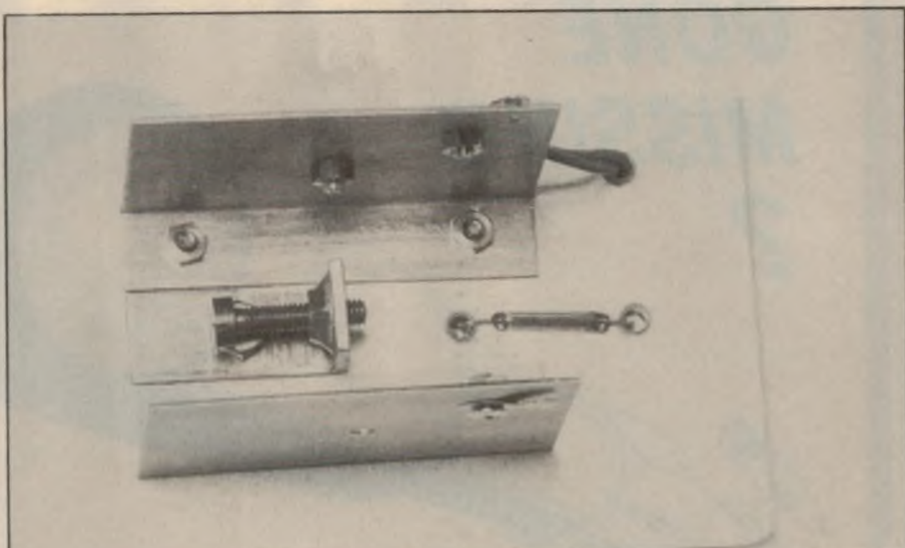
The 4-cell battery holder must be modified so that one of the battery compartments is shorted with a length



Our prototype rain collector used a square section funnel, but you can use a round funnel if you wish (see text). The grille consists of short lengths of tinned copper wire.



Above: view inside the rain collector showing how the spoon is positioned beneath the funnel. The magnets rest on the brass screw at left.



View showing the support bracket section of the spoon mechanism. The attraction plate (see Fig.1) must be made of steel while the adjustment screw must be made of brass.

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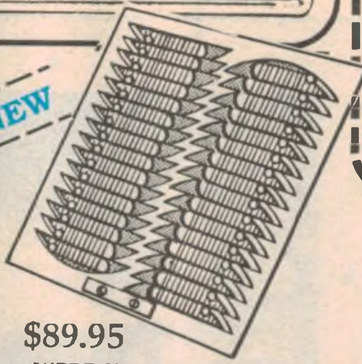

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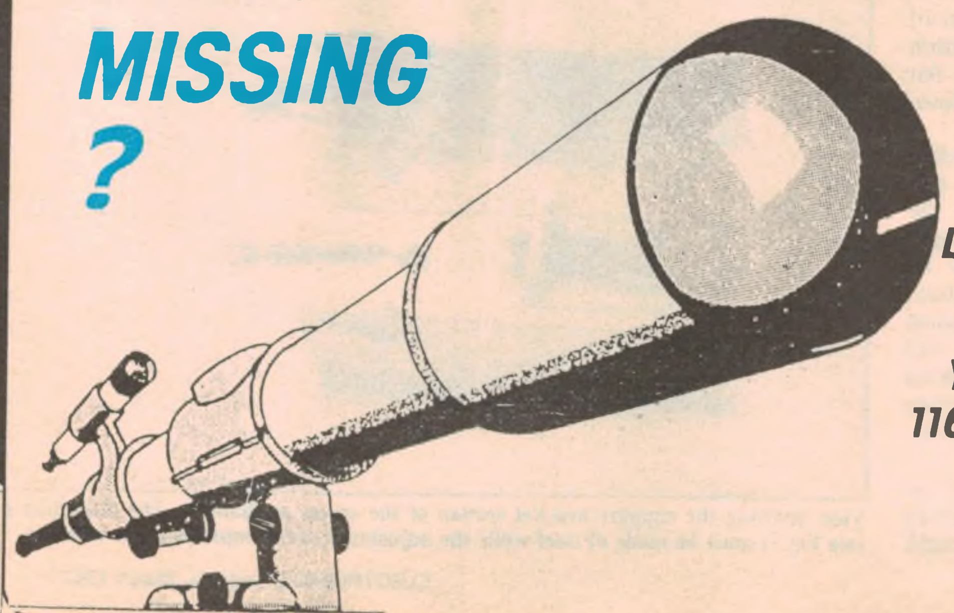

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Electronic rain gauge

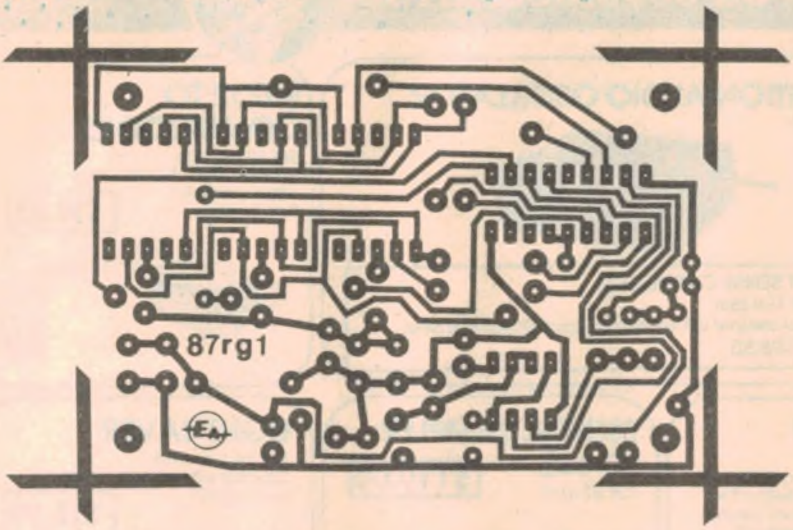


Fig.5: actual size PCB artwork. The board is coded 87rg1 and measures 82 x 55mm.

of wire. This will provide for three cells. Also the plastic support surrounds for the cell of the spare compartment will need to be cut away with side cutters. This will allow the PCB to fit within the case with the battery holder located in the right hand corner across the width of the case.

Finally, solder the battery clip leads to the PCB and install the leads to the reed switch.

Testing

You are now ready to test the electronics for correct operation. To do this, clip the battery into place and press the Display switch. The display should light and read 000. Now momentarily short the reed switch leads together. This should cause the counter to read 001 after about one second. From there on, shorting the leads at intervals of a little more than a second should continue to increment the counter.

Pressing the Reset switch should reset the counter to 000 again.

If the unit fails to function correctly check for shorts between PCB tracks, breaks in PCB tracks, incorrect parts placement or open-circuit connections. Do not immediately suspect the ICs since these are rugged devices and, unless installed back-to-front, are not likely to be faulty.

Once the counter is operating correctly, work can begin on the plastic case. Use the Scotchcal label as a guide when marking out the hole positions in the lid. Note that the PCB is mounted on the lid using countersunk screws. These are later hidden when the Scotchcal label is fitted.

For the display, we cut out a rectangular hole by drilling a series of small holes around the inside perimeter of the cutout and then filing to shape. A red plastic filter was then cut to snuggly fit into the cutout. This improves readability of the displays and the appearance.

Finally, a hole must be drilled in the rear of the case to allow entry for the reed switch leads. Once all the holes are drilled and the screws and nuts for the PCB are in place, the Scotchcal label can be fitted to the front panel.

Mechanical assembly

Construction of the rain gauge is dependent upon the type of funnel, measuring spoon and magnets used. The dimensions shown Fig.4 are of our prototype and may have to be varied to suit your particular unit.

We used a square rather than round section funnel, since it is easier to build a housing to accommodate this shape and the spoon mechanism. Note particularly that the collection volume of the funnel for 1mm of rain must be less than the spoon capacity, otherwise the spoon will overflow before 1mm of rain falls.

In fact, it is necessary to give the spoon a much larger capacity than the minimum to prevent water from splashing over the spoon lip.

For example, our funnel has a collection area of 75mm square or 56.25 sq. cm. The collected volume for 1mm (0.1cm) of rain is therefore 7.5 x 7.5 x 0.1 = 5.625ml (1ml = 1cc or 1 cubic cm). Therefore the measuring spoon

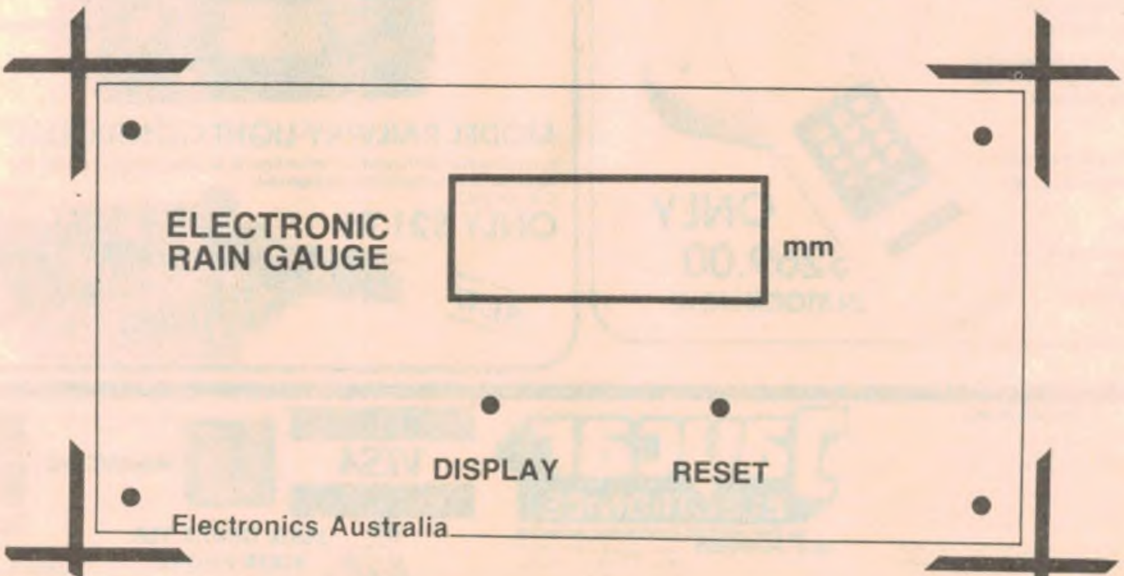


Fig.6: actual size front panel artwork.

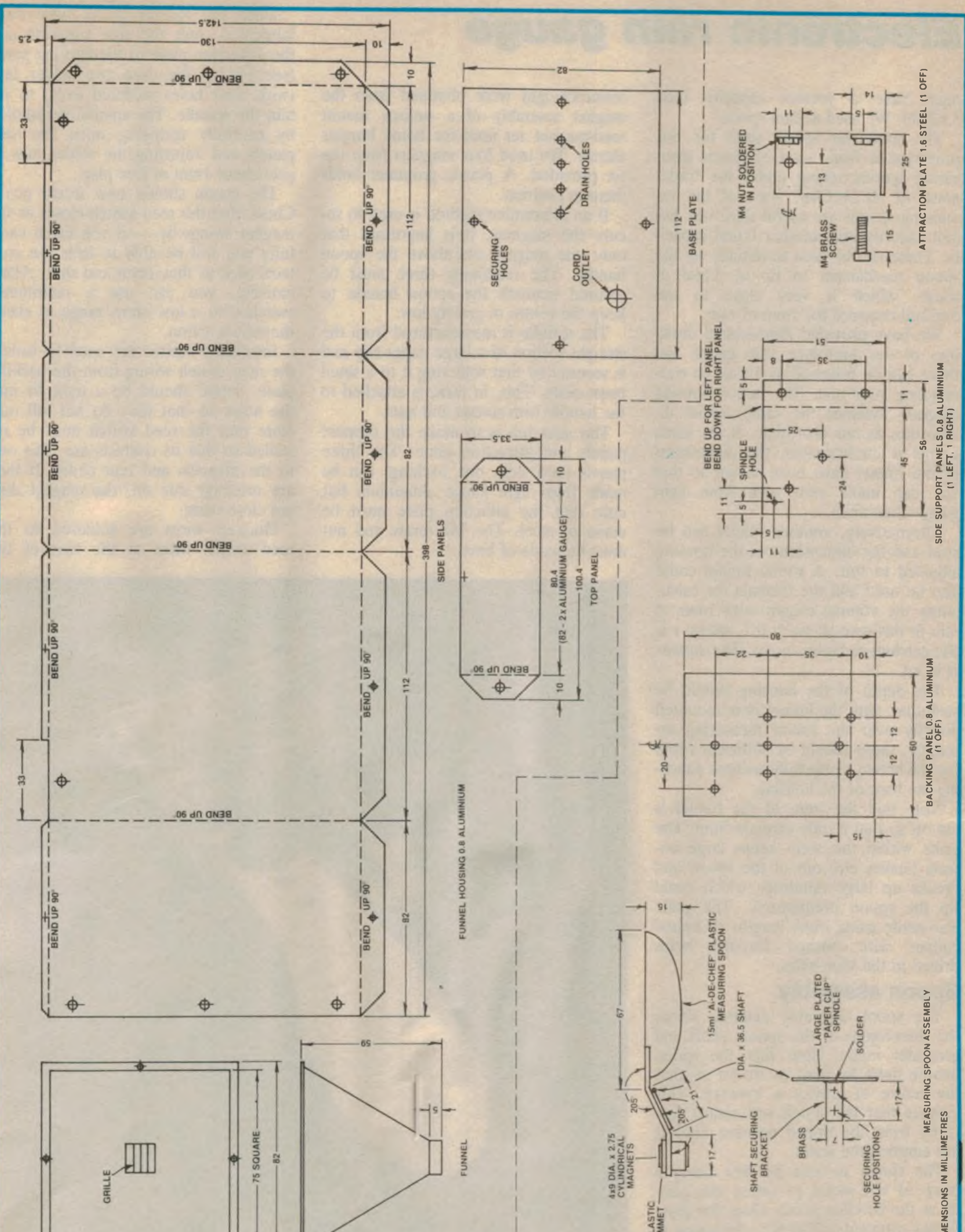


Fig.4: this diagram shows how the parts for the rain collector are made.

Electronic rain gauge

must have a greater capacity than 5.625ml. We used a 15ml spoon.

The particular spoon used for our prototype is from a set of plastic measuring spoons selling under the trademark of *Ai.De.Chef*. Two of the remaining spoons are useful since one has 5ml capacity and another 0.6ml capacity. These can be used to initially set the spoon mechanism to tip at 5.6ml of water, which is very close to the 5.625ml required for 1mm of rain.

We have provided dimensional drawings of our prototype rain gauge and these can be followed as an aid in constructing your unit. The funnel housing diagram assumes the same funnel dimensions as our prototype. If the same funnel is unobtainable, the dimensions of the funnel have been shown so that you can make your own from light gauge aluminium.

Alternatively, another funnel can be used and the dimensions of the housing adjusted to suit. A round funnel could also be used and the formula for calculating the volume caught with 1mm of rain in this case is: $\pi r^2 \times 0.1$, where r is the catchment radius in cm. The answer is in ml.

The depth of the housing should be such that, with the funnel stem mounted directly over the spoon measuring assembly, there should be sufficient room for the spoon to tip fully without touching the base of the housing.

Note that the stem of the funnel is cut off so that it only extends 5mm. The grille within this stem keeps large objects (leaves etc) out of the spoon and breaks up large raindrops which could tip the spoon prematurely. The grille was made using short lengths of tinned copper wire pushed through holes drilled in the stem sides.

Spoon assembly

The spoon assembly diagram shows the dimensions of the spoon, shaft and grommet items. Note that the spoon handle must be bent as shown so that the centre of gravity is lowered. This ensures that the spoon will return correctly from the tipped position after it has emptied the water.

The spoon is bent by first using a piece of hot metal to soften the plastic at the bending point. Once the plastic has softened sufficiently, the spoon is bent by hand and held in the required position until the plastic rehardens.

Cylindrical magnets for the spoon counterweight were obtained from the magnet assembly of a surface mount reed/magnet set used for home burglar alarms. We used four magnets from the six provided. A plastic grommet holds them in position.

If an alternative method is used to secure the magnets, it is important that only one magnet sits above the spoon handle. The remaining three must be secured beneath the spoon handle to keep the centre of gravity low.

The spindle is manufactured from the straight section of a large paper clip and is secured by first soldering it to a small brass plate. This, in turn, is attached to the handle with screws and nuts.

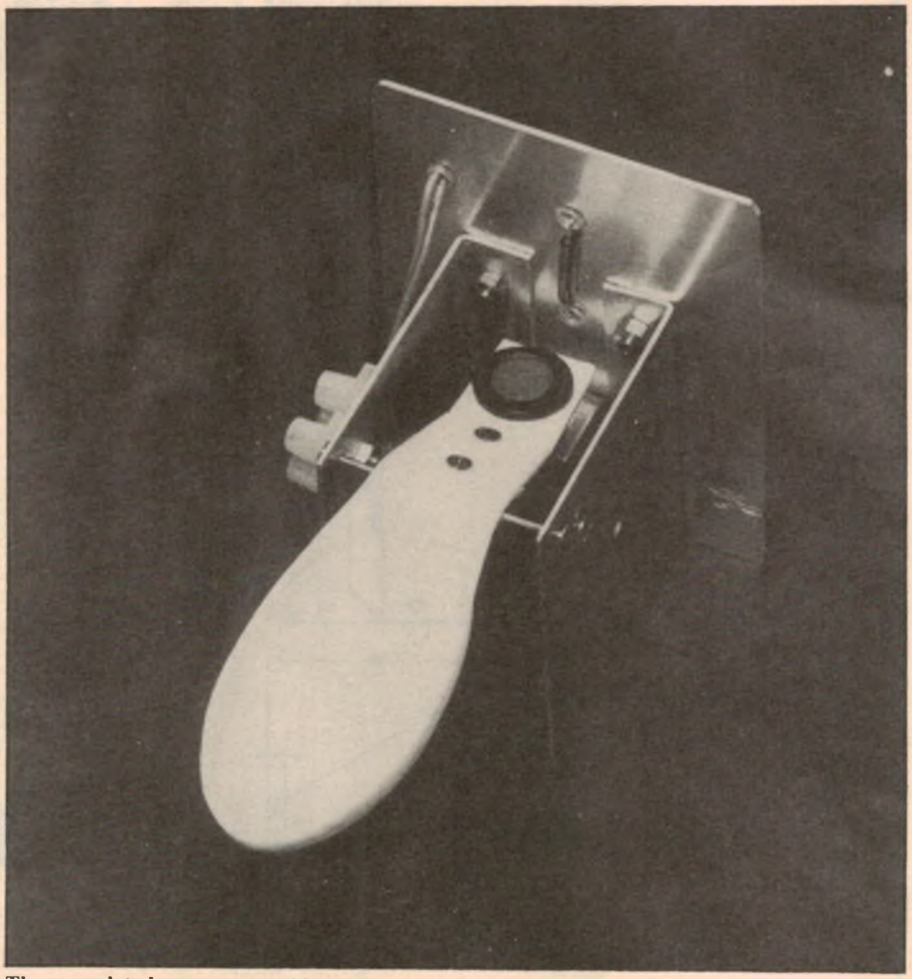
The next job is to make the support panels and attraction plate. The three panels (two side, one backing) can be made from light gauge aluminium but note that the attaction plate must be made of steel. The M4 screw and nut must be made of brass.

Once the various pieces have been fabricated, bolt the side supports and the attraction plate to the backing panel (see Fig.1). We used two solder lugs (with their holes soldered over) to retain the spindle. The spindle is installed by carefully springing open the side panels and adjusting the solder lugs to give about 1mm of free play.

The spoon should now freely pivot. Check that the reed switch closes as the magnet swings by — if you listen carefully you will be able to hear the contacts click as they open and shut. Alternatively, you can use a multimeter switched to a low ohms range to check the switch action.

Insulating bushes are used to isolate the reed switch wiring from the backing plate. These should be a tight fit into the holes so that they do not fall out. Note that the reed switch must be installed so that its contacts are "flat on" to the magnets and rear panel. If they are oriented side on, the magnet may not close them.

Hookup wires are soldered to the reed switch wires at the rear of the



The completed spoon assembly, prior to installation in the rain collector housing. Note the use of grommets to insulate the leads of the reed switch.

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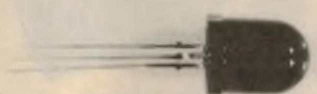

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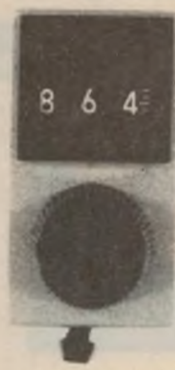

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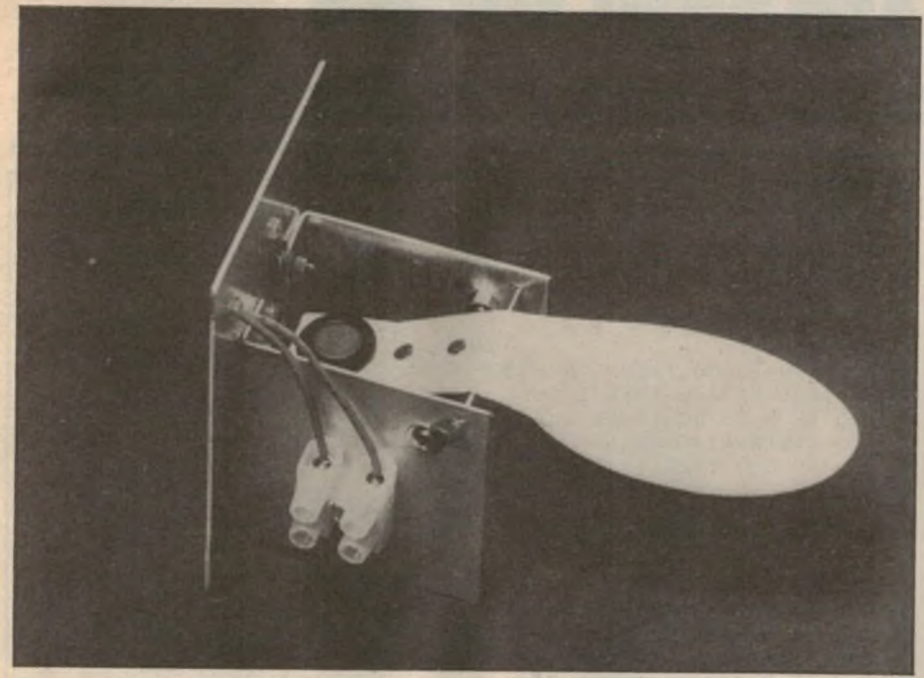
Electronic rain gauge



This view of the spoon assembly shows how the leads from the reed switch are terminated in the two-way terminal block. The spoon is positioned in the housing, directly beneath the funnel.

backing plate and pass through a third insulating bush (see Fig.1) to a terminal block. This is screwed to the left side support and is also used to terminate the leads from the counter circuit.

Testing

The mechanism can be checked by slowly trickling water into the spoon until it tips. Initially, the brass screw should be adjusted so that the spoon sits fairly level. Check that the spoon empties all the water when it trips and that it correctly returns to the rest position (ie, with the magnets sitting on top of the brass screw).

If the spoon does not tip when filled with water, adjust the brass screw so that the magnets are spaced further from the attraction plate. If necessary, remove some of the counterweight mass (eg, one of the magnets).

To calibrate the unit, adjust the brass screw until the spoon tips with the volume of water that the funnel will provide for 1mm of rain (see above). In our case, we adjusted the mechanism to tip at 5.625ml.

The measurement mechanism is bolted within the funnel housing such that the spoon sits directly beneath the funnel. It is a good idea to arrange matters so that the funnel protrudes into the spoon by about 2mm to prevent water spillage. Don't forget to connect the leads from the counter before finally installing the spoon assembly.

Final calibration

Best accuracy is obtained if the rain gauge is calibrated with a large quantity of water. This should be a multiple of the amount required to indicate 1mm of rain. All you have to do is feed the water slowly through the gauge, note the reading, then adjust the screw accordingly and repeat the procedure if necessary.

For example, our prototype requires 5.625ml of water to indicate 1mm of rain on the display. Consequently, 56.25ml of water should give a reading of 10mm. One litre of water should indicate 177mm.

During this procedure, it is important to drip the water very slowly into the funnel otherwise the spoon could falsely trip due to the momentum of the water rather than the actual accumulated volume.

Adjust the brass screw on the attraction plate clockwise if the reading is too low and anticlockwise if the reading is too high.

Installation

The rain measurement gauge should be located in a clear area free from trees, shrubs and so on which may shield the gauge from rainfall. A short pole can be used to support the gauge above the ground. Alternatively, it could be located at the peak of the roof of your home.

Run the leads between the gauge and display unit and carefully route them so that it is not possible for anyone to trip over them. They should either be run underground, supported high aboveground, or routed around the walls of the house.

PARTS LIST

1 PCB, code 87rg1, 82 x 55mm
1 Scotchcal front panel, 127 x 64mm
1 plastic box, 130 x 67 x 43mm
1 4 AA-size battery holder
1 battery snap
3 AA alkaline cells
0.8mm aluminium sheet, 400 x 340mm
1.6mm steel, 11 x 40mm
1 7 x 17 x 1mm brass shim
3mm red perspex, 45 x 20mm
1 15mm-long 4mm brass bolt plus nut
1 plastic funnel, 75mm square (see text)
1 2-way insulated terminal block
1 surface-mount reed switch/magnet set (DSE Cat. No L-5210 or equivalent)
1 15ml "Ai.De.Chef" measuring spoon set (from hardware stores)
1 10mm ID plastic grommet
3 insulating bushes
2 solder lugs
1 large plated paper clip
4 9mm spacers
2 PCB-mounting momentary contact pushbutton switches (Jaycar SP-0721 or equivalent)

Semiconductors
3 FND500 or equivalent commor cathode 7-segment displays
1 74C926 4-digit decade counte
1 7555 CMOS timer
3 BC338 NPN transistors
1 1N914, 1N4148 silicon diode

Capacitors
1 100μF 16VW PC electrolytic
1 33μF 16VW PC electrolytic
1 1μF 16VW RBLL electrolytic
1 0.01μF metallised polyester
2 0.001μF metallised polyester

Resistors (0.25W, 5%)
1 x 1MΩ, 1 x 10kΩ, 1 x 4.7kΩ, 1 x 2.2kΩ, 7 x 56Ω

Miscellaneous
Machine screws and nuts, solder, hookup wire, etc.

Circuit & Design Ideas

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.

Great Circle calculator for the Amstrad 6128

This computer program was prompted by a similar program in the *Circuit & Design Ideas* pages of the May 1986 issue. This version adds a few refinements so that it prints the desired antenna bearing and the return bearing. The latter is not always the reciprocal or long path bearing.

As presented, this program is set up for Whangarei, NZ. To make it work for your location, plug the name of your town into Line 10, and the appropriate latitude and longtitude into line 30.

The formulas used in the program are taken from the 13th edition of the ARRL "Antenna Handbook", pages 327-329. The formulas have been considerably manipulated to run on the Amstrad and corrections are made to allow for the conditions noted in the ARRL handbook.

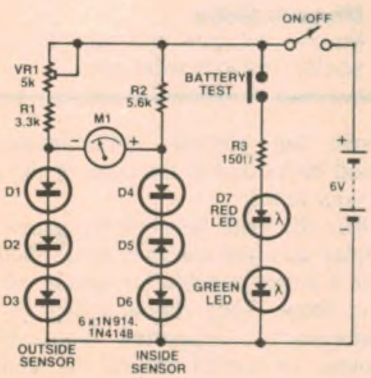
R. Woodfield,
Whangarei, NZ. **$20**

Editor's note: the program on page 54 of the May 1986 issue referred to above had two lines omitted from the end. They were:
500 LET HD = 360 — HD
510 RETURN

```
10 REM GREAT CIRCLE BEARINGS AND DISTANCES FROM WHANGAREI
20 DEG
30 A=-35.72:B=-174.33
40 PRINT "HIS LAT?"
50 INPUT X
60 PRINT"HIS LNG?"
70 INPUT Y
80 IF B-Y>180 THEN L=B-Y-360:GOTO 110
90 IF B-Y>-180 THEN L=B-Y
100 IF B-Y<-180 THEN L=B-Y+360
110 C=SIN(A)*SIN(X)+COS(A)*COS(X)*COS(L)
120 IF C<0 THEN D=180-ATN(SQR(1/C^2-1))
130 IF C>0 THEN D=ATN(SQR(1/C^2-1))
140 H=ATN(SIN(L)/(COS(A)*TAN(X)-SIN(A)*COS(L)))
150 IF L>0 THEN GOSUB 300
160 IF L<0 THEN GOSUB 500
170 IF Y-B>180 THEN M=Y-B-360:GOTO 200
180 IF Y-B>-180 THEN M=Y-B
190 IF Y-B<-180 THEN M=Y-B+360
200  R=ATN(SIN(M)/(COS(X)*TAN(A)-SIN(X)*COS(M)))
210 IF M>0 THEN GOSUB 700
220 IF M<0 THEN GOSUB 900
230 PRINT"DISTANCE IS"INT(D*69.048)"STATUTE MILES"
240 PRINT"DISTANCE IS"INT(D*111.12)"KILOMETRES"
250 END
300 IF H>0 THEN PRINT"BEARING IS"INT(H) "DEGREES"
310 IF H<0 THEN PRINT"BEARING IS"INT(H+180)"DEGREES"
320 RETURN
500 IF H>0 THEN PRINT"BEARING IS"INT(H+180)"DEGREES"
510 IF H<0 THEN PRINT"BEARING IS"INT(H+360)"DEGREES"
520 RETURN
700 IF R>0 THEN PRINT"RETURN BEARING IS"INT(R)"DEGREES"
710 IF R<0 THEN PRINT"RETURN BEARING IS"INT(R+180)"DEGREES
720 RETURN
900 IF R>0 THEN PRINT"RETURN BEARING IS"INT(R+180)"DEGREES
910 IF R<0 THEN PRINT"RETURN BEARING IS"INT(R+360)"DEGREES
920 RETURN
```

Temperature comparator

This temperature meter displays the difference between two temperature readings. For example, it can show whether the temperature inside is warmer or cooler than outside.



Circuit operation is based on the change in voltage across a silicon diode by about –2.3mV per degree Celsius. Three diodes are used in series for each of the two sensors to provide about a 7mV change for every degree Celsius.

Meter M1 is a centre zero type with a sensitivity of ±100μA. A full scale reading to the right indicates that the temperature is about nine degrees Celsius warmer inside than out. Conversely, a full scale reading to the left on the meter indicates that the temperature is about nine degrees Celsius colder inside than out.

The battery test switch lights the green LED when the battery voltage is greater than about 4V. The red LED (D6) is only used to provide a 2V drop.

The unit is calibrated with both sensors at the same temperature. Adjust VR1 to give a zero reading on the meter.

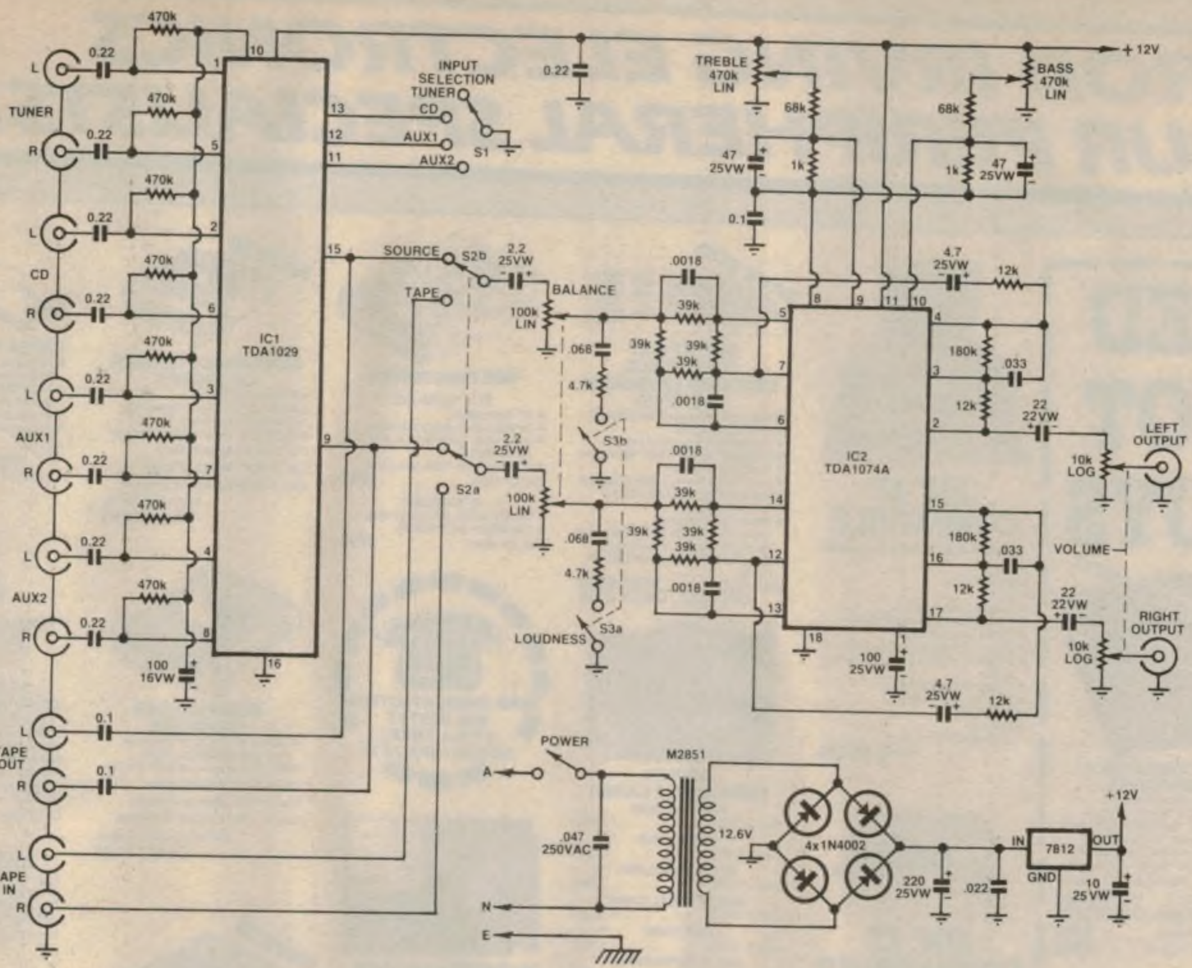
To provide weatherproofing, the outside sensor diodes can be sealed inside a small tube with long connecting leads.

E. Rodda,
Marion, SA. **$15**

Low current power amplifier

The LM386 is a versatile IC amplifier which can operate at between 5 and 12V and provide typically 325mW into an 8-ohm loudspeaker with a 6V supply. Quiescent current is typically 4mA with the same supply voltage which makes it ideal for battery operation.

A volume control is provided at the



IC preamplifier

Using just two ICs, this stereo preamplifier has four line-level inputs plus tape in and out. Controls include balance, bass, treble, volume and loudness. There is no preamplifier for a phono input.

Harmonic distortion of the circuit is typically 005% at 5V RMS output for a frequency range from 20Hz to 20kHz. Signal to noise ratio is typically 120dB with respect to 6V output and the frequency response is flat from 20Hz to 20kHz.

Bass and treble controls have a maximum 12dB boost or cut at 100Hz and 8kHz respectively.

The TDA1029 is a dual four channel signal source switch. Each input is capacitively connected to the IC which is biased via the 470kΩ resistors connected to pin 10. Selection of an input is made with switch S1 while Tape monitor switching conventionally switches the signal using double pole switch, S2.

Signal from switch S2 is balanced using a dual ganged linear potentiometer. A loudness control comprising a 4.7kΩ resistor and 0.068μF capacitor is switched in circuit using switch S3.

IC2 is a dual tandem electronic potentiometer circuit designed for use as a tone control. The tone control operates by adjusting the DC voltage on the requisite pins of the TDA1074. For treble, this is pin 9 and for bass, pin 10. Components connected to pins 5, 7 and 8 set the left treble response while the components connected to pins 12, 13 and 14 set the right treble response. For the bass control, components connected to pins 2, 3 and 4 set the left and components connected to pins 15, 16 and 17 set the right channel response.

Both bass and treble controls are 470kΩ linear potentiometers. The volume control is at the output of IC2 and is a dual ganged 10kΩ logarithmic pot.

D. Adkins,
Kensington, NSW.

$25

---

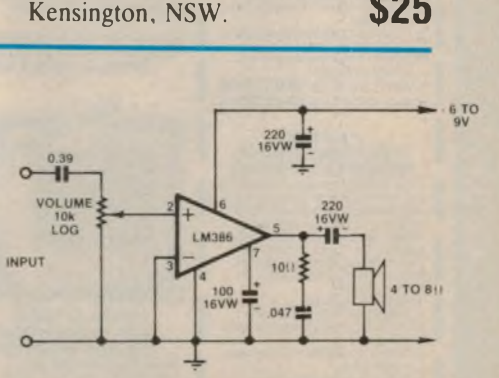
non-inverting input using a 10kΩ logarithmic potentiometer. Power supply decoupling for the IC is via the 100μF capacitor at pin 7 and at the 220μF capacitor at the supply input, pin 6.

A Zobel network consisting of the 10Ω resistor and 0.047μF capacitor at the output of the amplifier helps prevent high frequency oscillation. The loudspeaker is AC-coupled from the output using a 220μF capacitor.

Gain of the amplifier is 20 as it stands and can be increased to 200 if a 10μF electrolytic capacitor is connected between pins 1 and 8. In this case, the positive side of the capacitor connects to pin 1. To vary the gain between 20 and 200, connect a resistor of between 1kΩ and 15kΩ in series with the 10μF capacitor.

J. Emery,
Bullcreek, WA.

$20



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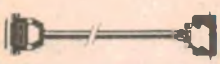

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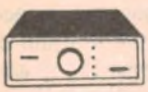

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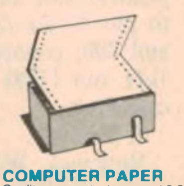

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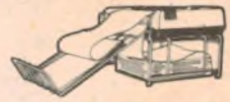

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Part 3: The PAL colour signal

Understanding colour television

In the third part of this series on the principles of colour television, the author discusses colour cameras and the makeup of the PAL colour signal.

by DAVID BOTTO

A colour television camera scans the scene to be transmitted, producing video signal outputs proportional to the black and white light, and of the colour present in the scene.

Fig.1 shows the principle of the three tube camera. Three dichroic mirrors are used to split the light into its red, green and blue components. Dichroic mirrors do this by reflecting only one primary colour and allowing light of all other wavelengths to pass through. These are so arranged that only red light falls on camera tube (a), blue light on tube (b), and green light on tube (c).

Camera beam current

Each of the camera tubes has a target of photoconductive material which is scanned by an electron beam which scans from left to right. As light strikes each element of the target, it produces an electric charge which is then removed as the electron beam scans across the element. The net effect is that the electron beam current varies as the scene is scanned, according to the variations in brightness.

In effect then, each camera tube can be considered to be a capacitor with a high value of parallel resistance which varies according to the brightness of the scene at any point (Fig.2). The electron beam through the tube circuit then becomes the video output signal.

In a 625-line system, the electron beam scan horizontally at a rate of 15,625 lines each second, the vertical scan rate being 50Hz. Field and line scan coils are used to deflect the beam and the scanning of the three colour tubes must be accurately synchronized.

Some colour TV cameras have used four pick-up tubes, one for each of the three primary additive colours, and a seperate tube for the monochrome or "Y" signal. Most colour cameras, however, use three pick-up tubes.

If for a scene consisting of pure white and correctly illuminated with white light, each camera tube supplies one volt of signal, then the outputs must be adjusted to produce 0.30 volts from camera tube A, 0.11 volts from tube C and 0.59 volts from tube B. These proportions combine to make up the luminance, or "Y" signal, as defined previously. ($Y = 0.59E_G + 0.30E_R + 0.11E_B$ where E represents the signal voltage, and G, R, and B the colours.)

In a three tube colour camera, the

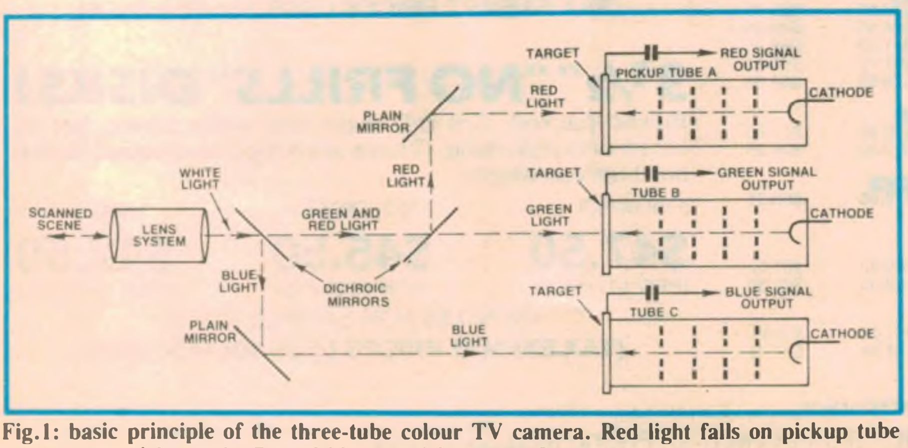


Fig.1: basic principle of the three-tube colour TV camera. Red light falls on pickup tube A, green on pickup tube B, and blue on pickup tube C.

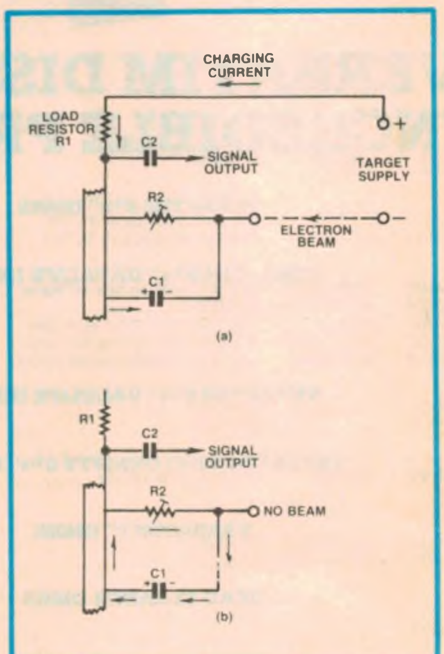


Fig.2: the camera tube can be considered as a capacitor with a high value parallel resistance.

A Philips LDK5 colour TV camera in use by a BBC London Outside Broadcast crew. (Photo courtesy BBC, London).

three colour output signals are added to obtain the "Y" signal. When the camera scans a pure green scene, the green and the "Y" outputs will both be 0.59 volts, because E_Y consists of the green signal voltage only. The figures below show the camera outputs for various colour backgrounds. Because additive colour mixing is used in colour television, yellow is produced by mixing red and green light, cyan by mixing green and blue, and magenta by mixing red and blue (see Table 1).

When a normal scene is scanned by the camera the output signals from the three tubes will vary continuously as the colour and brightness content of the scene changes. The three combined signals produce the "Y" signal which (as explained last month) contains the high definition detail of the picture.

Since only two colour signals will be transmitted, together with the luminance signal, all three colour signals, together with the "Y" signal are fed into a matrix circuit to obtain the desired signals. However, before being matrixed, the signals must be gamma corrected (see Fig.3).

TABLE 1

Red:	$E_Y = 0.30$	$E_R = 0.30$	$E_B = 0$	$E_G = 0$
Blue:	$E_Y = 0.11$	$E_R = 0$	$E_B = 0.11$	$E_G = 0$
Green:	$E_Y = 0.59$	$E_R = 0$	$E_B = 0$	$E_G = 0.59$
Yellow:	$E_Y = 0.89$	$E_R = 0.30$	$E_B = 0$	$E_G = 0.59$
Cyan:	$E_Y = 0.70$	$E_R = 0$	$E_B = 0.11$	$E_G = 0.59$
Magenta:	$E_Y = 0.41$	$E_R = 0.30$	$E_B = 0.11.$	$E_G = 0$

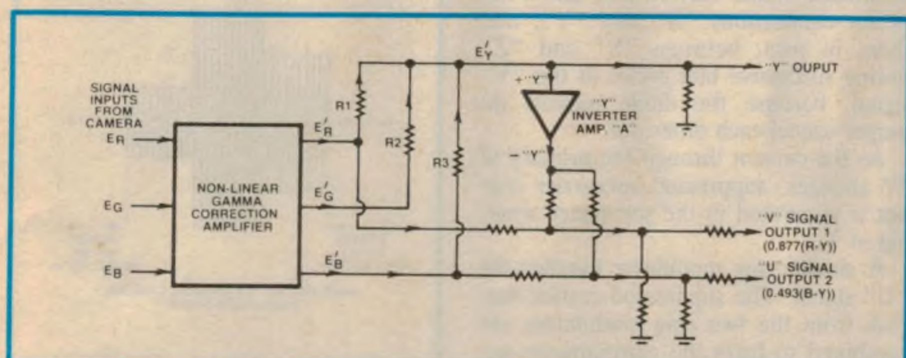


Fig.3: basic scheme for a matrix network. This is used to produce the weighted (R-Y) and (B-Y) colour difference signals (referred to as the PAL "V" and "U" signals respectively).

Gamma correction

When the signal input to the television receiver cathode ray tube increases, the light from the screen does not increase in direct proportion. As an example, if the signal voltage input to the picture tube doubles, the light output from the screen phosphors increases by approximately four times. So the picture tube is not linear and the camera output needs to be modified to compensate for it.

Gamma correction circuitry in the form of a non-linear amplifier is used to overcome this problem. This is interposed between the television camera, and what is known as the matrix circuitry. The non-linear amplifier compresses the signals non-linearly to compensate for the non-linear television receiver picture tube characteristics. Gamma corrected signals are shown with a little dash over them, called a "prime", so that for example E_Y gamma corrected is shown as E'_Y.

Matrixing the signals

Fig.3 shows a simplified diagram of a matrix network. The E'_R, E'_G and E'_B signals all go via resistors R1, R2, and R3, to form the E'_Y signal. Amplifier A inverts the E'_Y signal to produce a $-E'_Y$ signal. The E'_R and E'_B signals then have the $-E'_Y$ signal subtracted from them to produce two difference signals, ($E'_R - E'_Y$) and ($E'_B - E'_Y$), which are usually referred to as the (R-Y) and (B-Y) colour difference signals.

Notice that the signal at output (1) is 0.877 multiplied by the (R-Y) signal, and the signal at output (2) is 0.493 multiplied by (B-Y). This "weighting" of the colour signals is necessary to prevent overloading the transmitter. Without weighting, the peak colour signals would exceed 100% modulation and cause distortion (Fig.8). The weighted (R-Y) signal now becomes the PAL "V" signal, and the (B-Y) the "U" signal.

Because the (G-Y) colour difference signal is recovered at the television receiver, only the "U" and the "V" colour difference signals, together with the "Y" signal are transmitted.

The PAL transmitter

The "U" and "V" signals feed through low-pass filter stages A and B to the modulator stages (see Fig.4). The subcarrier generator has a precise frequency of 4.43361875MHz. This 4.43MHz signal must be modulated by both the "U" and the "V" signals to produce a single modulated carrier. Furthermore, the colour information must not interfere with the monochrome signal.

The output signal from the 4.43MHz oscillator is taken directly to modulator B to be modulated by the "U" colour difference signal. However, the 4.43MHz signal is not taken directly to modulator A but passes through circuitry which changes the phase by 90 degrees.

This 90 degree phase-shifted 4.43MHz signal goes via a PAL switch inverter circuit which switches the 4.43MHz signal 180 degrees to coincide with every alternate scanned line of the picture.

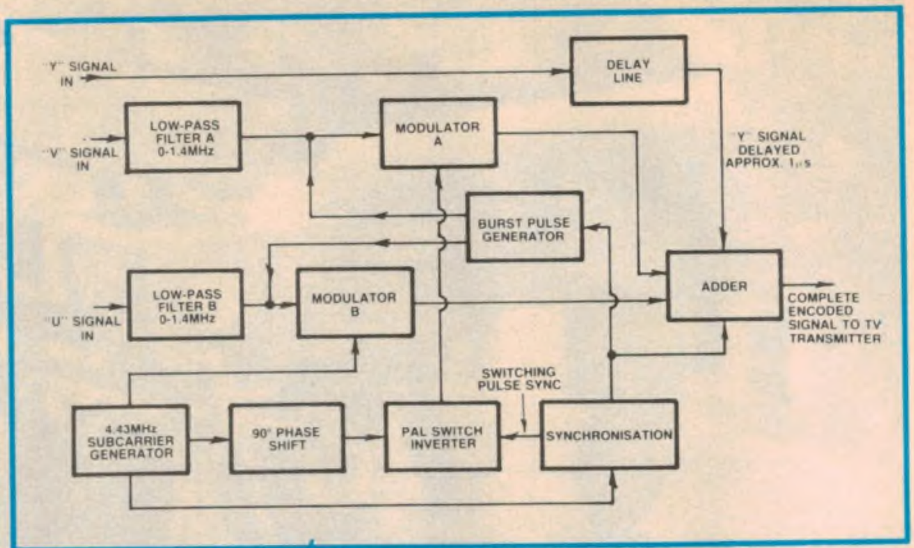


Fig.4: basic schematic of a PAL modulator.

Ring modulator

To prevent the colour subcarrier interfering with the monochrome signal, and producing objectionable patterning on the received colour picture, suppressed carrier modulation is used. One way to accomplish this is by use of a ring modulator circuit (Fig.5). The circuit is assumed to be perfectly balanced although in practice, preset adjustments are included.

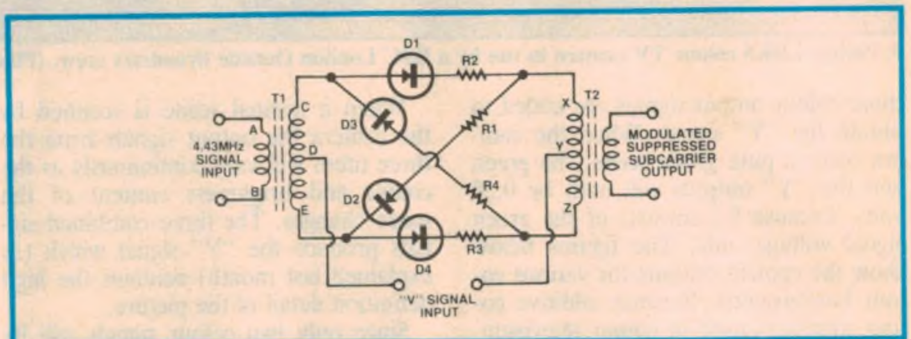


Fig.5: the ring modulator is used to produce suppressed carrier modulation.

When the 4.43MHz signal is positive-going at connection "C" of transformer T1, the signal at connection "E" will be negative-going. This means that only diodes D2 and D1 will conduct, D1 to produce a positive output and D2 a negative output, which exactly cancel each other out. Diodes D3 and D4 will not conduct, therefore no signal appears across connections "D" and "Y" or at connections "X" and "Z" of transformer T2, and so there will be no subcarrier output.

Similarly, when connection "C" is negative-going and connection "E" positive-going only diodes D3 and D4 produce outputs, again producing opposing voltages at connection "Z" on transformer T2.

As before, no signal appears across "D" and "Y", or at connections "X" and "Z", and the subcarrier output is zero. The output remains zero until a "V" signal input appears at the input terminals. Signal current now flows between connections "X" and "Y", and then, in turn, between "Y" and "Z" during successive half cycles of the "V" signal, because the diode outputs no longer cancel each other out.

As the current through the primary of T2 changes, suppressed subcarrier output is generated in the secondary winding of T2.

A similar ring modulator handles the "U" signal. The suppressed carrier outputs from the two ring modulators are combined to form the chrominance signal. Fig.6 compares amplitude modulation with suppressed carrier modulation.

The suppressed carrier outputs of the

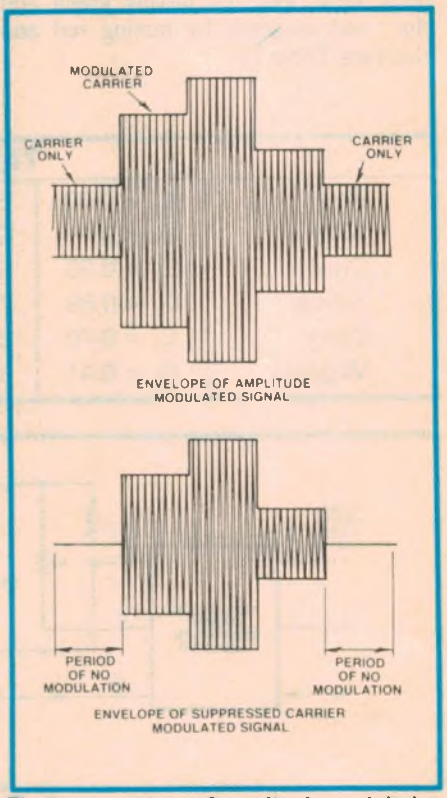


Fig.6: comparison of amplitude modulation (top) with suppressed carrier modulation (bottom).

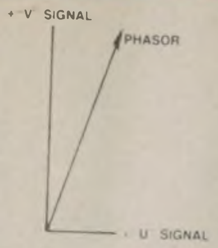
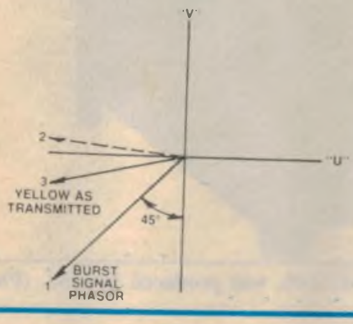


Fig.7a:
Above: the hue of the colour is determined by the relative signal voltages of the "V" and "U' signals. The resultant arrow is called a "phasor".
Below: arrow (3) indicates a yellow colour while arrow (2) shows the result of phase distortion at the TV receiver due to transmission path problems. Arrow (1) is the burst signal phasor.



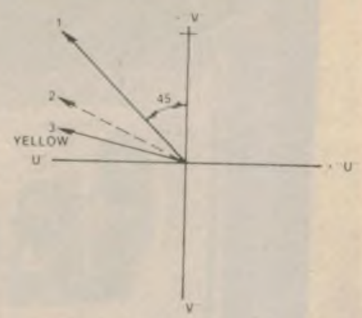
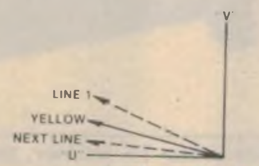


Fig.7b:
Above: for the next line, the "V" signal has been switched by 180 degrees. Compare the received phase distorted signal (2) with (2) in Fig.7a and note that the averaged resultant gives the correct colour.
Below: The dotted lines represent the alternate phase distorted signals while the solid line shows the resultant average signal.



two ring modulators are combined in the adder circuitry, producing a composite subcarrier containing all the colour information needed for the transmitter. The voltage amplitude and phase of this composite signal will depend on the relative amplitude voltage of the "V" and "U" signals (which always remain 90 degrees out of phase with each other)- see Fig.7. This method of modulation is known as quadrature modulation.

You will remember that the phase of the transmitted colour signal determines the hue, and the amplitude of the signal its saturation. Should the TV signal be distorted for any reason in its transmission path to the receiver, the phase of the colour signal will be changed, and incorrect colours will be displayed. This occurs in the NTSC system (Fig.7a).

This is the reason why, in the PAL system, the 4.43MHz oscillator signal supplied to the modulator handling the "V" signal is switched 180 degrees on alternate lines of picture signal. Now if the colour signal received by the viewer suffers phase distortion, the next line with the "V" signal 180 degrees in opposite phase will correct the error, producing the correct colour (Fig.7b).

The colour burst signal

The colour television receiver must "decode" the transmitted colour information. To do this the colour subcarrier is re-inserted, by means of a local 4.43MHz oscillator in the receiver. This re-inserted 4.43MHz carrier must be exactly locked in phase with the 4.43MHz oscillator at the TV transmitter.

To enable the TV's local oscillator to do this, 10 cycles of 4.43 MHz colour "burst" information are sent with each line of signal information. This burst sits on the back porch of the line synchronisation pulse. Fig.8 shows one complete line of signal as the camera scans a standard colour bar chart.

The burst signal is referred to as the "PAL swinging burst" because its phase changes with each transmitted line of picture information by 90 degrees, keeping it in step with the transmitted "V" signal (Fig.7a and 7b). Notice that the burst vector on the first line is shown 45 degrees above the –"U" axis line, and on the next line 45 degrees below the –"U" axis.

Looking again at the block diagram of the colour section of a PAL transmitter (Fig.4), you will see that the 4.43MHz subcarrier generator signal output also feeds into the sync generator. Sync pulses are supplied from this generator to the adder circuitry and also to the burst pulse generator, which feeds burst signals into the two modulators.

A further pulse from the sync generator synchronizes the PAL inverter switch.

The "Y" signal from the matrix circuitry goes via a delay line to the adder circuitry, and arrives at the correct time and phase to fit in with the chroma signals. The complete signal waveform now goes to the transmitter.

Interleaving the signals

One of the requirements of a colour television system is that there be no increase in the station bandwidth of the transmitted signal over that required by

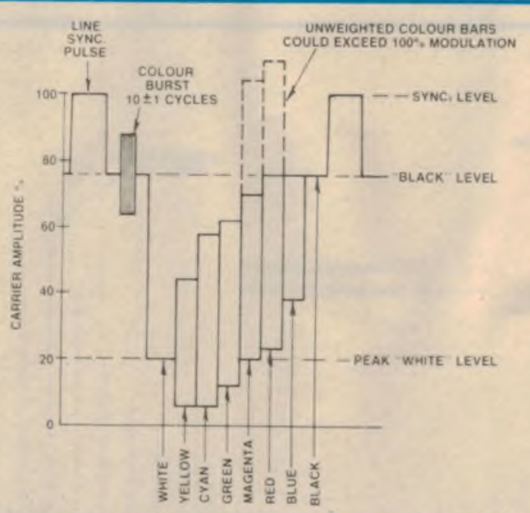


Fig.8: the video signal waveform generated by a standard colour bar chart. Note the colour burst signal on the back porch of the line sync pulse.

the existing monochrome TV stations. The total bandwidth used by the Australian 625 line transmitters is 7MHz which includes the sound signal carrier.

The high definition signals, which you'll recall convey the black and white detail of the picture, occupy 5MHz of the signal bandwidth. How then, can we add the colour subcarrier signal without increasing the station bandwidth? And how do we ensure that viewers with black and white TV receivers can still receive the programs in monochrome?

Fortunately, monochrome signals do not occupy the entire bandwidth of the signal, but occur in clusters of energy at multiples (harmonics) of the line frequency. This is because the monochrome picture is scanned one line at a time, building up the complete picture. This means that the transmitted colour information can be interleaved between peaks of monochrome energy (Fig. 9). The "distance" between each peak of colour signal energy and the last and next cluster of monochrome signal energy is half the line frequency.

To ensure that the colour signal energy clusters are properly spaced between the monochrome clusters, the frequency of the colour subcarrier must be carefully chosen. For a 625-line system, the line frequency is 15,625Hz and the field rate 50Hz.

The exact value of the colour subcarrier frequency chosen to do this is 4.43361875MHz. This is calculated using the formula:

Subcarrier frequency = 0.5 x field frequency + (283.5 + 0.25) x 15,625Hz.

The complete PAL signal

Our study of the PAL system has shown us that the complete PAL signal includes the "Y" signal containing the fine detail of the picture. Then the "U" and PAL switched "V" suppressed carrier colour signals, together with the colour burst signals, are quadrature modulated and combined together with the "Y" signal in the adding circuitry (Fig.4).

Line and field synchronizing signals to "lock" the television receiver picture to the transmitted picture, whether in monochrome or colour, plus the necessary blanking pulses are also supplied to the adder circuitry. The result is a complete video signal, known as an encoded signal, sent to the transmitter, and via the transmission path to the TV viewer's receiver where the received signal is decoded.

The 7MHz TV station bandwidth used in Australia has the frequency modulated sound carrier separated from the vision carrier by 5.5MHz (known as PAL system "B"). Britain uses a station bandwidth of 8MHz with the FM sound carrier being separated from the vision carrier by 6MHz (System I). PAL systems "B" and "I" both use 625 lines and 50 frames per second.

We have referred to the fact that the "Y" signal used in colour television is made up of the proportions Y = 0.59G + 0.30R + 0.11B. You will remember these proportions are used because the eye is most sensitive to green light, and more sensitive to red light than blue light. As we will be referring again to this formula you will find it helpful to commit it to memory.

Next month we'll discuss ways of viewing the received colour picture, including early mechanical methods, various types of cathode ray tubes, and flat panel colour display units. EA

RCA's first colour TV receiver, the Victor Model CT100, was produced in 1954. (Photo courtesy RCA Corporation, USA).

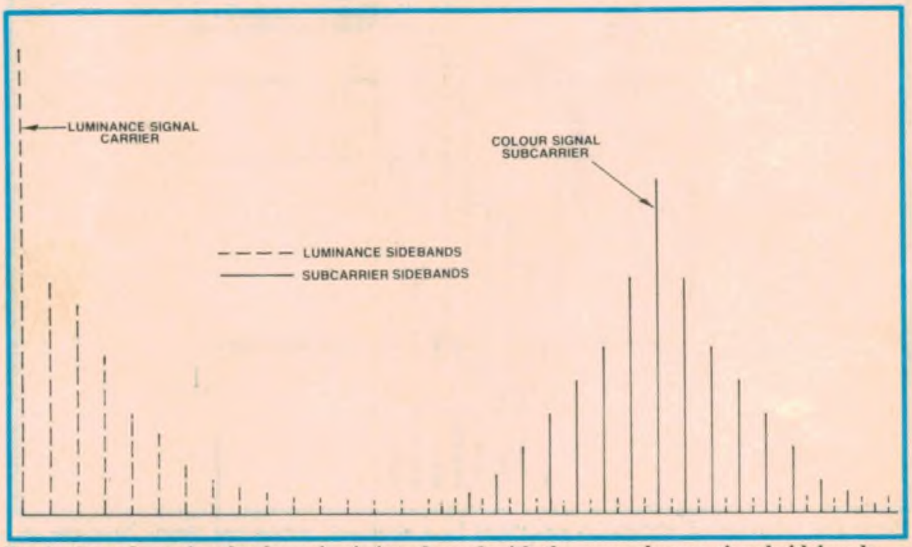


Fig.9: the colour signal subcarrier is interleaved with the monochrome signal sidebands.

A deep-cycle charger for Nicad batteries

This charger will dramatically improve the performance of your nicad batteries and cells by providing the correct charging conditions. It can be configured to charge four AA, C or D cells, two 9V battery types, or a combination of two cells and one 9V battery.

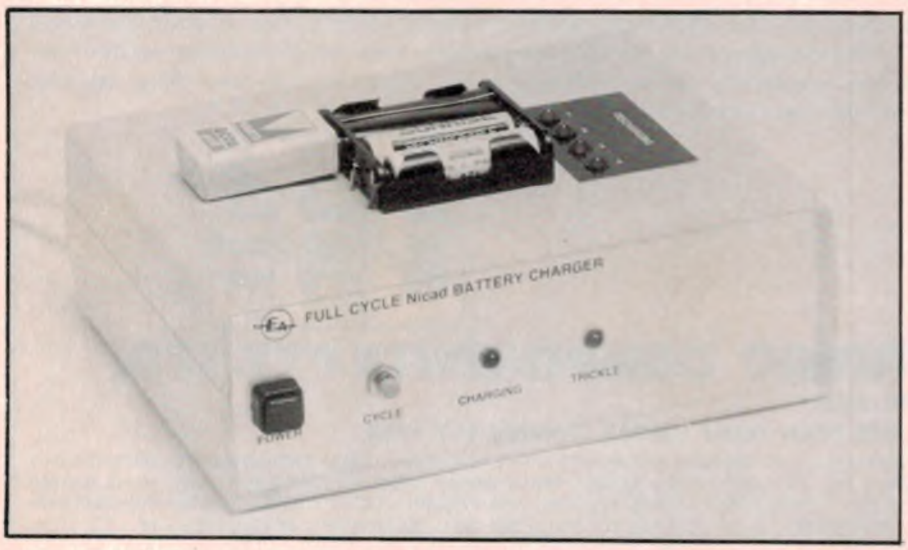
by JOHN CLARKE

Ever since their introduction, nicad cells have become increasingly popular in a range of electronic equipment, toys and power tools. Typical applications include powering tape players, radios, calculators, toy vehicles, portable computers and remote control transmitters and receivers.

The major advantage of nicads is that they can be recharged. This gives tiiem a long-term cost advantage over non-rechargeable types, even though their initial cost is much higher.

The main disadvantage of nicads is that their capacity is much lower than equivalent zinc-carbon cells and considerably lower than alkaline cells. Also the output voltage of a nicad cell is only about 1.25V compared to 1.5V for non-rechargeable types. However, the fact that nicads can be recharged far outweighs these drawbacks in many applications.

Given that nicads can save money in the long term, it is false economy to use a charger that is detrimental to the life of the cells or battery. Before discussing the advantages of our *Full Cycle Nicad Battery Charger* we need to clarify the requirements and characteristics of nicad cells.



Discharge

The capacity of a nicad cell (measured in amp hours) is based on a discharge time of 10 hours and an end voltage of about 1.1V. For example, the AA sized cells have a capacity of 500mAh. This means that if a current of 50mA is drawn, a fully charged cell will discharge to 1.1V after 10 hours. This discharge rate is called the C/10 rate.

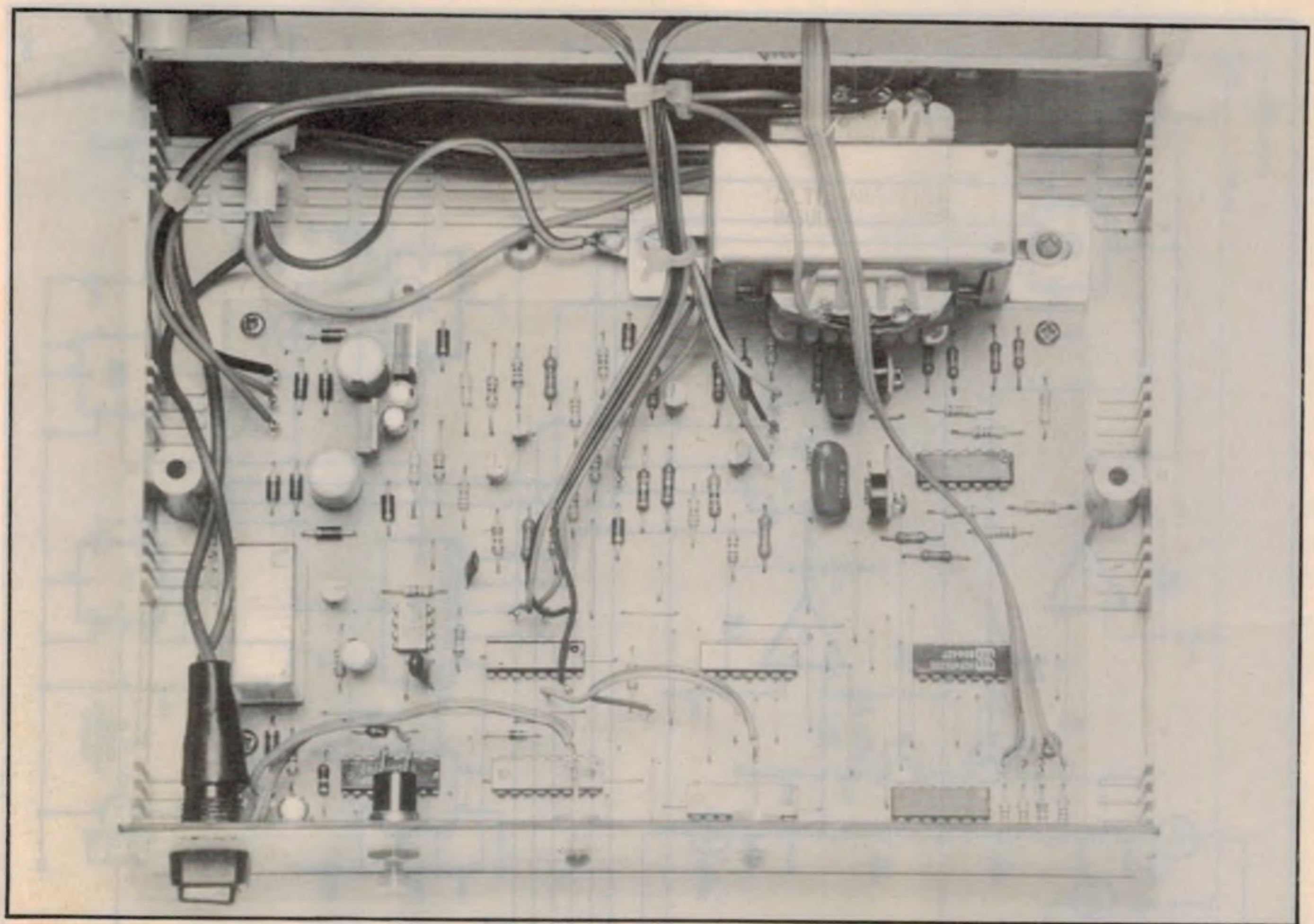
Fig.1 shows the C/5, C/2 and C discharge curves for nicad cells and for a 9V nicad battery. Note that at the C/5 discharge rate, the cells and battery can provide the rated current for the expected five hours before the end voltage (1.1V and 6.6V respectively) is reached. However, at the C/2 and C discharge rates, the end voltage is actually reached slightly sooner than expected.

In fact, at the C discharge rate, the discharge time is 55 minutes compared to the expected time of one hour.

Regardless of the discharge rate, the battery manufacturers recommend that nicads should only be recharged at the 10 hour rate for 14 hours. Charging at a faster rate is possible, of course, but it does lead to a reduction in useful life and usable capacity.

To prevent overcharging, the charging time for partly discharged cells should be reduced accordingly. This provision for charging partly discharged cells presents a problem since the state of charge cannot readily be determined.

Overcharging of nicads reduces the life of the cells and diminishes their charge capacity. This diminished charge capacity can be recovered by fully cycling the nicads through several charges and discharges. Similarly, after extended storage, nicad cells require several charge/discharge cycles to restore full capacity.



View inside the prototype. Be sure to use 240VAC-rated cable for the mains wiring to the transformer and on/off switch.

Our new *Full Cycle Nicad Battery Charger* elegantly solves the problem of overcharging by first discharging each cell (or individual cells within a battery) until it reaches 1.1V. When this end voltage is reached, the cell is charged at the 10 hour current rate for a period of 14 hours as set by an internal timer.

Once charging has occurred, the cells are trickle charged at between the 50 and 30 hour rate to keep them fully charged and to prevent self discharge.

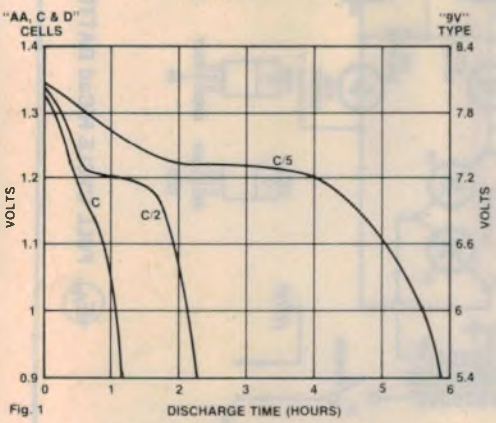


Fig. 1

Fig.1: this graph shows the C/5, C/2 and C discharge curves for nicad cells and for a 9V nicad battery.

Ideally, each cell should be discharged independently to avoid the possibility of polarity reversal and subsequent damage to the cell. Polarity reversal can occur when cells are series connected. Because of slight differences in cell capacity, one cell will discharge before the remainder of the cells. This cell then continues to discharge to 0V, whereupon it reverses polarity.

Note that polarity reversal is a risk in any equipment that connects cells in series. To prevent this occurring, the cells should be removed before full discharge.

While this problem cannot be solved with a 9V battery, since its cells are internally series connected, the AA, C and D size batteries can all be handled as separate cells. As a result, our new charger discharges and charges each of these cells individually. Discharging ceases for each cell when its voltage reaches 1.1V and charging only begins when all the cells have been discharged.

Note that if any of the cells have already been discharged below 1.1V before installation in the charger, they will not be further discharged.

An advantage of the above scheme is that it allows individual checking of the cell capacities. Because the charger can be used to cycle the cells through complete cycles of charge and discharge, the capacity of each cell can be checked simply by timing the discharge from full charge.

The charger discharges at the C/5 rate, so it should take about five hours for each cell to discharge. If a cell discharges well before this time, it may be faulty. Often, however, a low capacity cell can be "rejuvenated" by subjecting it to several full charge and discharge cycles.

As a practical example of just how effective this new charger is, the Author has found that since he has used the charger to recharge his calculator batteries, instead of using the calculator's series charger, the cells have lasted up to four times longer between charges.

Clearly, one of the cells was well down in capacity and needed rejuvenating.

Operation of our new nicad charger is

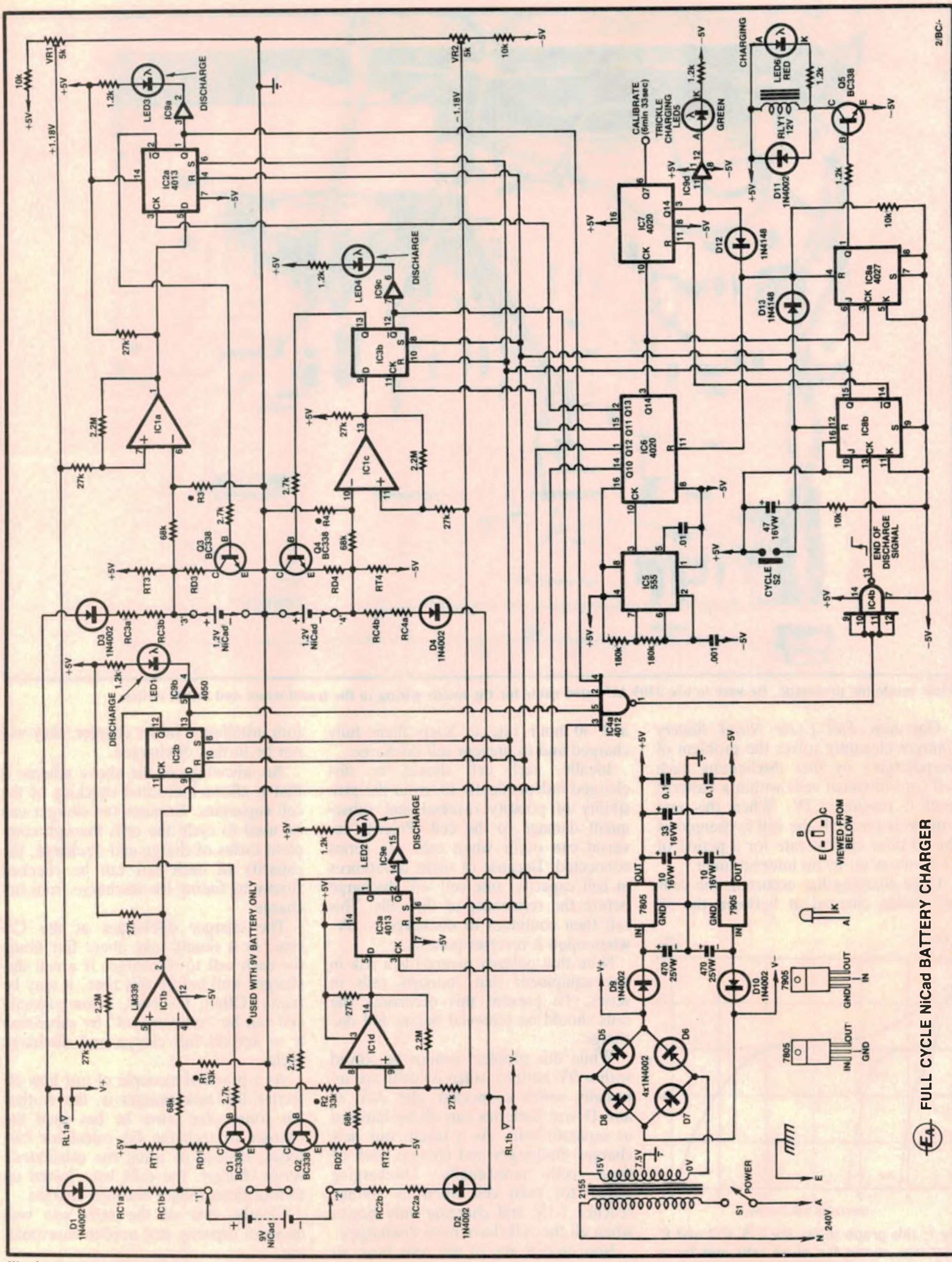


Fig.2: the circuit may look complicated but it will dramatically improve the performance of your nicad cells.

quite straightforward. The unit is mains powered and housed in a plastic instrument case. On the front panel are Power and Cycle switches, and charge and trickle indicator LEDs. The cell holders are located on the lid of the case along with four discharge LED indicators, one for each of the cells or battery.

When the discharge LEDs are lit, the charger is discharging the cells. If a LED goes out, then the cell adjacent to that particular LED has reached its end voltage and discharging for that cell has ceased. When all the cells are discharged, charging begins and the charging LED on the front panel lights. Finally, at the end of the charging cycle, the charging LED extinguishes and the trickle LED lights.

The cells can be left in the charger indefinitely since the trickle charge mode keeps the cells at full capacity without overcharging. However, if the cells are left in this condition for several months, it is a good idea to cycle them through the charge and discharge cycle before use by pressing the Cycle switch.

The circuit

Fig.2 shows the circuit details. As can be seen, there are nine integrated circuits plus a transformer and a relay. The transformer has a 15V centre-tapped winding, the output of which is full wave rectified using diodes D5-D8. Diodes D9 and D10 isolate the plus and minus rectified waveforms so that the supply rails can be filtered using 470μF capacitors.

A 7805 3-terminal regulator provides a +5V supply rail for the ICs, while a 7905 regulator provides a –5V supply rail. The 10μF capacitors on the outputs ensure stability of the regulators.

Charging for each of the cells is via D1, RC1a and RC1b for cell 1; D2, RC2a and RC2b for cell 2; D3, RC3a and RC3b for cell 3; and D4, RC4a and RC4b for cell 4. Note that charging is prevented if relay contacts RL1a and RL1b are open.

As drawn, the circuit shows the necessary connections for charging a 9V battery at positions 1 and 2, and two separate 1.2V cells at positions 3 and 4. To charge four cells, the arrangement shown at positions 3 and 4 is duplicated at positions 1 and 2.

Similarly, two 9V batteries can be charged by duplicating the arrangement shown for the 9V battery at positions 3 and 4.

The voltage at each position is monitored using an op amp comparator. IC1b monitors position 1, IC1d position 2, IC1a position 3 and IC1c position 4. Note that the output of the 9V battery at position 1 is attenuated using a voltage divider consisting of a 68kΩ resistor and resistor R1. A second voltage divider (68kΩ and R2) attenuates the output at position 2.

This attenuation is necessary to reduce the voltage on the inverting inputs of IC1b and IC1d to the same level as from a single cell.

A reference voltage of 1.18V for comparators IC1b and IC1a is set by trimpot VR1 which is simply part of a voltage divider in series with the +5V rail. Each non-inverting input monitors this reference voltage via a 27kΩ resistor. This resistor, in conjunction with the 2.2MΩ resistor and 27kΩ pullup resistor, sets the hysteresis voltage of the comparator.

In practice, the voltage at the inverting input must fall about 82mV below the 1.18V reference (ie, to about 1.1V) before the output of the comparator switches high.

In a similar manner, comparators IC1d and IC1c have a reference voltage of –1.18V on their non-inverting inputs, as set by VR2. In this case, the inverting input must fall to about 80mV above the –1.18V reference before the comparator switches low.

The output of each comparator is connected to the Data input of a D flipflop. These operate such that the level at the D input is transferred to the Q output on each rising edge of the clock (CK) signal. The Q-bar output is a complement of the Q output.

When pin 1 of IC1a is low, the Q-bar output of IC2a is switched high at the next clock input. This turns on transistor Q3 which in turn connects discharging resistor RD3 across the cell at position 3. When the cell has discharged to 1.1V, pin 1 of IC1a switches high again and Q3 switches off to end the discharge cycle.

IC1b and IC2b control Q1 in exactly the same manner. Similarly, IC1d and IC3a control Q2 while IC1c and IC3b control Q4. Note, however, that Q2 and Q4 are driven by the Q outputs of IC3a and IC3b rather than by the Q-bar outputs. This is because the outputs of IC1c and IC1d operate in the opposite sense to those of IC1a and IC1b.

If a 9V battery is used at positions 1 and 2, both Q1 and Q2 turn on and discharge the battery via RD1 and RD2. Since RD1 and RD2 are equal in value, the same voltage is developed across each resistor. Thus, when the 6.6V battery end voltage is reached, 3.3V is applied to each of the voltage divider networks on the inverting inputs of IC1b and IC1d.

The divider networks divide by three which means that just 1.1V (ie, the equivalent end voltage of a single cell) is applied to the IC1b and IC1d.

LEDs 1-4 are used to indicate when a cell or battery is discharging. These are driven via 4050 buffer stages (IC9a, IC9b, IC9c and IC9e) from the Q and Q-bar outputs of IC2 and IC3 respectively.

The Q outputs of IC2 and the Q-bar outputs of IC3 also drive the inputs of IC4a, a quad input NAND gate. Its output at pin 1 goes low when all its inputs at pins 2, 3, 4 and 5 are high. This occurs only when all the cells have been discharged. IC4b inverts the IC4a output to provide a positive clock input to IC8b to indicate the end of the discharge cycle.

Clock signals for IC2 and IC3 are derived from IC6 which is a 4020 binary counter. Its Q10, Q11, Q12 and Q13 outputs are connected to the individual clock inputs of the flipflops. IC6 in turn derives its own clock pulses from IC5, a 555 timer wired as an astable oscillator. The 180kΩ resistors at pin 7 and the 0.001μF capacitor at pin 6 set the frequency of operation to 2663Hz.

This may seem a messy number but is necessary to set the required time period as we shall see later.

By now, some readers may be wondering why separate clock signals are used to drive the flipflops (IC2a-IC3b). To understand the reason, let's initially assume that there is no cell in position 3 and that the Q-bar output of IC2a is high. Thus Q3 will be on and the output of comparator IC1a will be high. At the next positive edge of the clock input, the Q-bar output goes low and Q3 turns off. Pin 6 of IC1a is now pulled high via RT3 and thus pin 1 switches low.

On the next clock input, Q-bar switches high again, Q3 turns on, and the output of IC1a reverts high. Thus, the sequence continues indefinitely, with the Q-bar output changing state at each clock input. This sequence occurs at any of the cell positions where no cell is present.

While this is of no consequence when only one cell position is vacant, problems arise if two or more cells are missing. In this case, if the flipflops were all to have the same clock, their Q and Q-bar outputs could be such that the inputs to IC4a are never all high at the same time. This means that IC4a would be unable to detect when all the cells have discharged.

The use of different clock signals for

each flipflop overcomes this problem.

IC8b is a J-K flipflop connected with the J input high and the K input low. This flipflop derives its clock signals from the output of inverter IC4b. When the clock input goes high, at the end of the discharge cycle, the high at the J input sets the Q output high and the Q-bar output low.

IC8b controls several operations. First, the Q output resets IC3a and IC3b and sets IC2a and IC2b so that transistors Q1, Q2, Q3 and Q4 are held off. At the same time, the Q-bar output releases the Reset on IC7.

The Q output of IC8b also connects to the J input of IC8a. Since Q is now high, the next clock signal to IC8a from the Q14 output of IC6 sets the Q output of IC8a high. This turns on transistor Q5 which switches on relay RLY1 and the charging LED to begin the charging cycle.

IC6, a 4020 binary counter, divides the 2663Hz input from IC5 by 2^{14} (or 16,384). The Q14 output from IC6 provides the clock input to IC7, another 4020 binary counter.

Thus, the Q14 output of IC7 goes high after the 2663Hz signal has been divided by 2^{27}, or after 14 hours. This resets IC8a via diode D12 and also prevents further counting by resetting IC6.

The Q output of IC8a is now forced low by the Reset to switch off Q5 and the relay. The relay contacts disconnect the charging resistors from the power supply and the charging LED goes off.

With charging complete, each cell is trickle charged via trickle resistor RT connected between the +5V or –5V rail and the cell terminal. During this time, the Q14 output of IC7 sets the output of IC9d high and this drives the trickle LED via a 1.2kΩ resistor.

The charger can be recycled to discharge the cells again by pressing Cycle switch S2 or by switching the power off and on. When power is first applied, the 47μF capacitor is initially discharged and this pulls the Reset of IC8b high and the Resets of IC6 and IC8a high via diode D13.

This forces Q of IC8b low and Q-bar high, to hold IC7 reset. At the same time, the Q output of IC8a is also forced low. IC6 is now held Reset until the 47μF capacitor charges to the negative rail via the 10kΩ resistor. A similar sequence of events occur if the 47μF capacitor is discharged by pressing the Cycle switch.

Construction

Construction is straightforward with most of the parts mounted on a PCB coded 87bc2 and measuring 170 x 108mm. This is housed in a standard plastic instrument case measuring 200 x 160 x 70mm. A Scotchcal artwork measuring 239 x 64mm was used to make labels for the front panel and for the lid of the case.

Before starting construction, you must decide which types of cells are to be used with the charger. The charger can either charge four cells, two cells and one 9V battery, or two 9V batteries.

Table 1 shows the values of the resistors required for R1-R4, RC, RT and RD for the various AA, C, D and 9V battery types.

The charge resistor values were determined by assuming 7.5V from the transformer, a 0.5V drop across the series diode (D1-D4) and 1.5V per cell. The effect of the trickle charge resistor RT, which is always connected, was also taken into consideration. The trickle charge resistor values were determined by assuming 1.5V per cell and a 5V supply.

Calculations for the 9V battery assumed the equivalent of a three-cell battery (4.5V) between each cell terminal and ground. This is the equivalent of 9V across the two cell terminals.

Finally, calculations for the discharge resistors (RD) assumed that the cells had reached their end point voltage of 1.1V.

The battery holders for the cells should be either single or, preferably, dual types. Dual cell holders are ideal for two cells between terminals 1 and 2 and/or terminals 3 and 4. This is because the holders are designed for series connection of cells. The common connection of the holder is simply connected to the ground terminal.

A 9V battery can be connected either by a battery clip with flying leads or by using the clips supplied with the cell type holders. The latter allow easy modification back to single cell charging should this ever become necessary. Note, however, that the polarity of the clips is transposed when a 9V battery is plugged in, so exercise caution when wiring up this option.

Start construction by checking the PCB pattern for broken and short circuit tracks. These should be repaired before installing any parts.

Fig.3 shows the parts layout diagram. Install the wire links first, followed by the resistors, diodes and ICs. We used PC stakes to terminate all external connections since this makes the job of wiring so much easier later on.

Be careful when installing the diodes and ICs. These components are polarised and must be oriented correctly. Note that all the ICs face in the same direction with the exception of IC5.

Assembly of the PCB can now be completed by installing the capacitors, regulators, transistors, trimpots and relay. As before, take care to ensure that all polarised components are correctly installed.

Work can now begin on the case. Begin by drilling holes in the front panel for the switches and LEDs (use the Scotchcal label as a template), then drill a hole in the rear panel for the cord clamp grommet and file it to shape.

This done, strip back the outer insulation of the mains cable so that it is long enough to reach the front panel mains switch. The PCB can then be installed in the base of the case and secured to the integral standoffs using self-tapping screws.

Several holes are also required in the lid of the case for mounting the cell holders and discharge LEDs, and to pass leads to the holder terminals. Note that the Scotchcal label for the discharge LEDs has been designed to suit

TABLE 1

Type	Capacity	Charge Rate	Trickle Charge	RC (charge resistor)	RT (trickle resistor)	RD (discharge resistor)	Resistors R1-R4
AA	500mAh	50mA	10-17mA	series 82Ω + 82Ω, 0.5W	220Ω, 0.25W	12Ω, 0.25W	not used
C	1.2Ah	120mA	24-40mA	series 33Ω + 27Ω, 1W	120Ω, 0.25W	5Ω, 0.5W	not used
D	1.2Ah	120mA	24-40mA	series 33Ω + 27Ω, 1W	120Ω, 0.25W	5Ω, 0.5W	not used
9V	80mAh	8mA	1.6-2.7mA	series 390Ω + 47Ω, 0.25W	220Ω, 0.25W	220Ω, 0.25W	33kΩ, 0.25W
9V	100mAh	10mA	2.0-3.3mA	series 270Ω + 56Ω, 0.25W	220Ω, 0.25W	220Ω, 0.25W	33kΩ, 0.25W

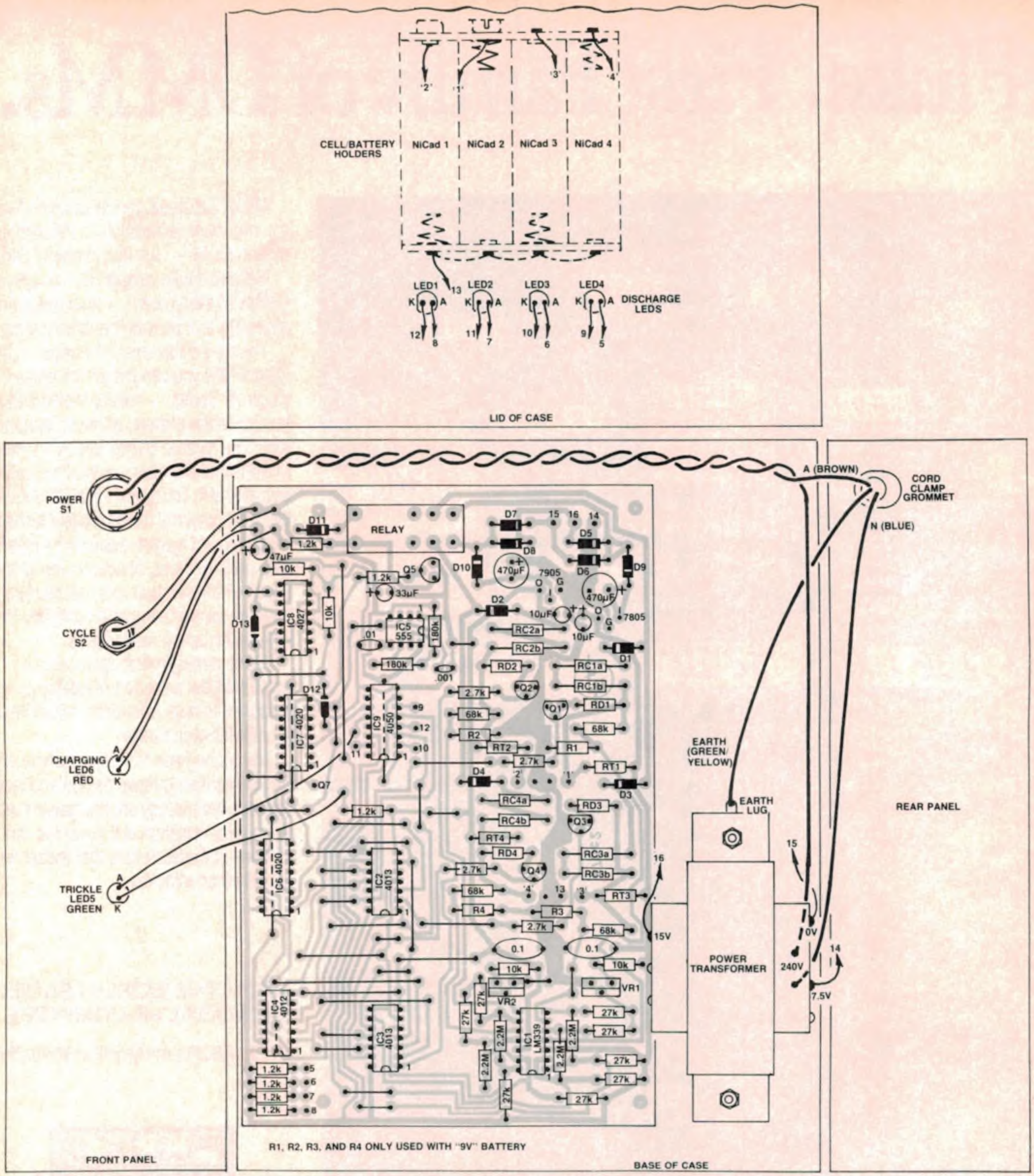


Fig.3: follow this wiring diagram carefully when building your battery charger. Take care when installing polarised parts.

AA-size cell holders. For larger cell holders, the label can be cut to suit the more widely spaced LEDs.

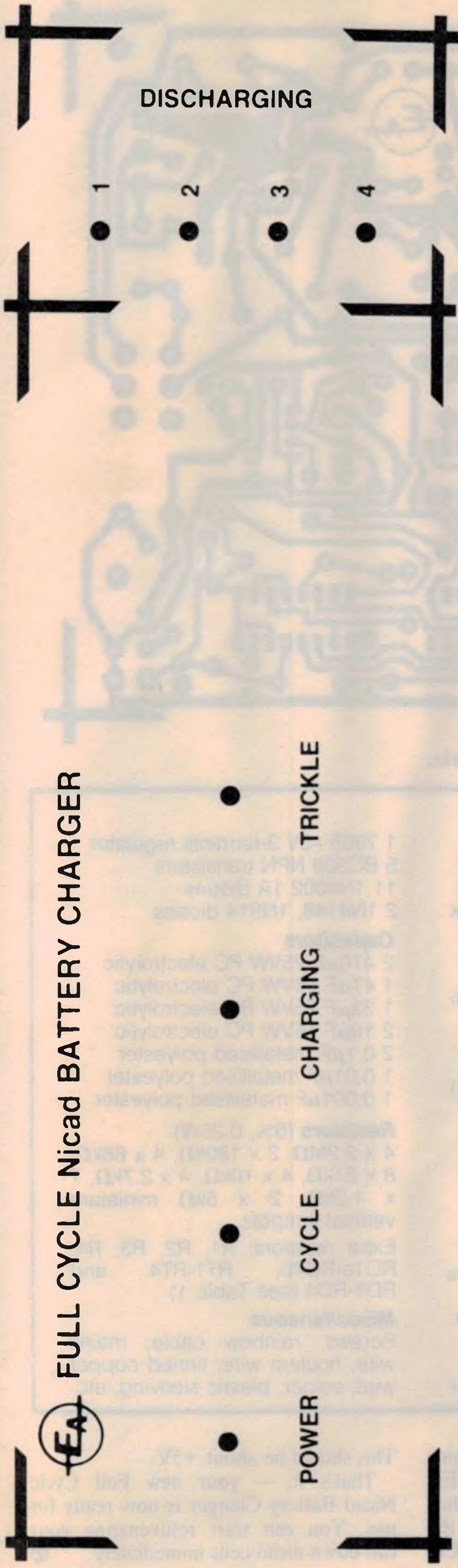
Note also that, in the case of 9V batteries, two LEDs are available to indicate discharging. You can leave one of these LEDs out if you wish, or you can use them both.

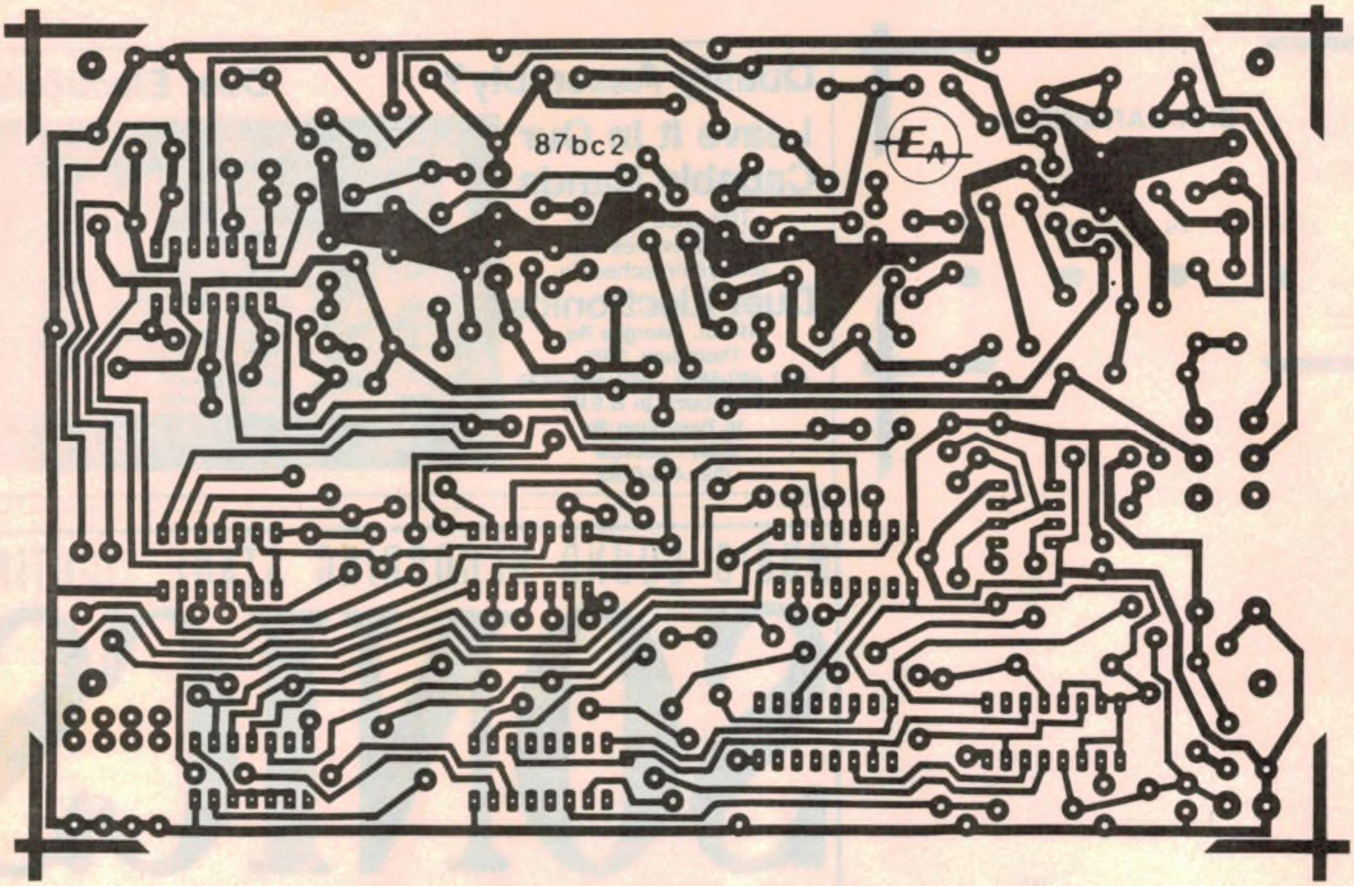
The Scotchcal labels can now be carefully affixed to the case and the various hardware items installed. The transformer is mounted on two standoffs at the rear of the case and secured using self-tapping screws. Note the earth lug under one of the transformer mounting screws (see Fig.3).

All that remains now is to complete the wiring. Be sure to use mains-rated cable for all mains wiring and sleeve the terminals of the mains switch to guard against accidental shock. Medium duty hookup wire is used for the low voltage transformer connections while rainbow cable can be used for all wiring to the cell holders, to the LEDs and to switch S2.

Testing

Before switching on the charger, go back over your work and carefully


DISCHARGING
1
2
3
4
FULL CYCLE Nicad BATTERY CHARGER
POWER
CYCLE
CHARGING
TRICKLE



Figs.4&5: at left and above are full size reproductions of the front panel and PC artworks.

check for wiring errors. Once you are satisfied that all is well, apply power and check for the +5V and -5V rails on the supply pins of the ICs. If these voltages are incorrect, switch off immediately and locate the source of the trouble before proceeding. (Note: do not install any nicad cells at this stage).

Assuming all is well, the reference voltages should now be set using trimpots VR1 and VR2. To do this, first connect your multimeter between the wiper of VR1 and ground, and adjust the trimpot for a reading of +1.18V. This done, adjust VR2 for a reading on its wiper of -1.18V.

Now press the Cycle switch. If the charger is operating correctly so far, the discharge LEDs should blink on and off for a few seconds and then all go out. The relay should activate within about six seconds and the charging LED should light.

The 14-hour charging time can be checked by monitoring the Q7 output of IC7. This connection has been marked on the overlay and should go high between 6 minutes and 33 seconds and 6 minutes and 39 seconds after the relay closes. If the time is within this vicinity, then the Q14 output of IC7 will go high after about 14 hours.

At the end of the charging period, the relay should switch off, the charging LED should go out and the trickle LED should light. Check that there is no further clocking of IC7 by measuring the voltage at the Reset pin (pin 11) of IC6. This should be about +5V.

That's it — your new Full Cycle Nicad Battery Charger is now ready for use. You can start rejuvenating your run-down nicad cells immediately.

PARTS LIST

1 PCB, code 87bc2, 170 x 108mm
1 Scotchcal label, 239 x 64mm
1 plastic instrument case, 200 x 160 x 70mm
1 2155 15V 1A transformer
1 pushbutton mains switch
1 momentary pushbutton switch
1 mains cord and plug
1 cord clamp grommet
1 12V DPDT PC relay
2 dual battery holders (see text)
6 5mm LEDs and bezels (4 orange, 1 red, 1 green)
26 PC stakes
1 earth lug

Semiconductors

1 LM339 quad comparator
2 4013 dual D flipflops
2 4020 14-stage binary counters
1 4027 dual J-K flipflop
1 4012 dual 4-input NAND gate
1 4050 hex buffer
1 555 timer
1 7805 +5V 3-terminal regulator
1 7905 –5V 3-terminal regulator
5 BC338 NPN transistors
11 1N4002 1A diodes
2 1N4148, 1N914 diodes

Capacitors

2 470μF 25VW PC electrolytic
1 47μF 16VW PC electrolytic
1 33μF 25VW PC electrolytic
2 10μF 16VW PC electrolytic
2 0.1μF metallised polyester
1 0.01μF metallised polyester
1 0.001μF metallised polyester

Resistors (5%, 0.25W)

4 x 2.2MΩ, 2 x 180kΩ, 4 x 68kΩ, 8 x 27kΩ, 4 x 10kΩ, 4 x 2.7kΩ, 7 x 1.2kΩ, 2 x 5kΩ miniature vertical trimpots

Extra resistors: R1, R2, R3, R4, RC1a-RC4b, RT1-RT4 and RD1-RD4 (see Table 1)

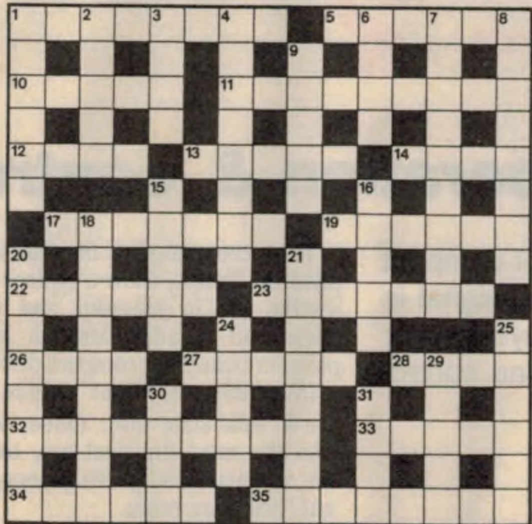
Miscellaneous

Screws, rainbow cable, mains wire, hookup wire, tinned copper wire, solder, plastic sleeving, etc.

MARCH CROSSWORD

ACROSS

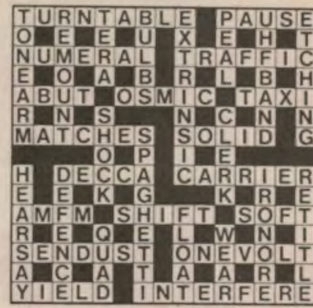
1. Chassis spacer. (5-3)
5. Non-metallic conductor. (6)
10. Chemical result of corrosion of metal. (5)
11. Poorly soldered connections. (3,6)
12. Decades. (4)
13. High-power incandescent electric lamp. (5)
14. Steam loco sound which can be simulated. (4)
17. Metric measurements. (1,1,5)
19. Early crystal detector. (6)
22. An increase in the volume of speaker sales? (6)
23. Produce sound waves. (7)
26. Principal component of ignition system. (4)
27. Protective devices. (5)
28. Power of three. (4)
32. Penultimate term in NSWIT. (9)
33. Acronym for a standard computer code. (5)
34. Electrode of the Edison cell. (6)
35. Graph line joining points of equal temperature. (8)



DOWN

1. Remove AC ripple. (6)
2. Adjust position. (5)
3. Area beyond solar system is called — space. (4)
4. Sound reproduction enthusiasts seek better — (8)
6. Analog-to-digital. (1-2-1)
7. Workshop check by serviceman. (5,4)
8. Quiescent condition of amplfier. (2,6)
9. Synthetic fibre. (5)
15. Said of chemically inactive elements. (5)
16. Transmit or transfer. (5)
18. Said of semiconductor without added impurities. (9)
20. Operate satisfactorily. (8)
21. Obsolete name for a radio receiver. (8)
24. Sequence of programs to be executed. (5)
25. Broadcast frequency band. (6)
29. Your Mother's brother. (5)
30. Early battery, the voltaic (4)
31. Component. (4)

SOLUTION FOR FEBRUARY



An introduction to hifi Pt.11

Compact disc players — 2

Internal mechanism, operation & controls

The previous chapter was devoted to a discussion of compact discs, their characteristics and the form in which the signal is recorded. It remains now to examine typical CD players, their internal mechanics and electronics, their facilities and control and their role in a domestic hifi system.

by NEVILLE WILLIAMS

After looking at the high technology involved in compact discs, the reader might well expect that a CD player would demand some technical awareness on the part of the user but such is not the case. They require no maintenance and, once having learned what buttons to push, their operation is easier than that of a conventional record player.

Nor does the user have to worry about such things as acoustic feedback or hum loops in the connecting leads. The signal is fully processed inside the player and is simply fed to the amplifier system via the usually non-critical "Auxiliary" input sockets.

In use, the disc to be played is placed in the drawer (or compartment) with the label facing up (or out). Closing the drawer locks the disc onto the spindle, and play is initiated by simply pushing the "Play" button.

As explained in the previous article, the CD system operates on the premise that information from the disc will be fed into the digital processing circuitry at a predetermined bit rate, governed in each individual player by a very precise quartz crystal timing "clock".

Since the "packing density" of the data in the spiral track is uniform from beginning to end, the lineal track speed past the laser pickup must itself be held to a constant figure. Depending on the individual recording, it will lie within the range 1.2 to 1.4 metres per second. To meet this requirement, discs must spin at around 500rpm when the pickup is reading the inner tracks, gradually slowing to about 200rpm as play progresses and the pickup moves outwards.

Disc drive normally involves the use of a small but robust electronically controlled direct drive (DD) motor, similar to those used for direct drive turntables (chapter 5, June 1986). However, instead of being servo-controlled to ensure a constant rotational speed (33 or 45rpm), the objective in a CD player is to achieve a constant lineal track speed and therefore a constant data bit rate (more about this later).

Reading the signal

Fig.1 is an "exploded" diagram showing how the optical system tracks and reads the spiral pattern of "pits" recorded on the disc, ultimately translating them into a corresponding sequence of electrical pulses.

In practice, the various elements in the optical system are combined in a single rigid assembly, which has become progressively smaller and lighter in successive models. The configuration and even the element sequence varies from brand to brand.

The accompanying illustrations, supplied by Philips, show a typical head assembly (1) in close-up and (2) supported on a radial arm, in a playing position beneath a compact disc.

Invariably, the "light" source is a tiny 5mW solid-state laser diode, which offers the most practical way to provide an adequate, single-frequency "coherent" scanning beam.

The wavelength of the laser output has been standardised at 780nm (nanometres) or 7800A (Angstrom), making it possible for the system optics to include elements which rely for their operation on wavelength-related dimensions.

Being in the infrared portion of the spectrum, the beam is invisible but it is not sufficiently intense to create any kind of a hazard.

As indicated in Fig.1, the beam from the laser diode is passed through a collimating lens to ensure that the rays entering the optical system are initially parallel.

Also in path of the beam is an optical grating, the function of which will be described later. It then passes through a polarised filter and prism/splitter, normally a composite unit, often referred to as a PBS (polarised beam splitter).

And so to the disc

Emerging from the PBS, the beam, now polarised, passes through a QWP or quarter-wave plate (at 7800A) which has the effect of rotating the polarity by 45 degrees.

Next comes an objective lens, the purpose of which is to bring the beam towards — but not to — focus at the under-surface of the polycarbonate substrate. This is of a standard thickness (1.2mm) and with a specified refractive

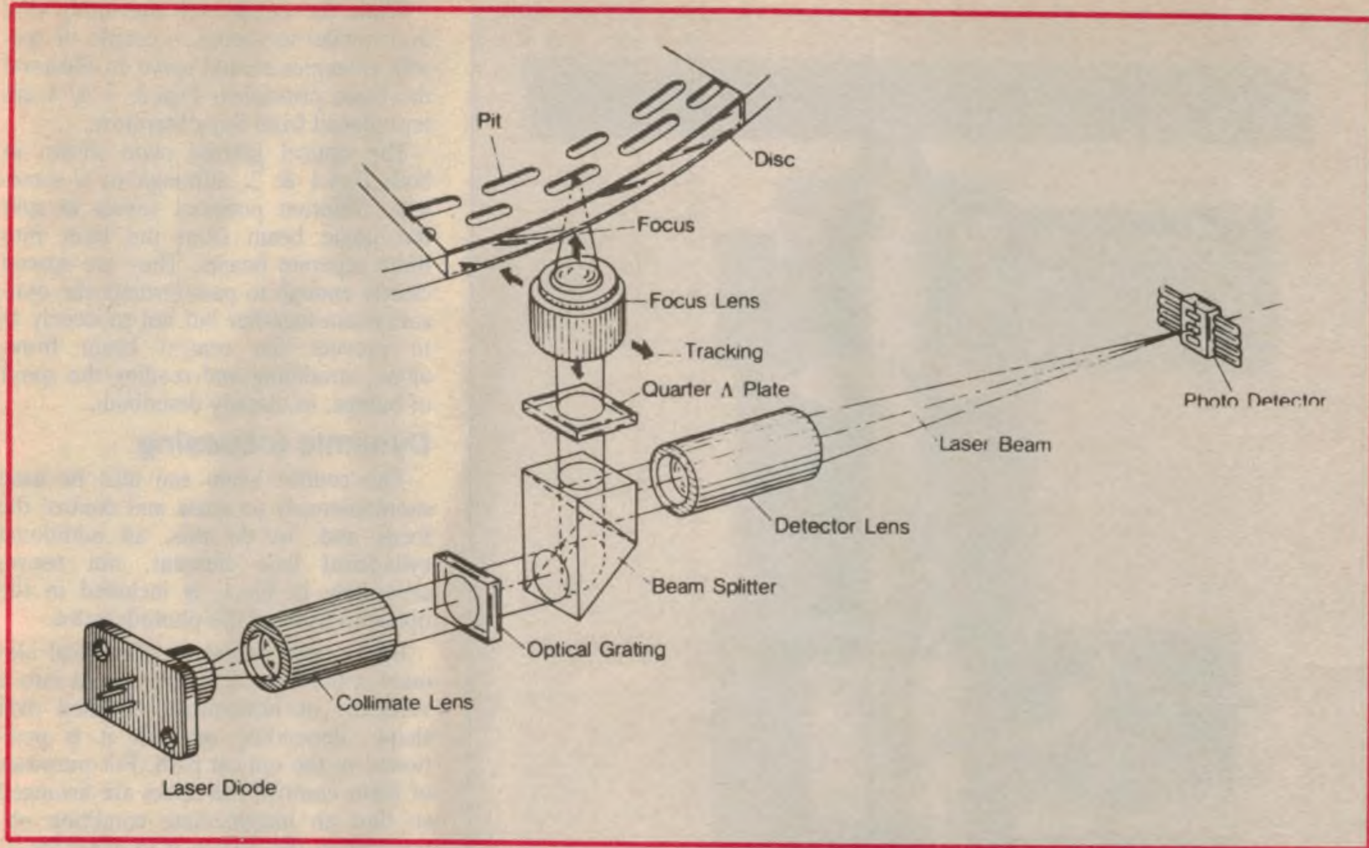


Fig.1: reproduced by courtesy of Technics, this exploded diagram illustrates the optical system in a typical CD player. It does not attempt to depict the multiple beam commonly used to monitor and maintain accurate tracking.

index of 1.5, such that it can form part of the optics, bringing the beam to focus on the internal reflective (pit/-bump) surface.

The diameter of the beam where it strikes the under surface of the disc is nominally 0.8mm but, where it encounters the reflective signal surface, it has been focussed to a mere 1.7um.

This means that imperfections or particles on the surface of the disc must be large relative to 0.8mm (0.5mm or more) before they can interrupt the beam. They must be very large indeed to interfere with the beam sufficiently to defeat the automatic error correction system.

When the beam strikes the mirror surface, it is reflected back through the objective lens to the quarter-wave plate. Here, it undergoes a further 45-degree rotation so that, by the time it re-enters the polarised beam splitter, it exhibits a full 90-degree shift.

This being the case, it is diverted by the splitter optics into a separate lens and thence to the photodetector assembly, substantially free from any direct rays from the laser diode. Here the modulated light is translated into electrical pulses.

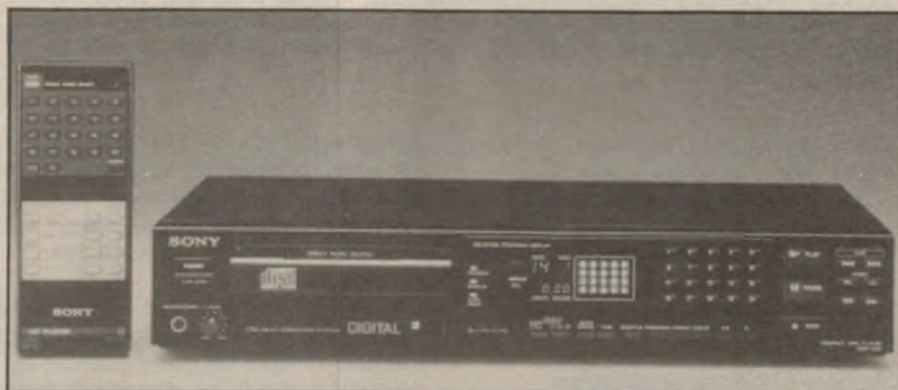
Beam modulation?

But, if the reflective layer is a continuous coating on the upper surface of the polycarbonate substrate, how can the tiny pits — or bumps, as seen from the underside — modulate the reflected beam? The answer is intriguingly subtle.

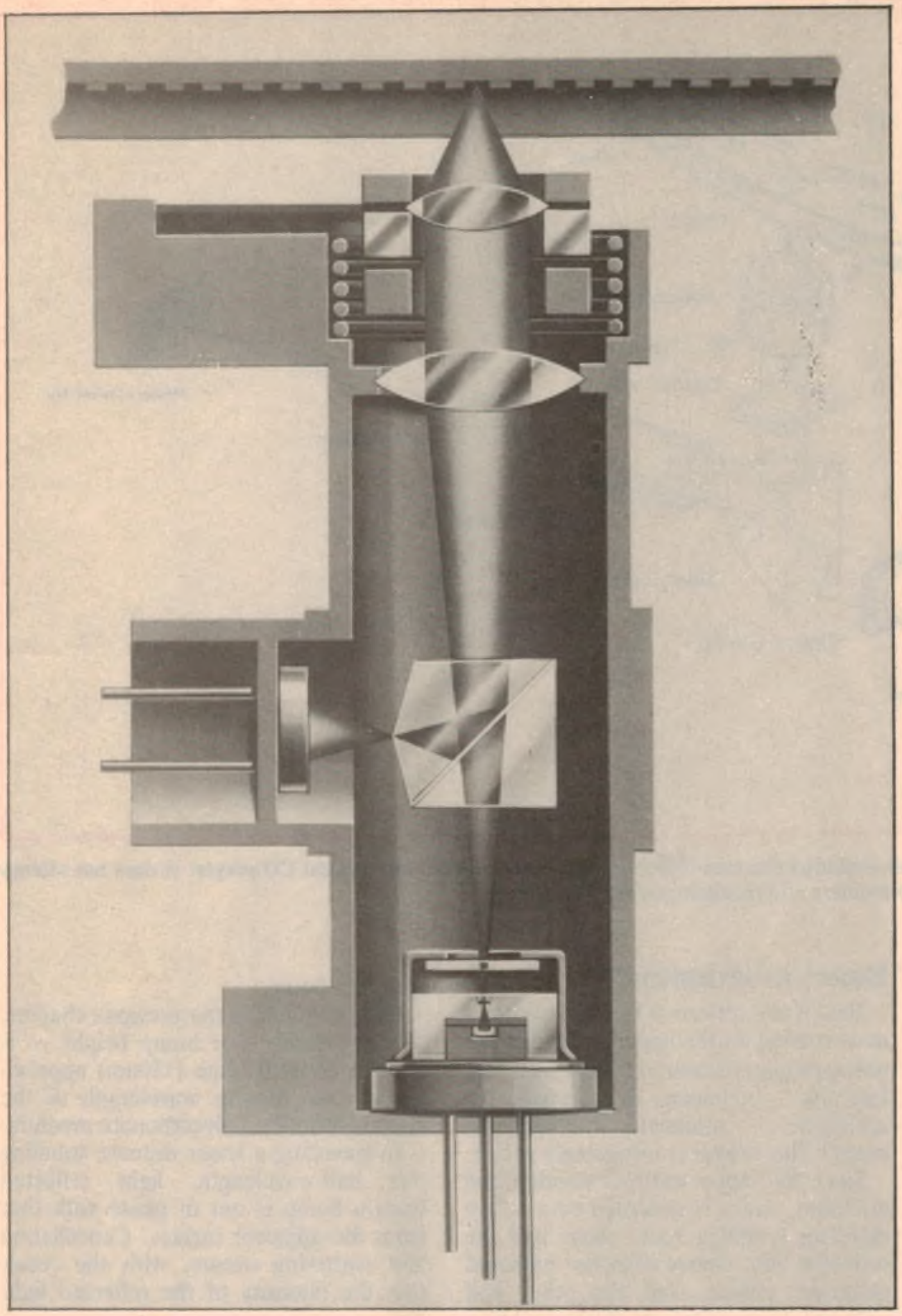
Since the bump width is standardised at 0.5um, and it is straddled by a 1.7um diameter scanning spot, about half the reflected light comes from the mirrored substrate surface, and the other half from the bump.

But, as noted in the previous chapter, the pit depth — or bump height — is kept to about 0.11um (110nm) approximating one quarter wavelength of the laser light in the polycarbonate medium.

In travelling a lesser distance totalling one half-wavelength, light reflected from a bump is out of phase with that from the adjacent surface. Cancellation and scattering occurs, with the result that the intensity of the reflected light



Recently released by Sony, the CDP-203ES features digital filtering and an upgraded analog output system. It is programmable for up to 20 selections, has extended index and search facilities, a 6-mode timing system and an infrared remote controller.



An artist's impression of an optical system assembly, with the diode laser at the bottom, the semi-reflecting prism (PBS) in the centre and the dynamically focussed lens system at the top. The returning beam is deflected to the photodetector on the left. (By courtesy of Philips).

diminishes sharply whenever a bump passes under the scanning spot.

Depending on the varying length of the bumps and lands, the photo detector receives a rapid sequence of longer or shorter, "light" and "dark" pulses which it is the business of the associated circuitry to decode.

Servo control systems

In the discussion thus far, it becomes fairly evident that no practical, purely mechanical system could track an information spiral having such a fine pitch, nor ensure a consistent critical focus on the reflective information surface. Moreover, mass-produced discs will inevitably introduce dimensional vagaries of their own.

In fact, the CD system relies on the promise that the manufacturers of discs and players alike will meet exacting mechanical standards, but that it will thereafter rely on electronic servo control systems to achieve the required end result.

While the details will inevitably vary from model to model, a couple of specific examples should serve to illustrate the basic principles. Figs.2, 3 & 4 are reproduced from Sony literature.

The optical grating plate shown in both Figs.1 & 2, although in a somewhat different position, serves to split the single beam from the laser into three separate beams. They are spaced closely enough to pass through the optical system together but not so closely as to prevent the central beam from, alone, straddling and reading the spiral of bumps, as already described.

Dynamic focussing

The central beam can also be used simultaneously to sense and control the focus and, to do this, an additional cylindrical lens element, not shown separately in Fig.1, is included in the optics in front of the photodetector.

By its very nature, a cylindrical element will distort a circular beam into a vertically or horizontally inclined oval shape, depending on how it is positioned in the optical path. For purposes of focus control, the optics are arranged so that an intermediate condition obtains when the system is in exact focus, with a round spot falling on the photodetector assembly.

This condition is illustrated in Fig.3a, which also indicates that the photodetector (centre) has been divided into four quadrants, each served by a separate sensing element: A, B, C and D.

For sensing the main light/dark signal off the disc, the quadrants simply operate in parallel, providing a signal equal to:

$A+B+C+D$

For focussing purposes, their relative output is processed by separate circuitry, sensitive to the area of each quadrant which is illuminated. As indicated in Fig.4, a difference signal:

$(A+C) — (B+D)$

applied to a differential amplifier and servo drive, adjusts the focus lens continuously and as necessary to correct the error conditions (Fig.3b & 3c) and maintain optimum focus (Fig.3a).

The focus drive coils are indicated in Fig.2 and depicted in the Philips' illustration of a laser read head, around the final focus lens.

The additional sensors and oval or round spots of laser light shown on either side of the photodetector in Figs.3 & 4 play no part in either signal sensing or focus control. Involving the two outer beams produced by the optical grating plate, their function is to control tracking.

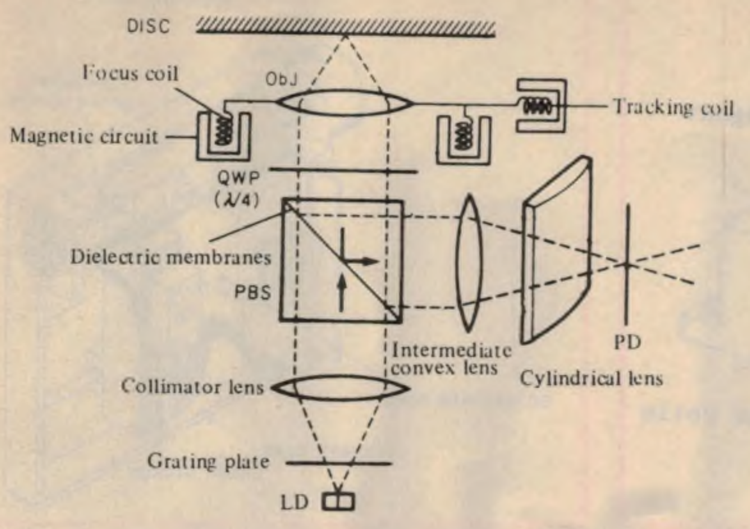


Fig.2: although less pictorial than Fig.1, this Sony diagram shows a cylindrical lens in the optical path to the photodetector and drive coils to provide continuous automatic correction for focus and tracking errors.

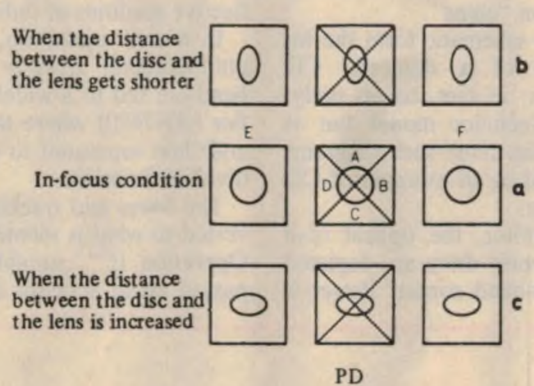


Fig.3: when the system is in correct focus, the beam illuminates equally all four quadrants of the signal photodetector (centre). Out of focus, the beam becomes oval (top, bottom), initiating corrective action by the servo system.

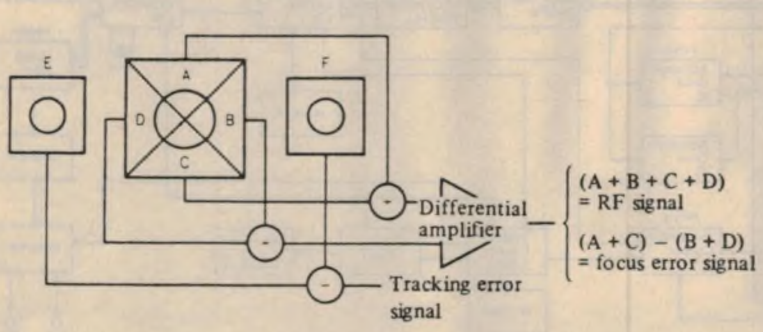


Fig.4: from Sony, this diagram shows how the photodetector array provides audio signal, plus information for servo control of focus and tracking.

The optics are arranged as shown in Fig.5 such that, when the signal sensing spot is centred on the spiral being scanned, the two outer spots are just overlapping the bumps but are mainly scanning the non-bump "land" to either side. In this condition of perfect tracking, the average intensity of the reflected light from the two tracking control spots is balanced.

If the tracking starts to deviate, the balance is disturbed and an error signal is generated which, in the short term, can be used to tilt the lens to follow an eccentric track and, in the longer term, to influence the transport of the reading head as a whole.

It may startle, at first, to think of a lens system being dynamically focussed and tilted to follow even slight undulations and eccentricities of a disc spinning at 500rpm but experience with traditional transducers (phono cartridges, headphones and particularly loudspeakers) is apparent in the electronically controlled lens mounts of a CD player.

Fig.6 illustrates an alternative type of construction for a servo controlled optical system and Fig.7 a complete CD mechanism using linear rather than radial suspension and drive.

Based on electronics

The disc drive motor and its precision electronic drive, plus the diode laser and its complex electronically controlled optics, comprise the basic mechanism of a compact disc player. In a way this is the counterpart of the turntable drive and pickup system of a conventional

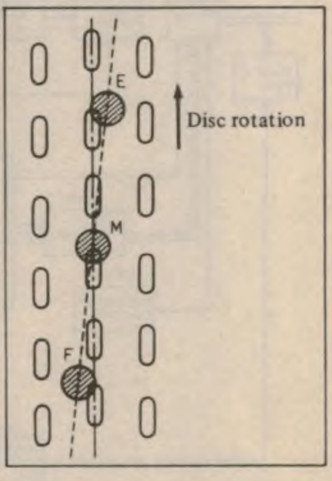


Fig.5: three beams from the one laser, straddling the spiral of bumps, collectively read the signal and sense focus and tracking. (Sony diagram)

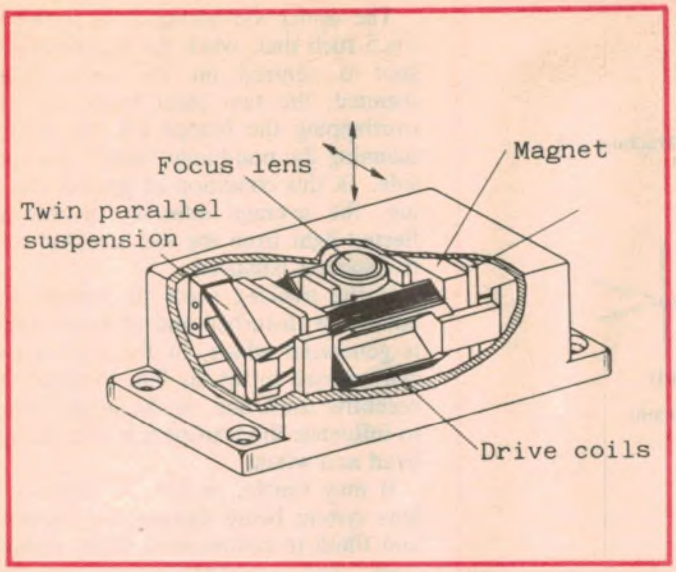


Fig.6: from Technics literature, a servo-controlled optical system in a rectangular rather than a tubular housing. Its heritage from electromagnetic devices and transducers is apparent.

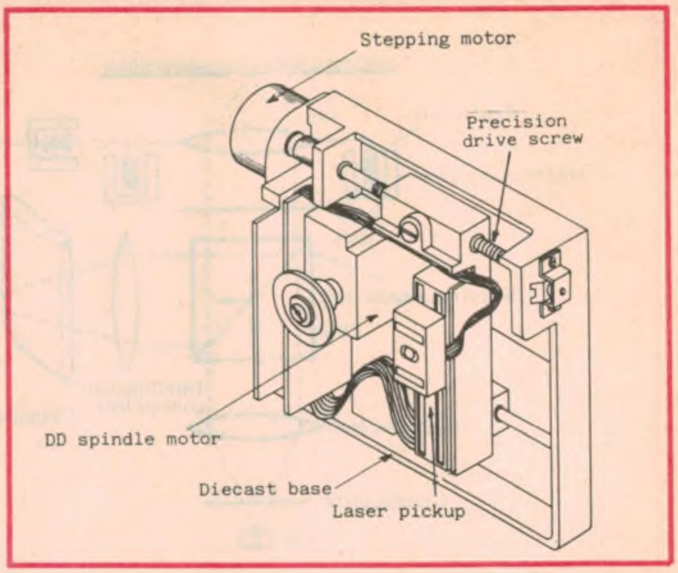


Fig.7: a complete CD mechanism — disc drive, read head drive, laser optics and servo control — housed in a rectangular diecast assembly. (Technics diagram).

phono deck.

But whereas a phono deck involves, at most, a modest amount of internal electronics, a CD player is packed tight with high technology circuitry, not only to provide the servo system already discussed, but for the extensive processing and decoding of the digital signal recovered from the disc.

In fact, domestic CD players have become a viable proposition only within the last decade, with the development of LSI (large scale integration) technology, able to concentrate highly complex circuit functions requiring literally hundreds of thousands of transistors and diodes into a dozen or so relatively inexpensive silicon "chips".

Fig.8 shows in schematic form the internal workings of a domestic CD player. It relates, in fact, to an early, top-of-the-line Technics model but is more detailed than most such diagrams and remains valid as an example of CD player technology.

The spindle motor, the optical read head and its traverse drive are depicted in the upper left-hand corner. Power is supplied to the diode laser via a special IC which, amongst other things, compensates for small variations in the reflective qualities of individual discs.

In normal operation, signals from the photodetector array in the optical read head are fed to a wideband head amplifier (AN7670) where they are amplified and then separated to perform their individual functions.

The focus and tracking signals are diverted to what is identified as a "Matrix Operation IC", suitably processed and passed on to actuator drive ICs, and fi-

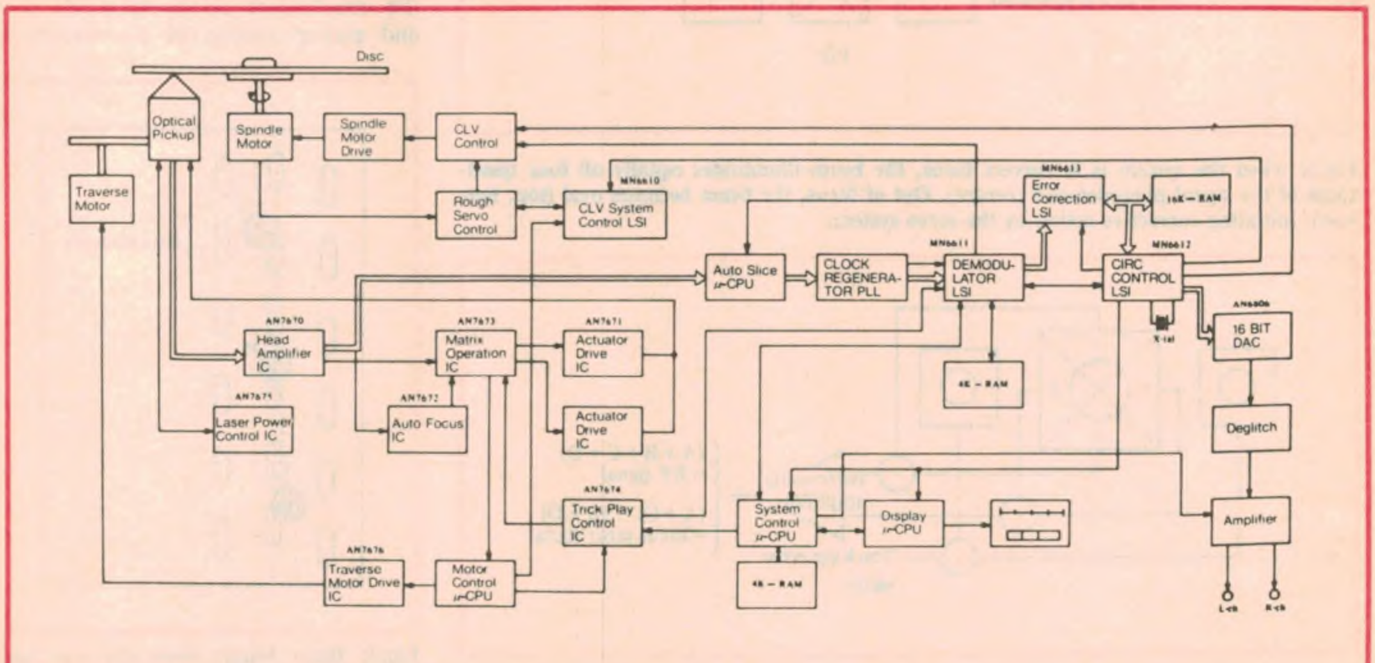
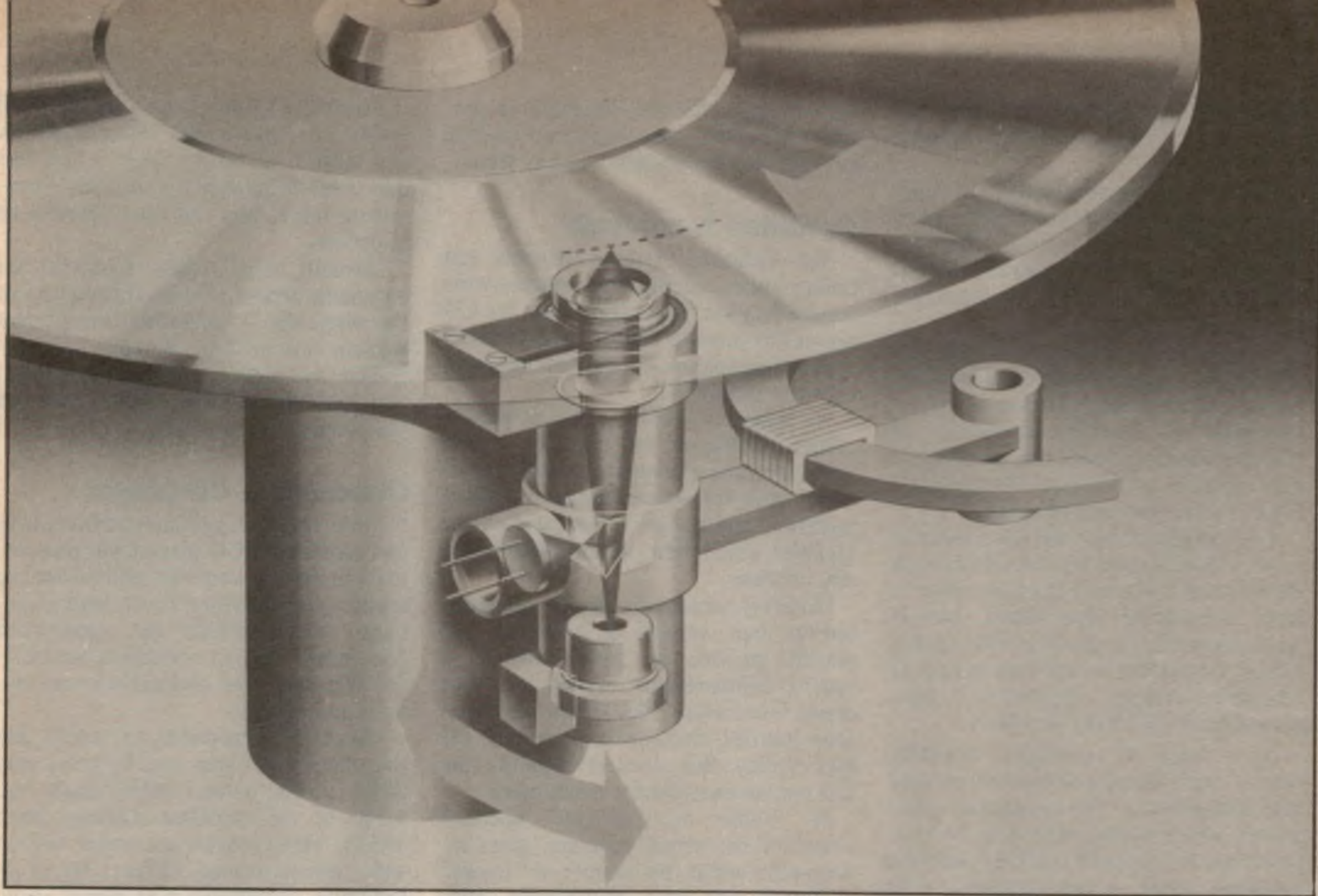


Fig.8: block schematic of the internal workings of a domestic CD player. (Technics diagram).



Also from Philips, this companion illustration shows the laser head assembly, supported by a radial arm, in position beneath a compact disc, with the beam focussed up through the polycarbonate substrate on to the reflective pit/bump surface.

nally to the respective control windings in the read head.

Motor servo control

Information from the tracking sensor is also fed to a "Motor Control CPU" — one of four microprocessors depicted. Here, the tracking information is translated into instructions to the "Traverse" stepping motor, such that the read head will follow the spiral being scanned at a suitable incremental rate, keeping within the adjustment range of the dynamic tracking system.

Information about tracking is also exchanged with the CLV (constant linear velocity) control system. As shown, a "Rough Servo Control" establishes an initial relationship between the spindle speed (500-200rpm) and the diameter of the spiral being scanned.

Feedback loops from the data chain thereafter provide correction to ensure that:

(1) The lineal speed, therefore the average data rate, conforms to system standards, as measured against the player's inbuilt crystal clock; and

(2) The memory bank, from which the samples are clocked out to the digital/analog converter (DAC), is maintained around half-full during normal play.

Provision to initiate or interrupt normal play involves boxes in the lower centre area of the diagram marked "Trick Play", "System Control" and "Display", plus another suggesting a read-out. These have to do with various panel indicators and pushbutton controls — Play, Pause, Track Select, Skip, Stop, etc. (More about these later).

While the above summary will not provide a detailed insight into how a compact disc is driven and read, it should nevertheless give some idea of the overall concept and how deeply electronic sensing and control is involved.

Signal processing

Turning again to the program signal, as indicated by the outlined arrow, it passes from the preamplifier to what Technics show as an "Auto Slice CPU". Its role is to convert the light/dark resultant pulses into unambiguous digital data — with transitions again becoming binary 1 and non-transition periods specific sequences of binary 0.

The reconstituted digital signal then passes to a demodulator which "unscrambles" the EFM modulation, described in the previous article. In so doing, it reconstitutes the original 2.330MHz pre-EFM data bit stream, ready for error checking and correction.

From this same point, a PLL (phase locked loop) signal is returned to the CLV spindle control system — the first of the three feedback loops mentioned earlier.

The program data stream is then processed through the CIRC error correction and clock-out circuitry, yielding precise timing pulses for the CLV motor control system, and twin streams of hopefully error-free 16-bit "words" for the digital to analog converter(s).

At this point, the raw analog signals must be filtered to remove unwanted components above 20kHz — residual artefacts of the digitisation process — after which they are passed on to twin buffer amplifiers supplying the left and right channel stereo output sockets.

Output filtering

The most obvious design approach in the analog output system is to use a very sharp ("brick-wall") filter in each channel, providing attenuation of at least 50dB at 24kHz.

Brick-wall filters, however, can be both bulky and costly. They can also cause substantial phase shift at the top end of the passband, with the further possibility of introducing residual distortion and transient effects. While there is argument as to whether such effects are audible, they are nevertheless regarded as undesirable.

Some designers have sought to minimise such problems by suppressing components immediately above 20kHz in the digital system itself, thereby permitting the use of simpler, less trouble-prone analog filters.

An elegant approach, adopted by Philips, uses a combination of digital filtering and what they describe as "over-sampling" — virtually an exercise in digital standards conversion involving a shift register, a delay line "transversal" filter, a multiplier and an adder.

The technique does not lend itself to cursory explanation but, in effect, each 16-bit word recovered from the disc is, itself re-sampled four times, not in isolation but in conjunction with nearby words, to produce a new data stream of "weighted average" samples at a sampling rate of 176.4kHz (4 x 44.1).

As a result of the higher sampling rate — with its proportionately smaller discontinuities — the quantising noise power which would otherwise be concentrated in the band 0-22kHz (half the sampling rate) is redistributed over 0-88kHz. Quantising noise power in the audio band is therefore reduced by 4:1, representing a 6dB improvement in audio S/N (signal-to-noise) ratio.

In addition, the digital averaging process is arranged so that the noise content progressively diminishes towards the lower end of the 0-88kHz band. This so-called "noise shaping" increases the S/N ratio by a further 7dB.

Facts vs marketing

In fact, it became apparent to Philips that, with over-sampling, it was possible to use a precision 14-bit D/A converter and end up with the same resolution and S/N ratio as for conventional 16-bit D/A conversion while, at the same time, avoiding the potential problems of brick wall analog filters.

Some early model players used a single D/A converter, with electronic switching to divert the output pulses respectively to the left and right channels. While it appeared to work well, the method was attacked by critics on the ground that it reconstructed the respective analog signals from sequential rather than simultaneous pulses.

Designers were quick to point out that the quibble was about a time discrepancy of the same order as would result from a path difference of a few millimetres from the left and right loudspeakers to the listeners ears! But it has proved easier for the designers to provide twin D/A converters and precise left/right synchronisation than to argue!

Facilities & controls

The inclusion of data channels and timing pulses, along with industry-wide standardisation, made it possible for CD players to provide features and facilities which were either difficult or impractical with turntables.

As indicated earlier, some of the facilities envisaged for the CD system have yet to be exploited. Indeed, not all decks cater for the full range of existing facilities, and not all owners use all the facilities which their present player actually provides.

However, automatic play, with push-button logic control is universal. All players provide an off/on switch, a record compartment drawer or door open/close facility, Play, Pause and even Stop buttons, and automatic stop at the end of play. But, even as it stands, the CD system provides for much more.

A "Table of Contents" encoded ahead of the actual program, gives information about the number of "tracks" to follow (ie; titles, movements, etc), start times and playing times. This is memorised by the player to facilitate program search and to provide timing display, if desired.

Some CD players offer no time display facilities at all but by way of contrast, the Sony CDP-203Es, pictured elsewhere in this article, features: "a 6-mode time keeper function which indicates the total playing time, remaining time of the total disc and programmed selections, time elapsed and remaining time for the current selection".

In practice, timing information is unimportant to anyone who simply wants to enjoy good sound but it can be helpful where the user wants to organise their listening time or to study the details of a performance.

With this in mind, a few players even provide access within selections, based on time. In the absence of full indexing, which has yet to be properly exploited, time-cue access is a useful alternative for music students and more precise than audible fast search.

Perhaps more important for the average listener are programming facilities, which allow users to pick and choose tracks to suit the occasion. With a phono deck it was normally a manual operation. CD players can do it automatically and elegantly — provided they can cope with the number of tracks available.

An ability to program up to about 20 tracks is a reasonable compromise. A few more is all to the good; a few less may limit programming with discs containing more than the usual number of selections.

Virtually all CD players provide for automatic repeat of individual tracks or the whole disc — a facility that operates without fuss or wear, because it is controlled by cues encoded in the track, and without physical contact between the playing head and disc.

Choosing a CD player

More could be said about the controls and facilities of CD players but prospective purchasers would be well advised to spend time inquiring about, and examining models within the appropriate price range. Try to envisage what facilities you may need and narrow your options accordingly.

Check the dimensions to ensure that the player you fancy can be accommodated within normal cable reach (eg, 1.3m) of the amplifier auxiliary input socket. Many players are about 440mm wide, others around 340mm. As an alternative, a portable CD player could be considered.

In most cases, amplifier systems can handle the input signal from a CD player, but, where there is any doubt on this score, a player fitted with an output level control has the advantage.

Level control aside, the CD system can accommodate a very wide dynamic range and, with some discs, this may demand listening conditions where very quiet passages can be heard and very loud passages enjoyed. A noisy amplifier in a noisy environment will not do justice to a CD player.

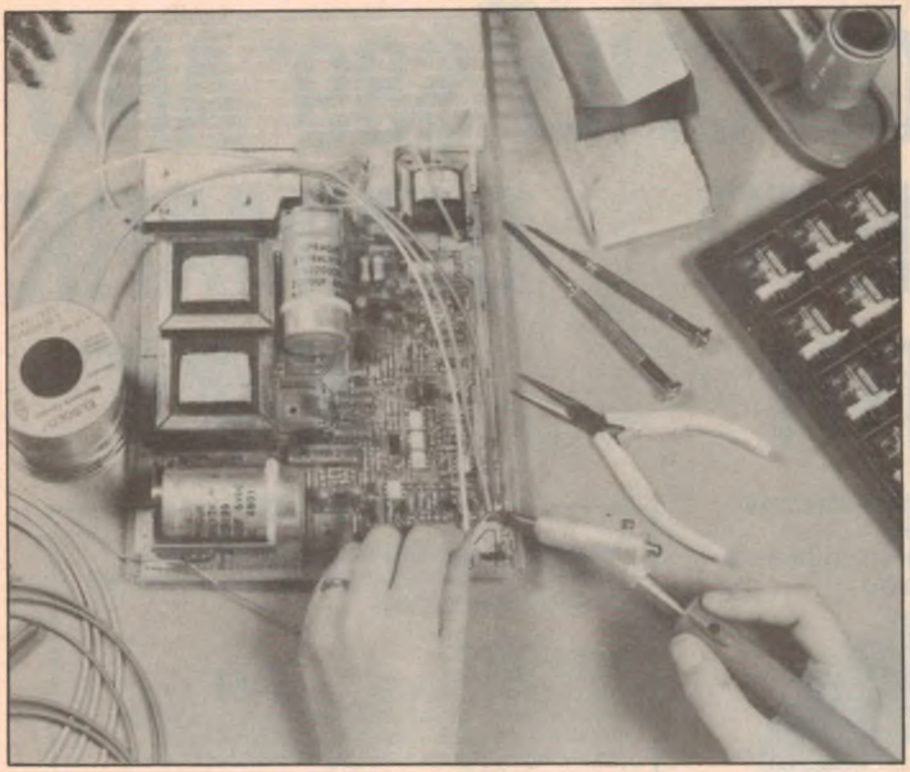
It should also be mentioned that the wide dynamic range poses a problem for those who may aspire (illegally) to copy compact discs on to cassette tape.

To date, and despite advertising claims to the contrary, CD players offered in the Australian marketplace have been substantially uniform in their perceived sound quality. Such differences as there might be are likely to be apparent only through top quality equipment, to listeners with very perceptive ears or, sometimes, an active imagination!

If you need to own the best and the most elaborate and can afford it, fine! But, if your budget is limited, don't fret. An economy model CD player may be less pretentious but it will deliver a signal virtually indistinguishgable from the deluxe model next door! EA

New Products...

Product reviews, releases & services



Zeva soldering irons

Alfatron has expanded its range of Zeva soldering equipment, including wave and drag soldering machines, by releasing the Zeva range of soldering irons.

Zeva produces a series of irons ranging from 35W to 450W units which cover virtually all hand soldering tasks. Although Zeva tools are situated in the upper price bracket, they have exceptional service life. This is due to the special design of the heating elements which are cast in aluminium and are shock proof and watertight etc.

The aluminium jacket protects the heating element from mechanical damage. At the same time, the aluminium serves as a heat accumulator and the resultant high heat capacity guarantees short recovery time, even in the case of rapid soldering sequences, making it possible to use lower wattage rating tools.

Zeva soldering tools come in three shapes: straight, angled and hatchet. In addition to their standard soldering iron range Zeva also manufacture low voltage soldering irons, stationary irons, soldering stations as well a complete range of desoldering and rework equipment.

For further information contact Alfatron direct on (03) 758-9000.

Computer control time switch

Economic scheduling of the running times of all types of machinery and lighting is now possible with the introduction of a range of microprocessor controlled time switches.

Known as the Microtime TX series, they are designed and manufactured by an Australian company, Micro Air Pty Ltd.

The TX series comprises three models: TX1000, TX2000 and TX500.

The TX1000 provides a time switch capable of starting air conditioning systems at the correct time each day, depending on outside weather conditions.

The TX1000 incorporates a temperature sensor, which is mounted in the air conditioned space, to measure the inside temperature at one minute intervals each morning. The microprocessor then calculates the correct time for the air conditioner to start and switches it on in order to have the room temperature comfortable when the office is occupied.

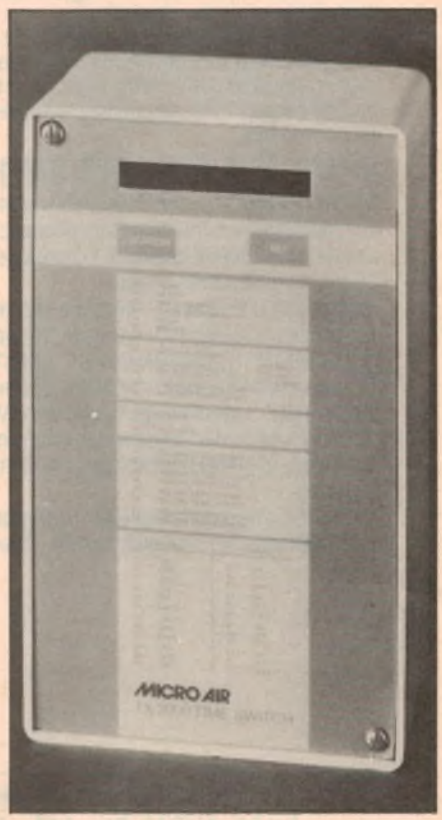
Other features of the TX1000 include automatic daylight saving time changes, pushbutton override, holiday programming for up to 12 months in advance, battery backup of programmed information and a security password to prevent unauthorised program changes.

The TX2000 and TX500 models were developed by Micro Air to meet the demand for a wider range of time switches. These time switches are suitable where muliple switchings and multiple channels are required. Ideal applications include lighting, automatic doors, pumps, supply/exhaust fans, school and university buildings, and a wide range of industrial and commercial uses.

All the standard features of the TX1000 are included in these units with the exception of the Temperature Optimized Starting.

According to Mr John Whiffen, the Managing Director of Micro Air Pty Ltd, the Microtime TX models are guaranteed to reduce energy bills, particularly at Christmas time and during other holdiay periods.

For further information contact Micro Air Pty Ltd, PO Box 439, Brookvale, NSW 2100. Phone (02) 938 2164.



PC-ICE in-circuit emulator

Alfatron has released a new low cost emulator for the Z80 microprocessor. The PC-ICE, in its basic version, is said to cost about one third to one half of currently available add-on emulators. It is small enough to fit into most briefcases and is thus suitable for field work.

The PC-ICE is available in a minimum configuration with 32K of memory but it can be expanded to 64K easily. An integral EPROM programmer allows devices from 16Kit to 512K to be programmed. It may be used together with a terminal in a stand-alone mode or connected to a host computer. Support programs are available for MSDOS etc, allowing a personal computer to be turned into a very powerful development system.

The emulator allows clock frequencies up to 6MHz to be utilized. A command set based on the popular DDT/ZSID reduces the learning time involved for the operator and provides the necessary flexibility for complex debugging. The whole memory address and I/O space is available and may be mapped in 8K increments. Memory can be loaned to the target system by the emulator. Connection to a host computer is via an RS-232 port.

For further information contact Alfatron Pty Ltd, 1761 Ferntree Gully Rd, Ferntree Gully, Vic. 3156. Phone (03) 758 9000.

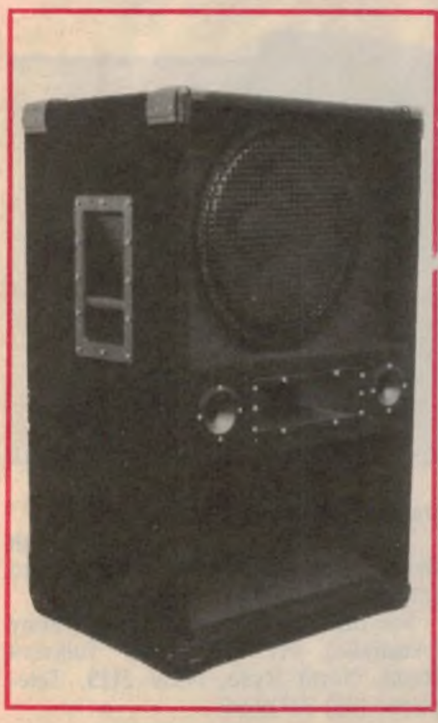
DJ Bins

A new addition to the Disco World range of products is the Australian-made DJ bin, for the domestic or entertainment markets.

Disco World market two sizes, the larger one housing a 38cm RCF P200, with a midrange horn and two Motorola piezo tweeters. It is capable of handling 200 watts RMS. The smaller of the two bins houses a 30cm Etone bass driver, midrange horn and two tweeters.

A metal grill covers the woofer as protection from wandering fingers and both models may be fitted with driver units of the customer's choice. Although black carpet is the most popular covering, other colours are available such as grey, red or grey/blue. Protective corners and recessed carry handles are standard with all models.

For further information contact Disco World Pty Ltd, 300 Main St, Lilydale, Vic. 3140. Phone (03) 735 0588.



New Products...

Automatic antenna tuner

One of the most frustrating aspects of mobile HF amateur operation, especially where more than one band is used, is the time-consuming and often inconvenient need to change antennas or to retune every time you change bands. Below 40 metres, it is often necessary to retune every time you change frequency more than a few kHz.

The end of this frustration is now in sight with the release of Icoms's AH-2 Automatic Antenna Tuner.

This microprocessor controlled automatic mobile antenna tuner is designed for use with the Icom IC-735 HF mobile transceiver on all HF bands from 80 to 10 metres, including WARC bands, using only the supplied AH-2b short stainless steel whip antenna. It can even operate on 160 metres with the addition of an extension whip antenna.

The brain behind the AH2 is an 8-bit microprocessor circuit inside the controller unit which obtains an optimum match from more than 260,000 possible LC combinations. Tuning usually takes place in less than six seconds between 80 and 10 metres. Up to eight pre-programmed LC combinations can be stored by the controller unit for favourite frequencies, with recall and tuning usually in than one second.

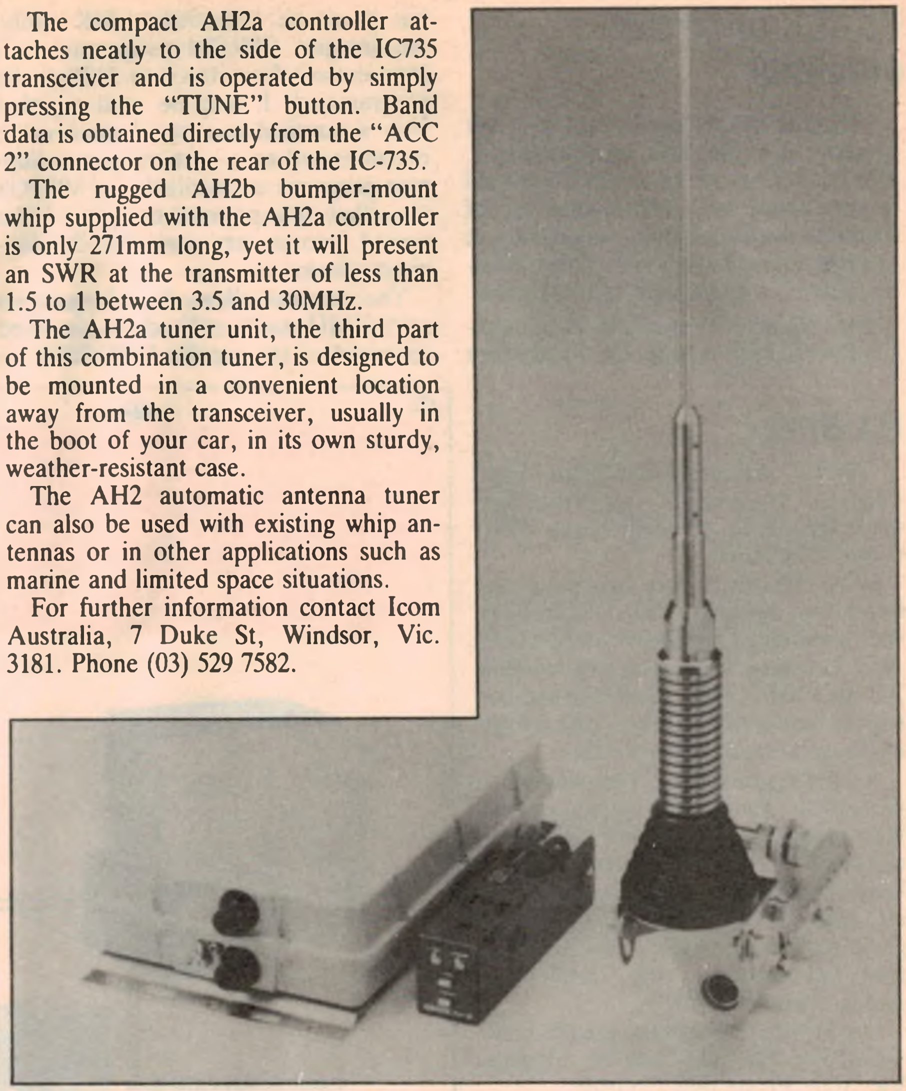
The compact AH2a controller attaches neatly to the side of the IC735 transceiver and is operated by simply pressing the "TUNE" button. Band data is obtained directly from the "ACC 2" connector on the rear of the IC-735.

The rugged AH2b bumper-mount whip supplied with the AH2a controller is only 271mm long, yet it will present an SWR at the transmitter of less than 1.5 to 1 between 3.5 and 30MHz.

The AH2a tuner unit, the third part of this combination tuner, is designed to be mounted in a convenient location away from the transceiver, usually in the boot of your car, in its own sturdy, weather-resistant case.

The AH2 automatic antenna tuner can also be used with existing whip antennas or in other applications such as marine and limited space situations.

For further information contact Icom Australia, 7 Duke St, Windsor, Vic. 3181. Phone (03) 529 7582.



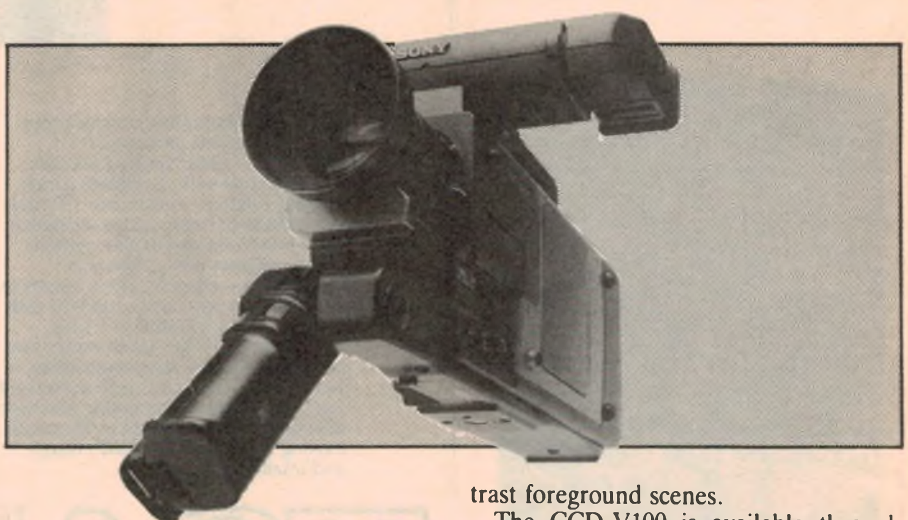
Sony expands camcorder line-up

Sony Australia has announced the release of a new Video-8 camera, the CCD-V100. This is an up-market unit featuring state of the art editing functions.

The CCD-V100 offers features such as a titling generator, video wiper function interval recording, auto/manual iris and time/date display.

With the built-in 7-colour titling generator, a title may be either superimposed in the field or inserted at a later date. The video wiper function allows you to add stunning effects to either the start or the finish of a scene.

The interval recording feature allows you to record eight frames every 15 seconds, repeatedly for 30 minutes, creating 30 seconds of video from 30 minutes of action. This is useful for speeding up events such as sunsets, flowers blooming etc. This feature can also be utilised for creating animated movies.



The auto iris, with manual override, lets you adjust for optimum image exposure in difficulat situations such as a high contrast background or high contrast foreground scenes.

The CCD-V100 is available through the Sony dealer network at a suggested retail price of $3999.

For further information contact Sony (Australia) Pty Ltd, 33-39 Talavera Road, North Ryde, NSW 2113. Telephone (02) 887 6666.

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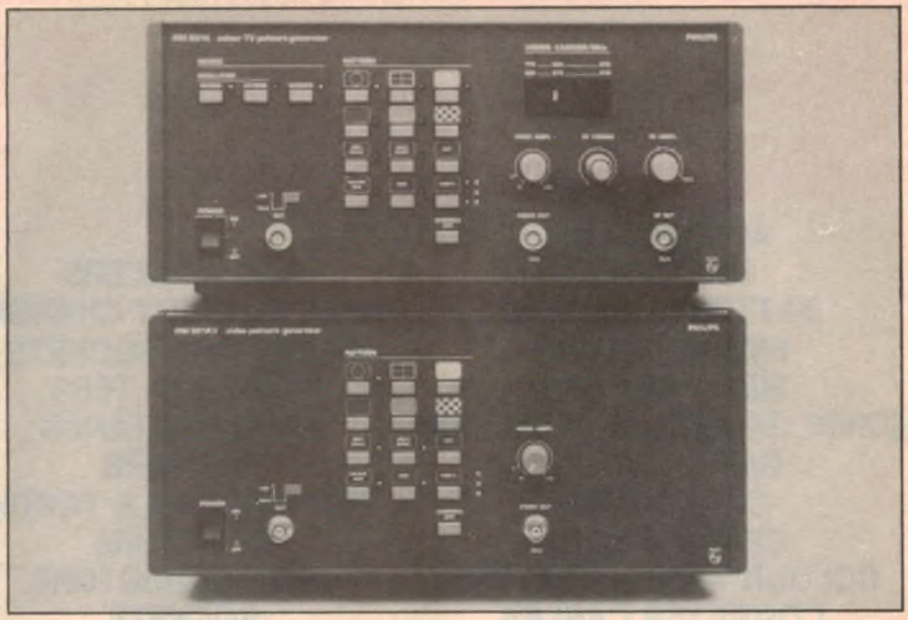
New Products...

TV pattern generators



Over 70 different patterns are available for comprehensive testing of monochrome and colour televisions, video recorders and monitors in two economic, compact and easy-to-use test pattern generators — the PM 5514 and PM 5514V from Philips from Philips Test and Measurement. A front panel keyboard speeds pattern selection on both instruments. LEDs next to each key show the pattern or combination selected.

The PM 5514 provides basic RF facilities for checking and alignment of consumer receiver and recording equipment. Simple coarse/fine tuning with a 16-point analog bar graph indicator allows selection of VHF or UHF signals from 175 to 275MHz or from 525 to 810MHz. And there is also a separate video output. Internal 1kHz or external sound modulation is switch selectable.

The PM 5514V meets the specific needs of video testing such as for computer and CCTV monitors, providing a variable 0 to 1.5V or fixed 1V compsite video output signal. An RGB option providing red, green and blue signals with separate sync and subcarrier allows servicing of those monitors which will not accept composite video signals.

A choice of models of the PM 5514 is available to meet PAL television standards B, G, H, I or D. The PM 5514V is supplied in versions meeting PAL B, G, H, I or D or NTSC M standards. Chroma subcarrier, line and field frequency in the PM 5514V match the TV standard chosen.

For further information contact Philips Test and Measuring Instruments, 15 Blue St, North Sydney, NSW 2060. Phone (02) 888 8222.

For the serious amateur: Icom IC-751A

Icom has announced the release of the IC-751A HF amateur transceiver.

Designed with the serious amateur operator in mind, the IC-751A covers all authorised amateur bands from 1.8 to 29.7MHz and features a general coverage receiver with tuning from 100kHz to 30MHz continuous.

Thirty-two memory channels store both frequency and mode. The memory capabilities of the IC-751A are enhanced by mode-selective scan, priority memory scan and scan lock-out. Receiver specifications include sensitivity figures of 0.15μV for 10dB S/N (1.6-30MHz, SSB/CW/RTTY, preamp on), selectivity of 2.3kHz at the –6dB points (SSB/CW/RTTY), image rejection of better than 80dB, and notch filter attenuation of more than 45dB on interfering carriers.

The state of the art receiver is a quadruple-conversion superhetrodyne circuit using four intermediate frequencies (all modes except FM) at 70-.4515MHz, around 9.01MHz, 455kHz and around 9.01MHz again.

CW enthusiasts will appreciate the inbuilt electronic keying circuit which is QSK rated at up to 40 words per minute. The standard 500Hz CW filter (FL-32A) and variable-level CW sidetone control, which operates in both receive and transmit modes, will also be popular features of this new ICOM transceiver.

General receiver performance is enchanced by the inclusion of variable passband tuning (PBT), a deep notch filter (45dB), variable pulse-type noise blanker, 9.9kHz XIT/RIT and a large, clear, multi-function meter.

Options available for the IC-751A include a 2.8kHz SSB filter (FL-70), 6kHz AM filter (FL-33), IC-PS30 external power supply, IC-AT500 automatic antenna tuner, C-EX309 microprocessor interface connector, IC-10 remote controller, IC-SMB or SM10 desk mictrophones, IC-2KL solid state linear amplifier, IC-SPO3 or SP7 external speakers, CR-64 high stability 30.72MHz reference crystal and the C-EX310 voice synthesiser.

For further details contact Icom Australia Pty Ltd, 7 Duke St, Windsor, Vic. 3181. Phone (03) 529 7582.

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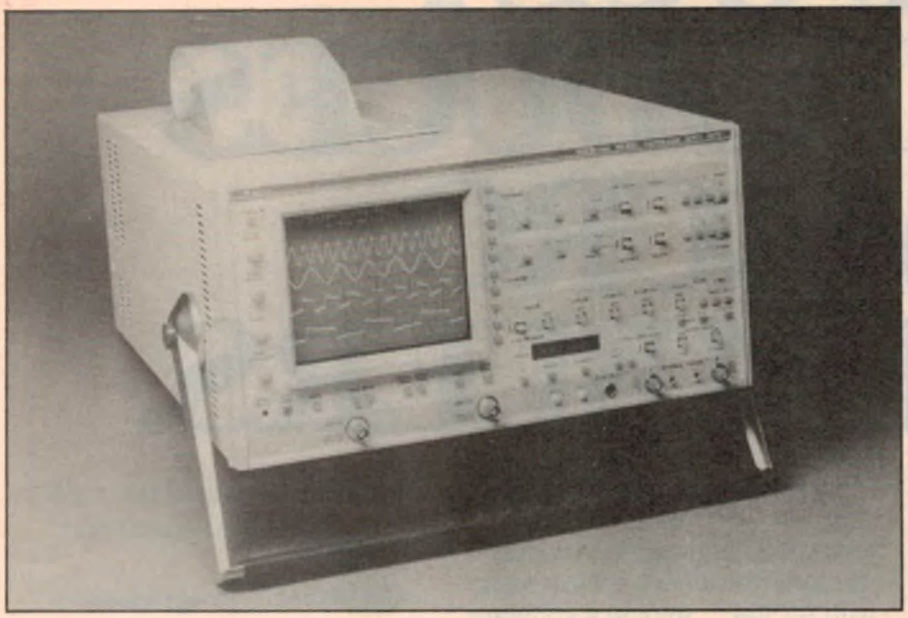


High-speed digital storage oscilloscope

Elmeasco has released the new Gould 4070 digital storage oscilloscope.

Featuring 400 megasample-per-second 8-bit digitisers plus a 1K word memory on each channel, the Gould 4070 is a fully programmable instrument which incorporates a wide variety of automatic measurement functions.

Post-storage processing, analysis and calculation facilities are provided by an optional waveform-processor keypad, while a built-in digital colour plotter offers integral hard-copy facilities in addition to external analog and digital plotter interfaces.

The transient-capture bandwidth of 100MHz is made possible by the use of a built-in sine interpolator, and repetitive capture at 100MHz is facilitated by the use of equivalent time-sampling techniques. The 400 megasamples-per-second sampling rate leads to a maximum resolution of 2.5ns.

The 4070 has full dual main and delayed timebases, with delay being set by time or events. Triggering facilities are very comprehensive, and the most complex trigger conditions can be set quickly and easily using a unique on-screen graphical trigger menu which allows the user to draw a diagram of the trigger configuration required.

Although fully digital in operation, the 4070 has been designed to look and operate like a real-time analog oscilloscope. A large 10 x 12cm screen allows multiple traces to be clearly displayed, while the front-panel pushbutton and lever-switch controls are designed to emulate the "feel" of conventional oscilloscope controls, with instant on-screen response.

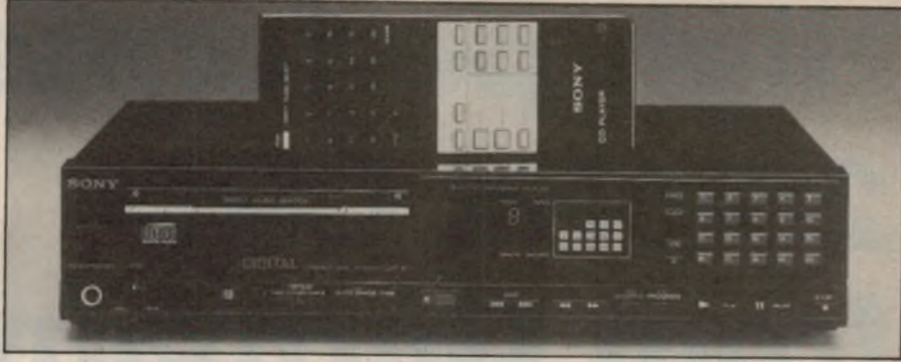
A major innovation on the Gould 4070 is an auto-setup feature, which provides instant viewing of unknown repetitive signals by automatically adjusting all the relevant gain, timebase, attentuation and trace position controls according to the parameters of the signal under observation.

The built-in digital plotter is a 4-pen unit using ball-point pen techniques to produce up to four different colours on 11cm wide plain roll paper. All traces are annotated with full measurement information, including cursor readouts as well as time and date information from a built-in elapsed time clock/calendar system.

The Gould 4070 is fully programmable via the IEEE-488 bus and an additional RS-423 interface, both of which also provide output facilities for readout of stored data.

The 4070 is initially being launched in its 2-channel version as the Model 4072 but a 4-channel version (Model 4074) will be introduced later this year.

For further information contact Elmeasco Instruments Pty Ltd, 15 McDonald St, Mortlake,NSW 2137. Phone (02) 736 2888.



DELUXE CD PLAYER: just released by Sony, the CDP-65 CD player features infrared remote control and full programming facilities. These include automatic music selection (AMS), 20-key direct music selection and quick index search, all of which are available via the remote control.

Another feature is the 20 track random music selection (RMS) which allows the listener to play up to 20 tracks in any predetermined order of preference. The unit is available now through the Sony dealer network and the suggested retail price is around the $850 mark.

For further information contact Sony (Australia) Pty Ltd, 33-39 Talavera Road, North Ryde, NSW 2113. Telephone: (02) 887 6666.

RS232 jumper box

Rod Irving Electronics has announced the release of an RS232 Jumper Box. Experimenters will find this item extremely interesting, as will those who wish to patch "in-line" on a temporary basis.

The box itself contains 25 input jumper pins and 25 output jumper pins. The unit retails for $49.95 (catalog number X15665).

For further information contact Rod Irving Electronics, PO Box 620, Clayton Vic. 3168. Phone (03) 663 6151.

High performance 20MHz CRO from Germany

We are all accustomed to reading "Made in Japan" on test equipment these days that it's quite a surprise to see something from Europe. This Hameg oscilloscope was manufactured in West Germany. The quality of German products is legendary — but how does the price compare, in view of the formidable state of the Deutschmark?

The first thing we noticed about this CRO was its light weight and compact size. It can easily be carried in one hand and uses a minimum of bench space. As such, it is ideal for servicemen on the move or for use in restricted work spaces.

The HM203-5 is specified as being a dual channel 20MHz CRO, with guaranteed triggering to 40MHz. In fact, we achieved useful triggering to over 60MHz. It has add/subtract capability, AC, DC, HF, LF, TV triggering modes, and inputs of up to 20V per division.

On paper at least, this machine seems to be in line with several other quality CROs in the under $1,000 category. It does have a built in component tester, but even some quite cheap machines have this facility available of late. The maximum input of 20V per division is rather better than the usual 5V.

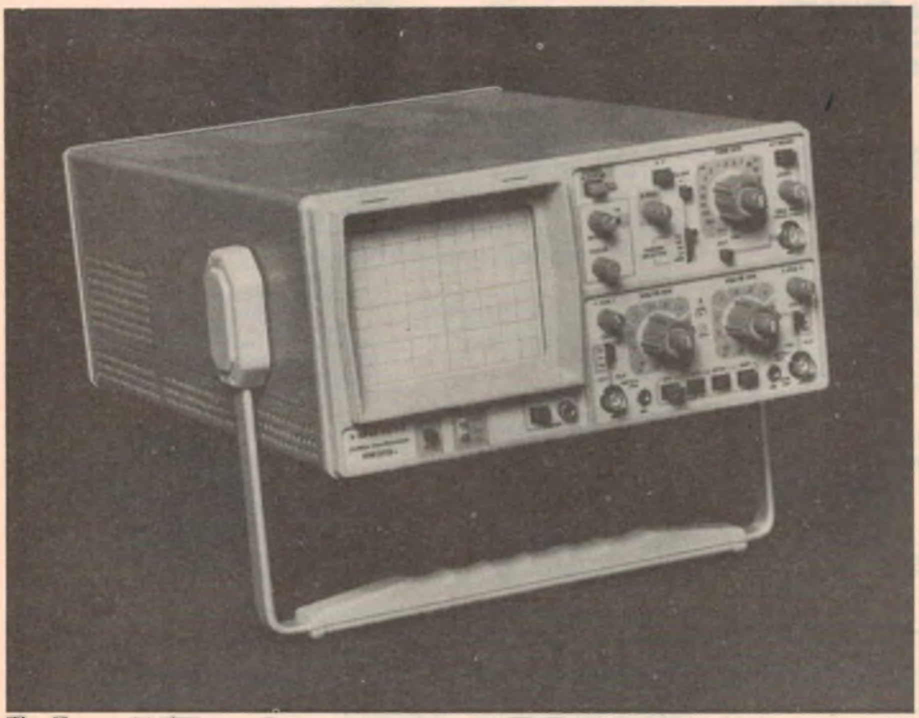
Take one look inside the cover, however, and you instantly realise that this machine is well above average with respect to its standard of finish and quality of design. There are no messy wire harnesses or unsightly point-to-point connections. Every aspect of its construction seems to have been well thought out.

Although the front panel is very compact, it still has a standard 8 x 10cm screen. Despite its small size the front panel layout is not at all overcrowded — the control groupings are logical and easy to follow.

While the compact front panel can be partly attributed to the use of small knobs, most of the credit for this is due to the use of remote switching. None of the switches or potentiometers are actually mounted on the front panel; instead, they are spread throughout the inside of the machine and operated by extension bars from the front panel. This may sound clumsy, but it eliminates a great deal of internal wiring and looks most elegant.

In fact, "elegant" is the ideal word to describe the internal layout of the Hameg 203-5. The outside cover is easily removed, exposing the printed circuit boards and other internals for servicing. The component spacing is neat and practical, with excellent access for test equipment. And all of the wiring between boards is terminated with PCB mounting connectors.

Access to the back of each PCB is also excellent — very few repairs would necessitate the removal of the boards. The exceptions here are the input am-



The Hameg HM203-5 oscilloscope — dual traces, 20MHz bandwidth and robust construction.

plifiers which are shielded; in the event of trouble you would have to remove them. They are, however, separate from the mains boards so that each amplifier can be easily removed without disturbing anything else.

A curious point is the method of selecting the mains input voltage. The selector switch is integral with the fuse holder. To change the fuse or select a different voltage, the square plastic cap has to be removed. The cap can be reinserted with any of four different orientations, each corresponding to a different mains standard.

While this is very simple to operate, it's perhaps just a little too clever. One can easily imagine an inexperienced operator replacing a blown fuse and replacing the cap at the 110V setting instead of 240V. We would prefer to see the fuse holder separate from the otherwise commendable voltage selector.

As mentioned earlier, the HM203-5 features a built in component tester. This is quite simple in concept, using the voltage across the test circuit for horizontal deflection and the current through it for vertical deflection. The main application for this facility is for in-circuit component testing.

Whilst this type of tester will never tell you whether a component is within tolerance or not, it is a very quick and efficient way of verifying that it has the right characteristics; ie, resistance, capacitance, etc. The shape of the trace can also indicate combinations of characteristics; eg. a resistor in series with a capacitor. To derive the best results from this feature, practice would be essential, but the manual gives a good cross section of waveforms to get you started.

The manual is well written and comprehensive. In fact, the machine is quite easy to use and, apart from the component tester, normal operations would not necessitate reference to the manual. Should servicing become necessary, circuit diagrams, some waverforms, test voltages and procedures are given in the servicing section. The instructions are particularly easy to follow.

In summary, the Hameg HM203-5 oscilloscope is an ideal instrument for TV servicemen and for routine laboratory work. Its best features are light weight, robust construction, ease of servicing and good performance.

The recommended retail price is $980 plus tax. Further information can be obtained from Kenelec (Aust.) Pty Ltd, 48 Henderson Rd, Clayton, Vic 3168. Telephone (03) 560 1011. (C.D.)

50 and 25 years ago...

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

March 1937

Shure crystal pick-up: The Shure "Zephyr", first of a series of improved crystal phono-record reproducers, has just been announced by Shure Brothers. The "Zephyr" is a notable example of modern design in both form and performance. Tonearm and base are attractively streamlined in black moulded bakelite.

Ultrawide-range frequency response to 10,000 cycles, sufficient output to operate through the audio system of a modern radio receiver, and the new exclusive built-in "needle-tilt" method of reducing "tracking error" are among the important technical features.

Improving television: The Philips Laboratories have been working in great secret over the realisation of a new television system and the results which have been attained and made now public, are really astounding.

For the first time in fact, it has been possible to transmit and receive pictures on 405 lines, which is the highest number of lines at present employed. It is easy to see what a serious improvement that is if one considers that the production of pictures has been realised, lines being no longer visible.

Capacity v. Condenser: New York. N.Y.- The name "condenser" is not the proper one to use because of the possible confusion between electrical and mechanical devices, according to the Aerovox Corporation. The name "capacitor" is therefore urged which is also accepted as standard by the IRE.

March 1962

Control wire guides anti-tank missile: The idea of a guided missile dragging its own control cable behind it may appear somewhat crude in this age of radio control but the scheme has many advantages. It offers a useful range, freedom from jamming, excellent accuracy, a high order of reliability and calls for very little special training.

In 1957, Vickers-Armstrongs (Aircraft) Ltd initiated the development of an anti-tank weapon for infantry use which was intended to be light enough to carried into action by one man. The demand for small size and weight resulted in a vehicle flying faster than previous weapons of this class, thus increasing greatly the available manoeuvrability.

Novel voice coil designs used in flat dynamic speakers: One of the surprises of the Parts Show in Paris last year was an entirely new speaker. Based on a novel concept that makes possible a dynamic speaker as flat as an electrostatic, it drew crowds away from the classic dyanmics and the rare electrostatic. It was called the Orthophase and its performance was remarkable.

It is based on the same principle as the ribbon mike. A light ribbon of conductive alloy is laid out in a grid or "zig-zag" design and attached to an extremely light but rigid sheet of polystyrene foam. The polystyrene is channeled out so that the ribbon rests on raised portions. Each section of the ribbon is placed in the field of a powerful magnet. When low-frequency current is passed through the ribbon the entire sheet vibrates and the amplitude of the oscillations can reach nearly 3/4in.

Letters

ctd from p5.

Comments on high current amplifiers

The articles on high current amplifiers and "An Introduction to Hifi Pt9: More on Digital Technology", published in the November 1986 issue, need comment.

Although high current amplifiers are becoming more popular nowadays, there is a valid reason for their existence. Everything else being equal, high current amplifiers sound better than low current amplifiers, especially in bass frequencies. Of course it depends on what loudspeakers are coupled with the amplifier and the cable used to make that coupling, but nonetheless, the more current the amplifier can produce, the better the sound.

An example, of which I have personal experience, will suffice to demonstrate the point. Jamo make a small, 4-ohm, loudspeaker called the Compact 50. Using identical sources, to wit a Kenwood DP 850 CD, but different amplifiers — a Kenwood KA 35 and a NAD 3020 — totally different results of an audible nature occur.

Remember that the Kenwood amplifier is latest technology, while the NAD is 1978 technology. Simply, the NAD produced better bass performance. The NAD is designed for high current output, even at low impedances. A similar result can be obtained by listening to the Luxman LV 105, NAD 1155/2200 into KEF 104/2 loudspeakers using the same source. Again, this result was demonstrated consistently.

I recently owned one of the biggest amplifiers in Australia, the Accuphase M100 Mono Blocs, capable of prodigious outputs, even into two ohms. That amplifier has been replaced by a Norwegian amplifier of more modest output, but superior current capability. Why? Because it sounds better.

I cannot argue with the mathematics in your article on High Current Amplifiers, but I suspect that such an approach would also conclude that a Stradivari Violin sounded no different to a Yamaha.

A similar theoretical approach seems present in the articles on digital audio, etc. That the titles to the articles emphasise that there is yet again another nail in the analog coffin, (sic), supports my interpretation. I say only this:

Digital processing of audio information, in its present form, offers the listener a musical presentation that suffers from an absolute loss of information.

By using an anti-aliasing filter prior to digitisation, as well as traditional sampling techniques which essentially smooth data, we have a sampled population that must bear a close resemblance to the original, within the constraints of the error of estimation used. It cannot be equivalent to the original, ever. All data beyond 20,000Hz are removed, and the dynamic range is compressed.

The pro digital camp thus says that less is better? Analog may be guilty of adding something to the music, but removing totally some information?

Of course, I'm wrong, and you are right; there are no audible differences between a Steinway and Yamaha pianoforte.

L.Hissink, M.Sc,
Perth, WA.

Stooges of the kit retailers

The question of whether or not to purchase a kit does not relate so much to the purchasing power of the individual but to that which is basically wrong with the kit system.

Unlike the situation overseas, most kits in Australia find their birth in electronic magazine publications. For several reasons, this is entirely the wrong approach.

1. It ties the magazine to vested interests — kit suppliers who are only interested in making a fast buck in the shortest possible time, for as little effort as possible.

2. Once this "tie in" is in place the true home constructor loses individuality, initiative and the opportunity to justifiably impress friends with his or her efforts and skill.

3. Difficulties arise in obtaining components when and if the project loses its place on the "top ten" of kits.

4. The magazine subscriber loses the reason why the electronic magazine was set up in the first place.

Let's face it, kits have become so professional it is impossible to impress one's friends. One cannot convince them it is self-built. There is nothing wrong with kits as a consumer item but they do not belong in electronic magazines except maybe as advertising space.

At this time, everything is wrong with kits . . . they are mediocre and expensive. The obvious dilemma is how to return the Australian electronic magazines back onto the straight and narrow. At present editors seem not able to make up their minds whether they are producing a consumer guide or a true hobby magazine catering for the true home constructor and the hobby professional.

What is a true builder? A person who obtains the printed circuit board, then proceeds to patiently fill in all the holes; to fabricate or purchase a case according to choice; and to make it work. Result: a unique project built from a magazine article.

In turn, the magazines must place more emphasis on standard components. Avoid custom-built coils and transformers.

Without doubt the magazines have lost their way to become by all appearances stooges of the kit manufacturers, pushed from behind to churn out an endless supply of gadgetry for the kit assemblers.

Furthermore, the magazines are chasing each others tails. If, one produces a preamplifier they all will. Where has originality gone? Where is the newness, the ideas, the experimenting?

Lastly, magazines should realise only a few hobbyist are well-to-do or middle class at best. All are battling, some are wageplugs, many are students or ambitious unemployed. The foregoing are the majority who buy or subscribe. Once these people are catered for subscription offers will overflow and allow magazines to be independent from kit manufacturers payola.

M. Bortella,
Derby, WA.

Copyright a matter of conscience

Because of the obvious difficulties of policing the copyright laws in the case of private copying of audio tapes it becomes largely a matter of conscience. I think that before I copy a tape or record I should ask myself whether I am depriving the composer, artists and recording company of their rightful payment.

If I buy a cassette and make a copy for a friend, then I think this is clearly dishonest, but if there is a recording I particularly want and it is no longer in production or on sale I don't regard copying it as very dishonest.

Also, if I buy a compact disc and dub it on to a cassette to use in my car, then I don't consider this as dishonest because I have already paid the composer, the artists and the recording company for the right to enjoy it.

The "law" of course is unlikely to agree with me.

J.Emery,
Bullcreek, WA.

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M12840 2840 240V to 9V C.T. at 150mA	3.50	3.30	3.10
M12860 2860 240V to 15V C.T. at 250mA	3.50	3.30	3.10
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2764	$ 6.00	$ 5.00	$ 4.50	$ 4.00

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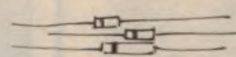

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7818uC	.50	.48	.48
7818KC	1.50	1.40	1.20
7905uC	.70	.60	.55
7912uC	.70	.60	.55
uA323KC	4.50	3.90	3.75

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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
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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

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T12465	240V 3½"	11.00	10.00	9.50
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PN3463	.15	.13	PN3565	.12	.11
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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
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BU326	1.75	1.60	BC547	.07	.06
BC548	.07	.06	BC549	.07	.06
BC557	.07	.06	BC558	.07	.06
BC559	.07	.06			

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Compact Disc Reviews by RON COOPER

ELLY AMELING

Belioz — Les Nuits D'ete
Faure — Pelleas et Melisande
Atlanta Symphony Orchestra conducted by Robert Shaw
Telarc CD-80084 DDD 1985
Playing Time: 49 mins 33 sec

PERFORMANCE 1 2 3 4 5 6 7 8 9 10

SOUND QUALITY 1 2 3 4 5 6 7 8 9 10

Berlioz was often regarded in his own lifetime by Parisians as being mad or wildly impractical with his mammoth works and gradiose schemes. His requiem called for four auxiliary brass bands and a chorus of four hundred, and his opera Les Troyers lasted four and a half hours!

Likewise his use of very large orchestras and extravagant programs such as the mighty Symphony Fantastique caused him to be ridiculed by the press at the time.

However, contrasted with all this we have a considerable number of intimate works such as songs and vocal ensembles and this disc is a magnificent example of these songs which were originally written with piano accompaniment.

It would be easy to run out of superlatives in trying to describe the voice of Dutch soprano Elly Ameling on this recording — powerful yet tender is a description that comes to mind.

The other work on this excellent disc, the suite from Faure's Pelleas et Melisande is a complementary contrast and is most enjoyable. The music was set to a play by Maeterlinck, which was described as moody, wistful and cryptic. Faure has expressed these moods well and many will be familiar with the fourth movement "Sicilienne" which was actually written before the rest of the music.

Once again, superlatives are in order regarding the flawless technical quality of this all digital disc from Telarc and under my own very critical listening conditions everything was just right. Excellent program notes and a libretto are provided. At $31.95, this disc is worth every cent. (R.L.C.)

A SWINGIN' SAFARI

Bert Kaempfert and his Orchestra.
Polydor International 825 494-2. AAD 1962
Playing time: 33 mins

PERFORMANCE 1 2 3 4 5 6 7 8 9 10

SOUND QUALITY 1 2 3 4 5 6 7 8 9 10

This little nostalgic evergreen will be familiar to many hifi buffs as it was the standard vinyl "demo disc" of the hifi shops in the sixties. I think Polydor have probably lost count of the number of millions this album has sold. New on CD, it has lost none of its charm and while some may describe the music as dated, it is great to have it preserved on CD.

There appears to be nothing lost from the original except surface noise which is as it should be. Obviously this type of music does not have the dynamic range of classical music and there is some tape hiss but it does not mar the overall pleasure of this great fun music.

One serious detriment though is insufficient playing time, as there is plenty of room to include another full album of Bert Kaempfert. So at $28 for 33 minutes it is expensive fun music. (R.L.C.)

FLUTE & HARP

The Romance of the Flute & Harp
Thelma Own, harp. Philippa Davies, flute.
IMP PCD-835 DDD
Playing time: 59min 15 sec.

PERFORMANCE 1 2 3 4 5 6 7 8 9 10

SOUND QUALITY 1 2 3 4 5 6 7 8 9 10

There aren't enough harpists or harp music discs around, are there? I'm very keen on the harp so when this album came in from Virgin Records I leapt on it like a man dying of thirst.

It had one of my favourite harp pieces on it too, "La Source", which added to the attraction. The surging restlessness of this piece is ideally suited to this instrument and on this album it is wonderfully played, as are the rest of the pieces, some of which are duets for the harp and flute.

Some of the other compositions are "Berceuse" and "Impromptu" by Faure, "The Swan" by Saint-Saens and "Clair de Lune" by Debussy. In all, there are 14 tracks which are most enjoyable for relaxed listening.

On the debit side, there is a surprising amount of background noise and hiss, especially for a record which is supposedly all digital. The hiss is most apparent on headphones but also intrudes on loudspeakers. You can even make out traffic noise in the background, in between tracks. So even though the performance by these two able players is well recorded, it is a little marred by noises that should have been well and truly eliminated for CD.

Still, at the Virgin Records price of $21.99 it is a good buy. (L.D.S.)

HANDEL

Handel: Highlights from "Messiah".
The Scottish Chamber Orchestra and the Scottish Philharmonic Singers. Directed by George Malcolm.
IMP PCD 803 DDD
Playing time: 53 min 13 sec.

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

Every album of highights of the Messiah will always present the drawback, to a person who knows the work, that a favourite song will inevitably be omitted. This was the case here and so I was disappointed that "Why Do the Nations Rage so Furiously Together?" was omitted.

In other respects though, this is a thoroughly pleasing album with some wonderful singing and the diction is very good. The sound quality is good although not outstanding as there is some analog noise (tape hiss?) present although it is not unduly obtrusive.

Some of the 20 pieces included are: Comfort Ye My People — Ev'ry Valley Shall Be Exalted — And The Glory Of The Lord — For Unto Us A Child Is Born — I Know That My Redeemer Liveth — The Trumpet Shall Sound — Worthy Is The Lamb That Was Slain.

Again, at the price of $21.99, this is a compact disc that is hard to pass up. (L.D.S.)

PAGANINI

Violin Concertos 1 & 2
Concerto for Violin and Orchestra No. 1 in D major, Op. 6
Concerto for Violin and Orchestra No. 2 in B minor, Op. 7 "La Campanella".
Salvadore Accardo, violin. The London Philharmonic Orchestra conducted by Charles Dutoit.
Deutsche Grammophon CD 415-378-2 ADD 1975
Playing time: 68 min 42 sec.

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

The first of Paganini's concertos was written around 1818 when the composer was 36 and well established as a virtuoso. The technical wizardry involved in the piece is staggering, even more so when you realise this composer was writing for himself as a virtuoso! Double stop thirds abound, chromatic in places, as well as mere octaves and glissando sixths.

All this aside, the melodic side shows Paganini's brilliance in creating very tuneful music influenced no doubt by Italian opera of his time. There is a very expressive adagio and the rondo-finale has an airy character with a combination of "ricochet" bowing and staccato.

The second concerto is in slight contrast as the demonstration of virtuosity is restrained, yielding to a more melodic style. However, by the last movement, virtuosity returns with a vengeance in the wonderful "La Campanella" — the little bell, which the composer uses to introduce each recurring rondo. This gypsy-like theme is mimicked by the orchestra and in some of the soloists' passages with harmonics.

These concertos are stunning showpieces for virtuosos only and as such can leave an audience gasping.

I am sure that is the least they would have done, for I feel that if these works were heard via an Edison cylinder and played as Salvatore Accardo does here, you would still be left musically stunned.

This 1975 analog recording is in the very good class and the balance is an improvement on some of the other DGG's I have reviewed lately. There is still a tendency to favour strings at the expense of woodwind and brass but with the works here the audible effect of this is less noticeable.

At almost 69 minutes it is very good value for $28 and while there are good cover notes on the Concertos nothing is said of Salvatore Accardo whose performances on this disc are exceptional. (R.L.C.)

CHOPIN

John Ogdon Plays Chopin.
IMP PCD 834 DDD
Playing time: 73 min 25 sec.

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

If nothing else, this compact disc is outstanding for its playing time. It must be one of the longest playing CDs available. The only other album I have come across which is comparable is a Denon CD which accommodates the entire Beethoven Ninth Symphony.

Apart from the excellent playing time, this disc will be most attractive to people who like the works of Chopin. It is a collection of well-known favourites ably played by John Ogdon. The nine tracks include: Fantasy in F Minor, Op. 49 — Berceuse in D Flat, Op. 57 ("Variantes") — Barcarolle in F Sharp, Op. 60 and Polonaise in F, Op 15 No 1. (L.D.S.)

Back by Popular Dem

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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

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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.
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176 pages (Available February 1987)

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R. A. Penfold — **BP0076**
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$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

ELECTRONIC SECURITY DEVICES
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$9.50
112 pages

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Information centre

Control system for petrol-electric locomotive

I am building a miniature petrol-electric locomotive in 5-inch gauge, and as part of the drive mechanism I want to operate the throttle of the petrol motor in direct relation to motor current.

In the design, I have employed two 12V lead-acid batteries connected in parallel, which provide the source to drive four DC motors via a variable mark-space ratio oscillator driven transistorised power controller. The petrol motor drives an 80 ampere automotive alternator, without regulator, to 'boost' the batteries at starting, to then level off to a motor current of say 30 amperes.

To drive the locomotive, I have incorporated a simple one-lever-operational-potentiometer which is moved from 'stop' to 'go'. What I now wish to do is operate the throttle of the petrol motor such that it 'revs up' at starting, as the initial current hits the motors, but then taper off in speed as the motor current declines.

I have purchased an aircraft model radio control servo mechanism with in-built operational amplifier. This device has a three-wire input and is fitted with a star type lever on top, which is normally used to drive flaps, rudders, etc.

What I would like to do is drive this servo, both forward and backwards, in direct relationship with an input voltage which I can derive across the motor power wiring (voltage drop) which amounts to 0-100mV from zero to full motor current.

Would you know of the source of a circuit, or where I can find the design of a circuit which will accept 0-100mV DC range input, with sensitivity adjustment 0-50, 0-100, 0-150mV via trimpot? It needs to drive the servo in a forward direction through 0 to 30/45 degrees as the voltage is increasing and in the reverse direction as the voltage changes to decreasing. (P.P., Blackburn, Vic).

• Your project sounds most interesting. As we understand it, you are attempting to build a miniature petrol equivalent of a diesel-electric locomotive. We have little knowledge of servo motors but we assume that it could be driven by a conventional servo driver amplifier which is essentially the same as a direct-coupled audio amplifier which has flat gain down to DC. The Playmaster 60/60 power amplifiers would probably be as suitable as any and they could be adapted easily to run from a ±12V supply.

On the other hand, we are not sure why you are taking the servo approach. Do you really need the bank of batteries? Couldn't you just use the alternator and transistor chopper system to directly drive the traction motors? That way you could dispense with fancy throttle controls and have a more predictable throttle response.

Needs help using the frequency meter

Recently I purchased a frequency counter kit from Dick Smith Electronics and, after putting it together, I can't quite understand how it works. Do you have any more information on it. This is the counter that was in the December 1981 issue of *Electronics Australia*.

It seems to work, the displays all light up, but I notice that the decimal points don't light up. When I put it on a circuit to take a reading, the reading is way off. I put it on a circuit of about 450kHz and the display reads 83414.

I noticed in the assembly manual that sometimes you must invert the reading on a calculator. Do you have information how to do this, what number or constant or whatever to use? And do you know what kind of test leads to use? Will 50Ω coax work or must you use a special probe with a detector in it.

I have never noticed any test leads for frequency counters in any of the electronics parts books. I sure do need some information on it, so as I can tell if I put it together wrongly or I am just not operating it the right way. Can help me on this? (J.G., Mineral Wells, Texas, USA).

• First of all, we would like to point out that the Dick Smith kit version of this project is changed from our original design and differs in a couple of respects. In particular, DSE used common cathode displays together with the "B" version of the ICM7216 counter chip. They also redesigned the display PCB to make construction somewhat easier.

Apart from that, the circuitry is virtually identical to the original *Electronics Australia* design.

The decimal points were not switched in our original design and a follow-up project in the July 1982 issue described the necessary circuitry to add this feature. The modifications to the DSE kit version should be quite similar.

You state in your letter that your DFM displays 83414 when you attempt to measure a 450kHz signal. Please note that, if you are trying to measure the IF stage of a receiver, the signal level may well be insufficient to give a reliable reading. The signal level must be at least 10mV for signals below 30MHz and 100mV or more for signals above 50MHz.

In the IF stages of a receiver, the signal level may superficially be more than sufficient to drive the frequency meter but the fact that the signal is amplitude modulated may cause the circuit to misread.

An oscilloscope probe makes an ideal test lead for the DFM (you should be able to obtain one from your local electronics store). Note that you should generally use such a probe in the "direct" mode. If you use a CRO probe in the 10:1 mode you will naturally reduce the input signal level to the DFM to a tenth of its value.

Alternatively, for frequencies below 1MHz, you can use either 50-ohm coax or screened test leads.

The only time it is necessary to invert a reading is to calculate the signal frequency when the counter is operating in the period mode (ie, $f = 1/T$, where f is the frequency and T is the time in seconds). Note: the period mode is useful when making low frequency measurements below about 100Hz.

The second part of our article on the frequency meter, in February 1982, gave useul information on calibration and using the unit.

Needs sector delay in burglar alarm

I have built the Multi-Sector Burglar Alarm described in the January and February 1985 issues of EA but have some queries. I only need one delay (for back door exit/entry). Can I convert one delay sector to instant? If so, how can this be done? I can leave one of the two delay sectors empty (not used) if too much work is entailed.

Can one instant sector be made to be on at all times (when the keyswitch is off)? If so, how can this be done? I can leave all sector switches off except the one sector for panic/emergency switches. Alternatively, if too much work is entailed, I can leave it. (J.T., Avondale Heights, Vic).

- It is quite easy to convert one of the delayed entry sectors to an instant sector. In the case of sector one, all you have to do is lift the cathode of D1 from the printed circuit board and connect it directly to pin 12 of IC7b. Similarly, to convert sector 2, connect the cathode of D2 to pin 12 of IC7d.

It is not practicable to modify the circuit so that one instant sector is on when the keyswitch is off. We suggest instead that you simply switch off those sectors which are not required using switches S1 to S8.

Distortion in the modulated RF oscillator

I have recently built this RF oscillator (described May 1979) and while it works, I am not sure its performance is totally correct.

Firstly, should the output of the RF oscillator be a sinewave or should it be repetitive sine pulses? I am getting repetitive sine pulses. The dead time is not horizontal but increases amplitude (negative) in time. Is this correct? The amplitude of the RF changes with frequency as you say in the article, however in my unit, the amplitude drops right off at the end of each range. Have you considered an AGC for this RF oscillator?

The audio oscillator part of the circuit produced a very distorted sine wave which was corrected by changing the 220Ω emitter resistor in the audio buffer stage to 470Ω. The oscillator frequency is 800Hz but I believe the frequency was originally meant to be 400Hz (through using formulae). It can be changed to 400Hz by changing the 0.047μΦ capacitor to 0.1μΦ and the 0.022μΦ capacitor to 0.039μΦ. (P.B., Gordon, NSW).

- From your drawings of the oscillator waveforms, it appears that the output of your RF oscillator is going into clipping. It is supposed to be an undistorted sine wave although simple RF oscillators of this type often do not have really "clean" waveforms. In this case, however, it does seem as though the circuit is simply clipping which could be due to either excessive gain or insufficient supply voltage.

The first job is to check the values of the inductors on the drains of the FETs. If these are OK, try reducing the feedback between the first two FETs (reduce the 4.7pF capacitor).

As far as the audio oscillator is concerned, we are not aware, after all this time, just what frequency was intended by the designer, however the modulation frequency in the original article was quoted at 780Hz. On this basis, your circuit is close to the mark.

We agree that 400Hz or 1kHz has been commonly used for the audio frequency in amplitude modulated oscillators and signal generators. It is a simple matter to change the frequency to 400Hz as you suggest, but the difference between 1kHz and 800Hz is unimportant.

In fact, 400Hz was the conventional reference frequency used for telephony, audio and RF engineering up until just after WWII. Since then 1kHz has become more or less standard but there is nothing sacred about this figure.

Lamp saver needs rescuing

I recently constructed two lamp savers as described in the June 1986 issue and while one appeared to work (at first) the other gave a light of constantly varying brightness. After a while, the first unit developed this same fault.

I then checked the Notes & Errata columns and found the item in the August 1986 issue re 1W zener diodes (unfortunately, you didn't say what effect a one watt zener would have). Anyway, as the ones in my kits were 1W types I changed them to 400mW types but without any noticeable result. I then noticed that R1 was running very hot.

Can you please suggest what may be causing this problem? (J.G., Nairne, SA)

The reason why 400mW zeners are preferred to the 1W types is that their "knee" characteristic is sharper and this gives better voltage clamping for the circuit. If the 1W zeners are used, R1 tends to overheat because the Triac is not triggered so early in each half-cycle (and so voltage is applied to R1 for longer periods).

As to the fault in your units, it appears likely to us that you have a combination of quite a high mains voltage input combined with an incorrect or high value for R1.

Untouchable ballast resistor with TAI

Having purchased a kit of parts for the TAI (transistor-assisted ignition) shortly after it was featured in the February 1983 issue of *Electronics Australia*, it was not until recently that I was able to construct the unit and install it in our car. I am happy to report everything worked fine from first switch on but I would be happy if you could answer a few queries for me.

Our car is a Toyota Crown 1971 and is in very good condition all over. The ballast resistor sits atop the ignition coil so installation of the TAI was easy. The ballast resistor is controlled by a relay which shorts out the resistor until the motor fires.

This resistor has a resistance of approx 1.4Ω and on normal ignition has very little increase in temperature and resistance. On TAI, it becomes so hot as to be untouchable and I have measured its resistance up to 2.7Ω. I assume this all happens because TAI draws a lot more current than normal ignition.

On normal ignition the positive terminal of the coil measures approximately 9V; on TAI it is approximately 6V. Could one assume a 33% drop in primary voltage results in a 33% drop in secondary voltage and less voltage to the plugs?

I obtained another resistor and paralled it with the existing resistor. This brought the voltage (primary) for TAI up to about the same as for normal ignition and the temperature of the resistors to approximately that of running on normal ignition. Would these two resistors affect the working of the TAI or present any danger to coil? The coil does run hotter on TAI.

Plug gaps, timing, etc were all to manufacturer's specs. Your thoughts on this would be appreciated. All the best to EA for the coming year, I have been a fan of EA since *Wireless Weekly* days. (L.H., Toowoomba, Qld.)

• Because the current drawn by the TAI is higher than for conventional ignition, the voltage drop across the ballast resistor is also higher. This does not mean a 33% drop in primary voltage, because the coil current has had a longer time to build up. Hence the energy stored in the coil is much higher and the resulting available voltage and energy to the plugs will be consistently higher than for conventional ignition.

You can leave the additional resistor in if you wish. However, it will give very little benefit and will cause the coil to run even hotter. On balance, we suggest you leave it out.

Footnote to AM stereo requirements

I was interested to note the letters on AM stereo in the information pages of the February issue and in particular, the letter concerning the use of a 3.58MHz crystal. It is not quite correct to suggest that the nominal crystal frequency should be exactly eight times the intermediate frequency. It should be about 1kHz higher, to allow it to be pulled down to the exact frequency.

In practice, for an intermediate frequency (IF) of 450kHz, the AM stereo decoder's crystal should be 3.601MHz. Alternatively, for a crystal of 3.579545MHz (the American colour TV intercarrier frequency), the IF should be 447.318kHz; ie, 125Hz lower than the figure of 447.443kHz which would be expected. When the crystal is adjusted for the lock condition, then it will be exactly eight times the actual intermediate frequency.

Ultimately, better performance can be obtained from the Motorola AM stereo decoder by using a crystal, but it makes the capture range for the PLL (phase lock loop) much narrower and therefore more critical to initially adjust. (W.S., Auburn, NSW).

• That's a good point which we had forgotten. Since a crystal can only be pulled down in frequency, it makes sense for it to be slightly higher than eight times the IF. Thanks for bringing it to our attention.

Notes & Errata

COMPRESSOR FOR COMPACT DISCS (May 1986, File 1/MS/32): there is an error on the 86ms3 PCB. This connects the positive power supply 470μF capacitor (nearest the 7812 regulator) between the positive and negative unregulated rails instead of between the positive rail and ground. The circuit will work quite happily in this condition but the voltage rating of the capacitor is being exceeded.

To correct this, cut the track between the negative terminal of the 470μF capacitor and the "IN" terminal of the 7912 regulator and then connect a short length of wire between the negative terminal of the capacitor and the GND terminal of the 7912 regulator.

CAR BURGLAR ALARM (May 1984, 3/AU/39): It has come to our attention that at least one kit seller has been substituting 14584 Schmitt trigger ICs for the specified 74C14 or 40106. This will not function correctly because it has different hysteresis levels. The symptoms will be incorrect exit and entry delay times, wrong flasher rate and different alarm frequency and modulation. The only practical solution is to change back to the specified 40106 or 74C14.

Editorial . . . ctd from p.5

with no fraying of insulation? Are all connections tight? Is the main earth wire for your house wiring solidly connected to a metal pipe which runs into the ground? Huh? Can you answer that? And are some members of your family using portable radiators or hair-dryers in the bathroom? People have died recently in this situation.

Further, are you using a two-core extension lead with your washing machine? Do you have your stereo system down by the pool? Or do you put your half-finished glass of wine on top of your VCR? Your VCR or stereo might be double-insulated but if water is spilt over it the case could become live. Think about that. And be aware that dirt and grime on a double-insulated power tool may provide a conductive path from your hands to the live parts inside the motor.

Don't be complacent with electrical appliances. The life you save could be your own or your loved one's.

Leo Simpson

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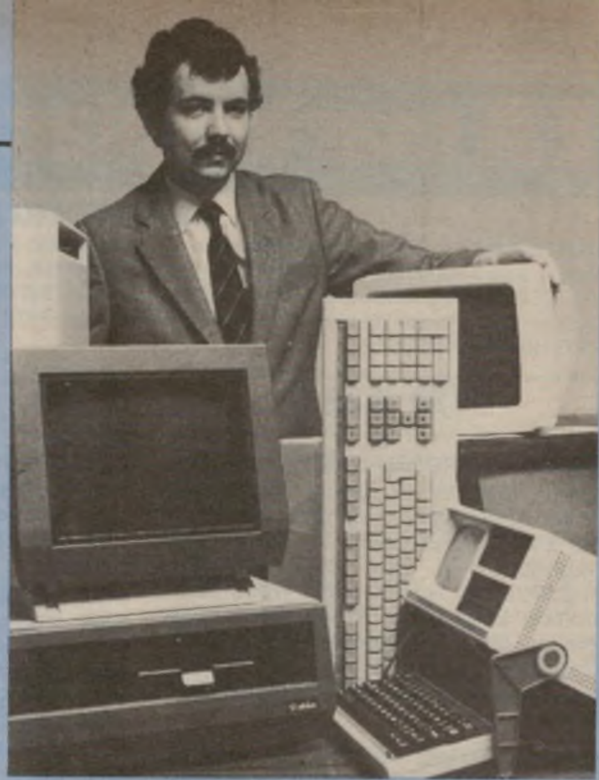

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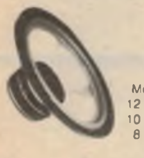

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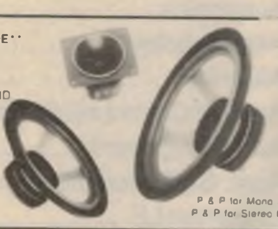

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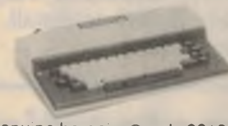

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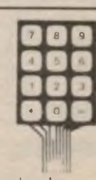

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Ultrasonic burglar alarm

Protect your home or car with our new Ultrasonic Burglar Alarm. It's easy to build, offers reliable performance and is easy to install. It's the perfect partner to the UHF Remote Switch described in January.

Vintage radio restoration

A real blast from the past this one! Vintage radio enthusiast John Hill gives a run down on restoring old valve radios and there are lots of photographs to illustrate. Not to be missed.

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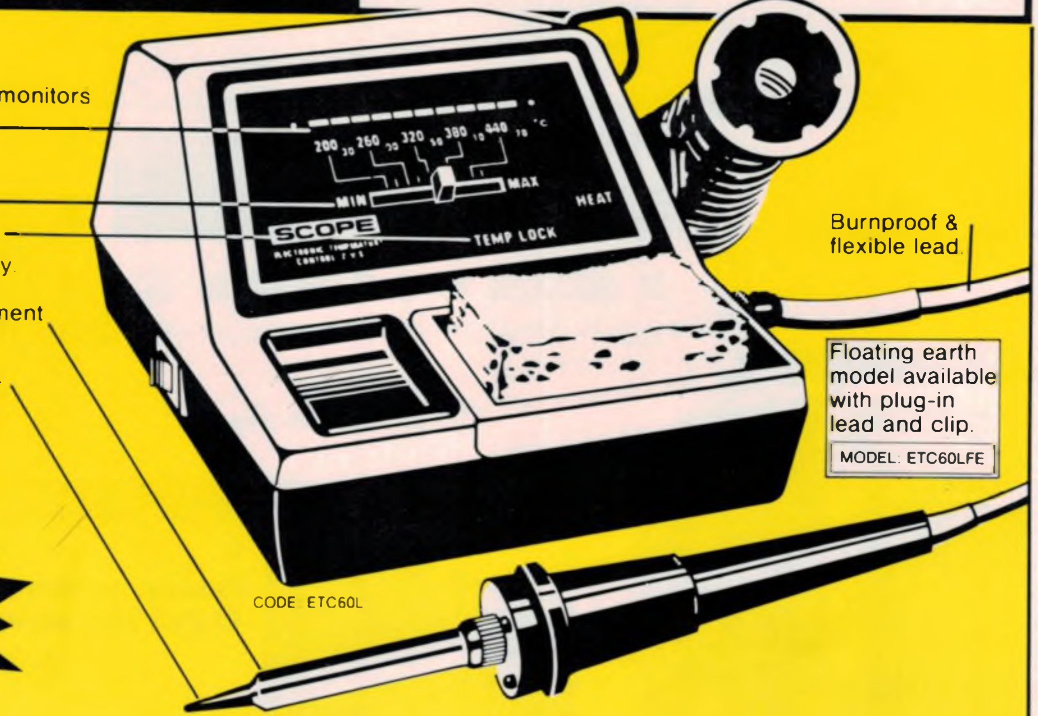
ADVERTISING INDEX

SCOPE

60W SOLDERING SYSTEM



- Illuminated Temp. readout monitors actual tip temperature.
- Select the tip temp. required.
- Zero Voltage switching for maximum component safety.
- Ceramic encapsulated element for lowest earth leakage.
- 60 Watts of back-up power -30W Pencil optional.

Burnproof & flexible lead.

Floating earth model available with plug-in lead and clip.

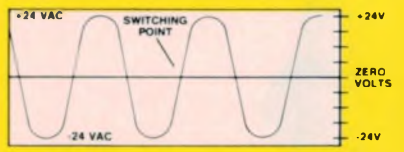
MODEL: ETC60LFE

CODE: ETC60L

INFINITELY ADJUSTABLE 200°–470°C
with zero voltage protection

Screw type connector prevents accidental plug removal.

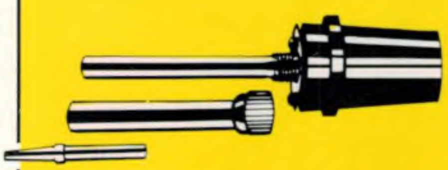
30 Watt Soldering Pencil is an optional tool to replace 60W standard tool. Special miniature tips are available.



Damaging Spikes and induced tip voltages likely to damage MOS devices are virtually eliminated by Z.V.S.* circuitry.

* ZERO VOLTAGE SWITCHING OF HEATER

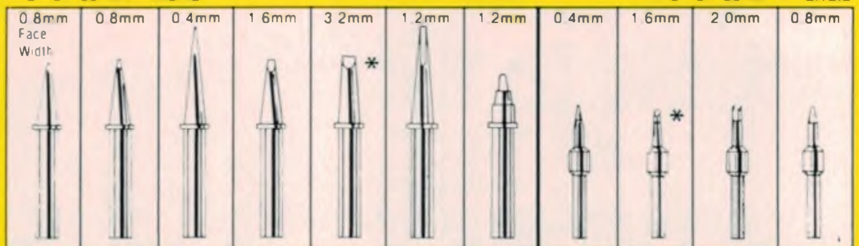
Anti Seize tip retention design - reduced risk of thread seizure by removing locking nut to cooler end of barrel.



REPLACEMENT TIPS

* FITTED AS STANDARD

TIPS FOR 60 WATT IRONS — TIPS FOR 30 WATT PENCIL



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