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Australia's Top Selling Electronics Magazine

Electronics Australia

DECEMBER 1986

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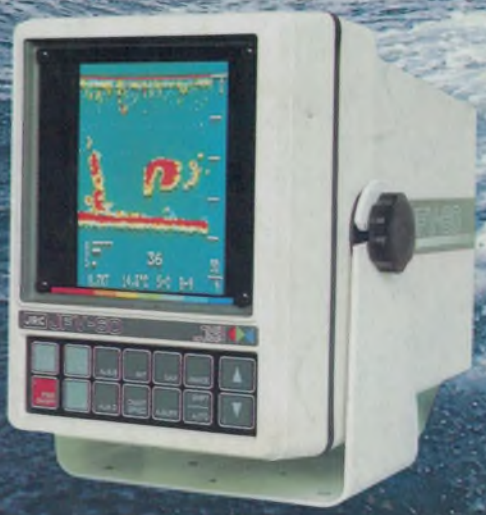
HI-TECH ON THE HI-SEAS



FAX machines
— How they work

HOTOL:
— Britain's super new space plane
TO BUILD

AUDIO OSCILLATOR
— ultra low distortion
TO BUILD

ACTIVE ANTENNA
— pull in those distant stations

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You get what you pay for.
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Volume 48, No. 12

Electronics Australia

December 1986

THIS MONTH'S COVER

Water and electronics definitely do mix. Check out the latest marine electronics gear in this month's special feature commencing on page 33.

Special Summer Feature

Features

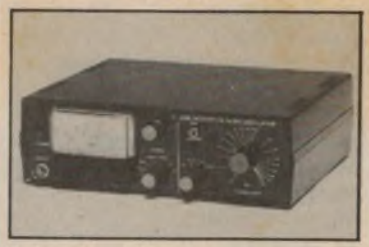
Entertainment Electronics

Projects and Technical

News and Comment

Departments

Low distortion audio oscillator



Our latest audio oscillator is comparable with the very best commercial units. It features ultra-low distortion, sine and square wave outputs, excellent envelope stability and optional output level metering. Details page 24.

What's coming

January's issue will be a big start to the year. It will feature a UHF keyswitch for burglar alarms, a digital sound recorder and an easy-to-build shortwave radio project. See page 130 for further details.

Active loop antenna

Interested in long distance radio reception. This active loop antenna will dramatically improve reception on the long wave, broadcast and shortwave bands. We show you how to build it on page 52.

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Letters to the editor

Appreciation for Playmaster 60/60

I would like to express my appreciation for the fine magazine you are producing. You have really had some great articles in the last 12 months, many of which I have put to some practical use.

I have just recently completed the Playmaster 60/60 amplifier and am really impressed. When your articles first appeared on this amplifier I was looking at purchasing a commercial unit to upgrade my system, but nothing can really compare with the price and specifications of your 60/60.

Of course I purchased it as a kit and was very impressed by the way the kit was supplied.

Everything went together like a breeze and it all worked beautifully at first power up! For me this is the only way to build such a project as this and I doubt if there could be any improvement upon the design by doing it another way.

Once again thanks for a great magazine.

T. Butler,
Glenroy, Vic.

Warning on FM transmitter

Doubtless you are aware of the serious and continuing problem of interference to radiocommunications services around Australia, particularly through the use of equipment not approved for operation in this country.

The FM wireless transmitter, for operation in the FM broadcast band, described in your September 1986 edition, falls within this category. Devices such as these have the potential to interfere with the licensed services and, in fact, have done so.

I have enclosed a copy of the departmental brochure, DOC 228, which sets out the technical standards and frequency bands governing the operation of low-power radio equipment for radio-linked microphones. You will notice that the FM wireless transmitter, if designed and built as your article advised, would fail to meet the technical standards put forward in DOC 228.

It is a measure of the seriousness of the interference problem that a person operating a transmitter without a licence or a test permit can face a fine of up to $2000 and/or a maximum of a year's gaol. Use of any transmitter for the purpose of overhearing, recording, monitoring or listening to a private conversation could also be in breach of State Government legislation relating to the use of listening devices.

Could I suggest that it would be very helpful if, when publishing articles about the construction and operation of transmitters, a paragraph along these lines could be printed:

Readers are reminded that all radiocommunications transmitting equipment must first be approved by the Department of Communications. The Radiocommunications Act prescribes severe penalties for the operation, or possession for the purpose of operation, of any radiocommunications transmitter without a licence, or the possession of substandard radio transmitting equipment.

The Department is happy to consult with any publisher about planned articles and would welcome the opportunity to give advice on the legal position concerning the suitability of any equipment for licensing.

G. Barrow,
Department of Communications,
ACT.

Problems with kit manuals

The comments by Mr Gary Crapp have prompted me to write again. I hope you will allow me to respond via your magazine as some of his comments were directed towards me.

I have followed with interest all comments on the kitset saga. It would appear that there is considerable support for the purchase of components individually. I hope that the various suppliers are able and willing to respond to consumer demand. This would of course require production of the full kit and a

"Scotsman's" kit consisting of circuit board, specialist ICs and detailed instruction manual etc., leaving garden type components and cabinets to the individual.

I'm sure we all appreciate that Australian kit producers have only a limited market. This should not prevent us from striving for perfection and improvement in any product produced in this country. I still maintain that Australian kits leave a lot to be desired, particularly in the instruction manual area.

I have taken the trouble to talk with others who have assembled both Heathkits and local kits, and everyone of them all said the same thing: the instruction manual was poor (usually a reproduction of the magazine article).

Other comments included poor quality control (ie, wrong value components) and faulty components. Tantalum capacitors are a favourite.

It has already been suggested that each project be accompanied by CRO diagrams and voltages at various test points around the circuit, thus enabling the constructor to carry out some fault finding and narrow a fault to a particular area.

I agree with Mr Crapp that the 100 watt amplifier does appear good value for money. I had already done my homework on this project.

If I could have bought the circuit board separately or been able to produce it from a 1:1 diagram in the article, that project would have already been under way. Mr Crapp also asks what else would I have done. Well to be quite honest, nothing.

The purchase and construction of such an amplifier would have been purely an impulse buy. Isn't this how all kits are sold? Had I stopped to read the article and realised that it was only available from DSE as a kit the magazine would have still been sitting there. No matter; I have now decided to build a 2-metre amplifier using 4CX250s instead. The cost of this will no doubt exceed $240.

The Heathkit gear I bought was quite some years ago when the exchange rate was in our favour and the only comparable products available in this country were twice the price. Naturally, I couldn't expect to do the same today. If you get the chance have a look at a Heathkit manual sometime and I'm sure you'll agree — Australian kits just don't measure up.

I. Glanville,
Myrtleford, Vic.

Editorial Viewpoint

The truth about turntables

To read the publicity material put out by some hifi dealers and distributors you could be forgiven for thinking that the arrival of CD players was a non-event. Further, if you read the pronunciations of some so-called audio writers on the subject, you could be forgiven for thinking that, they too, believed that compact discs were inferior to the vinyl disc. And that is apart from the outrageous arguments put forth about the superior/inferior sound quality of particular CD players.

Now enough is enough. It is about time that the people who distribute and sell hifi equipment learnt about the virtue of telling the truth. Some of them have been lying for so long that they can no longer tell the difference between fact and fiction, which is all that some hifi publicity material is.

Let us state a few facts. You can forget most of the subjective nonsense put about by some hifi dealers. Vinyl discs and turntables are inferior to CD players. Anyone with functioning ears can tell the difference because CD players do not have cracks and pops from surface defects, hiss, hum, wow, flutter, inner groove distortion or acoustic feedback. To suggest that turntables are superior, in the face of this evidence, is stupid.

Under ideal conditions, the very best turntables and cartridges playing virgin vinyl discs can sound stunningly good but in a direct comparison with the same material on a CD player, the digital version will almost always sound better. The rare exceptions are transcriptions to CD which are not as good as they should be.

That is not to say that people should not think about buying a new turntable and cartridge, and an expensive one at that. If your turntable or cartridge is more than five years old, you could well have a good reason for buying a new one. The reason for buying an expensive new cartridge and/or turntable could be simply that you want to have a good system to keep playing your existing collection of vinyl discs. Fair enough.

You could even make a sensible decision to keep buying vinyl discs for the time being, in view of the high price of compact discs. But to expect that you will get superior sound to that of a CD player reproducing the same material is foolish. And any hifi dealer who tries to persuade buyers using the argument that turntables are superior is either misinformed, which is unlikely, or a liar.

Leo Simpson

News Highlights

Eye-dentification system!

Most people relate personal identification to finger printing, but now new technology has developed a foolproof method of identification by scanning people's eyes.

Developed in the US, the new system is being used to screen personnel in defence bases and other high security areas. These include chemical and petroleum plants, power stations, research laboratories, communications rooms, bank vaults and computer complexes.

The equipment is called the EyeDentification System and uses precision optics and computer technology to "read" the retinal patterns of the eyes. It works on the principle that every person, even an identical twin, has a distinct retinal pattern.

In fact, the accuracy is said to be unmatched by other personal identification systems such as written signatures and fingerprints, plastic card systems and digital locks, and security guards.

It is claimed that the unique security system will help combat computer crime, theft, vandalism and industrial espionage. These crimes are generally crimes of opportunity and can often be prevented by eliminating unauthorised access to sensitive areas.

The EyeDentification System is being marketed in Australia by Access Control Systems (Australia) Pty Ltd, 20 Powells Rd, Brookvale, NSW 2100. Telephone (02) 938 2122.

Dick Smith Electronics to market Heathkit

Good news for Australian electronics enthusiasts — Dick Smith Electronics has announced plans to market a range of Heathkit products in Australia.

For those unfamiliar with the name, Heath is an American company based in Benton Harbour, Michigan. It has earned a worldwide reputation for the quality of its kits and for the thoroughness of its instruction manuals. In fact, assembled Heathkits are generally of much higher quality than equivalent commercial products, both in terms of performance and appearance.

From the constructors' viewpoint, Heathkits are easy to build. The manuals are meticulously prepared and detail each step of the construction, even down to the installation of a single resistor and to trimming lead lengths. You don't even have to know the resistor colour code — the manual tells you the colour code of the resistor to be installed at each step.

Even a complete novice can build a Heathkit. Each manual contains an introduction to the assembly process, soldering information, a detailed parts identification section, kit operation, and comprehensive troubleshooting and service notes. And, in the unlikely event that the constructor cannot get his project to work, Dick Smith Electronics will be providing full service backup.

Initially, Dick Smith Electronics will be marketing some 20 products from the Heathkit range. In addition, Dick Smith Electronics will order any kit from the Heathkit range direct from the USA against a 25% deposit. The only exceptions include computer kits and learning/training aids.

DSE will also be selling instruction manuals for Heathkit projects separately. This is designed to overcome the problem of buying kits sight unseen from a catalog. By purchasing the manual first, the customer can study the details of a particular kit carefully before committing himself.

Further information on the Heathkit range is available from your local Dick Smith Electronics store or from Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde, NSW 2113.

Stealth anti-radar technology improved

Pioneered in the US, "stealth technology" is used to reduce the "radar signature" of ships and aircraft so that they appear invisible to enemy radar.

The latest development in stealth technology is a top secret, lightweight coating material produced by Plessey Microwave of the UK.

Called ADRAM (advanced radar absorption material), the new material has sparked off a great deal of interest as a means of protecting naval vessels against sea-skimming missiles. These were widely used in the Falklands War and have been used on several occasions in the Gulf War.

Stealth technology has been heralded as the most significant military development of the 80s. Its first application was in design, whereby all the angular sections in the American B-1 bomber were removed and the air intakes hidden. Making engine parts of plastics or ceramics also cut down the area which radar could detect.

Chinese telecommunications

Telecom Australia recently signed a Memorandum of Understanding to assist the Chinese Posts and Telecommunications administration to develop key areas of China's telecommunications networks.

China has recently embarked on this major program to increase the number of telephone services from 6.2 million in 1985 to 13 million by 1990 and 30 million by the year 2000.

According to Managing Director Mel Ward, Telecom has developed a close working relationship with its Chinese counterpart over the last few years. The two countries both share problems of distances and Telecom is now recognised as being among the world's leaders in the construction of rural telecommunications networks.

Radar tracks down buried pipes

After scanning the skies for more than 40 years, radar is being turned in the opposite direction — to explore the ground for buried pipes and cables.

The British Gas Corporation recently developed a prototype ground probing radar which will be given trials this year. They believe it will remove the need to excavate for pipes, which can cause damage to transmission lines and other utilities such as water.

The radar unit consists of a trolley-mounted antenna unit which scans the ground to collect signals and converts them to digital form. A cable transmits the data to a mobile command and control computer contained in a van.

RCA ends CED production

The CED videodisc has reached the end of the road with RCA finally abandoning production of CED discs at its Indianapolis plant last June.

A number of factors contributed to the demise of the videodisc, including the fact that the VCR format became much cheaper to produce than was at first thought possible. Along with this came a very successful Japanese marketing strategy which put the VCR format on the map to stay.

CBS, the only other manufacturer of CED discs, ended production in 1984. RCA is now being sold to General Electric which at one time supported the competing VHD videodisc system developed by JVC, and still marketed in Japan.

Business Briefs

• Amtex Electronics has been appointed the Australian distributor for Cotag International, a UK based manufacturer of radio tag automatic identification systems.

Identification systems based on radio tags have been around for some years but were often big, costly and inaccurate.

The Cotag tag, with a microchip memory, can hold any one of 9 x 10 different identification codes. It can be reprogrammed in seconds and as often as required, and the built-in lithium cell has a typical life of seven years.

• Laser Systems Pty Ltd, a Melbourne-based importer, manufacturer and exporter of lasers and laser accessories, has been acquired by Corporate Development Ltd, a subsidiary of BWD Industries Ltd.

The Managing director of Laser Systems, Mr Jeff Lacey, will continue in his position.

BWD Precision Instruments will manufacture lasers and carry out research and development on behalf of Laser Systems. As a part of the merger, Laser Systems has relocated into BWD's Mulgrave Complex. Their new address is 5 Dunlop Road, Mulgrave, Vic. 3171. Telephone (03) 561 2888.

• Bourns Inc has announced the appointment of VSI Electronics (Australia) Pty Limited as Australian Distributor for their range of Electronic Components. Bourns Inc is known for its range of resistive products which include potentiometers, resistor networks and precision control devices.

From left: Rob Harkness (Product Development Manager for Thorn EMI Information Technology), Greg Macdonald (Director of Sales, Webster Computer Corporation) and Barry Jeanes (Managing Director of Thorn EMI Information Technology).

• Local computer hardware manufacturer Webster Computer Corporation has appointed Thorn EMI Information Technology Ltd as its official stocking distributor for all Webster board level product sales in Australia.

Thorn EMI's decision to step-up data peripheral sales coincided earlier this year with the release of Webster's ESDI (Enhanced Small Device Interface) and SMD (Storage Device Module) disc controllers.

The new arrangement is aimed at providing a better service for existing Webster customers.

News Highlights

Sweden gets the Long March

A Chinese rocket, "The Long March", is to launch the first of a new generation of Swedish telecommunications satellites in 1990.

The satellite system, known as Mailstar, will circle in a low orbit over the poles as opposed to the usual geostationary satellites. This means that the satellite passes all places on the earth several times a day, resulting in much shorter communication times.

This enables Swedish companies to communicate with subsidiary companies and branch offices, primarily in developing countries, independent of the local communications capacity. The maximum delay between message forwarding and reception will be about three hours.

Encouraging results from fusion machine

Results from tests carried out with Europe's experimental fusion machine are reported to show that it is well on the way towards reproducing the conditions needed for a successful fusion reactor.

The aim of a fusion reactor is to copy the natural nuclear fusion process from which the Sun and stars derive their energy. This means generating plasma temperatures of around 100 million degrees C.

It is envisaged that a fusion power station would produce around 1000 megawatts of power a year using just 150kg of deuterium and 450kg of lithium.

The major problem with the fusion technique is that the plasma cannot be contained at fusion temperature by any known materials. The plan now is to use huge magnets to keep the hot writhing gas from touching the walls of the vessels.

On the positive side of things the plasma current of JET has been increased from 17,000 amperes, since it first went into operation in 1983, to last years dizzy height of five million amperes for one second.

Correction:

In the October issue of EA, page 117, the telephone numbers given for the Odyl group were incorrect. The correct numbers are as follows: Melbourne (03) 899 0500 and Sydney (02) 212 6617. There is no Queensland outlet.

Soldering by laser

Hang up your trusty soldering iron — laser soldering is on the way!

In the UK, scientists are hard at work building soldering stations which are capable of assembling surface mount circuits automatically. The new work stations will use a combination of robotic and laser technologies.

Laser soldering is said to offer the advantages of speed, flexibility and precision, and the joints are said to be less brittle and more resistant to fatigue failures than those made by conventional methods.

A further advantage of laser soldering is that the beam can be focussed precisely on the area to be soldered. And since the radiation and exposure can be accurately controlled, only the precise amount of heat necessary to make the bond need be used.

The new system incorporates a compact infrared laser, based on research carried out in the UK on radio frequency gas discharges, and has taken two years to develop.

1986 the year for hifi - but only just

Making long term predictions about the way industry will perform can be a risky business. This year was to be the year of audio and in some ways this has proven correct.

The hifi flyer of the year has been the compact disc player, with sales more than double those of the corresponding six-month period last year. But this phenomenal growth in CDs has had to compensate for the sales drop in other areas of hifi.

Sales of receivers, turntables and tape decks have all dropped in unit terms by between 13% and 18%. Although these actual unit sales are down on 1985, retailers report that those items which are being sold are of better quality. This is no doubt due to consumers upgrading complete systems to match the performance of newly acquired CD players.

The only other area experiencing a boom is loudspeaker sales. Again, this is due to the consumer seeking better quality loudspeakers to match the new CD player.

With one of these on your desk, you may not need a computer.

Thinking about a computer for the office?

There's one fact that computer sales people generally won't be too keen to admit: most of the time, computers in offices are used for one thing: simple word processing. Typing up letters, memos and reports.

When they're not being used for that, they're most likely to be used as a communications terminal, fetching information from remote databases. Fairly basic information, too. Like how many Japanese yen the Australian dollar is worth today, or when the first plane leaves for Canberra tomorrow.

It tends to be pretty basic stuff, and doing it with a computer costing thousands of dollars can be expensive overkill. Rather like using the space shuttle to do your weekend shopping.

Now Microbee Systems has the answer: a new desktop tool called the **TeleTerm**. It's a simple, easy to use word processor, combined with the two main kinds of communications terminal (ASCII and Videotex). It comes complete with built-in telephone and automatic dialling data communications modem. And it costs much less than any computer capable of doing the same jobs: only $990.00 (not including the video monitor or printer of your choice).

Best of all, it's designed and made by Australians, specifically for Australian conditions.

By the way, we'll let you into a little secret: the TeleTerm is really a dedicated computer. But it's so friendly, you'd never guess.

You can try one for yourself at any of our Computer Centres. Or ring us, to arrange a demonstration in your office.

microbee computer

Sydney: Ryde (02) 886 4444
Waitara (02) 487 2711
Melbourne (03) 817 1371
Canberra (062) 51 5883
Newcastle (049) 61 1090
Gosford (043) 24 2711
Brisbane (07) 394 3688
Adelaide (08) 212 3299
Perth (09) 386 8289
New Zealand: Auckland (09) 88 1138
Prices quoted are subject to change without notice.

HOTOL: Britain's super spaceplane

London to Sydney in 67 minutes!

Imagine a single-stage spacecraft that could take off horizontally, fly into space and land at any jet airport. It's called HOTOL and it could fly early next century.

by IAN COUGHLAN

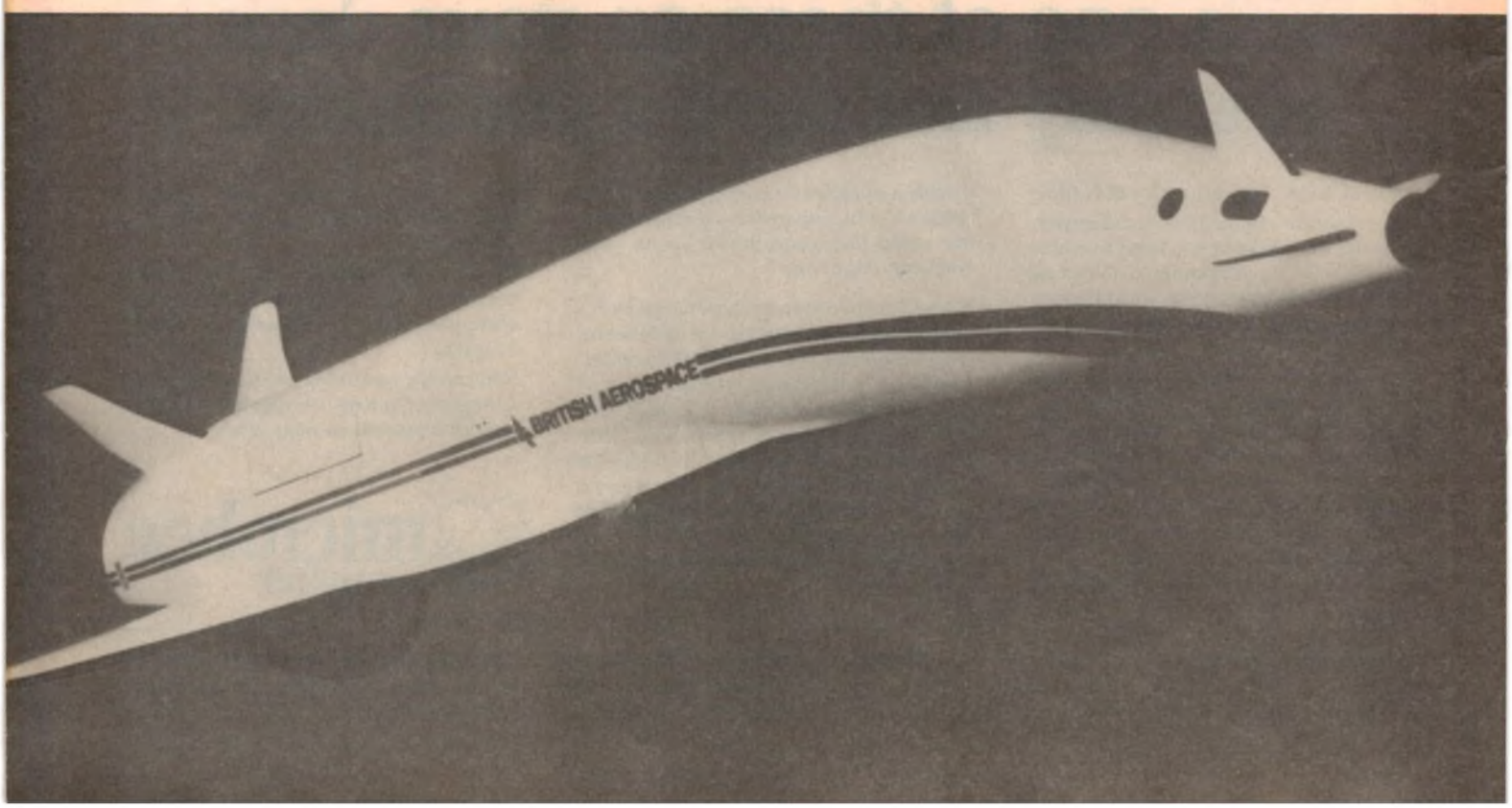
Even if the recent *Challenger* disaster had not happened, it is a certainty that the American Space Shuttle program would have come in for a major rethink in the near future.

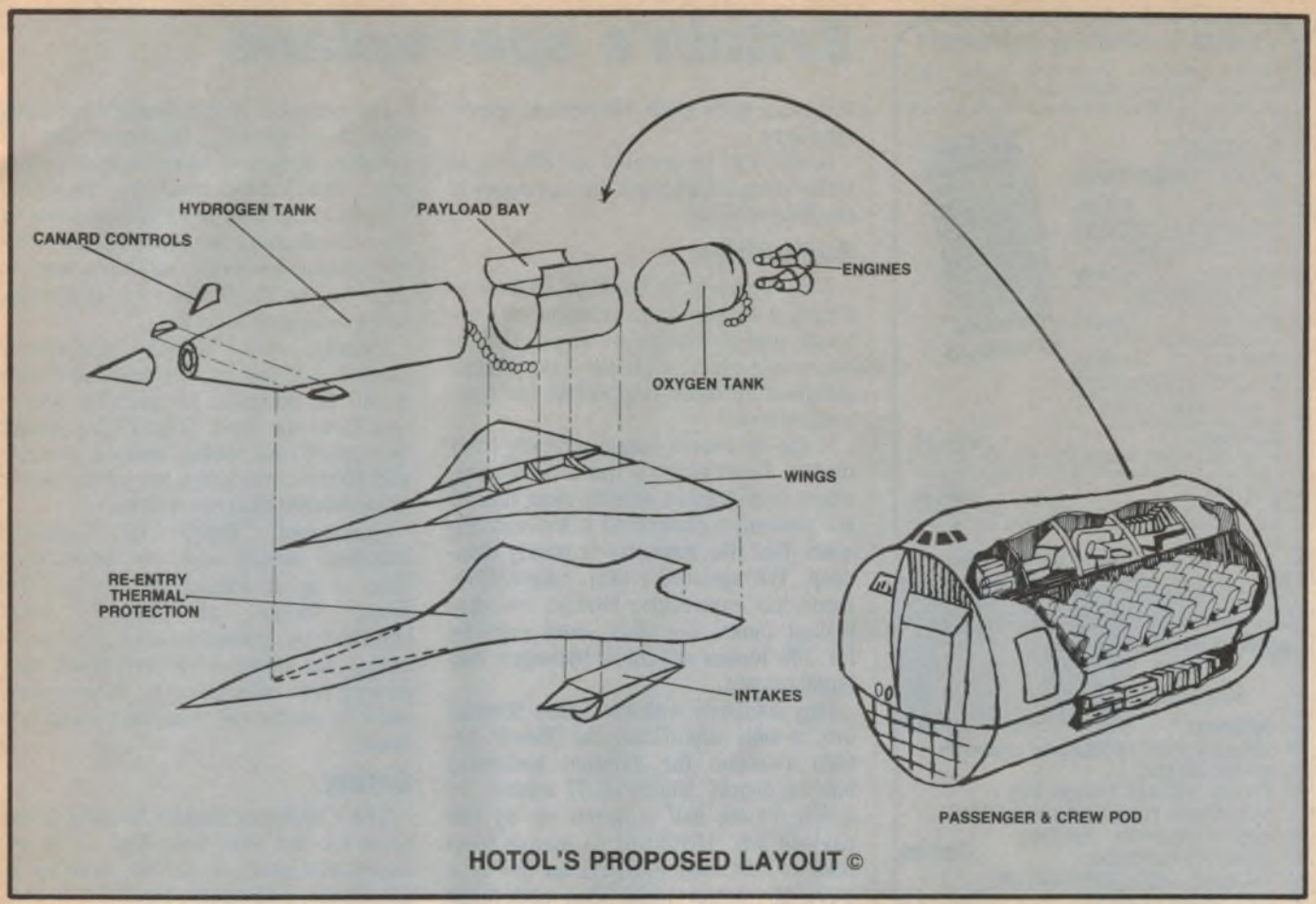
As the market for satellites grows, so the machinery for launching them will be examined closely in an attempt to stop costs following payloads skyward.

The European Space Agency (ESA) has for years been putting satellites into orbit aboard *Ariane*, a conventional, unmanned rocket, and doing so at a price that competed with the Shuttle, so it was clear that the Americans were going to have to take a long, hard look at their spacecraft, to discover how it could be improved.

That horrific accident, in which seven astronauts died in full view of the world, may have grounded flights of the Space Shuttle for many months, but it will also precipitate the development of a replacement launcher system, bringing it forward by many years. In the aftermath of the accident, much of the original design will be changed. What is certain to remain is the concept of a reusable orbiter. Throwing huge chunks of very expensive hardware into the Atlantic, which is what ESA's *Ariane* rocket does, is not the best way of keeping costs down.

Ariane has had its share of problems too, and a couple of dramatic failures have brought the European space program to a grinding halt. The development of a replacement for *Ariane*, on the cards for quite some time, has also been precipitated by this series of unfortunate accidents and, if ESA's space program is to remain viable, that re-





HOTOL'S PROPOSED LAYOUT ©

placement system will have to compete with the next generation of American Space Shuttles.

Recognising this need, British Aerospace PLC (part of the European consortium responsible for Concord), recently announced a proposal for a European spaceplane, and called it HOTOL (for HOrizontal Take-Off and Landing). This announcement came before the *Challenger* and *Ariane* problems. Not surprisingly, HOTOL looks like a cross between Concord and the Space Shuttle, and it is indeed intended to be half-aircraft, half-spacecraft.

How it works

It is proposed that HOTOL should take off and land at ordinary airports, and that it should do so horizontally and without the assistance of rocket boosters. It will accelerate along the runway on board what may best be described as a glorified shopping-trolley, which is left behind on take-off (a lightweight undercarriage is provided for landing).

The entire spacecraft, fuel tanks included, then goes into orbit.

Conventional launch systems — including the Shuttle — only manage to get into orbit by dumping an awful lot of bits and pieces such as rocket-stages and solid-fuel boosters: the mass that reaches orbit is a mere fraction of the mass that stood at the launch-pad.

How can HOTOL, like some supercharged Jumbo jet, simply fly into orbit with none of the messy business of casting-off large chunks of metal? A single-stage-to-orbit launcher has long been dreamt of but never attained. Has British Aerospace cracked it at last?

They seem to think so.

The company has been developing a propulsion system — codenamed *Swallow* — that will operate as a jet engine up to some 26 kilometres altitude, and thereafter as a rocket motor. Breathing atmospheric oxygen, HOTOL would not need nearly as much liquid oxygen as would a conventional launcher, and so gain an enormous saving in take-off weight.

British Aerospace claim to have done "considerable work" on the propulsion system, but for the moment they're keeping it all hush-hush. At best, that could mean they've tested a prototype engine; at worst, it would mean that such an engine may just be theoretically possible.

The implications

If the system does work, the implications are tremendous, for it would render existing launch systems obsolete overnight, at least in certain applications; and if re-filling the propellant tanks is all that has to be done after each landing, then HOTOL looks set to be the launch system of the future.

Interestingly, while the present Shuttle can put payloads of up to 30,000 kilograms into orbit (and the next generation is likely to have an even greater capacity), HOTOL will lift only 7000 kilograms. Despite that, HOTOL will probably still be the more efficient system, and in any case, says British Aerospace, that is enough to cater for most customers.

The Shuttle's mass at lift-off is more than two million kilograms, of which something like 90% is liquid hydrogen and liquid oxygen; the payload only contributes about 1.5% to the lift-off mass.

HOTOL's take-off mass is only one tenth of the Shuttle's, but more importantly, only 75% is propellant, while more than 3% is payload. So while HOTOL may not be able to carry more than 7000 kilograms on each flight, it

Britain's spaceplane

will carry such loads with much greater efficiency.

It will also be possible for HOTOL to make several flights for the same cost as one Shuttle flight.

Similarities

It is tempting to think of HOTOL as simply a bigger, faster version of Concorde, and it certainly looks precisely as one would expect a Shuttle-type vehicle, designed by those responsible for Concord, to look.

It has an overall length virtually identical to Concorde's; it has a delta-wing, albeit considerably smaller than that of the passenger plane; and it has a droop nose. But the similarity is purely skin-deep. For under the skin, where Concorde has passengers, HOTOL has propellant tanks; big ones, with capacity for 150 tonnes of liquid hydrogen and liquid oxygen.

Any similarity with the Space Shuttle, too, is only superficial: the Shuttle orbiter (without the external fuel-tank) has an overall length of 37 metres, of which almost half is taken up by the payload bay. HOTOL is 63 metres from nose to tail, and the payload bay is a mere 10 metres long. This underlines the fact that the Shuttle Orbiter is part of a launch system that includes the external fuel-tank and solid-fuel boosters, while HOTOL is intended to be completely self-contained.

Launch sites

Launch sites have traditionally been close to the equator, to make use of the Earth's spin, and although such sites are not strictly necessary, they considerably reduce the power required to get into orbit — particularly Equatorial orbit.

Cape Canaveral has a latitude of some 28° north, while ESA's launch site is in French Guiana, 5° north.

The USSR launches its rockets from Central Asia, at considerably greater distances from the Equator, and this may have something to do with the fact that the Soviets have some of the most powerful rocket launchers of all!

The laws of physics are the same for HOTOL as they are for everyone else, so while it can take off from any latitude, the payload decreases with increased distance from the Equator.

What makes HOTOL different is its ability to take off from ordinary airports: it doesn't need a specially constructed launch facility. This opens up all sorts of possibilities.

For instance, at the moment payloads have to be taken to the launch site by ordinary aircraft or other form of transport, and loaded onto the launcher. HOTOL could land at an airport close to the manufacturer of the payload, take the payload on board, and then make a short hop to the Equator for re-fuelling before taking off for orbit.

Initially, say British Aerospace, HOTOL will not have a crew, although it will be designed for manned operation from the start. Test flights would be carried out under remote control, and HOTOL will make use of the latest in artificial intelligence systems.

Operational flights (ie, satellite launches) would also be unmanned. That is as it should be. Before the Space Shuttle, all satellites were launched by unmanned craft; the technology for doing so is well tried, and putting men into space to do a robot's work is surely not a technological advance.

Safety

The *Challenger* disaster brought home to us the fact that space flight is by no means as routine, or as safe, as flying in an airliner. Eventually, however, British Aerospace envisages manned flights for HOTOL, and doubtless these are necessary for certain experiments, although any space administration will now think very, very seriously about the possibility of replacing men with super-intelligent robots.

The biggest problem with manned spaceflight is, of course, that people and propellants do not mix: the image of *Challenger* exploding must be deeply etched in everyone's mind. British Aerospace say that HOTOL's fuel load can be dumped quickly and safely in the event of a flight being aborted shortly after take-off, but they don't say how.

One outstanding safety feature that HOTOL has — and which owes nothing to the *Challenger* disaster, since it was designed before the accident — is that if a crew is to fly with HOTOL, it will do so within the payload bay. The crew compartment, contained in a separate pod, could be quickly ejected in an emergency.

Commercial flights

Perhaps the most exciting aspect of HOTOL is its ability to carry passengers. It won't happen for many more years, and when it does, the price of a ticket will be suitably astronomical, but if

HOTOL can be made to fly, then there seems to be no reason why it should not be used for passenger flights.

Operating as a sort of Intercontinental Ballistic Airliner, it could take off from London, for example, cutting its motors before reaching orbital velocity, and following a ballistic trajectory before re-entering and gliding in to land at Sydney, Australia. British Aerospace reckon it would have a take-off to touchdown time of 67 minutes. Pie in the sky? Well, if someone had told Captain Cook that the journey which had just taken him several months would one day be done in twenty one hours — the scheduled journey time of a Jumbo flight — he'd have laughed, too.

Concorde can do the trip in even less time than a Jumbo jet.

HOTOL's payload bay, at 10 metres long by 5.7 metres wide, is large enough to accommodate about 50 passengers in comfort, in surroundings much the same as today's wide-bodied airliners. As for the manned orbital flights, a self-contained, ejectable pod would be used. (In-flight meals would probably not be served: being weightless for a large part of the trip, many passengers may have problems keeping food down).

Re-entry

Friction heating on re-entry reveals another interesting thing about HOTOL. Whereas the Shuttle uses heat-resistant tiles, HOTOL will be protected by a layer of high-temperature metal alloy. This isn't another attempt to bend the laws of physics. HOTOL will be going just as fast as the Shuttle on re-entry, but because it is much lighter, and has a larger wing, it will shed energy (ie. speed) much more rapidly.

It will be interesting to see how British Aerospace overcomes the problem of thermal expansion: Concorde, travelling at Mach 2, stretches by several centimetres, and Lockheed's SR-71 Blackbird stretches by about 30 centimetres at Mach 3.5.

For the upper surfaces of HOTOL, ordinary (ordinary?) titanium will be used.

The large wing has another benefit: with twice the lift-to-drag ratio of the Shuttle, HOTOL will have a good cross-range capability, so it could, if required, land in Europe from an Equatorial orbit, and if sufficient fuel was available, a powered flight to anywhere on the globe would be possible, from any orbit. And, as mentioned earlier, it could fly from any ordinary airport to the optimum launch site.

Subsonically, HOTOL has a still better lift-to-drag ratio, and for flights within the atmosphere, it should be possible to strap on a couple of air-breathing jets and fly HOTOL like an ordinary aircraft.

Here's how British Aerospace see HOTOL working. Take-off speed is 290 knots, vertical acceleration at take-off is 1.15g, and climb attitude is 24 degrees. HOTOL would go supersonic after two minutes, reach 12 kilometres after four and a half minutes, and 26 kilometres and Mach 5 after nine minutes. At this altitude, there would be insufficient atmospheric oxygen, and so HOTOL would continue with on-board liquid oxygen.

At 90 kilometres altitude, orbital velocity (7.9 kilometres per second) is reached, and the engine is cut. HOTOL then coasts to low orbit, at 300 kilometres altitude.

At the end of the mission, the Orbital Manoeuvering System slows the vehcile, and the perigee is brought down to some 70 kilometres for re-entry.

With its high cross-range capability, and because its engine can be re-lit, HOTOL could be put down just about anywhere. Touchdown speed is 170 knots, and wet runway groundroll is 1.8 kilometres.

Conclusions

So when will HOTOL fly? British Aerospace hope to be in the satellite launching business by the year 2000, but that is almost certainly over optimistic. It took thirteen years to get the first Concorde prototype off the drawing-board and into the air, and another seven years of testing before it could go into service — and the designers knew before they started that the technology worked and that all they had to do was see if they could make a commercial airliner out of it.

HOTOL's designers don't yet know if the technology will work, and really are stepping into unknown territory. They will have massive problems to overcome, not least with the revolutionary drive system. If the system can be made to work, HOTOL will have to prove itself, launching satellites, for many, many years before it will be used for passenger flights.

HOTOL is very much a long term research program then, and it will probably be twenty years or more before a prototype gets off the ground. By then, it will probably bear little resemblance to British Aerospace's original proposal.

There can be no doubt that one day a single-stage-to-orbit launcher will be built. Whether HOTOL will be that launcher remains to be seen.

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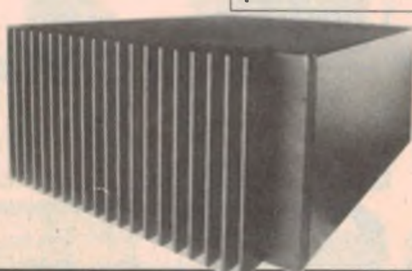

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FORUM

Conducted by Neville Williams

Low loss cables, valve amplifiers &c

With December with us once again, it would seem an appropriate time to gather up a few loose ends left over from the past year. For starters, an interesting parallel has emerged from the instalment in the September issue entitled: CD — Do Some Models Sound Better Than Others?

As you may recall, the article mentioned a double-blind subjective comparison of six representative compact disc players, the whole procedure being controlled and scored by computerised equipment in an IEC standard listening room at DLC Design Inc. in Michigan, USA.

The purpose of the tests was to establish whether experienced listeners could discern differences in the sound of the respective models consistently enough to represent a statistically valid verdict.

It was reasoned that, if perceptible differences could be verified, there would be a logical basis on which to speculate about the nature of the differences and the merits of the respective players. On the other hand, debate about sound quality would obviously be pointless if the observers could not even reliably pick one from the other.

Amongst other things, special care was taken, in setting up the tests, to ensure that the level of sound from each player was identical. I quote:

According to the Author, the levels had to be precisely balanced before each set of tests (presumably on white noise) because it was found that a loudness margin of even 0.2dB was enough to make a player sound "better".

The statement came to mind when Editor Greg Swain mentioned recently in casual conversation, that there was still a fair amount of debate within the hifi industry about the claims being made for super-quality audio cables, &c. Their proponents continued to claim advantages ranging from modest to preposterous, while detractors were no less persistent in calling — so far in vain — for any shred of objective supporting evidence.

While the more outlandish claims may well be the product of a commercially advantageous imagination, subjective reaction to low-loss loudspeaker cables, at least, could conceivably be attributable to marginal differences in loudness.

Calculations suggest that ordinary loudspeaker cables typically introduce a loss in level of about one quarter of a decibel in an 8-ohm circuit, compared with nominally loss-free heavy duty cables. As such, it is comparable to the 0.2dB loudness margin suggested above as being unacceptable in an A-B test situation.

There is nothing new about the basic notion. Subtly turning up the level of the equipment you're trying to sell is one of the oldest tricks in the hifi demonstrator's handbook! The present claim is that even a small fraction of a decibel can be significant in a critical environment.

Loudness, not quality

It should be emphasised that what we are talking about is purely and simply a function of loudness — not quality. Whether due to the setting of the volume control or to any other circumstance, the slightly louder version of a given signal will normally sound marginally "better" than its counterpart; more "forward", more "body", less constricted — describe it how you will.

In short, if by generously designed switching, low-loss cables are compared directly with the standard variety, all other things remaining equal, the low-loss cables may sound "better", simply because of that critical quarter-decibel loudness margin.

Whether the sound is "better" in terms of actual quality is quite another matter. Before one could reach any such conclusion, the switching would need to be modified to vary the amplifier gain simultaneously to compensate for any difference in output level.

If it should transpire that the difference is purely one of loudness, then the installation of super low-loss loudspeaker cables would be a rather expensive alternative to an almost imperceptible clockwise nudge to the volume control!

If you still consider the expenditure worth the benefit of any doubt, so be it. As someone remarked to me recently, you at least have the assurance of that, for your outlay, you've received a generous helping of copper and decent end connections!

I'm less sanguine, however, about other fancy small-signal cables that are currently on offer. Gold plated end connectors may provide long-term protection against contact corrosion but, in those normally medium impedance circuits, I have yet to discover any justification whatever for exotic claims, exotic materials and exotic prices.

Until those claims, materials and prices can be justified, my money stays right where it is!

Turning the clock back

A reader from Berridale, NSW, who wishes not to be identified in print, has sent me a copy of an historic circuit blueprint which he found tucked away inside the pages of an even more historic wireless textbook — a 1928 edition of Nelson & Hornung's "Practical Radio Telegraphy".

Included as a supplement in the July 13, 1934 issue of "Wireless Weekly", it was a circuit of the "Champion Superhet", the winning design in a competition conducted by the particular journal in that year and subsequently detailed for home construction.

More elaborate than most commercial receivers of the day, it was an 8-valve superheterodyne, using a type 58 pentode as an RF amplifier, a 57 pentode as an autodyne frequency changer, another 58 as an IF amplifier, a 2A6 combined diode detector and triode audio voltage amplifier, and a 56 triode phase splitter feeding a pair of European E406 directly heated power triodes in push-pull.

The rectifier was a 523, also directly heated, fed from a heavy duty 385-0-385V power transformer.

In a nostalgic mood, the writer recalls that he had built up a version of a somewhat similar design — probably the "1933 Standard" using much the same front end, followed by a type 55 diode detector and audio triode, driving a pair of 2A5 output pentodes.

One small problem!

It was quite a good receiver, he said, except for one rather disturbing problem; the first electrolytic filter capacitor would occasionally explode and spray its liquid contents over the contents of the wooden cabinet!

That, I'm afraid, was a not infrequent occurrence in those days when power transformers were conventionally wound with 385-0-385V secondaries, to ensure sufficient voltage to supply the output valve(s) and energise the loudspeaker field coil.

With a directly heated rectifier and indirectly heated output valves, there was a critical period after switch-on when the virtually overloaded power transformer and rectifier might, on occasions, apply 550-odd peak volts to a "wet" electrolytic filter capacitor officially rated at 525PV. It was very much a "Russian roulette" situation. I quote:

"The noise of such an explosion in a wooden cabinet was really something but the mess inside normally left one speechless for a minute or so!"

Taking a cue from the 1934 circuit, the correspondent recalls that he modified his receiver to accommodate directly heated output valves — the older type 47 power pentodes. The change-over involved some loss of output but it overcame the problem.

Another valve enthusiast

Something more than mere nostalgia prompts another letter to do with valve-based hifi equipment, this one from R.C. in Hawker, ACT.

He begins with a word of appreciation for the many "WNW" articles which have been published in EA over the years and says that, as a one-time "impoverished student and ardent music lover", he relied heavily on information which appeared in EA (then "Radio, TV and Hobbies"), "Radiotronics", "Mullard Outlook" and Philips' "Miniwatt Digest".

His favourite relic from those now far-off days, which is still in use in Melbourne, is an EA Playmaster 10W stereo amplifier, as described in the December 1959 issue. It used EL84/6BQ5 output valves in a push-pull ultralinear configuration, with A&R type 4007 output transformers. Says R.C.:

It is connected to a high performance transistor preamplifier of recent design. Recently, I was impressed anew when I heard it reproducing a compact disc recording of piano music broadcast by ABC FM.

Because the particular amplifier is fitted with 15-ohm output transformers, it is unsuitable for use in his present transistor based 8-ohm system. However, "out of interest (to see how it would sound) and sheer nostalgia", R.C. has been putting together an 8-ohm version using parts picked up from here and there, including a pair of output transformers imported from Sowter, England.

"Unsurpassable quality"

Beyond mere interest and nostalgia, R.C. insists that there are other more practical considerations why readers like himself may, once again, want to get involved in building valve type amplifiers. He explains it this way:

One is the fact that really good valve amplifiers produce sound of unsurpassable quality. I believe that it is not necessary to argue that view.

However, the cost of commercially made valve amplifiers, these days, is incredible. One Melbourne firm recently put a price of $2500 on an imported stereo power amplifier which consisted of nothing more, above chassis, than one power and two output transformers, two capacitors, and valves. The matching preamplifier was another $2500.

While not inconsiderable, the cost of building such an amplifier need not be prohibitive, either.

The iron-cored components would present the greatest difficulty. A couple of years ago, the traditional local manufacturers quoted me about $100 each, including tax. However, responding to an advertisement in "Wireless World" I imported a pair of output transformers from the English firm of Sowter for an all-up cost of about $A110.

Sowter claims that they can supply transformers for the more common applications ex-stock and, assuming that this would cover EL34 output valves, one might expect to land the power transformer, output transformers and choke for a high-powered stereo ampli-

Those plastic credit cards.

Dear Sir,

Despite early reservations, I accepted Bankcard and have found it a handy facility, even if it is one that calls for a certain amount of discipline in its use.

However, when my bank installed automatic teller machines and supplied my wife and I with access cards and personal identification numbers, I was apprehensive about their security. Since we didn't really need the service, I aborted it in the only way the bank staff seemed to know about, namely by shredding both cards and numbers before they had a chance to be used.

That was that until the bank extended the service to include ordinary bankcards. Again I was told that if I did not want to take advantage of it, I should merely destroy the PIN number. This I did, but without having any real assurance that, by simply not using the number, my account would be rendered inaccessible.

I am not ignorant of computers and other technical matters but, in a society plagued with everyone from pickpockets to hackers, I'm obviously a lot more cautious than the people I see around the place, carrying a whole line-up of plastic cards.

However, in view of recent publicity about card and computer frauds, my old-fashioned, conservative caution may not be misplaced.

If you choose to reproduce this letter, just call me Y.Z. (Wise 'ead). That way, I'll keep my local bank guessing!

Y.Z. (Epping, NSW)

fier for something over $A300.

On this basis, a complete basic power amplifier should not cost much more than about $400 — competitive with premium grade transistor amplifiers and not a lot to pay to get into top-of-the-world class sound. The valve unit may not be as powerful as the transistor models but, at 35-40W per channel, it may be adequate for many readers.

In summary, I am suggesting a restatement of the 17 + 17W Playmaster, using valves that may be around for a while yet, and with possible options that would offer higher output. If the information could not extend to an actual prototype, a circuit diagram with essential specifications and voltages would give us something to go on.

Perhaps this letter could provide the basis for a "Forum" article along the lines of "Valve amplifiers in retrospect".

Responding to R.C.'s letter, I guess that, during my career, I've been more deeply involved in the manufacture and application of valves than most readers of this magazine and I certainly know what valve nostalgia is all about.

Nostalgia's okay, but . . .

A few days prior to writing this instalment, I had on my home workbench a veteran church amplifier based on the 17W Playmaster circuit. An enthusiast from way back walked in while I was replacing a few tired bits, looked over my shoulder and proceeded to make all the usual clucking noises.

"Say what you like, these old valve amplifiers are friendly bits of gear", he said. "Switch 'em on and they come alive. You can trace the circuit from socket to socket by just looking at the wiring; and you can measure the voltages just as easily and pick those that make sense from those that don't.

"Transistor amplifiers aren't like that and IC amplifiers are even worse. They may be more efficient and all that but they're a bit like diesel and electric locos; they don't have the personality of a steam engine!"

I can understand that but to proceed from a sentimental attachment to attributing uniquely musical qualities to valve-based amplifiers is something that I baulk at. Maybe, living with valves for all those years, I became a little too familiar with their limitations!

By the standards of the day, the final generation of ultralinear Playmaster designs were good and, in kit form, represented outstanding value. But, for all that, they simply couldn't match the performance figures, the reliability and the economy that became possible as solid-state audio technology matured.

Admittedly, the first generation of transistor amplifiers had its share of problems that prolonged support for the Quad, Leak, Wharfedale, Williamson — and Playmaster — amplifiers that had gained pride of place in the listening room.

Fact or fancy?

But that's history and I don't accept R.C.'s facile assumption that the superiority of a "really good" valve amplifier is "unsurpassable" — beyond challenge or debate. He's guilty, I fear, of reciting a cult credo, supported passionately by some and ridiculed by others.

Don't get me wrong. A "really good" valve amplifier may indeed be just that but, to my mind, it's a difficult, a cumbersome, expensive, uneconomic and somewhat precarious way to attain a given end result — particularly if the design philosophy is extended to include an all-valve preamplifier.

The last high-power valve amplifier project I can recall (not in this magazine) offered 140W from four 6CA7 output pentodes in parallel push-pull. It called for a potentially lethal 750V supply for the anodes and the descriptive article made considerable point of precautions to forestall possible problems with flashovers and breakdown.

Maybe R.C. has something rather less ambitious — and less fearsome — in mind but, even so, he might need to revise substantially upwards his cost estimate extrapolated from 1983/84 prices.

I certainly do not accept the further apparent assumption that the intrinsic superiority of a valve amplifier is such that one can settle for modest 30-year old levels of power output, distortion and noise and come out ahead of a modern, more highly specified, cost-competitive solid-state unit.

For sure, a 17+17W ultralinear Playmaster will sound fine playing a compact disc via FM, but so also will a lot of other amplifiers, valve and solid state. It proves nothing and, as a proposition I don't see how it could possibly compare, for example, with the Playmaster 60/60, featured in the May, June and July issues and currently offered for an all-up kit price of $249.

In closing, R.C. suggests that I might consider writing something along the lines of "valve amplifiers in retrospect".

That may not be a bad idea because, over and above the historic and nostalgic aspects of what we call "valves" and the Americans call "toobs", they did provide a penetrating insight into the fundamentals of audio-hifi technology — one that has been largely lost to the last generation of engineers and enthusiasts.

It may even be possible to resurrect one of the old valve amplifiers and see how it stacks up on the kind of test gear that we now use to evaluate solid-state equipment.

Thanks for the suggestion, R.C. I'll keep it in mind.

Finally, there's the letter in the accompanying panel which raises the question of security, relative to credit cards, &c. The correspondent is not alone in his concern.

One can be forgiven for imagining that, in the new and unfamiliar area of computerised banking, we are watching a see-sawing game between the goodies and the baddies, the Wits and the Outwits.

It lends a certain wry humour to the advertising slogan: "They're good sports with money" — especially our money.

FREE POSTAGE FOR ALL ORDERS OVER $75 & UNDER 3KG!!

ARGUS 726 ADJUSTABLE MAGNIFIER WITH LAMP

Absolutely perfect for close up work! Intricate PCB's, projects, etc will be a breeze under this superb adjustable magnifying lamp.

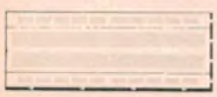
- Magnifies 1.75 times
- 40 watt incandescent lamp
- 2 spring-balanced arms, extendable to 95cm
- Adjustable head for optimum viewing angle
- Comes with desk clamp, (interchangeable with base)
- Fantastic Value!!

Cat. Our price **$89**

STROBE LIGHTS 12V

Available in 3 colours, red, blue and yellow. These units have a magnetic base and are fitted with 4 metres of cable terminating in a cigarette lighter plug. Ideal for displays, parties, attention getting, motoring emergencies/breakdowns etc.

Cat.No.	Description	Price
A15046	Blue	**$32.95**
A15047	Red	**$32.95**
A15045	Amber	**$32.95**



BREADBOARD SPECIALS

Why pay more?

Cat.P11000 100 holes	$2.75
Cat.P11005 640 holes	$10.75
Cat.P11007 640 + 100 holes	$13.00
Cat.P11009 840 + 200 holes	$17.50
Cat.P11010 1280 + 100 holes	$19.95
Cat.P11011 1280 + 300 holes	$32.50
Cat.P11012 1280 + 400 holes	$36.75
Cat.P11015 1920 + 500 holes	$57.50
Cat.P11018 2560 + 700 holes	$64.95

PC BOARD HOLDER

Better than an extra pair of hands! A must for all PCB work.

Cat. T12444 **$9.95**

HIGH EFFICIENCY RADIAL FIN HEATSINK

Black anodised with a thick base plate, this radial fin heatsink can dissipate large amounts of heat for maximum efficiency. Designed by Rod Irving.

105x30mm	Cat. H10520	**$ 3.50**
105x75mm	Cat. H10525	**$ 3.50**
105x100mm	Cat. H10529	**$ 4.90**
105x140mm	Cat. H10534	**$ 6.50**
105x150mm	Cat. H10535	**$ 6.75**
105x170mm	Cat. H10538	**$ 7.95**
105x195mm	Cat. H10542	**$ 9.90**
105x200mm	Cat. H10543	**$ 9.90**
105x225mm	Cat. H10546	**$10.50**
105x300mm	Cat. H10549	**$12.00**
105x600mm	Cat. H10560	**$24.95**

DIGITAL SPEEDO/ DIGITAL TACHO/ SPEED ALERT

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

Cat. A15064 R.R.P. $89.95

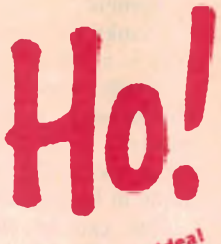
OUR PRICE $74.95

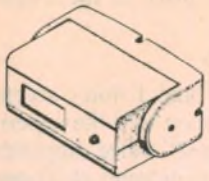
CODE KEY PAD

- Telephone type digital keypad.
- Four digit, changeable code.
- Over 5000 possible combinations.
- Power consumption: 5mA standby, 50mA alarm.
- Two sector LED and 1 arm LED.
- Wrong number lockout.
- 12V DC operation.
- Relay output.
- Panic button.
- Normally open tamper switch.
- Dimensions: 145 x 100 x 37mm.
- ACP3 compatible.

Cat. A13014 R.R.P. $79.95

SPECIAL, ONLY $69.95





PASSIVE INFRA RED DETECTOR

Compact P.I.R. with adjustable corner or wall mounting bracket, dual pyroelectric infra red sensing element gives a coverage 2 x 14 zones 2m high and 10m wide.

- Sensitivity adjustment control
- Detecting range 12-15 metres at 90 degrees
- Detecting zones 9 long (up), 5 short (down)
- LED indicator for walk test. (can be disabled)
- Shielded against RF interference
- Relay output NC or NO at 30V (AC/DC) 0.5A max
- Integral NC tamper switch
- Operating voltage 10.5 - 16V DC
- Current 20mA with LED 25mA

$145

MINI UTILITY CASE

Features a clear plastic lid for instant inspection of contents. Up to five adjustable lower compartments plus a self elevating upper tray for smaller items.

Dimensions: 110 x 210 x 43mm.

Cat. H10087 **$7.95**

RITRON 19" RACK CASE

Tremendous Value! Dimensions 480(W) x 134(H) x 250(D)mm.

Cat. H10415 **Normally $47.95**

SPECIAL, ONLY $42.95

POWERFULL MINI DRILL

Featuring a powerful 6000 r.p.m. motor, this lightweight (113gm) drill is ideal for many jobs. Perfect for PCB work! Has a 0.8 to 1.2mm chuck and 1mm drill bit. Requires 12V 1 AMP (use with M19010)

Cat. T12302 **$17.95**

TRANSISTOR NIPPERS

Normally $13.95!

Cat. T12070 **$11.95**

MICRO NIPPERS

Normally $13.95

Cat. T12050 **$11.95**

BRAND NEW FANS

Quality, new fans for use in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.

240V	4⅝"	Cat. T12461	**$14.95**
115V	4⅝"	Cat. T12463	**$14.95**
240V	3½"	Cat. T12465	**$14.95**
115V	3½"	Cat. T12467	**$14.95**

10+ fans (mixed) only $10 each!

FAN GUARDS TO SUIT

4⅝"	Cat	T12471	**$3.95**
3½"	Cat	T12475	**$3.95**

ARLEC SECURITY BEAM

This compact security system transmits an invisible, modulated beam of infrared light which can be directed across a doorway, path or any other to be monitored. Anyone walking through the beam immediately causes an audible warning to sound. Suitable for shops, homes, factories etc.

FEATURES:

- Small compact design
- Infrared modulated beam
- Prismatic reflector allows up to 10° misalignment
- Effective range is 2 - 8 metres
- Low voltage (9V) operation via S.E.C. approved adaptor
- Negligible power consumption
- Simplified wiring
- Solid state electronic circuitry
- Produces audible warning
- Easy installation
- 12 months guarantee

Cat. A15060 **$89.95**

ELECTRONIC DOOR ALARM AND CHIME

Electronic control system with powerful in-built 100dB alarm. Changeable 3 digit, push button, secret code controller that is tamper proof. 3 function switch provides off position, chime and 7 seconds delay entry. Emergency panic button. Suitable for left or right hand door opening. Simple installation, no wiring required. Low current 15mA at 9V. Operates on 9V battery.

Cat. S????? **$44.95**

PIEZO SIREN

- 4 piezo units in a high impact plastic cabinet
- Input 12V DC - 200mA
- Output 115dB at 1m, dual tone
- Compact size 105 x 85 x 45mm
- Smart design suits interior use

Cat. S15071 **$23.95**

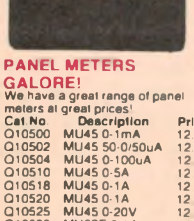
RITRON KEYLESS CAR ALARM

The first shipment sold out immediately to the trade. They didn't reach our own retail stores!

- Activated and disarmed by ignition key, so you never forget to turn it on.
- Multi-function, built in siren or external siren, car signal horn output.
- Easy to install, no door switch required.
- Automatic reset after 60 seconds (avoids noise pollution)
- Special sensor protects Stereo or CB
- 12V DC

Cat. S15054 **Normally $39.95**

NOW $29.95



PANEL METERS GALORE!

We have a great range of panel meters at great prices!

Cat.No.	Description	Price
Q10500	MU45 0-1mA	12.50
Q10502	MU45 50-0-50uA	12.50
Q10504	MU45 0-100uA	12.50
Q10510	MU45 0-5A	12.50
Q10518	MU45 0-1A	12.50
Q10520	MU45 0-1A	12.50
Q10525	MU45 0-20V	12.50
Q10530	MU52E 0-1A	14.50
Q10533	MU52E 0-5A	14.50
Q10535	MU45 VU PMetre	14.95
Q10538	MU65 0-50uA	16.95
Q10540	MU65 0-1mA	16.95
Q10550	MU65 0-100uA	16.95
Q10560	MU65 0-20V	16.95

ARLEC SUPER TOOL

A versatile 12V electric tool for...

- Sanding
- Engraving
- Grinding
- Polishing
- Cutting
- Drilling
- Milling
- Erasing, etc.

Features:

Operates on safe, low 12 volts from mains electricity via AC adaptor (supplied). Light and easy to handle with touch switch and lock for continuous running. High torque motor. 10,000 R.P.M. Can drill 2mm holes in steel. 2 year guarantee.

Contents:

- 12V Super Tool
- Plugpack AC adaptor
- 1 spherical milling cutter
- 1 wire brush
- 1 grinding wheel
- 4 drill bits, 0.6, 0.8, 1.0, 1.2mm
- Set of 5 chuck collets
- 6 eraser sticks
- Instruction sheets

Cat. T12300 **$59.95**

FREE STANDING, FOLD UP MAGNIFIER

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

Cat. T12083 **$14.95**

CORDLESS RECHARGEABLE SOLDERING IRON

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

Cat. T12480 Normally $79.95

SPECIAL, $69.95

WELLER WTCPN SOLDERING STATION

The WTCPN Features:

- Power Unit 240 V AC
- Temperature controlled iron, 24 V AC
- Flexible silicon lead for ease of use
- Can be left on without fear of damaged tips!

The best is always worth having.

Cat. T12500 R.R.P. $149

SPECIAL, ONLY $129

ANTISTATIC SOLDER SUCKER

- Light weight
- Sturdy construction
- Easy to remove tip
- Excellent value for money!

Cat. T11281 **$13.95**

METEX MULTIMETERS

These instruments are compact, rugged, battery operated, hand held 3½ digit multimeters. Dual-slope A-D converters use C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided.

METEX 3800 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3½ digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, for testing Audible continuity and transistor hFE. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.

Features:

- Push-button ON/OFF power switch.
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection.
- ½" high contrast LCD.
- Automatic over-range indication with the "1" displayed.
- Automatic polarity indication on DC ranges.
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001".
- High Surge Voltage protection 1.5 KV.3 KV.
- Diode testing with 1 mA fixed current.
- Audible Continuity Test.
- Transistor hFE Test.

SPECIFICATIONS

Maximum Display: 1999 counts 3½ digit type with automatic polarity indication.

Indication Method: LCD display.

Measuring Method: Dual-slope in A-D converter system.

Over-range Indication: "1" Figure only in the display.

Temperature Ranges: Operating 0-C to +40-C.

Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat. Q91530 **Normally $99.95**

SPECIAL $89.95

METEX 3530 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3½ digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, Capacitance, Transistor hFE and Continuity Test. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.

Features:

- Push-button ON/OFF power switch.
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection.
- ½" high contrast LCD.
- Automatic over-range indication with the "1" displayed.
- Automatic polarity indication on DC ranges.
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001".
- High Surge Voltage protection 1.5 KV.3 KV.
- Capacitance measurements to 1pF
- Diode testing with 1 mA fixed current.
- Audible Continuity Test.
- Transistor hFE Test.

SPECIFICATIONS

Maximum Display: 1999 counts 3½ digit type with automatic polarity indication.

Indication Method: LCD display.

Measuring Method: Dual-slope in A-D converter system.

Over-range Indication: "1" Figure only in the display.

Temperature Ranges: Operating 0-C to +40-C.

Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat. Q91540 **Normally $129**

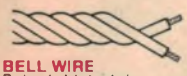
SPECIAL $119

FREE POSTAGE FOR ALL ORDERS OVER $75 & UNDER 3KG!!

"SNAP TOGETHER" PLASTIC CASE

Top and bottom simply snap together (no screws required). removable front and back panels. Size 186(W) x 125(D) x 50(H)mm

Cat. H10116 ..... $7.95



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	10+ rolls
$19.00/m	$17.50/m

Ho!

ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A Cat. M12155	$9.95	$8.95
2156 240V 6-15V 2A Cat. M12156	$14.95	$13.95
2840 240V 9V CT Cat. M12840	$5.95	$4.95
2851 240V 12-6V CT 150mA Cat. M12851	$5.95	$5.50
2860 240V 15V CT 250mA Cat. M12860	$5.95	$4.95
6672 240V 15-30V 1A tapped Cat. M16672	$14.95	$13.95

ELECTRET MIC INSERTS

With pins for easy board insertion Cat. C10170

1+	10+	100+
$1.95	$1.70	$1.50

HOOK UP WIRE

Cat. No.	Description
W11251	13/.12 TND BLK
W11252	13/.12 TLD BROWN
W11253	13/.12 TLD ORANGE
W11254	13/.12 TLD YELLOW
W11255	13/.12 TLD GREEN
W11256	13/.12 TLD BLUE
W11257	13/.12 TLD WHITE

PRICES PER 100 METRE ROLL

1-9	10+
~~$5.95~~	~~$5.00~~
$5.35	$4.50

W11260	14/.20 RED
W11261	14/.20 BLACK
W11265	14/.20 BLUE
W11268	14/.20 WHITE

PRICES PER 100 METRE ROLL

1-9	10+
~~$12.00~~	~~$10.00~~
$10.80	$9.00

W11270	24/.20 RED
W11272	24/.20 BLACK
W11274	24/.20 GREEN

PRICES PER 100 METRE ROLL

1-9	10+
~~$14.00~~	~~$12.00~~
$12.60	$10.80

W11280	32/.2 BROWN
W11282	32/.2 BLUE

PRICES PER 100 METRE ROLL

1-9	10+
~~$20.00~~	~~$18.00~~
$18.00	$16.20

HIGH INTENSITY ALPHANUMERIC RED DISPLAY

Interlockable 2" display module with 35 high intensity, 5mm pixels per module allowing vast scope for custom displays.

Brightness: 3000 ucd I_F = 10mA

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

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

DIRECT IMPORT!

½" HIGH INTENSITY RED LED DISPLAYS

(Available in Common Cathode and Common Anode)

Dimensions: Overall: 12.7mm across, 19mm high Display: 12.7mm(H) x 7.3mm(W) Segment Width: 1.2mm Brightness: 3400 ucd I_F = 10mA

COMMON CATHODE:

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

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

COMMON ANODE:

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

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

DIRECT IMPORT!

HIGH INTENSITY RED LED BAR GRAPH

Dimensions: Overall: 63mm across, 5mm high LEDs: 10 x 5mm x 1mm

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

UNIVERSAL SOLDERING IRON STAND

Cat. T11302 ..... $5.95

SOLDER ROLLS

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

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

NICADS!

Save a fortune on expensive throw away batteries this Christmas with these quality Nicads and Rechargers!

NICADS!

Size	Desc	1-9	10+	100+
AA	0.5 A.H.	$2.50	$2.25	$1.95
C	1.2 A.H.	$7.95	$6.50	$6.25
D	1.2 A.H.	$7.95	$6.50	$6.25

UNIVERSAL BATTERY CHARGER AND TESTER

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

Cat. M23533 ..... $29.95

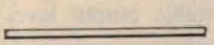
DELUXE UNIVERSAL BATTERY CHARGER AND TESTER

Save money on expensive batteries with this universal battery charger. Features include meter tester, and provisions for up to 8 pieces of any size, (D, C, AA or AAA type batteries) at once, plus positions for a button and cell battery. Two times 9V, and one times N type batteries. Recharging lead with alligator clips, 9V clip and 4-way universal. Select currents from 2.5-3V 150mA, 1.2-1.5V 80mA, 1.2-1.5V 25mA, 6-9V 14mA, 12V 50mA. Includes detailed instructions.

Cat. M23535 ..... $39.95

CANNON TYPE CONNECTORS

Cat. No.	Description	Price
P10960	3 pin line male	
Was $3.90		NOW $2.90
P10962	3 pin chasis male	
Was $3.00		NOW $2.40
P10964	3 pin line female	
Was $4.50		NOW $3.25
P10966	3 pin chasis female	
Was $4.95		NOW $3.45



FERRITE AERIAL ROD

200mm x 9mm

Cat. L11401 Normally $2.75

SPECIAL, ONLY $1.50

POT CORES

FX2242 Assembly
2 halves, 36mm diameter
L12100 ..... $9.95

Former to suit FX2242
L12101 ..... $0.95

FX2243 Assembly
2 halves, 24mm diameter
L12110 ..... $9.95

Former to suit FX2243
L12111 ..... $1.00

E Core, 2 halves
L12115 ..... $8.95

Former to suit E Core
L12116 ..... $4.95

Complete E Core assembly
(including end plates and bolts)
L12117 ..... $16.95

PUSH BUTTON DIALLERS

Tired of old fashion dialling and re-dialling engaged numbers? These convenient push button diallers include last number redial (up to 16 digits) and instructions for an easy changeover.

Cat. A12030 **NORMALLY $19.95**

SPECIAL, ONLY $14.95

TELEPHONE EXTENSION CABLE UNIT

Allows 15 metres of telephone extension cable to be neatly wound into a protable storage container. The reel sits on a flat base and has a handle to wind cable back on to it after use. No tangles - no mess! Ideal for the workshop, around the house, office, pool etc.

Cat. Y16013 ..... $24.95

Ho!

Great Christmas Idea!

RECHARGEABLE LANTERN

- Up to 1,000 recharges
- No more expensive batteries
- Beam length 1,050 feet
- Cannot be over charged
- Shoulder strap included
- 240V charge lead connects direct
- 12V Car lighter recharging lead (ideal for camping, travel, boating etc)
- Red safety shade cover

Cat. A15053 ..... only $29.95

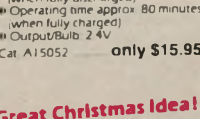
Great Christmas Idea!

RECHARGEABLE FLASH LIGHT

- Up to 1,000 recharges
- No more expensive batteries
- Beam range 150 metres
- Size: 160(L) x 60(W) x 60(H)mm
- Weight: 140 gram
- Shoulder strap included
- To recharge simply unclip the handle which contains the power pack and plug directly into a 240V power point
- Charging time: approx. 10 hours (when fully discharged)
- Operating time approx. 80 minutes (when fully charged)
- Output/Bulb: 2.4V

Cat. A15052 ..... only $15.95

Great Christmas Idea!



RECHARGEABLE POCKET LIGHT

- Compact and very convenient!
- No more expensive batteries
- Up to 1,000 recharges
- To recharge, simply remove the rear cover and plug directly into a 240V power point
- Charging time: approx. 15 hours (when fully discharged)

Cat. A15051 ..... only $13.95

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

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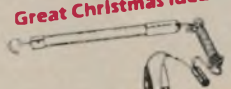

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Build this ultra-low distortion oscillator

This ultra-low distortion oscillator is the best we have ever produced. It is comparable with the very best laboratory-standard sine wave oscillators but can be put together for a fraction of their cost. As well as having very low distortion it has excellent envelope stability, square wave output and optional output metering.

by JOHN CLARKE

Audio oscillators have always been very popular projects amongst our readers and perhaps the main reason for this is their importance as a piece of test equipment. In this they would rate second only to the multimeter for the laboratory or home workshop.

The main use of an audio oscillator is as a signal source for amplifiers, filters, loudspeakers and other items of audio and electronic equipment.

Our most recent oscillator was the Function Generator, published in April 1982. This was extremely popular and provided a reasonable quality waveform with very stable envelope. It used an integrated circuit containing a voltage controlled oscillator (VCO) and sine wave shaper which gave a reasonably low distortion waveform (about 1% distortion) with a very stable envelope.

Other oscillators we have previously published have been based on the Wein Bridge circuit which used a thermistor for signal level stabilisation. This type of oscillator generally gives much lower distortion but has always had the tendency for the signal level to bounce up and down each time the frequency is varied.

Now while low distortion is important, so is having a stable output level, such as when checking loudspeaker frequency response and filter tracking.

This latest Low Distortion Audio Oscillator has a good stable output level with the bonus of very low distortion. The low distortion is particularly important for the accurate setting of steep-cut notch filters and measuring the vanishingly low distortion of today's high performance amplifiers. A further advantage of the new circuit is that it obtains its excellent envelope stability without using a thermistor, a component which has become more expensive and hard to obtain as the years have progressed.

The unmetered version is built into the smaller instrument case.

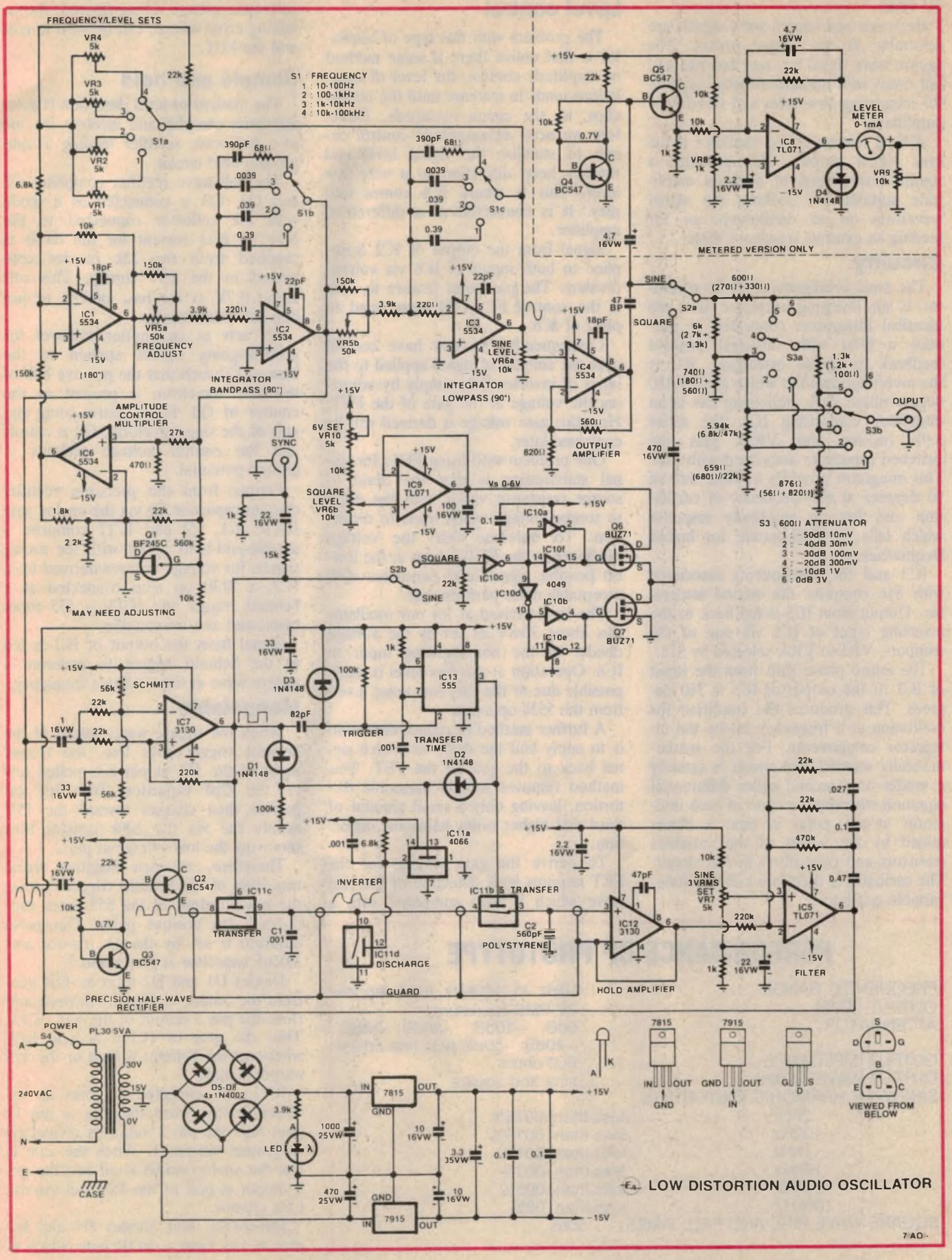
Features

As mentioned, the oscillator can be built in two versions, with and without an output level meter. Both are housed within standard plastic instrument cases with metal front and rear panels. The version without the meter is housed in a smaller plastic case to reduce the overall cost. We estimate that the unmetered version will be about $25 cheaper than the metered version.

The signal frequency can be continuously varied from 10Hz up to 100kHz in four ranges. The continuously variable frequency control adjusts from 10 to 100, while the range switch acts as a multiplier, in steps of X1, X10, X100 and X1000.

The signal output is continuously variable over a 50dB range by means of a six-position switch and a continuously variable control. On the unmetered version of the oscillator, the attenuator switch is marked in 10dB steps while the continuous control gives a further 10dB.

On the version with output metering, the output level switch gives the same 10dB steps but is labelled in volts or millivolts to indicate the full scale deflection of the meter. The meter has a 0 to 3 scale for the 30mV, 300mV and 3V attenuator settings and a 0 to 1 scale for the 10mV, 100mV and 1V attenuator settings. In both the metered and unmetered versions of the oscillator, the maximum sine and square wave output is


FREQUENCY/LEVEL SETS
S1 : FREQUENCY
1 : 10-100Hz
2 : 100-1kHz
3 : 1k-10kHz
4 : 10k-100kHz
METERED VERSION ONLY
LEVEL METER 0-1mA
SINE
SQUARE
OUPUT
S3 : 600Ω ATTENUATOR
1 : -50dB 10mV
2 : -40dB 30mV
3 : -30dB 100mV
4 : -20dB 300mV
5 : -10dB 1V
6 : 0dB 3V
FREQUENCY ADJUST
INTEGRATOR BANDPASS (90°)
INTEGRATOR LOWPASS (90°)
SINE LEVEL VR6a 10k
OUTPUT AMPLIFIER
AMPLITUDE CONTROL MULTIPLIER
SQUARE LEVEL VR6b 10k
6V SET VR10 5k
SYNC
MAY NEED ADJUSTING
SCHMITT
TRIGGER
TRANSFER TIME
INVERTER
TRANSFER
DISCHARGE
GUARD
PRECISION HALF-WAVE RECTIFIER
HOLD AMPLIFIER
FILTER
SINE 3VRMS SET VR7 5k
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POWER
PL30/5VA
240VAC
CASE
D5-D8 4x1N4002
LED
7815
7915
VIEWED FROM BELOW
LOW DISTORTION AUDIO OSCILLATOR

3V RMS.

Both sine and square wave signals are selectable at the output socket. The square wave signal has very fast rise and fall times with minimal ringing, suitable for measuring slew rates and stability of amplifiers.

A final feature of the oscillator is the sync signal output. This provides a square wave signal of constant amplitude suitable for locking the signal waveform on an oscilloscope or for feeding an external frequency meter.

Circuitry

The basic arrangement of the oscillator is an inverting amplifier and two identical integrators connected to produce a filter with sufficient positive feedback to enable oscillation. IC1 is the inverting amplifier which gives a 180 degree phase shift. Following this is an integrator comprising IC2, the series 3.9k resistor and VR5a plus the switched capacitors associated with S1b. This integrator provides a phase shift of 90 degrees at the frequency of oscillation and has an amplitude response which falls at 20dB/decade for higher frequencies.

IC3 and the components associated with S1c comprise the second integrator. Output from IC3 is fed back to the inverting input of IC1 via one of the trimpots, VR1 to VR4, selected by S1a.

The entire phase shift from the input of IC1 to the output of IC3 is 360 degrees. This produces the condition for oscillation at a frequency set by the integrator components. For the mathematically minded, the circuit is actually a model of a second order differential equation whereby the state of each integrator at any point in time is determined by the values of the variables (resistors and capacitors) in the circuit. The oscillator is therefore called a state-variable oscillator.

Level control

The problem with this type of oscillator is that unless there is some method of amplitude control, the level of oscillations tends to increase until the output clips, ie, the circuit overloads. Therefore we need an amplitude control circuit to stabilise the signal level and thereby keep distortion to a very low level. This is where IC6 comes into play. It is connected as a differential amplifier.

Signal from the output of IC2 is applied to both inputs of IC6 via voltage dividers. The particular feature to note is the control FET, Q1, connected to pin 2 of IC6.

Consequently, we can have control over the amount of signal applied to the input of inverter IC1, simply by adjusting the voltage at the gate of the FET. How this gate voltage is derived will be explained later.

One problem with using FETs for signal stabilisation is that the drain to source resistance varies with the drain to source voltage which leads to distortion. To minimise this, the voltage swing across the FET is kept at the lowest possible signal level consistent with acceptable noise performance.

The level arrived at for our oscillator was about 30mV as set by the voltage divider at the non-inverting input to IC6. Operation at this low level is made possible due to the very low noise levels from the 5534 op amps.

A further method to reduce distortion is to apply half the drain to source signal back to the gate of the FET. This method removes second harmonic distortion, leaving only a small amount of third and higher order harmonic distortion.

To derive the gate voltage for the FET requires level detection of the sine wave which is then compared with a reference voltage. Once filtered, the resulting error voltage can be used to control the FET.

Sample and hold

The method of level detection is actually fairly complex and involves the use of a half-wave rectifier feeding a sample-and-hold circuit.

The half-wave rectifier comprises Q2 and Q3. Q3 is connected as a diode with the collector connected to the base. A bias current for the diode is supplied from the 22k resistor connected to the 15V supply. This sets about 0.7V at the base of Q2, to just bias this transistor on.

Q2 acts as an emitter follower for positive-going signals applied to the base of Q2 such that the positive half of the sine waveform is present at the emitter of Q2. For negative-going signals of the sine waveform, Q2 is cut-off and the emitter voltage remains at ground potential.

Output from the precision rectifier charges capacitor C1 via the analog gate IC11c. C1, C2 and IC11 comprise a sample-and-hold circuit with the timing signals for voltage transfer derived from IC7, a 3130 op amp connected as a Schmitt trigger and IC13, a 555 timer connected as a monostable.

Signal from the output of IC1 is fed to the Schmitt trigger to generate a square wave at the oscillator frequency.

Monostable

When the square wave output of the Schmitt trigger goes low, the trigger input of the 555 at pin 2 is pulled low via the 82pF capacitor. The 82pF capacitor then charges toward the 15V supply rail via the 100k resistor thus removing the low voltage at pin 2.

Therefore, at each negative signal transition of the Schmitt trigger output, the pin 3 output of the 555 timer produces a 1us positive pulse. This pulse duration is set by the 1k resistor and .001uF capacitor at pins 6 and 7.

Diodes D1 and D2 form an OR gate from the output of the IC7 Schmitt and from the pin 3 output of the 555, IC13. Thus the gate of IC11a is held high whenever the Schmitt is high or the 555 output is high.

IC11a is connected to form an inverter so that when the gate at pin 13 goes high the pin 2 output is connected to ground via pin 1. When the gate is low the analog switch is off and the pin 2 output is tied to the 15V rail via the 6.8k resistor.

Effectively then, diodes D1 and D2 plus IC11a form a NOR gate which is

PERFORMANCE OF PROTOTYPE

FREQUENCY RANGE	10Hz to 100kHz in 4 ranges
OUTPUT LEVEL	3V RMS maximum
ATTENUATOR	0dB, –10dB, –20dB, -30dB, –40dB, –50dB plus fine adjust
OUTPUT IMPEDANCE	600 ohms
OUTPUT WAVEFORMS	sine and square
SINEWAVE HARMONIC DISTORTION	
20Hz	less than .0075%
100Hz	less than .0015%
1kHz	less than .001%
10kHz	less than .002%
20kHz	less than .005%
100kHz	less than .02%
SQUARE WAVE RISE AND FALL TIMES	50ns

used to drive another gate, IC11d.

So the Schmitt, 555 timer and inverter IC11a provide the timing signals for the sample-and-hold circuit. So let us look at the sequence which is depicted in Fig.1.

As already noted, the sine wave signal at the output of IC1 is squared by the Schmitt trigger, IC7, and each time the output of the Schmitt trigger goes low, the monostable IC13 produces a one microsecond pulse. The output of IC7 is then used to turn on gate IC11c so that capacitor C1 is charged from the precision half wave rectifier to the peak of the sine waveform. Immediately IC7 goes low, IC11c opens and the pulse output of IC13 closes analog gate IC11b. This transfers the charge on C1 to C2.

When pin 3 of IC13 goes low after about 1us, IC11b and IC11a switch open. IC11b disconnects C1 from C2

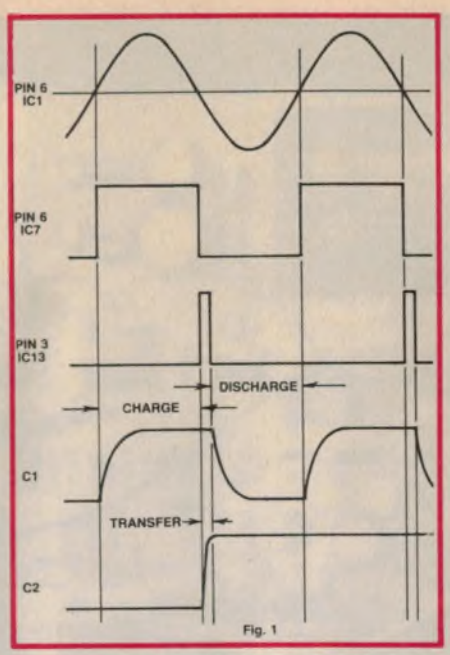


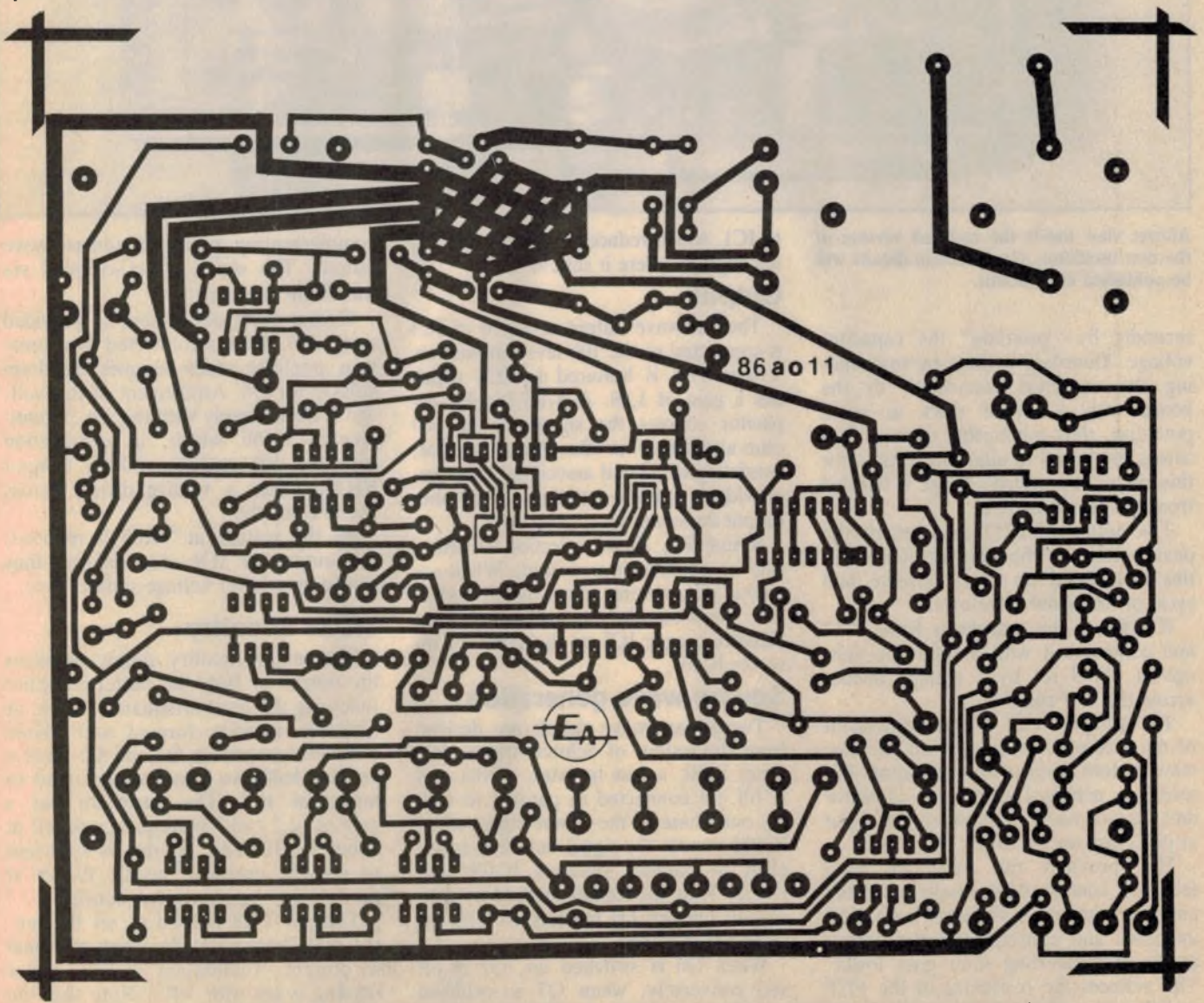
Fig. 1

and the now high output of IC11a closes gate IC11d to discharge C1. When IC7 again goes high the sequence begins again.

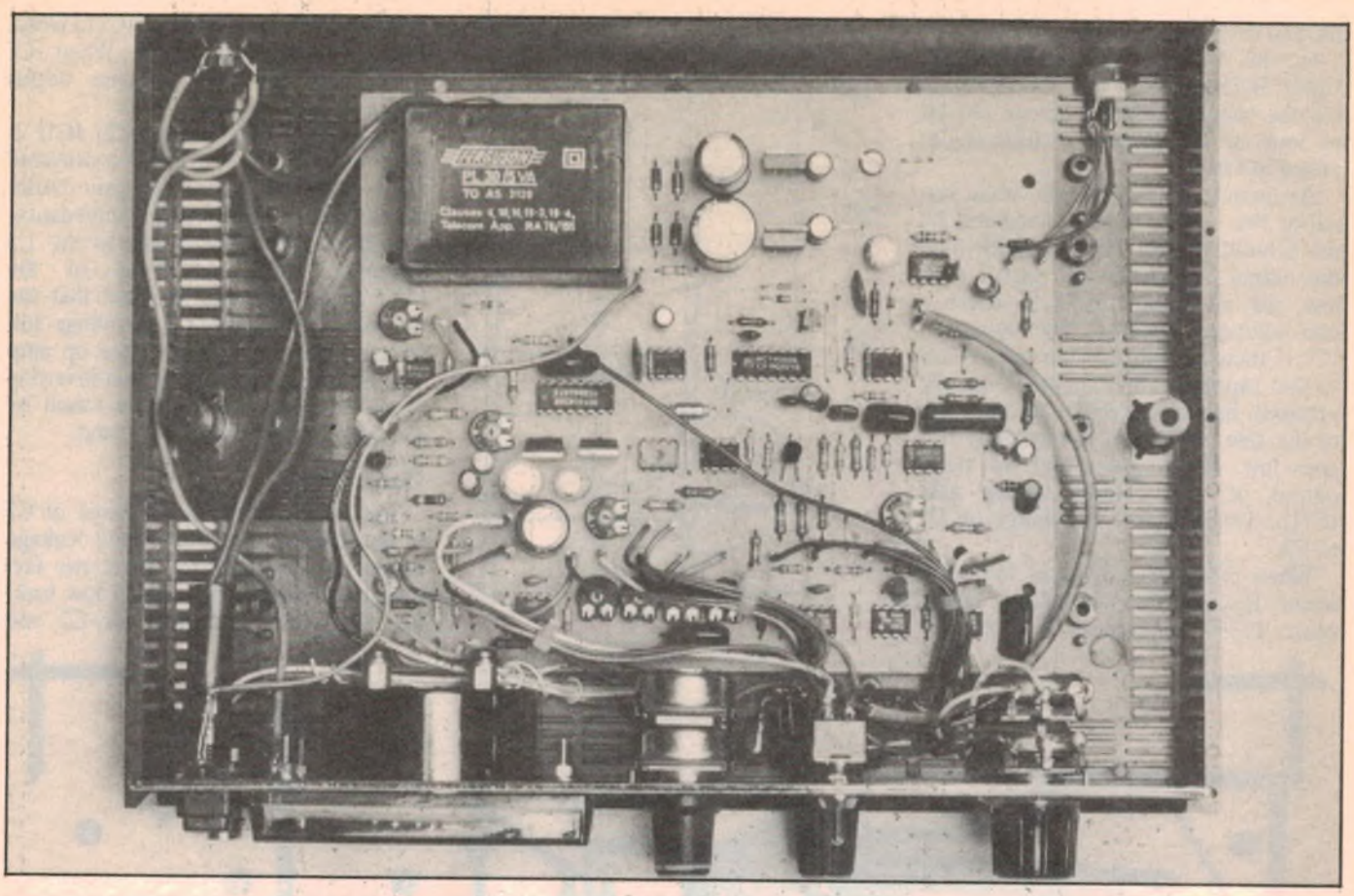
To prevent discharge of C2, IC12 is used to buffer the voltage transferred from C1. IC12 is a unity gain buffer which has a very high input impedance. This high impedance is due to the 1.5 Teraohm input impedance of the CA3130 op amp plus the fact that the op amp is connected as a voltage follower. Since the output of the op amp equals the voltage at the non-inverting input the input impedance is raised by the open loop gain of the op amp.

Guarding

The major source of discharge of C2 is the leakage of C2 itself and leakage across the circuit board. These two factors are minimised by using a low leakage polystyrene capacitor for C2 and



Above: full size reproduction of the PCB artwork. Note that the same artwork is used for both versions.



Above: view inside the metered version of the new oscillator. Construction details will be published next month.

secondly by "guarding" the capacitor voltage. Guarding is done by surrounding the capacitor connection to the board with a copper track at equal potential, thus minimising current flow across the board to adjacent tracks. For this circuit, the guard voltage is derived from the output of IC12.

The output of IC12 thus retains the peak voltage of the sine waveform and this is updated on every positive half cycle of the signal waveform.

IC5 filters the waveform from IC12 and compares it with a reference voltage at pin 3 set by a voltage divider across the 15V supply.

The trimpot VR7 allows adjustment of the reference voltage to set the sine wave output level of the oscillator. Filtering is achieved using the capacitor and resistor network between the input at pin 2 and output at pin 6.

This provides the amplitude level feedback control of the oscillator. If the amplitude increases, the level from IC12 increases and consequently the output at the IC5 inverting filter goes lower. This reduces the resistance of the FET and thereby reduces the signal feedback to IC1, which reduces the sine wave signal back to where it should be.

Output

The sinewave output at pin 6 of IC3 is connected to the 10k level attenuator, VR6a. This is buffered by IC4 which has a gain of 1.68. A 47uF bipolar capacitor couples the signal to the 600 ohm attenuator via S2a. The attenuator, consisting of S3 and associated resistors, provides a genuine unbalanced 600 ohm output impedance.

Switch S2a allows selection of either sine or square wave output. When selecting the square wave signal, switch S2b connects the square wave from Schmitt trigger IC7 to the input of inverter IC10c.

Square wave generation

Two square wave signals are derived from the output of Schmitt trigger IC7 using IC10, a hex inverter. IC10a and IC10f are connected in parallel to supply one phase of the square signal while IC10d inverts the signal before it is applied to parallel inverters IC10b and IC10e. Thus the signals applied to each gate of Q6 and Q7 mosfets are 180 degrees out of phase.

When Q6 is switched on, Q7 is off and conversely, when Q7 is switched on, Q6 is switched off. This provides a complementary push-pull square wave output. The signal is AC-coupled via the 470uF capacitor.

Output level adjustment is provided using IC9. This is connected as a unity gain amplifier which supplies the drain voltage for Q6. Adjustment of this voltage is made simply with the 10k potentiometer VR6b which, in conjunction with the 10k resistor and 5k trimpot VR10, forms a voltage divider across the 15V supply.

As the voltage at VR6b is reduced, the output of IC9 also reduces thus providing a lower voltage square wave.

Meter circuitry

The meter circuitry simply monitors the output of IC4, the buffer amplifier following the level attenuator, VR6a. A halfwave rectifier formed with diode connected transistor Q4 and Q5 gives a positive halfwave signal at the input to integrator IC8. The integrator has a gain of –2.2 and low frequency rolloff at about 1.5Hz. This filtering is sufficient to prevent excessive needle flicker at the very low sine wave frequencies.

Trimpot VR8 is used to set the output of IC8 to zero volts when no signal is present. Calibration of the meter reading is set with VR9. Note that the meter reads the sine wave signal regard-

less of whether sine or square wave signals are applied to the output. The accuracy of the square wave measurement is still good, since the 10k level pots for the sine and square wave signals are dual gang types and track reasonably closely together. Note that the maximum signal output voltage is 3V RMS for both sine and square wave modes.

Power

Power supply for the oscillator is derived from the mains using a Ferguson PL30/5VA PC mounting-transformer. It is connected as a center tapped transformer for full wave rectification using diodes D5 to D8. A 1000uF capacitor filters the positive supply while the negative rail is filtered with a 470uF capacitor.

7815 and 7915 regulators provide the plus and minus 15V supplies for the circuit. The 10uF capacitors at the output of the regulators are for transient stability of the regulators while the two 0.1uF capacitors and 3.3uF capacitors across the supply rails are located near the op amps for stability.

The alternative version features the output level metering circuitry.

Power is switched using a mains power switch on the active line of the mains. Power on is indicated with the LED connected between ground and the unregulated positive rail via a 3.9k limiting resistor.

Finally, the sync output is derived from the output of Schmitt trigger IC7 and attenuated with a 15k and 1k resistive divider.

Next month we will conclude the description of this ultra low distortion oscillator with the construction and setting-up procedure.

AUDIO OSCILLATOR PARTS LIST

1 PCB coded 86ao11, 169 x 143mm
1 Plastic instrument case 260 x 190 x 80mm (metered version)
2 metal panels for above case 260 x 80mm (metered version)
1 Scotchcal label for metered version 250 x 76mm
1 MU-52 RMS meter scale bromide 73 x 47mm
1 Plastic instrument case 200 x 160 x 70mm (unmetered version)
2 metal panels for above case 200 x 70mm (unmetered version)
1 Scotchcal label for unmetered version 195 x 64mm
1 Ferguson PL30/5VA PC mounting transformer
1 mains cord and plug
1 cord clamp grommet
2 earth lugs
2 insulated panel mount BNC sockets
1 push on push off mains switch
1 DPDT miniature toggle switch
1 3-pole 4-way rotary switch (make before break)
1 2-pole 6-way rotary switch
1 10k dual ganged linear potentiometer
1 50k dual ganged linear potentiometer
4 knobs
1 5mm LED and bezel

Semiconductors
5 5534 op amps
2 TL071, LF351 op amps
2 CA3130 op amps
1 555 timer
1 4049 hex inverter
1 4066 quad analog switch
1 7815 positive 15V regulator
1 7915 negative 15V regulator
2 BUZ71 FETs (Siemens)
1 BF245C FET (Philips)
2 BC547 transistors
4 1N4002 diodes
3 1N4148, 1N914 diodes

Capacitors
1 1000uF 25VW PC electrolytic
1 470uF 25VW PC electrolytic
1 470uF 16VW PC electrolytic
1 100uF 16VW PC electrolytic
1 47uF bipolar electrolytic
2 33uF 16VW PC electrolytic
2 22uF 16VW PC electrolytic
2 10uF 16VW PC electrolytic
1 4.7uF 16VW PC electrolytic
1 3.3uF 35VW PC electrolytic
1 2.2uF 16VW PC electrolytic
1 1uF 16VW PC electrolytic
1 0.47uF metallised polyester
2 0.39uF metallised polyester
4 0.1uF metallised polyester
2 .039uF metallised polyester
2 .0039uF metallised polyester
1 .027uF metallised polyester
2 .001uF metallised polyester
1 560pF polystyrene
2 390pF polystyrene
1 82pF ceramic
1 47pF ceramic
2 22pF ceramic
2 18pF ceramic

Resistors (1/4W, 5%)
1 x 560k, 1 x 470k, 2 x 220k, 3 x 150k, 2 x 100k, 2 x 56k, 1 x 47k, 1 x 27k, 8 x 22k, 1 x 15k, 5 x 10k, 3 x 6.8k, 3 x 3.9k, 1 x 3.3k, 1 x 2.7k, 1 x 2.2k, 1 x 1.8k, 1 x 1.2k, 3 x 1k, 2 x 820 ohm, 1 x 680 ohm, 2 x 560 ohm, 1 x 330 ohm, 1 x 270 ohm, 2 x 220 ohm, 1 x 180 ohm, 1 x 100 ohm, 2 x 68 ohm, 1 x 56 ohm, 6 x 5k miniature trimpots.

Extra circuitry for metered version
1 1mA MU-52 meter
1 TL071, LF351 op amp
2 BC547 transistors
1 1N4148, 1N914 diodes
2 4.7uF 16VW PC electrolytic capacitors
1 2.2uF 16VW PC electrolytic capacitor
2 22k 1/4W resistors
3 10k 1/4W resistors
1 1k 1/4W resistor
1 1k horizontal miniature trimpot
1 10k horizontal miniature trimpot

Miscellaneous
Hookup wire, shielded cable, tinned copper wire, 4 self tapping screws, heatshrink tubing or insulation tape, solder etc.

Kits! Kits! Kits! Kits! Kits! Kits!

SOLDERING IRON TEMPERATURE CONTROL KIT

An important factor in good soldering technique is the correct choice of soldering temperature. If you have put off buying a temperature controlled soldering iron because they are so expensive, your problems are solved with this low cost soldering iron temperature controller kit. It provides fully regulated, adjustable temperature control over a reasonably wide range and will work with just about any conventional 240V soldering iron rated from 20W to 75W.
(ETI 1532, ETI Sept. '86)
Cat. K55320 ..... **$24.95**

TELEPHONE APPLIANCE CONTROLLER

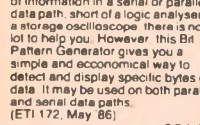
This clever project lets you dial your home number and switch a mains appliance on or off, without paying for the phone call. You can use it to turn on outside lights, a spa or an electric blanket.
(86ts6, EA June '86)
Cat. K86061 ..... **$54.95**

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 construction 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**

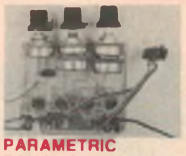
BIT PATTERN GENERATOR KIT

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)



FOUR CHANNEL MIXER

This four channel mixer project gives professional quality with impressive specifications.
SPECIFICATIONS:
Max. input sensitivity –50dB (2.5mV)
Signal to noise ratio: –78dB relative to +4dB
Distortion: 0.03% at +4dB, 2kHz
Input impedance: 3k ohm nominal
Output impedance: 100 ohms
Frequency Response: 10Hz to 30kHz (–+1dB)
(ETI1404, ETI July '85)
Cat. K54040 ..... **$99**



PARAMETRIC EQUALISER

Does your music system want a new frequency response? Does your guitar or keyboard need some equalisation to brighten the sound? Well, here is a module which can be used by itself on individual instruments or ganged to equalise your music system.
(ETI 1406, ETI August '86)
Cat. K54060 ..... **$16.50**

RS232 FOR COMMODORE

A simple project to give your Commodore RS232 compatibility.
(ETI 1601, ETI July '86)
Cat. K56010 ..... **$14.95**

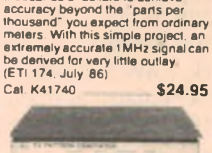
MULTI SECTOR ALARM STATION

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 $129
SPECIAL, $119

FREQUENCY STANDARD

Get the equivalent of a rubidium frequency standard by draping a piece of wire over the back of your TV set!! Believe it or not your humble television can provide an extremely stable and accurate reference frequency. The wire acts as a transducer to pick up electromagnetic radiation from the back of the set. Normally you would need to spend thousands of dollars to achieve accuracy beyond the "parts per thousand" you expect from ordinary meters. With this simple project, an extremely accurate 1MHz signal can be derived for very little outlay.
(ETI 174, July '86)
Cat. K41740 ..... **$24.95**



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 ..... Normally $67.50
SPECIAL, $62.50

DIGITAL CAPACITANCE METER Mk.2

Updated from the EA March '80 issue, this Digital Capacitance Meter checks capacitor values from 1pF to 99.99uF over three ranges. Its main features include a nulling circuit and a bright 4 digit LED display.
***Note:** The RIE kit contains quality silk screen printed and prepunched front panel AND an exclusive High Intensity Display!
(80cm3a, EA August '85)
Cat. K80030 ..... **$69.50**

TRANSISTOR TESTER

Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. 83) 83TT8
Cat. K83080 ..... **Normally $18.95**
SPECIAL, ONLY $14.95

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. Furthermore, of the 10 most important features listed by NRMA, this EA Deluxe Car Alrm has 9 of them!
(84ba5, EA May '84)
Cat. K84050 ..... **$79.50**

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 ..... **$59.50**

PLAYMASTER 300 WATT AMPLIFIER

This module will deliver up to 200 watts into an 8 ohm load and up to 300 watts into a 4 ohm load. Comprehensive protection is included and a printer circuit board brings it all together in a rugged, easy-to-build module. It can be built in either fully-complemetary or quasi-complementary versions, so output transistor shortages should be no problem at all!
(80PA6) (EA July '80)
Cat. K80060 ..... **Normally $109**
SPECIAL, ONLY $99
(Heatsink not included)

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 ..... **$39.50**

MUSICOLOR IV

Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety.
(EA Aug. 81) 81MC8
Cat. K81080 ..... **$99**

VIDEO FADER CIRCUIT

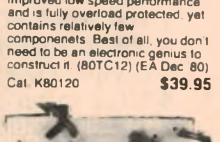
Add a touch of professionalism to your video movies with this simple Video Fader Circuit. It enables you to fade a scene to black (and back again) without loss of picture lock (sync) or colour.
(EA Jan. 86, 85fl10)
Cat K86010 ..... **$19.95**

MOTORCYCLE INTERCOM

OVER 300 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 ..... **$45.00**

LOW-COST BIPOLAR MODEL TRAIN CONTROLLER

Here is a simple model train control for those enthusiasts who desire something better than the usual rheostat control. It provides much improved low speed performance and is fully overload protected, yet contains relatively few componenets. Best of all, you don't need to be an electronic genius to construct it. (80TC12) (EA Dec. 80)
Cat. K80120 ..... **$39.95**



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 ..... **$7.95**

ELECTRIC FENCE

Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automative ignition coil, it should prove an adequeate deterrent to all manner of livestock. Additonally, its operation comforms to the relevant clauses of Australian Stnd 3129. (EA Sept '82) 82EF9
Cat. K82092 ..... **Normally $19.95**
SPECIAL, ONLY $14.95

AUDIO TEST UNIT

Just about everyone these days who has a stereo system also has a good cassette deck, but not many people are able to get the best performance from it. Our Audio Test Unit allows you to set your cassette recorder's bias for optimum frequency response for a given tape or alternatively, it allows you to find out which tape is best for your recorder.
(81AO10) (EA Oct '81)
Cat. K81101 ..... **$59.50**

15V DUAL POWER SUPPLY

This simple project is suitable for most projects requiring a dual voltage. Includes transformer.
(ETI 581, June '76)
Cat. K45810 ..... **$34.95**

30 V/1 A FULLY PROTECTED POWER SUPPLY

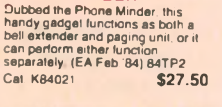
The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both voltage and current metering is provided. (ETI Dec '83) ETI 162
Cat. K41620 ..... Normally $59.50
SPECIAL, $44.50

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**
SPECIAL, ONLY $149

PHONE MINDER

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb '84) 84TP2
Cat. K84021 ..... **$27.50**



FUNCTION GENERATOR

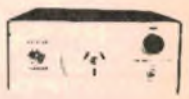
This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting.
(EA April '82, 82AO3A/B)
Note: The RIE Function Generator has a high quality screen printed and prepunched front panel!
Cat. K82040
Cat. K82041 ..... **$109**

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 ..... **$34.95**

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**



12/240V 40W INVERTER

This 12 240V inverter can be used to power up mains appliances rated up to 40W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May 82) 82IV5
Cat. K82050 ..... **$69.95**

12-240V DC-AC INVERTER INCLCLUDING 300 WATTS TRANSFORMER

This EA inverter is capable of driving mains appliances rated up to 300VA and features voltage regulation and full over load protection.
(EA June '82) 82IV6
Nominal Supply: Voltage 12V DC
Output: Voltage see table
Frequency: 50Hz +–005%
Regulation: see table
Maximum Load: 300VA
Current Limiting: 30A (primary)
Efficiency: see table

Resistive Load Watts	Output Voltage (RMS)	Input Current (A)	Efficiency (%)	Battery life 40Ah/20h Rate (minutes)
0	210	1.2	0	-
40	235	4.5	60	240
100	240	11.3	62	80
140	240	15.0	69	60
200	240	20.1	78	50
240	240	24.0	79	32
300	235	29.6	82	28

P&P $10.00 Anywhere in Australia
Cat. K82062 ..... **$219**

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**

SERIES 5000

INDIVIDUAL COMPONENTS TO MAKE UP A SUPERB HIFI SYSTEM!

By directly importing and a more technically orientated organisation, ROD IRVING ELECTRONICS can bring you these products at lower prices than their competitors. Enjoy the many other advantages of RIE Series 5000 kits such as "Superb Finish" front panels at no extra cost, top quality components supplied throughout. Over 1,000 sold!

For those who haven't the time and want a quality hi-fi, we also sell the Series 5000 kits assembled and tested.

POWER AMPLIFIER

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

- 1% Metal Film resistors throughout for low noise and stability.

SPECIAL, ONLY $329

SAVE $30

Designed and developed by ROD IRVING ELECTRONICS and is being supplied to other kit suppliers.

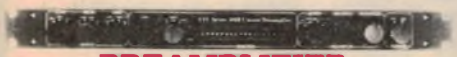
SPECIFICATIONS: 150 W RMS into 4 ohms

POWER AMPLIFIER: 100W RMS into 8 ohms (+ - 55V Supply)
FREQUENCY RESPONSE: 8Hz to 20Hz +0 -3 dB. 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 ..... $359

Assembled and tested $549

packing and post $10



PREAMPLIFIER

THE ADVANTAGES OF BUYING A "ROD IRVING ELECTRONICS" PREAMPLIFIER

SPECIAL, ONLY $299

SAVE $20

...ds. (We believe that dollar for ...s a commercial unit available that sounds as good!)

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 ..... $319

Assembled and tested $599

packing and postage $10

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS:

BANDS: 28 Bands from 31.5Hz to 16KHz.
NOISE: -0.008mV, sliders at 0, gain at 0[illegible]
20KHz BANDWIDTH DISTORTION: [illegible]
sliders at 0, gain at [illegible]
FREQU[illegible]

SPECIAL, ONLY $209

SAVE $10

...unit $219

$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

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 (to 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 (to 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 $1,095
Speaker Kit Cat K16031 ... $879
Cabinet Kit Cat K16032 ... $349

HI FI SPEAKERS

A comprehensive range of matched appearance speakers, all with square silver grey frames and black cones - ideal for building up low cost speaker systems that will look and sound superb.

1½" TWEETER

SPECIFICATIONS:
Sensitivity: 90dB
Freq. Response: 1.2 - 20 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz

Cat. C10200 ..... $5.95

2½" TWEETER

SPECIFICATIONS:
Sensitivity: 94dB
Freq. Response: 1.1 - 17 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz

Cat. C10202 ..... $6.95

4" MIDRANGE WITH SEALED BACK

SPECIFICATIONS:
Sensitivity: 96dB
Freq. Response: 650 - 15 kHz
Impedance: 8 ohms
Power RMS: 15 watts
Magnet Weight: 3.6 oz

Cat. C10204 ..... $11.95

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 performance 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 ... $699
Speaker Kit Cat K16021 ... $549
Cabinet Kit Cat K16022 ... $209

4½" MIDRANGE WITH SEALED BACK

Clothed edge surrounds.
SPECIFICATIONS:
Sensitivity: 97dB
Freq. Response: 600 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz

Cat. C10206 ..... $14.95

8" WOOFER RIBBED CONE

Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 94dB
Freq. Response: 55 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz

Cat. C10210 ..... $20.95

10" WOOFER RIBBED CONE

Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 95dB
Freq. Response: 37 - 6 kHz
Impedance: 8 ohms
Power RMS: 25 watts
Magnet Weight: 10 oz

Cat. C10212 ..... $35.95

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 (to 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. K86091 ..... R R P $499

Our Price $449

12" WOOFER RIBBED CONE

Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 92dB
Freq. Response: 32 - 4 kHz
Impedance: 8 ohms
Power RMS: 30 watts
Magnet Weight: 13.3oz

Cat. C10214 ..... $49.95

12" HIGH POWER MUSICAL SPEAKER

- Aluminium die cast chassis
- Carbon fibre impregnated cone paper
- Foam edge
- Light grey cone, silver dust cap
- High temperature "NOMEX" voice coil

SPECIFICATIONS:
Sensitivity: 97dB
Frequency Response: 50-4kHZ
Impedance: 8 ohms
Power RMS: 60 watt
Magnet Weight: 30 oz

Cat. C10216 ..... $82.50

ARLEC "DISCO LITE" CONTROLLER

Give your parties a professional touch with the arlec "Disco Lite". Simply plug your light(s) into the "Disco Lite" and you've instant party life!

3 DIFFERENT MODES!
Music Mode: Place the "Disco Lite" in range of the speakers and it flashes the lights to the beat of the music!
Strobe Mode: Simply adjust to desired speed! Great for mime or theatre. The christmas season or advertising!
Dim Mode: Allows you to dim the lights to create moods, effects etc.

Cat. M22003 ..... $49.50

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 ..... $89

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

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(TOLL FREE)
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$10 - $24.99	$3.00
$25 - $49.99	$4.00
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$100 - $199	$7.50
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$500 plus	$12.50

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

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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

MasterCard VISA

FREE POSTAGE FOR ALL ORDERS OVER $75 & UNDER 3KG!!

JW3900

KODEN

NEW 20cm RADAR

A BREAKTHROUGH IN

FINE COLOUR IMAGE & MINIATURISATION

NEW MDC-400

- RED IMAGE ON BLACK • BLUE PLOT TRACKS
- ALARM ZONES • VESSEL'S POSITION READ-OUT

VRM, EBL, BRILLIANT, SIMPLE COLOUR

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Brochure please KODEN MDC-400 ☐
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..... P/CODE .....
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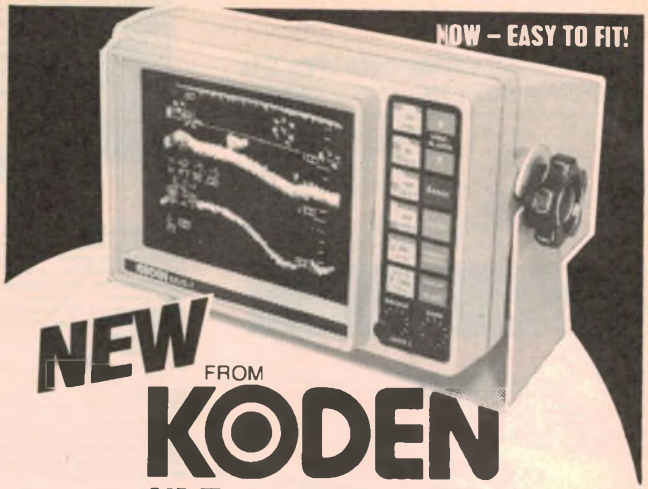

NEW FROM KODEN

ULTRA MINIATURE

SOUNDER

COLOUR CVS-101 **WITH ALARM** MONO MVS-1

15cm (6") Screen; All KODEN Hi-Tech Features. PLUS!
■ SPEED, LOG, WATER TEMP. DISPLAY. PLUS! PLUS! ■
■ DISPLAY FROM YOUR NAV. EQUIPT. ALL ON ONE SCREEN! ■

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S.A. 5015
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TELEX 88009
TELEFAX 08 47 7331

Please mail me a brochure on KODEN SOUNDER
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NAME .....
ADDRESS .....
..... PCODE .....
TEL EA12

JW3838

SHIPMATE

RS 5100, our latest SATELLITE NAVIGATOR, is built for fully automatic operation...

The RS 5100's built-in computer updates your vessel's position every 10 secs and corrects for set and drift on a regular basis using extremely accurate satellite signals.

ACT NOW BEFORE THE NEXT PRICE RISE!

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ADDRESS .....
..... P/CODE .....
TEL EA12

JW4004

Robertson

AP-100 PILOT SMART ENOUGH FOR ANY SKIPPER!

AWARD WINNING
LCD Displays of Programmes, Course & Alarm are featured in this Award Winning, Microprocessor controlled Pilot. Available are Rudder Indicator, Audio Alarm & Remote Control.

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SPECIAL SUMMER FEATURE

Marine ELECTRONICS

by Terry Ayscough*

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Last December, we explored a new area with our special 'Electronics on the Water' supplement. Nothing stays the same for very long in either electronics or boating, so we now present an update on last year's article.

Having in mind that EA is an electronics, rather than a boating magazine, we have tried to broaden the scope of this year's offering by highlighting technology which also has connections with general communications, aerospace, radar and information systems, as well as particular marine applications.

A CONTINUING TREND in marine electronics is for smaller, lighter, easier to operate units. Pocket sized multi-channel transceivers have been with us for some time and there is now serious talk about hand held satnav (satellite navigation) receivers and radar systems, no bigger than a household toaster.

Medium and large scale ICs are being used in the latest designs to reduce circuit board complexity, improve reliability and hold down costs. At the same time, these sophisticated devices often provide new facilities, giving the purchaser even better value for his hard earned dollar.

Marine electronic equipment is also changing on the outside, with fully waterproof membrane touch pads, often in conjunction with microprocessor control systems, replacing rotary controls and conventional switches. LCD numerical displays with their good visibility in sunlight, low power consumption and long life are rapidly gaining ground. Matrixed LCD panels are starting to challenge CRTs in some pictorial display roles and are opening up new applications in the radar, sonar and data display areas.

MOST NEWCOMERS to the marine radio scene find themselves thoroughly bewildered by the profusion of equipment available.

A couple of decades ago, things were much simpler. Just about all voice communication was on MF or HF in the 2 to 6MHz range and used simple double sideband amplitude modulation. Several local manufacturers produced transceivers with four or five crystal controlled channels and these sold at prices most small boat owners could afford.

In the mid 1970s, Australia was caught up in international moves to change to single sideband (SSB) marine operation and the cheap and simple equipment that had served so well was relegated to the scrap heap. In its place came a new generation of high performance solid state SSB transceivers, but these cost more than many inshore and coastal sailors could readily afford.

At about the same time, our neighbours to the north started to produce huge quantities of cheap and reliable 27MHz CB sets. As there were no restrictions preventing the importation or sale of these units in Australia, they soon became generally available and were snapped up by the boating public, to fill the void left by the scrapping of MF/HF AM equipment.

To start with, the use of 27MHz for marine communications did not enjoy the full blessing of frequency planning and licensing authorities. It was not long before the fait accompli was accepted however, and a handful of exclusive marine channels in the 27.68 to 27.98MHz range was officially allocated. Marinised versions of various CB sets, with 8 or 10 crystal controlled channels, DOC type approval and attractive price tags, came on the market and have continued to sell like hot cakes ever since.

The tremendous popularity of 27MHz equipment has in fact become one of its major drawbacks. In thickly populated areas at weekends, there are now so many users on the few channels available that it is often difficult to communicate without interference. This problem can only get worse as usage continues to grow. It will also be added to as rising sun spot activity hots up ionospheric propagation over the next few years, causing strong 27MHz skip signals to be received from interstate and overseas.

The real answer for small boat communications, and one which has been generally adopted overseas, is to use appropriate channels in the Marine VHF band. Some advantages of VHF include plenty of channel space, no skip signals, low levels of static or other interference and small, easily installed antennas.

VHF Transceivers

Australia uses internationally agreed marine channel numbers and frequencies on VHF. At the moment 55 transmit/receive channels are available and most of these have been designated for specific purposes such as safety, Seaphone, harbour control, commercial or pleasure craft, etc. Pleasure craft skippers will be interested in about 12 channels only, but it is wise to purchase a transceiver which covers the whole range, so any newly allocated channels can be used without the need for costly modifications.

Some of the first marine VHF sets in Australia had separate crystals for each channel, but in recent times, phase locked loop (PLL) synthesisers have been used to generate the multiplicity of highly stable transmit and receive frequencies required.

VHF marine channels utilise frequencies in one of two different ways. The first system, known as simplex operation, uses the same frequency for transmission and reception. The second system, known as two frequency simplex or half duplex operation, uses a receive frequency which is 4.6MHz higher than the transmit frequency. All simplex and half duplex channel frequencies fall within a band which extends from roughly 156 to 162MHz. Channel spacing is 25kHz and modulation is FM with ±5MHz maximum deviation.

One of the latest VHF transceivers to be announced is GME's model GX552. As our photograph shows, this unit is very small and neat, but offers most facilities found on larger and more expensive equipment including full 25 watt transmitter output and a super sensitive receiver.

Channel numbers are indicated by two, seven segment displays and are changed by operating pushbuttons which control up/down counters stepped three times per second. Transmitter drive and receiver local oscillator frequencies are generated by a PLL synthesiser built around two ICs and a few discrete transistors. As this synthesiser is typical of current 'state of the art' technology, readers will probably be interested in some details of its operation.

Phase Locked Loop Synthesiser

Fig.1a shows the synthesiser in simplified block form.

The 8MHz crystal oscillator on the left has its output divided by 320 and provides a very stable 25kHz 'reference' signal to

The GME Model GX552 VHF transceiver – digital readout and a PLL synthesiser.

Wide range of marine gear from JRC

A wide range of marine electronics equipment is manufactured by Japan Radio Company (JRC) Ltd, Tokyo. The company is represented in Australia by C.H. Smith and the range includes marine radars, echo sounders and satellite navigation (satnav) equipment.

Typical of this high-quality gear is the JMA-2010 radar which is claimed to be the world's smallest. Unlike other radars, it features a unique 10cm liquid crystal display which presents a 360 degree picture of boats, buoys, shorelines and other targets. The display features adjustable contrast control and illumination for night time use.

Display functions such as range, plothold, interference rejection and rain clutter are controlled by a splashproof keyboard, with normal tuning functions (gain, seal clutter, tune and contrast) controlled by recessed knobs below the keyboard. Target expansion is included as standard and the range is from 400 metres to around 13km. The unit is supplied complete with a radome enclosed PCB-type antenna.

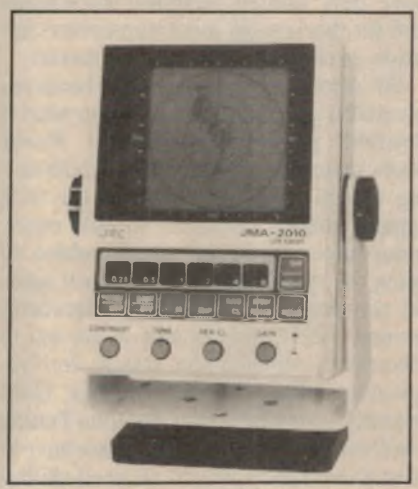
Big brothers to the JMA-2010 are the JMA-3710 Compact Colour Radar and the JMA-3304 Marine Radar. These both use conventional round CRT displays and boast a host of features too numerous to mention here. Note: a full review of the JMA-2010 Marine LCD Radar will appear in the January 1987 issue of Modern Boating.

JRC is also big on echo sounders and the JFV-60 is a versatile compact unit designed specifically for pleasure boats. It is microprocessor controlled and features an 8cm CRT colour display. Fishing and navigational information, including colour echoes, water temperature and boat speed, are directly indicated on the CRT.

Other features include shallow, deep and window alarms to aid fish finding, a zoom mode, a splashproof keyboard and compact gimball mounting.

For further information on the range of JRC marine products contact C.H. Smith, 16 Longridge St, Collingwood, Vic. 3006. Phone (03) 417 1077.

Above: the JFV-60 colour echo sounder.



The JMA-2010 radar uses a unique liquid crystal display.

one input of the phase detector. Synthesiser output is generated by a voltage controlled oscillator (VCO). This can have its frequency varied over the range 134-141MHz by changing the control voltage applied to a varicap diode.

The programmable divider, shown below the phase detector, is controlled by a 6-bit binary code and can be made to divide by any number between 71 and 127. When the transceiver is operating on a simplex channel, VCO output is mixed with a 137.8MHz signal from the switchable crystal oscillator on the right. A difference frequency in the range 1.7 to 3.2MHz is produced by the mixer and fed to the programmable divider input. The selected divider ratio will reduce this frequency down to exactly 25kHz and this provides a second input to the phase detector.

The 25kHz 'reference' signal and the programmable divider output are compared in the phase detector. If a frequency or phase difference exists, a control voltage is produced which changes the VCO frequency until both 25kHz signals are identical. When this occurs, the loop consisting of VCO, mixer, divider and phase detector is said to be phase locked, hence the name phase locked loop.

If the user selects a different channel, the 6-bit binary code and the programmable divider ratio also change. The divider output will no longer be exactly 25kHz, so PLL action swings the VCO to a frequency which, when divided by the new ratio, will again give exactly 25kHz. Some simple arithmetic will show that if the divider ratio is changed up or down by one, the VCO frequency changes by 25kHz which is the spacing between adjacent channels.

When the transceiver is being used on a half duplex channel (receiver frequency 4.6MHz higher than transmit frequency), the switchable crystal oscillator frequency is increased by 4.6MHz to 142.4MHz on receive only. The programmable divider ratio does not change from transmit to

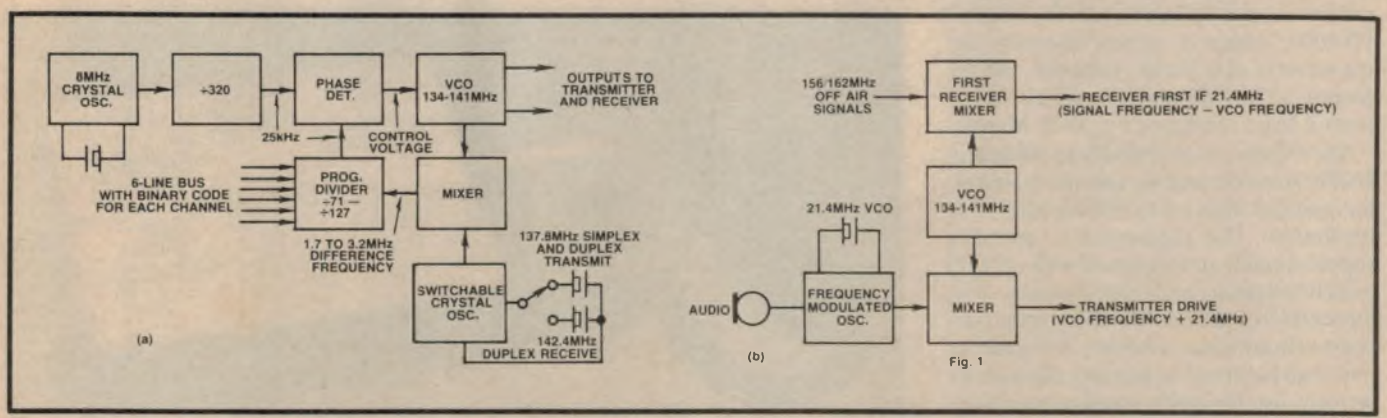


Fig.1a: block diagram of the PLL synthesiser in the GX552.

Fig.1b: the VCO forms the local oscillator during receive.

receive, so the PLL quickly raises the VCO frequency by 4.6MHz, to give the same difference frequency from the mixer and maintain 25kHz into the phase detector.

Fig.1b shows how the VCO output is used on receive to provide a local oscillator signal for the first mixer. The VCO operates 21.4MHz below the 156-162MHz off-air signal frequencies, to generate the required first IF.

On transmit, audio from the microphone amplifier frequency modulates a 21.4MHz crystal oscillator. Output from this modulated oscillator is added to the VCO frequency, producing transmitter drive in the 156-157.5MHz range.

The use of IC dividers and PLL technology has made VHF frequency synthesisers of this type simple, cheap and reliable. As a result, a good 55 channel VHF marine radio can now be purchased for about $450 which, after taking account of inflation, represents about the same value as a 27MHz CB based set of a few years ago.

HF/SSB Transceivers

VHF radio signals show very little inclination to follow the curve of the Earth's surface and a practical range of about 50 nautical miles or 90 kilometres is about the best that can be expected. The sort of range given by VHF is fine for boating on inshore or coastal waters, but is not a lot of use for vessels making long distance ocean passages. Large ships are increasingly using satellite links for long distance voice and data transmission, but for smaller craft, HF/SSB radio still reigns supreme.

Military HF equipment has been using frequency synthesis for years and at long last, the technology has started to filter down to civilian HF land mobile and marine equipment. Two examples of currently available units are the Codan HF4000, which is locally designed and manufactured in South Australia, and the Skanti 8250 (illustrated), which is imported from Denmark by AWA Marine.

The Skanti covers 100kHz to 30MHz in 100Hz steps on receive and the transmitter operates from 1.6 to 30MHz with 10Hz resolution. The equipment is normally supplied ready programmed with all ITU paired telephony and telex channels, plus any extra frequencies specified by the purchaser. In addition, a further 75 frequency pairs can be stored in memory during subsequent use for quick recall or scanning. The unit shown contains the control circuits and loudspeaker only and there are two additional boxes housing the transceiver circuits and automatic antenna tuning unit (ATU).

The Codan HF4000 follows the same basic concept as the Skanti, but has a less exotic specification and much lower price tag. A programmable read only memory (PROM) is set up in the factory to give a maximum of 256 synthesised simplex or half duplex channels.

Automatic ATUs

Although operators of marine HF and VHF equipment need to pass a Department of Communications examination to obtain an operators licence, they often have only limited technical knowledge and for this reason, most transceivers are made as simple as possible to operate.

HF Antenna systems on small boats are invariably a compromise between what is desirable and what is practical. Power boats generally use long whips, whilst sailing vessels often have part of the wire rigging suitably insulated. In both cases, inductance usually has to be added to bring the system up to an electrical quarter wavelength on the lower frequencies around 2MHz and capacity is needed to electrically shorten the system for frequencies in the 4, 6 or 8MHz range. Until recently, a manual ATU (Antenna Tuning Unit) was generally used but, these have at least three knobs, which all need skillful tweaking by the operator.

This difficulty can be overcome by fitting one of the fully automatic ATUs, incorporating a microprocessor, which are now rapidly gaining in popularity for both land mobile and marine use. As these are a fairly recent innovation, we will have a quick look at how one unit, the Codan Type 4203, performs its own particular brand of magic.

Basically there are three separate jobs for the ATU to do. Firstly, if more than one antenna is available, it needs to select the best one for the frequency being used. Secondly, it must compensate for load reactance by adding inductance or capacity. And finally, it must match the transceiver output impedance (nominally 50 ohms) to a wide range of possible antenna impedances.

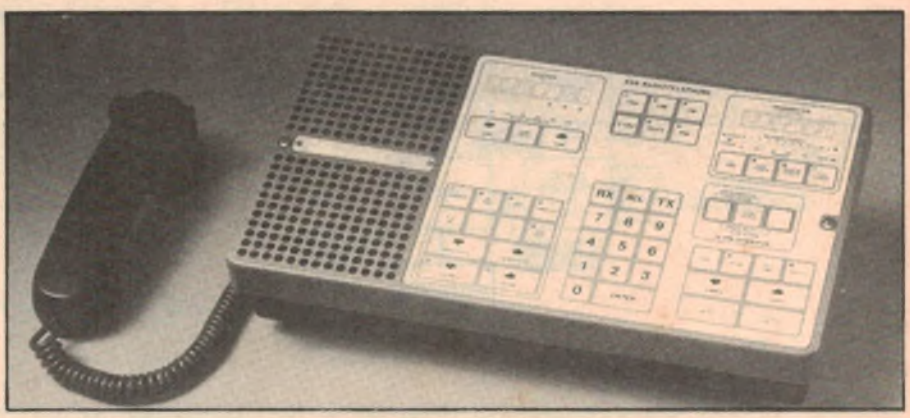
To do this, a microprocessor is supplied with various inputs indicating transmitter frequency, forward and reflected power, and the antenna feed voltage/current phase relationship. The microprocessor in turn operates relays which switch coils and capacitors in and out of circuit and change transformer taps until the best possible VSWR is obtained.

A simplified block diagram of the Codan 4203 automatic ATU is shown in Fig.2.

When the tune sequence is initiated, about 20 watts of RF carrier is fed to the ATU and the frequency divided by 256 by the prescaler. The microprocessor checks this frequency and selects antenna option one or two according to preset links adjusted at the time of installation.

Information on the degree of mismatch is provided by comparing the forward and reflected voltages provided by the VSWR bridge. The microprocessor runs through a program activating five relays which select one of 12 taps on auto transformer T1. This enables the 50-ohm transceiver to be closely matched to antenna loads in the range 5.6 to 270 ohms.

Any reactive component in the load is detected by comparing the phase of the RF current and voltage feeding the antenna. A further 17 relays, controlling series inductors and series and parallel capacitors, can be activated by a program in the microprocessor until optimum VSWR is obtained. If a VSWR ratio of better than 2:1 cannot be achieved, the alternative antenna will be selected and the tuning



The Skanti 8250 HF SSB transceiver is imported from Denmark by AWA Marine.

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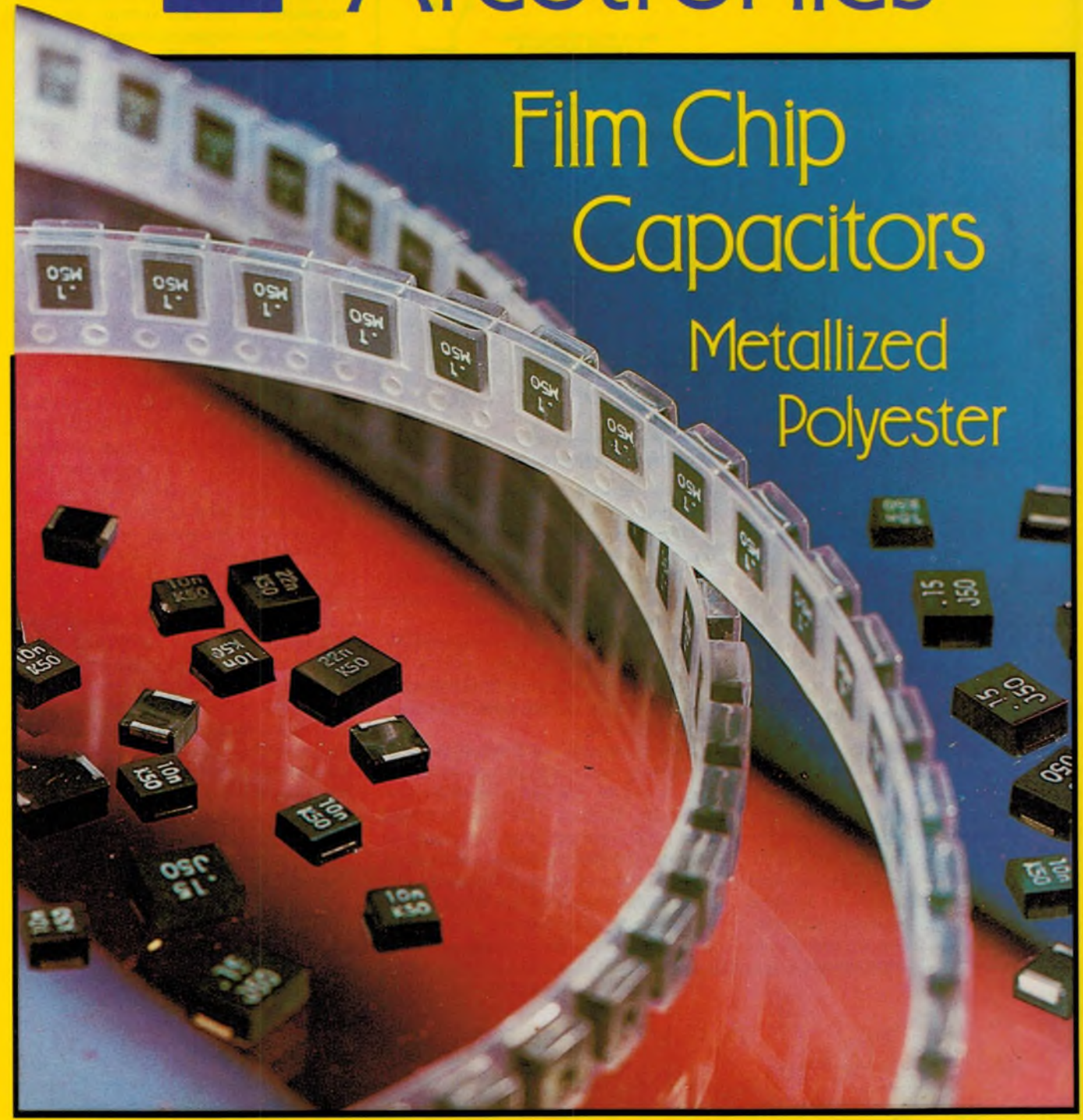

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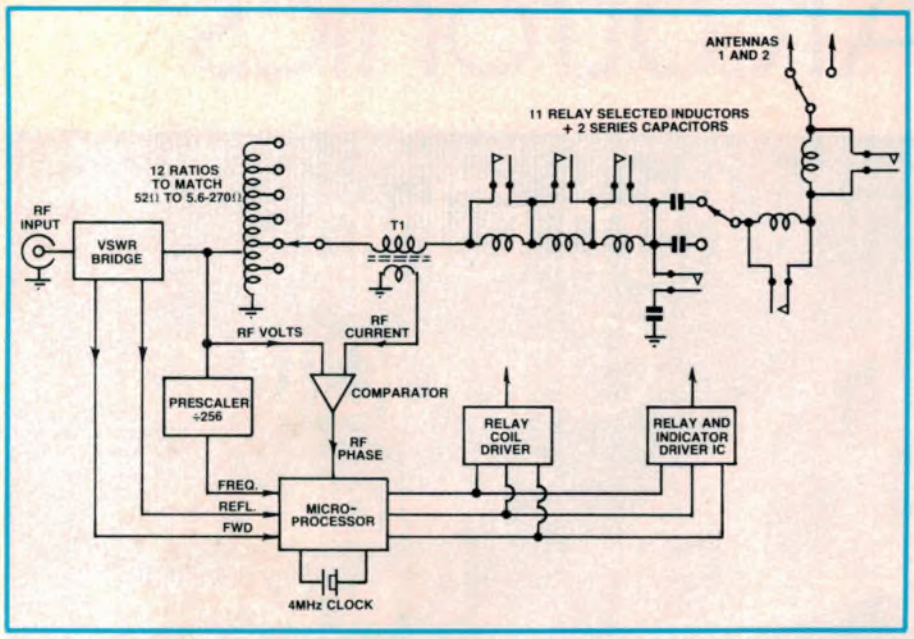


Fig.2: simplified block diagram of the Codan 4203 automatic antenna tuning unit (ATU).

process repeated.

Full tune up is normally completed in just a few seconds. When all adjustments are optimised, the microprocessor deactivates and the RF carrier from the transmitter is turned off. There are various indicators which warn the operator that an antenna fault is present if a VSWR of better than 2:1 cannot be obtained.

Private Conversations

Whilst most of us go boating to escape from telephones and the pressures of business, there are a growing number of mariners who simply cannot afford the luxury of being incommunicardo for a few days or even a few hours. OTC's VHF Seaphone and HF Radphone services provide excellent facilities for business communications but, as anyone with similar equipment can listen in, they do not give the privacy and security which is sometimes desired.

Operators of fishing fleets and people involved in major sporting events, such as the America's Cup defence, also want to have the occasional private conversation on normal marine channels.

Both situations can now be handled by installing a scrambler unit, such as the Sailor CRY2001 imported from Denmark by E. S. Rubin, at both ends of the communications link.

Two commonly used techniques for scrambling voice signals are shown in Figs.3a and 3b. The first method is called frequency division. This takes a typical base band voice spectrum containing audio from 400-2600 Hertz and subdivides it into a number of separate frequency segments. These segments are then changed in frequency, according to a prearranged sequence so that, for example, a syllable spoken by a deep male voice might be translated to the 2/3kHz region for a fraction of a second.

The second scrambling method, shown in Fig.3b, uses time division multiplexing techniques. With this system, the voice waveform is chopped into segments with a fixed time duration. These are then mixed up in a pre-arranged sequence so, for example, the last syllable of the word 'hello' might actually be transmitted before the first syllable. This means that an overall time delay is required, as early parts of a word could be transmitted last, but still need to be reproduced first when the signal is re-assembled during descrambling.

The Sailor CRY2001 scrambler actually uses a combination of both frequency division and time division multiplexing to ensure absolute zero intelligibility when listening to a scrambled signal on an ordinary receiver. After passing through the descrambling process however, the signal sounds crisp and natural and there is nothing to indicate the dramatic chopping up and putting back together which has taken place. The time delay mentioned earlier is about the same as for a telephone link over an international satellite circuit. This should not cause any problems, as simplex or half duplex operation, with each party taking turns to talk, will normally be used.

Every scrambler has its own exclusive 8-digit selcall number which need not be kept secret. This operates like a telephone number and is used to establish a fully private call between stations. When two scramblers exchange numbers, a secret code is calculated and this determines the complex sequence of frequency and timer switching to be used. There are nearly 17 million possible code keys, so the chance of an eavesdropper accidently cracking the sequence being used is just about non-existent.

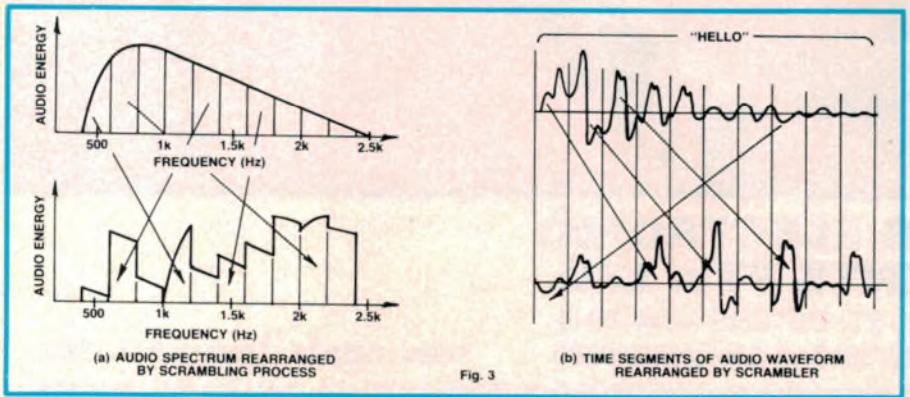
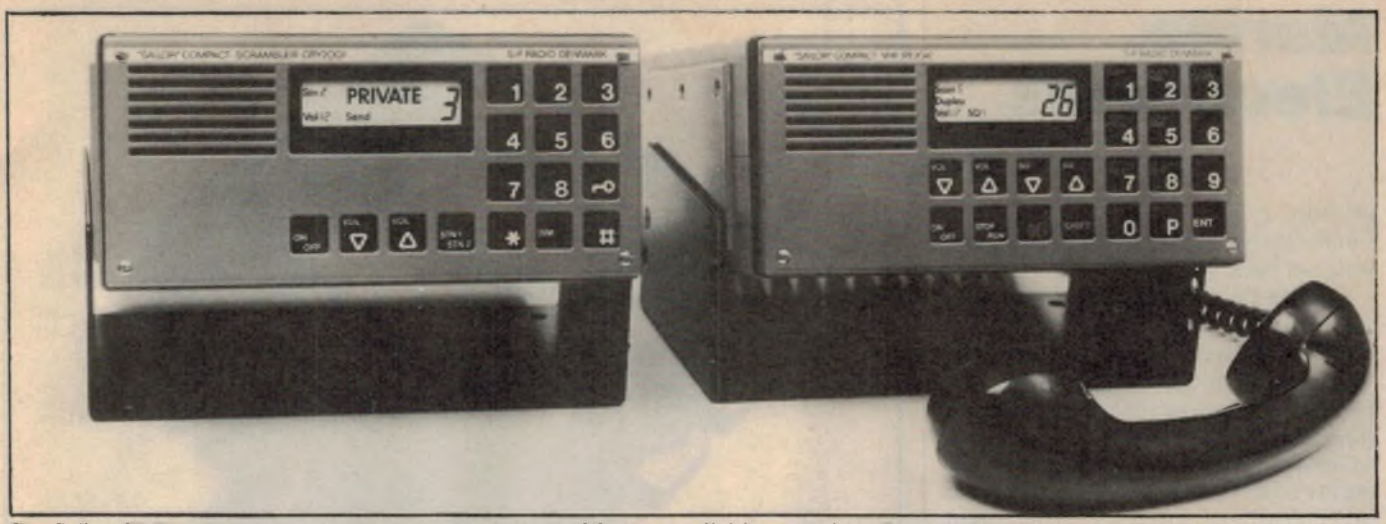


Fig.3: two common techniques for voice scrambling — (a) frequency division multiplexing and (b) time division multiplexing.

Satellite Navigation

THE US TRANSIT satellite navigation system, commonly known as Satnav, dates back to the early 1960s. It was originally developed to enable missile carrying submarines to accurately fix their positions, but in 1967 security was lifted and the system was made available for general non military use. Since that time, tens of thousands of receivers have been sold and are now to be found on most large ships and a great many smaller power boats and yachts.

Most of the basic concepts and technology used in the Transit system are now almost a quarter of a century old and the 'wonder' system of the late 60s and early 70s is starting to look a little dated. Fortu-



The Sailor CRY2001 scrambler unit uses a combination of frequency division and time division multiplexing.

nately for those many people who have invested in Satnav equipment, US authorities had the foresight to provide a few spare Nova satellites and launching rockets and current expectations are that Transit will be kept running until about 1995.

Back in 1973, work started on a satellite navigation system to replace Transit. This has become known as Navstar or Global Positioning System (GPS).

One of the limitations of Transit, is that satellites are in a relatively low (1000km) orbit and only remain in radio range for 10/20 minutes. This means that the average time between good fixes is more than one hour in most latitudes and there can sometimes be a long wait of several hours for the next satellite pass.

With the new navstar GPS System, satellites use a 20,183 km (10,898n.m.) circular orbit which means they remain 'above the horizon' for many hours at a time. Each satellite transmits simultaneously on 1227.6 and 1575.42MHz. Both frequencies carry what is called a P code signal (recently renamed Precise Positioning Signal) which is encrypted and only available for military and other specially authorised use. The higher frequency also carries a second C/A or coarse aquisition code (recently renamed Standard Positioning Signal) which gives less precise information on orbital position, known clock error, etc.

Each operational satellite contains a cesium frequency standard to provide time signals accurate to a few parts in 10^{14} per day. This is equivalent to about 1 second in 3,000,000 years!

If signals from four GPS satellites are available, a three dimensional position fix can be obtained. This is the way the system will be used by aircraft, space and land vehicles. Unless something very unusual is happening, most ship's navigators requiring position fixes will already know that they are close to sea level! In this case, signals from only three satellites are needed to give a good two dimensional fix.

The commercially available C/A code gives positions with an accuracy of about 100 metres for 95% of the time, which is more than adequate for marine navigation. The restricted access dual frequency P code signals will give positions with an accuracy of a few metres and if the receiver is stationary and can accumulate data over several hours, accuracies of two centimetres are said to be possible.

For 24-hour round the world coverage, 12 satellites are needed to give two dimensional fix capability and 18 satellites for three dimensional capability. In all cases, positions can be updated about once per second, so speed can also be very accurately measured.

At the moment, a mixture of about six prototype and operational satellites are in use and these provide nine to 12 hours of marine position fixing per day. The deployment schedule originally called for regular satellite launches by space shuttle from 1986 through to the end of 1988 and full operational status by early 1989. Re-

This combined GPS/Loran satellite navigation system is manufactured in the US by Trimble Navigation and imported by AWA Marine.

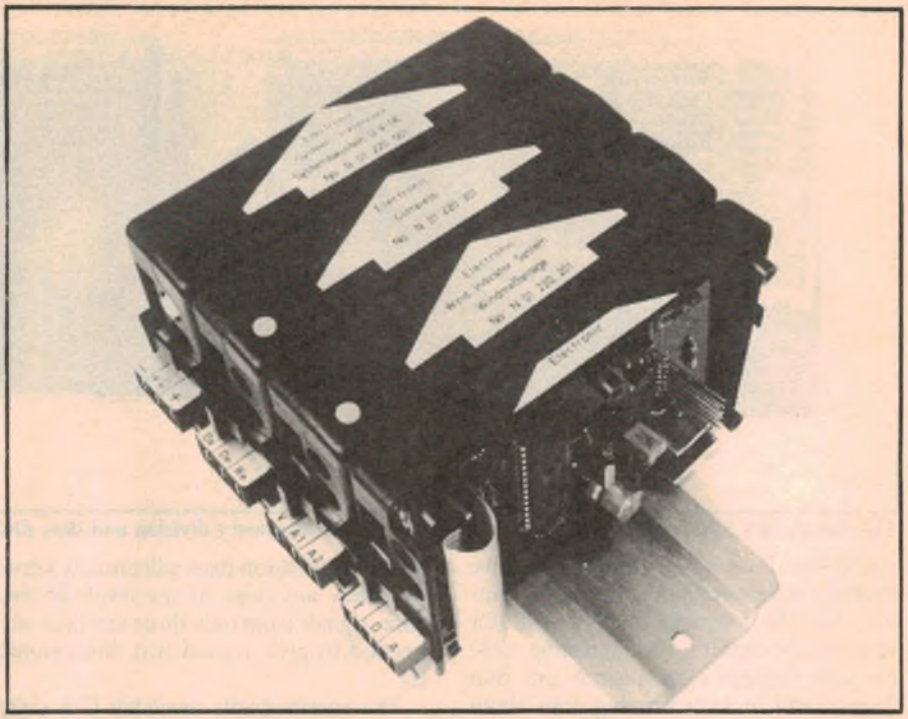
Marine Electronics

gretably, the tragic accident to shuttle Challenger in January 1986 will set this program back quite a bit.

Despite the setback however, GPS is starting to create serious interest amongst commercial users. Trimble Navigation of California have a combined GPS/Loran System which is available in Australia from AWA Marine. An interim software solution enables fixes to be obtained from only two GPS satellites and this allows the present partly deployed system to be used for about 16 hours per day.

Trimble's Loran-GPS 10X equipment consists of a 1.6GHz double helix antenna, a black box containing the receiver and computer, and a touch-pad control unit with LCD readout of latitude and longitude, as shown in our photograph.

GPS really is a most exciting development and has lots of technical and social implications. Engineers close to the technology are suggesting that receivers could be available for a few hundred dollars by the mid 1990s. Systems for use in road vehicles and even hand-held units are under development. Perhaps by the end of this century, we will be addressing our letters using mail box position co-ordinates rather than street names and numbers!



VDO's innovative microprocessor-controlled Navpac modules plug together on a mounting rail.

Sonic Speed

IN THE RECENT PAST, boat speed has been measured by having a little paddle wheel or propellor mounted below the hull which was spun around by the water flowing past. Each turn of the wheel or propellor generated electrical pulses and these were integrated and used to drive an analog or digital indicator showing speed in knots. Semi mechanical systems of this type give fair results in the middle of their ranges, but often do strange things at either very high or very low speeds.

Last year the UK firm of Brooks and Gatehouse (B and G), represented in Australia by Peter Green Shipchandlers, introduced their sonic speed system for yachts. Two transducers are mounted below the vessel, one in front of the other and about one metre apart. A pulse of sound produced by the front transducer travels through the water and is picked up by the rear transducer a fraction of a second later. If the boat is moving forward, water flow carries the sound with it and speeds up its journey. The rear transducer next sends a pulse to the front transducer. This time, water flow is against the direction of pulse travel so it takes a little longer to get there.

Some simple electronics to measure the difference between the two pulse travelling times and divide this by two will give the boat's speed through the water. The velocity of sound in water does vary with temperature and salinity, but because a

at some of the facilities available. For example, the multifunction log will show speed in knots, km/h or mph, average speed, acceleration or deceleration as sails are trimmed, trip distance and total distance covered with a 10 year memory back up. The wind speed indicates in knots, Beaufort strength or metres per second. Readings can relate to apparent or true wind (all moving objects create their own apparent wind) and there is a wind alarm which activates an audible warning if gusts exceed a pre-set limit.

VDO will even supply a set of new white bezels, so you can upgrade the appearance of your old black circular instruments to match the colour of new Navpac additions. This is a simple but elegant idea, which could save your instrument panel from ending up looking like a chess board.

Many instrumentation packages, including B & G and VDO, can be integrated with suitable Satnav and autopilot equipment. This enables the various units to chatter away to each other in the privacy of their own circuits and language, comparing desired courses and positions with those actually made good due to the effects of wind and current. If substantial errors are occurring, the autopilot will be quietly instructed to change heading, so the boat ends up where the skipper originally planned.

A 'total system' approach of this kind, which includes the autopilot, is offered by the Travacrest Seaway package imported from the UK by Magna-Tech Marine. Our illustration shows how all the units are inter-connected via a central junction box. The autopilot is an advanced design and its characteristics are automatically adjusted to allow for changing sea state, etc., giving optimum course accuracy and minimum power consumption.

Sounders and Sonar

AFTER A PERIOD of rapid innovation, especially in the use of LCD and CRT displays, depth sounder technology seems to have settled down and stabilised a little over the past year.

Colour picture tube displays, which were initially regarded by some as rather gimmicky, are now finding wider acceptance. This is not surprising, as having different strength echo signals show up in different colours, really helps identify and separate large and small fish, weed patches and various types of bottom material.

Those who have graduated from a chart sounder also appreciate not having to satisfy the latter's insatiable appetite for rolls of sensitised paper. Enthusiasts have even been heard to argue that, after a few hundred hours of use, the money saved on paper more than offsets the higher cost of a colour unit, so they actually come out ahead.

Normal sounder transducers project their beam of ultrasonic pulses straight downwards, so the depth indicator or pictorial display only shows what is happening directly below the boat. Sometimes, as with rocks or coral reefs, which can rise almost vertically from the depths, the sounder only warns of danger when the boat is actually on top of the hazard or too close for avoiding action to be taken. Likewise, when using a sounder as a fish finder, the boat has to pass right over individual fish or shoals before they show up. Other fish, which may be just a few boat lengths to either side, can escape detection altogether.

The answer to both these limitations is provided by scanning sonar. This works along exactly the same lines as an ultrasonic depth sounder, but the transducer beam can be made to scan ahead, on either side, or even all around the boat, just like underwater radar.

The US company, Wesmar Marine Electronics, produces three different professional and semi professional scanning sonar systems. These can all provide colour images on a suitable monitor, complete with range rings and other on-screen calibration data.

As with conventional 'vertical' sounders, the maximum usable range depends on the power and ultrasonic frequency used. For example, Wesmar's long range commercial fishing unit operates at 60kHz and, with a transmitter power of 1500 watts peak, can give indications from objects up to 1440 metres away. Their medium range unit uses 160kHz signals with 1000 watts peak power and gives a maximum range of 800 metres. Both units have motor driven retractable transducers.

The Wesmar long range 60kHz system has a fairly wide horizontal beam width of 14 degrees, whilst the medium range 160kHz system's beam is only 6.5 degrees wide. In general terms, the narrower the beam, the better will be the system's ability to pick out and separate small objects, such as individual fish, rocks, parts of wrecks, etc.

Glename Engineering, who are an Australian company based near Sydney, has developed a small sonar which is aimed specifically at the cruising yacht and amateur sports fishing market. Our

Echo Sounders from Imark

Imark Pty Ltd carries a range of video echo sounders for use by sportsfishermen and pleasure boaters. Included in the range are the Sunmaster DM-2000 and DM-2000A colour units, and the DM-1500 mono unit. All three use CRTs (ie, no chart paper) to display the sea bottom and to show reefs and fish beneath the vessel.

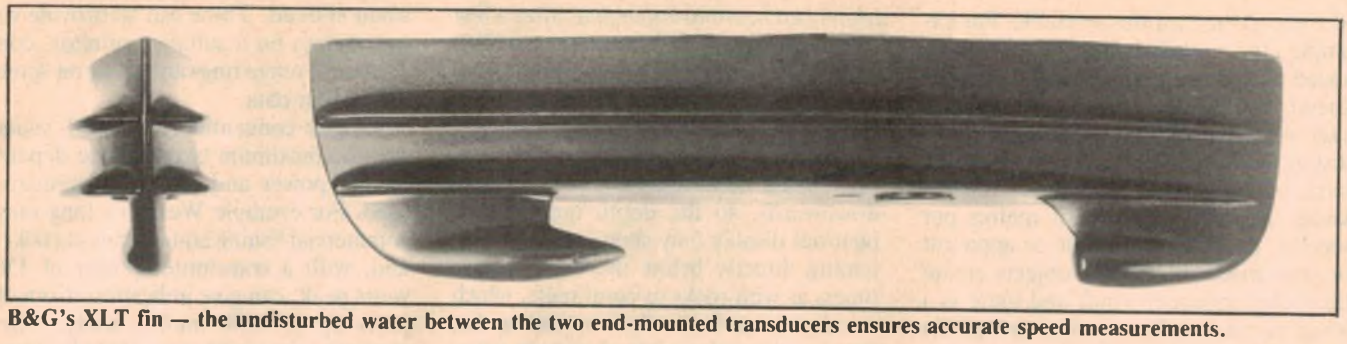
"The DM-2000 is a 200kHz unit and operates down to 160 metres while the DM-2000A is a 40kHz model and operates down to 320 metres. Both feature six basic depth ranges: 0-10, 0-20, 0-40, 0-80, 0-160 and 0-320 metres. An auto range tracking (ART) mode can be engaged to automatically select the most suitable depth range while under way.

A zoom facility enables the operator to display any 5-metre section of water over the entire 15cm screen. In addition, the units feature a freeze frame facility, four sweep speeds and a synchronised sweep speed. Both shallow and deep water alarm settings are provided and these are displayed on the CRT.

Other features which can be displayed include battery voltage, water depth, selected depth range, speed through the water and total distance. The controls are all backlit for night use and are easy to use. Dimensions are just 239 x 230 x 155mm (W x D x H) and the units are supplied complete with DC cable, mounting bracket, sun shade hood, operator's manual and a transducer.

With the exception of the colour display, the DM-1500 has virtually identical features.

For further information contact Imark Pty Ltd, 167 Roden St, West Melbourne, Vic 3003. Telephone (03) 329 5433.



B&G's XLT fin — the undisturbed water between the two end-mounted transducers ensures accurate speed measurements.

two way system is used, any changes cancel out. Thirty samples are taken per second and speeds down to 0.001 knots can be measured. This means that even the small movement produced by pulling on the dock lines of a moored boat will give a positive reading on a log of this type.

Following the success of their yacht system, and after a further period of research, B and G have just come up with new sonic speed equipment designed specifically for power boats travelling at up to 40 knots. Yachts normally move along in a fairly sedate manner and water flows smoothly over the bottom surfaces. High speed power craft on the other hand, have a lot of air bubbles and very turbulent water flow beneath them, which can deafen the transducers and prevent the sonic pulses being detected.

Using facilities at the UK's Southampton University, B & G have developed the XLT fin which is shown in one of our photographs. This is a bit like Australia II's fin keel in reverse and works by forcing turbulence and bubbles up to the hull, leaving undisturbed water between the transducers which are mounted in streamlined fairings at either end of the unit. Having created an area of no turbulent water, B & G have taken advantage of this by also mounting the ultrasonic transducer for the depth sounder in the same assembly.

At high speed, power boats often leap out of the water, so a sample and hold circuit is incorporated in the electronics to prevent erratic speed readings if sonic signals are interrupted for a second or two.

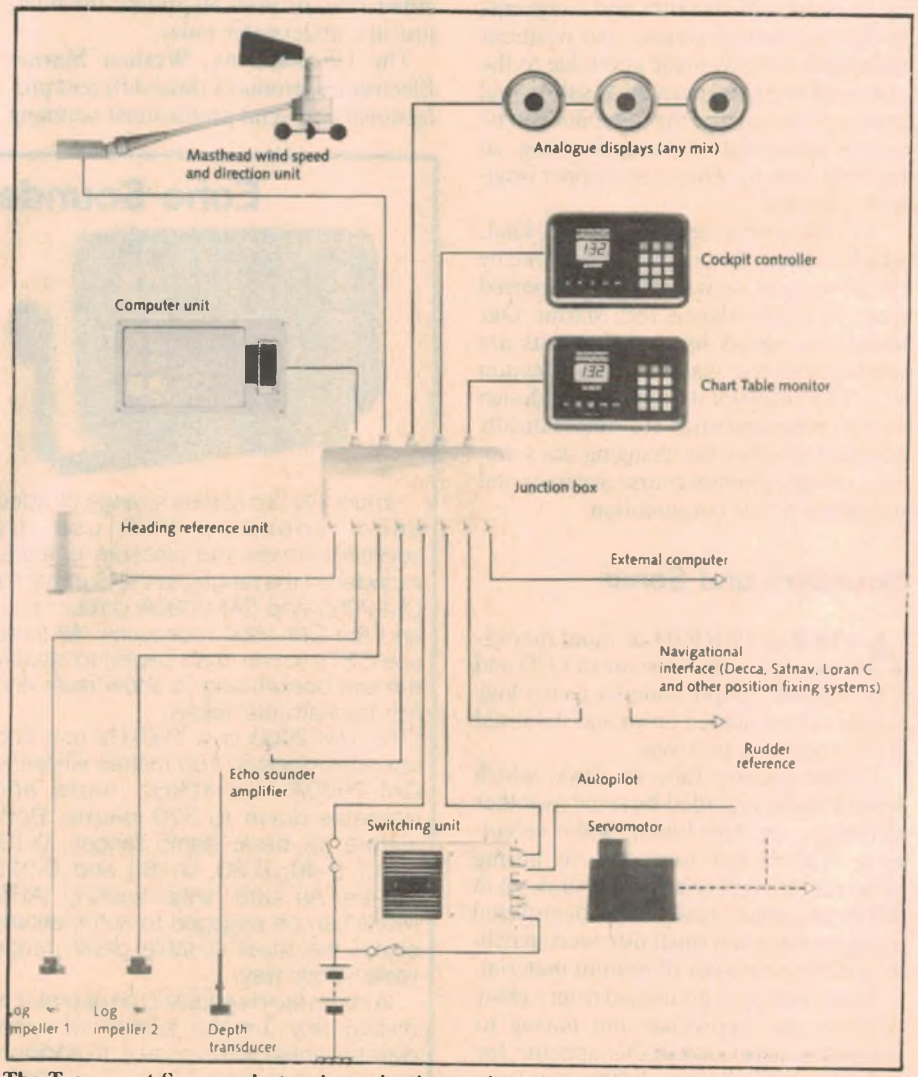
New Instruments

FIRST PRIZE for style and innovation in marine instruments has to go to the new VDO Navpac system. As shown on page 42, there are initially five display units in the range, giving all the basic information required to sail or navigate a boat. It is only when one looks in detail at the features and facilities provided that it becomes apparent just how different this new system is from what has gone before.

Each display has its own electronics module containing a microprocessor, so it is capable of doing a lot more than just indicating the present output from its associated sensor. Liquid crystal displays show the main data in big clear 20mm high numbers, but there are also a variety of analog symbols to aid rapid comprehension of details. Single units can be purchased and used alone, combined with existing round analog meters or progressively built up to form a comprehensive system.

The electronics modules which support each display mount on a common plastic rail and plug together as shown, permitting easy expansion or servicing. If a failure does occur, some interchange of information may be lost, but the unaffected displays with their own microprocessors will keep on working. A single data link connects the module assembly to the display units on deck, so the usual 'rats nest' of cables is avoided.

An idea of the 'intelligence' associated with each display can be gained by looking



The Travacrest Seaway electronic navigation package includes an autopilot system.

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Just look what's in FunWay 2 Gift Box. Over $36 value for under $27. Includes: • soldering iron and solder pack • wireless microphone kit • FunWay 2 book • 9V battery. Your kids will love it!

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FunWay 3 Bonus Pack is hard to beat... Two projects — Electronic Cricket and Mini Amplifier (worth over $31) Plus the FunWay 3 book (value $6.95) all for under $30!

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T55 Terrace Level	Bankstown Sq	(02)707 4888	**VIC**			77 Grenfell St	Adelaide	(08)232 1200
Shop 1, 65-75 Main St	Blacktown	(02)671 7722	Creswick Rd & Webster St	Ballarat	(053)31 5433	Main South & Flagstaff Rds	Darlington	(08)298 8977
613 Princess Hwy	Blakehurst	(02)546 7744	145 McCrae St	Bendigo	(054)43 0388	Main North Rd & Darlington St	Enfield	(08)260 6088
Oxford & Adelaide Sts	Bondi Junction	(02)387 1444	Shop 46,Box Hill Central,Main St	Box Hill	(03)890 0699	24 Park Terrace	Salisbury	(08)281 1593
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George & Smith Sts	Parramatta	(02)689 2188	Queen Elizabeth Dr & Bernard St	Rockhampton	(079)27 9644			
The Gateway High & Henry Sts	Penrith	(047)32 3400	2nd Level Western Entrance Redbank Shopping Plaza	Redbank	(07)288 5599			
818 George St	Railway Square	(02)211 3777	Gold Coast Hwy & Welch St	Southport	(075)32 9863			
125 York St	Sydney City	(02)267 9111	Bowen & Ruthven Sts	Toowoomba	(076)38 4300			
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Quite often, the products we advertise are so popular they run out within a few days, or unforseen circumstances might hold up shipments so that advertised lines are not in the stores by the time the advert appears. And very occasionally, an error might slip through our checks and appear in the advert (after all, we're human too!) Please don't blame the store manager or staff; they cannot solve a dock strike on the other side of the world, nor fix an error that's appeared in print. If you're about to drive across town to pick up an advertised line, why not play it safe and give them a call first... just in case! Thanks. Dick Smith Electronics

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NSW: • **Ballina:** A. Cummings & Co. 91-93 River St 86 2284 • **Ulladulla:** Pauls Electronics, 10 Wason Street, 55 3989 • **Bowral:** F.R.H. Electrical, 28 Station St 61 1861 • **Broken Hill:** Hobbies & Electronics, 31 Oxide St 88 4098 • **Charlestown:** Newtronics 131 Pacific Hwy 43 9600 • **Coffs Harbour:** Coffs Harbour Electronics, 3 Coffs Plaza, Park Ave. 56 5684 • **Deniliquin:** Deni Electronics, 220 Cressy St, 81 3672 • **Dubbo:** Mavins Electronics, 35 Talbragar St, 82 8500 • **Gosford:** Tomorrows Electronics & HiFi, 68 William St, 24 7246 • **Lismore:** Decro 3A/6-18 Carrington St, 21 4137 • **Port Macquarie:** Hall of Electronics, Horton Centre, Horton St, 83 7440 • **Orange:** Fyle Electronics 173 Summer St, 62 6491 • **Springwood:** Wellington's Electrical Discounts 115 Macquarie Rd, 51 4888 • **Taree:** Brad's Electronics Shop 6, Civic Cinema Centre, Pulteney St, 52 6603 • **Tumut:** Tumut Electronics Wynyard St, 47 1631 • **Tweed Heads:** Stuart Street Electronic Sales, Stuart St, 36 5744 • **Wagga:** Phillips Electronics 60 Forsyth St, 21 6558 • **Windsor:** M & E Electronics, Sh 7, Mc Ewans Arcade, 206 George St, 77 5935 • **Young:** Keith Donges Electronics 186 Boorowa St 82 1279 **VIC:** • **Echuca:** Webster Electronics, 220 Packeham St 82 2956 • **Mildura:** McWilliams Electronics 110A Langtree Ave, 23 6410 • **Morwell:** Morwell Electronics, 95 George St, 34 6133 • **Shepparton:** GV Electronics Centre 100 High St, 21 8866 **QLD:** • **Bundaberg:** Bob Elkin Electronics, 81 Bourbong St, 72 1785 • **Cairns:** Electronic World Shop 27 K-mart Westcourt Plaza, 51 8555 • **Caloundra:** Hume's Electro-Mart, 9 Tay Ave, 91 4270 • **Gladstone:** Supertronics, 9 Tank St, 72 4321 • **Mackay:** Stevens Electronics, 42 Victoria St, 51 1723 • **Maryborough:** Keller Electronics, 218 Adelaide St, 21 4559 • **Mt Isa:** Outback Electronics Shop 71 Barkley Hwy 43 3331 • **Nambour:** Nambour Electronics Shop 4, Lowan House, Ann St, 41 1604 • **Rockhampton:** Access Electronics, 15 East St, 21 058 **SA:** • **Mt Gambier:** Hutchessons Communications, 5 Elizabeth St, 25 0400 • **Whyalla:** Eyre Electronics Shop 2 Forsythe St, 45 4764 **WA:** • **Albany:** Micro Electronics 133 Lockyer Ave, 41 3432 **TAS:** • **Launceston:** Wills Electronics 5A The Quadrant, 31 5688

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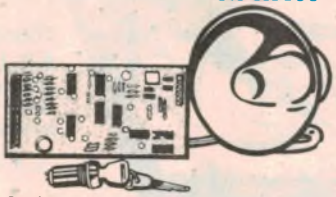
Deluxe car alarm



9 of the 10 protection features recommended by the NRMA: • delayed & instant inputs • flashing light • key on/off... and more! Optional ignition killer for 10 out of 10! Cat K-3252

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Careful! It may not be Santa creeping in at night. 4 Sector alarm provides real security for $$$ less than commercial systems. Cat K-3254

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VCR Sound processor adds sensational stereo-like sound to videos. Graphic equaliser tailors output to suit your tastes. Cat K-3422

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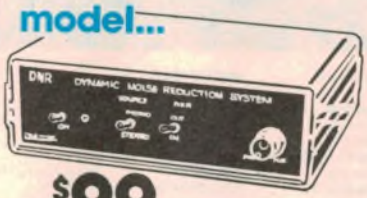

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VCR DNR reduces annoying 'hiss' — improves signal-to-noise ratio up to 18dB. Adds brilliant simulated stereo too! Cat K-3423

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As described in EA April '86

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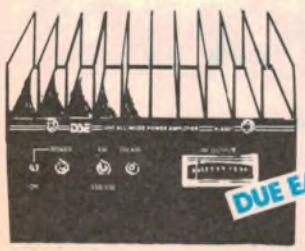

HF Amplifier

Sick of QRP? This new kit gives your HF transceiver a new lease of life with around 10-14dB gain. That's about 100 watts out from a 4 watt drive — and it covers the full HF spectrum from 2 to 30MHz (about 50W output on 10m). Wide-band ferrites used so no tuning required for band changes (switched low-pass filter covers all amateur bands). 4 to 10W drive required (15W if 2:1 attenuator included).

$249 ONLY Cat K-6331

DUE EARLY DEC

Play around!

With our Anywhere Amp it's easy! Plug in a guitar, organ or electronic Chistmas bells — ideal portable PA amp. Compact, battery operated for use 'anywhere'. Cat K-3447

$87.95 BARGAIN

Short form kit — only
Case & hardware not included!

Speaking of value...

40W bookshelf speakers for quality stereo at a bargain price. Ideal gift for the 'do-it-yourselfer' or teenager.

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As described in EA Nov '85

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Handy power supply for kits: 240V primary with 37V/17V tappings. Ideal for amplifiers, power supplies, etc. Cat M-1200

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Great for audio applications

TBA820A 8-pin audio amp IC with a 2 watt output. Two make a great amp. Cat Z-2507

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2N4427 1W-175W RF transistor

Great all rounder for amplifier, frequency multiplier or oscillator applications. Also suitable for use as an output driver or pre-driver stages in VHF and UHF equipment. • Power output: 1.0W • minimum gain: 10dB • efficiency: 50%. Cat Z-2506

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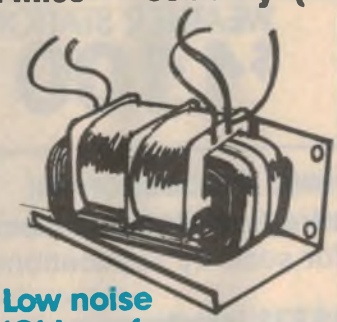

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For that extra oomph — gives 36 volts a side at 2 amps. As used in higher powered amplifiers, power supplies, etc. Cat M-0152

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Toggle switch with legs brought out at 90° for circuit board mounting. Ideal for projects with board mounted controls through the front panel. Cat S-1290

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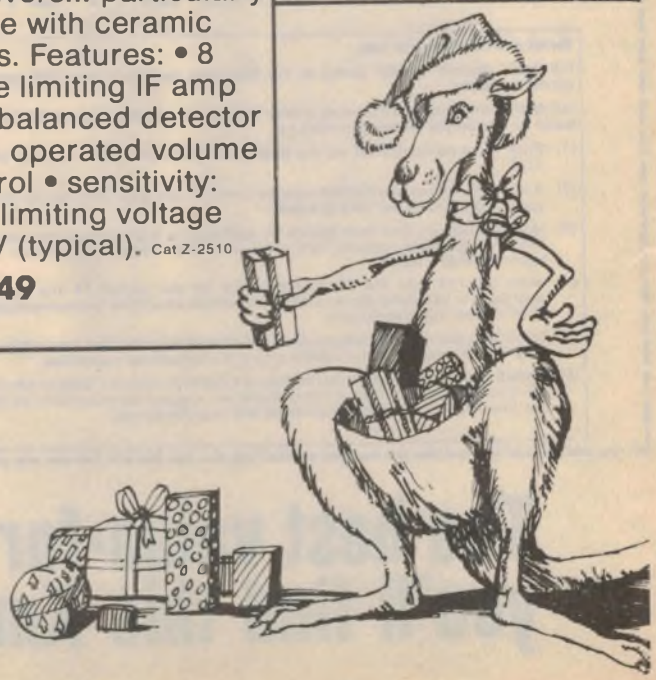

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Get better weather information than the weather bureau gives! Famous world-wide, the Heathkit computerised weather station gives wind speed and direction, wind chill factor, temperature, barometric pressure (and whether its rising or falling)... everything! If your business is knowing the weather, the Heathkit weather computer is for you! Everything supplied — including sensors and cable. Cat G-2000

WEATHER STATION
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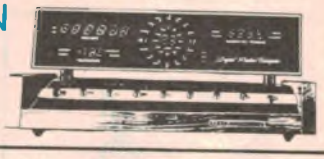

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Terms and conditions of sale:

For items stocked in DSE stores or the DSXpress centre, normal DSE terms and conditions apply.

For items from the Heathkit catalogue other than those normally stocked, DSE will order these for you on the following conditions:

(1) Price must be confirmed via the Heathkit Information Line — Sydney (02) 888 2105.

(2) A 25% non-refundable deposit must be made on any order (this can be done with your credit card as per normal sales).

(3) Normally delivery time from the US via seafreight is 8 to 10 weeks from order. Air freight is available (approx 10% extra) and this reduces the delivery time to approximately 4 weeks.

(4) Items ordered from the US do not qualify for our normal 14 day satisfaction guarantee or for refund: if in doubt about the kit you would like, take advantage of our special assembly manual offer.

(5) Quotations given for Heathkit products, whether written or verbal, are valid for 7 days only. This is because of the volatile nature of international currencies.

(6) Orders may be made by phone (toll free 008 226610), mail, fax, telex or any other of our normal order methods. If using phone, we suggest the order form be filled out to confirm the details of your order and retained by you.

Did you miss out on a Heathkit Catalogue?

Some issues of this magazine did not contain the Heathkit Catalogue (it is in very short supply world-wide!)

Or it may be that some light-fingered larrikin has lifted, purloined or pinched it before you saw it...

Don't panic: send this coupon to The Heathkit Information Service, Dick Smith Electronics, PO Box 321, North Ryde — and we'll send you one free of charge.

Or if you talk nicely to your local DSE store manager he/she might be able to find one for you (just give them this coupon).

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The best value-for-money you'll find this Xmas!

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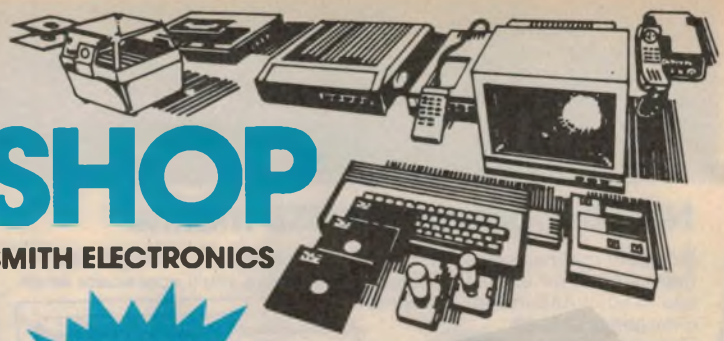
ONE STOP COMPUTER SHOP

A COMPLETE RANGE OF PERIPHERALS FROM DICK SMITH ELECTRONICS



VZ 300 Family Pack

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THOUSANDS SOLD!

The best value-for-money in computers today!

The ideal start to home computing. Easy to use, affordable and there's nothing extra to buy for an immediate start — plugs into any standard colour TV.

Includes Data Cassette! Usually an option with other systems, it's part of the ready-to-use VZ 300 pack. Run software cassettes and store programs you've developed on the versatile VZ 300.

We include FREE programs! The first thing the family will want to do is play a game, and you can without spending another cent. The VZ 300 pack includes 2 game AND 2 educational programs... more than enough to keep them going. Cat X-7307

More extras than you thought possible for the price!

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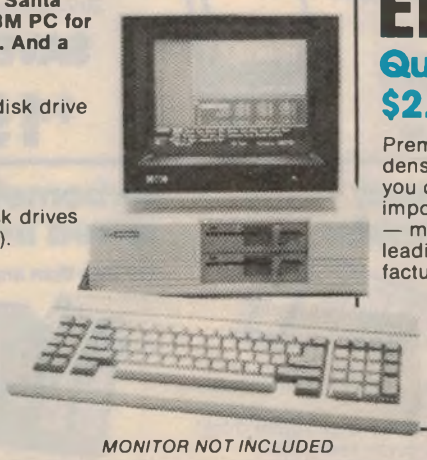

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Economy marine

27MHz Marine performance without your budget taking a dive! Maximum legal power with all 10 channels fitted, auto noise limiter for clear communications. Doubles as a PA amp with optional power horn.
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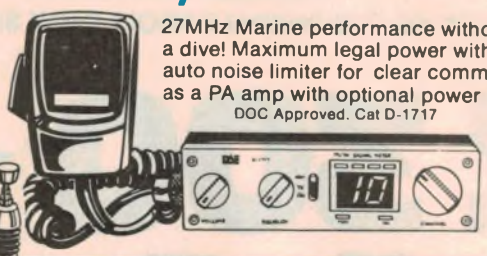

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Prefer a hand held marine?

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Our bargain priced 27MHz hand-held is the right choice. Performs with maximum legal power on 6 fitted channels; connects to an external antenna for greater range! Compact for go anywhere action. DOC Approved. Cat D-1125

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VHF Marine with Seaphone

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Your DSE marine transceiver needs the best antenna

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Reliable antenna for your VHF marine transceiver. And what value: includes 'any-which-way' base with quick release lever that lowers antenna to prevent damage from tree branches, bridges and those flying fish that get away! Cat D-4016

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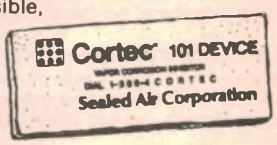

Xtals for hand-helds

Value stocking fillers for the old Salt. Transmit/receive pairs for popular 27MHz marine channels.

27.620 Cat D-6062	
27.860 Cat D-6086	27.910 Cat D-6091
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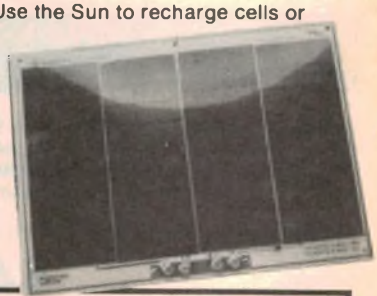
Save $$$ buying new batteries! Use the Sun to recharge cells or power radios, tape players, etc. on the boat, while camping or at home. Have fun with solar experiments.

20V/500mA Solar Panel

SAVE $50

$159 Cat Z-4844



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Affordable 4.5 digit bench top that's versatile enough to take with you! Extremely accurate with high resolution.

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- 6 resistance ranges — accuracy .15%
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Cat Q-1550

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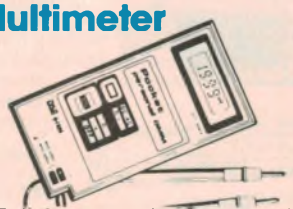
Personal Multimeter



3.5 digit meter only 10mm thick! Features super fast auto ranging, buzzer continuity, polarity indication with minus sign, 2x/second sampling

- 8 auto ranging AC/DC voltage ranges
- 5 auto resistance ranges
- 5M ohm input resistance

WOW! Cat Q-1555 **$59.95**

Turbometer — air speed indicator

$30 less than anywhere else!

Santa can tell how fast he travels in flight! You can use it to test wind speed: yachting, ballooning, etc. (displays speed in knots, mph and metres per second). Handy tester for experiments and servicemen too! Cat Q-1405

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Unbeatable value for dual trace 20MHz CRO!

Sensational value! An affordable, professional standard 20MHz oscilloscope that's got the lot: **Bandwidth:** DC to 20MHz (-3dB). **Input impedance:** 1m ohm to 25pF +/-2%. **Algebraic addition:** CHI+CHII, -CHI+CHIII. **Sweep time:** 0.1us/DIV - 0.2s/DIV +/-3% (20 steps) in 1-2-5 sequence.

Cat Q-1260 **$949**

Does Santa use a CB? How else could he travel the world!

For a safe Chistmas

Plan to go bush-walking, fishing or camping? Smart adventurers take our popular 3-Ch. Safety Transceiver. Small for easy packing, fitted with the bushwalking frequency 27.620 (remaining 2 open for your choice). DOC Approved. Cat D-1102

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Great gift for the kids...

Pocket Com II. They'll have a ball playing spies and commandos with this fully operational 2-way transceiver. No licence required. Complies with DOC spec. RFME001. Cat D-1101

$15.95 each

Let the kids talk to Santa

With this fantastic 3 channel hand-held it's easy. Bushwalkers, campers and fishermen can ask Santa to get them out of trouble too... what a gift! One channel fitted with CB crystal, two left free for your choice. DOC Approved Cat D-1106

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Yo-Ho-Ho.. Budget Mobile CB

Compact to fit Santa's sleigh and today's smaller cars. But full 40 channel power, digital frequency display, RF power meter and more for reliable motoring.

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DOC Approved Cat D-1450

Top range AM/SSB Mobile

Name it and this compact CB has it... all the best Uniden features! Plus SSB band for that extra range when you need it most. Ideal as base station with optional 12V supply. DOC Approved. Cat D-1715

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All the most wanted Uniden features to jingle your bells. 40 channel UHF CB has the lot — even repeater capability built-in! Maximum legal power. DOC Approved. Cat D-1806

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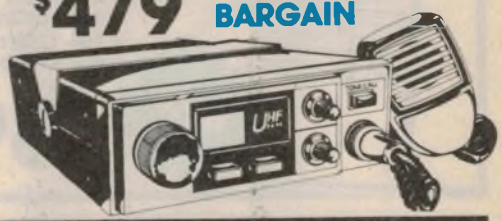

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27MHz gutter mount takes a moment to set up and what performance! Centre loading coil for increased efficiency. No hole required. Cat D-4411

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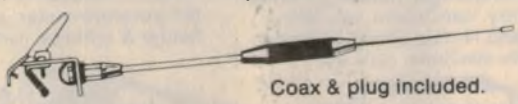
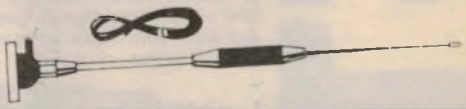


Coax & plug included.

27MHz with magnetic base really pulls in signals. Ideal for company cars and hire cars: no holes! Includes 3.3m coax cable and PL-259 plug. Cat D-4412

$29.95



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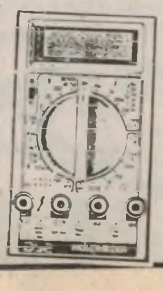

NEW! $115

Economy 3.5 Digit Multimeter

Economy wide-angled LCD meter with RF shielding and overload protection. Handles 250V or 350V indefinitely.

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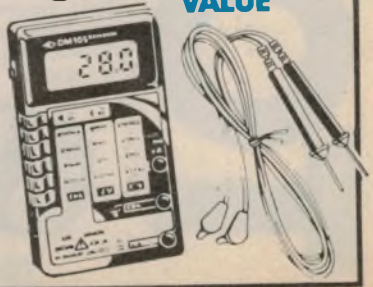

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- 29-54MHz
- 136-174MHz
- 406-512MHz

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low-impedance antenna input socket which disables the internal ferrite rod for the BC and LF bands when in use.

Using this receiver, the following points were noted when comparing the Techniloop 3 with the normal antenna arrangement:

● LF Band (153 — 519kHz) — the loop covers this band from 200kHz upwards, which is where most of the activity is in the form of RDF and weather beacons for aircraft, marine and other use. The Sony receiver normally uses an inbuilt ferrite rod for this band.

Plugging in the loop dramatically improved the performance, and beacon signals which were barely discernible were brought to useful strength with a significant improvement in signal-to-noise ratio. By comparison, attaching an indoor 10-metre wire antenna to the receiver on this band increased both the signal and the noise, with no real improvement in readability.

● Broadcast Band (531 — 1602kHz) — at Armadale in Melbourne during daytime, country radio stations which were again just discernible above the noise level were brought to useful listening level with the loop. For country listeners who want to listen to city stations, or vice versa, the loop will prove a real benefit. And broadcast band DX fans will not only find a worthwhile improvement in signal-noise ratio, but also a reduction in beat-note interference, which occurs when two stations share the same frequency.

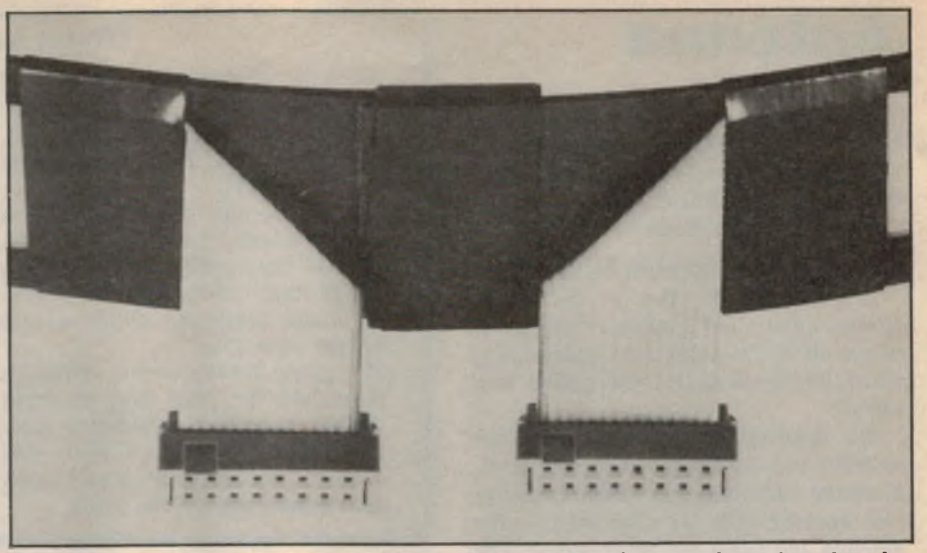
● AM Stereo & High Fidelity — owners of hifi AM stereo receivers will find the improved signal-to-noise ratio of benefit, particularly when the signal quality is only marginal with the normal antenna.

● Shortwave Bands — useful improvements were noted on both the 80-metre and 40-metre bands. The added selectivity and directionality of the loop often helps to reduce or eliminate interferring transmissions on nearby frequencies. As predicted, a long wire can give more signal strength, but the loop generally gives the better signal-to-noise ratio.

For international short wave transmissions, the loop provides a neat and portable alternative to stringing up a long wire.

Other Receivers

The loop was tried with various receivers, including the Sony ICF-2001D which is a higher performance "big brother" to the ICF-7600D. Improvements were not as marked as with the smaller set, as the ICF-2001D has a larger ferrite rod antenna and a better front-end. Nevertheless, the improvements were significant enough for the owner of the set to consider the loop a "must-have" accessory.



This close up view shows how the ends of the loop coils are folded and terminated to the IDC connectors.

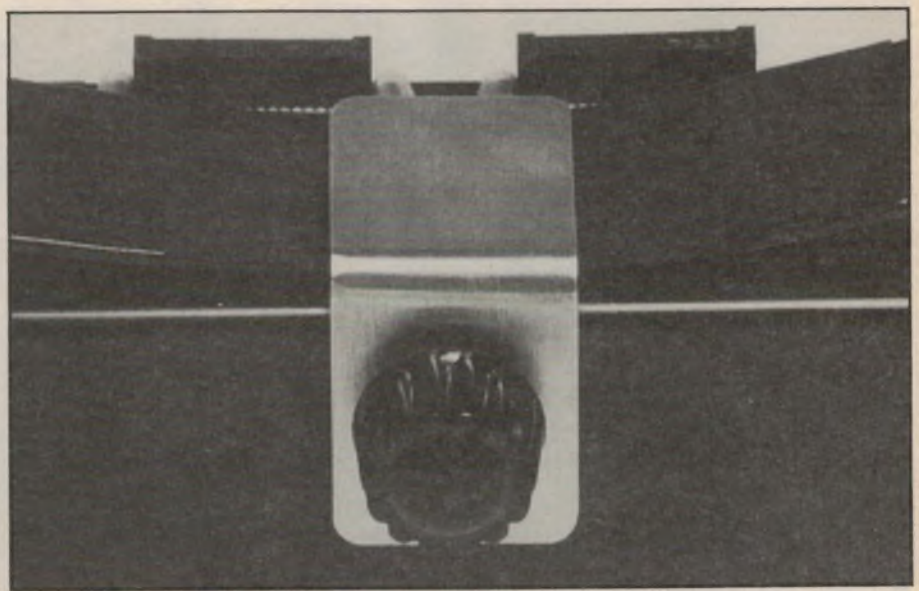
PARTS LIST

1 PCB, code Techniloop 3, 85 x 130mm
1 plastic case, 50 x 90 x 150mm
1 coaxial socket
2 IDC 16-way connectors
2 IDC 16-way sockets
1 6-pole 3-position slider switch
1 2-pole 3-position slider switch
1 Sato 10-turn vernier dial
1 knob to suit
1 right-angle bracket
1 battery snap connector
1 380mm loop former strip
1 16-way length of ribbon cable (3-metres)
1 piece of foam (to insulate battery)

Semiconductors
D1 — 1N4148, 1N914
Q1 — MPF102 N-channel FET

Capacitors
C1 — 10uF 16V tantalum
C2 — 0.1uF ceramic
C3 — .01uF ceramic
VC1 — 0-470pF variable

Resistors
R1 — 470k
VR1 — 1k miniature pot.



The coils are plugged into the top of the case and clamped using a right angle bracket.

from the connectors apply pressure using a pair of multigrips or similar until the connector is fully closed.

The unit is now ready to be tested.

Connection to the Receiver

If your receiver has a 50-75 ohm coaxial input then a cable between the two is all that is needed. A coaxial plug and a length of cable are supplied with the kit.

For receivers with only a telescopic antenna and no external antenna input, a twisted pair from the Techniloop with two crocodile clips for connection to the antenna and earth will be required. The earth is not strictly necessary but will help on the lower frequencies.

Receivers with existing ferrite rod antennas for the broadcast and or LF bands present more of a problem. If there is no provision for an external antenna or earth then a two or three-turn winding may be added to the rod and brought out to a connector or terminals on the back of the set.

Note that when using the loop simultaneously with a ferrite rod you will need to keep both correctly orientated towards the station. The edge of the loop should be pointed in the direction of the station, while the ferrite rod should be broadside to the station for maximum signal pickup.

Small hand-held radios may simply be placed or held near the loop antenna. Orient the radio so that the end of its inbuilt ferrite rod antenna points towards the centre of the loop. Note that in this case the coupling is inductive and the loop needs only to be set for passive operation.

Tuning the Loop

With the receiver set to a vacant spot around the centre of the band of interest, switch the loop to Active and set the output level control to maximum. When the loop tuning coincides with the receiver tuning, there is an unmistakable increase in activity from the receiver.

Note that the loop tuning is not so sharp as to require constant tracking with the receiver. It is possible to move the receiver tuning a reasonable distance away from the loop resonance without losing reception.

As previously mentioned, to obtain optimum tuning and direction, particularly for weak signals, it helps greatly to reduce the ouput level of the loop to the point where the AGC action of the receiver begins to drop out (indicated by a sudden increase in background noise and a decrease in signal level). After finding the optimum tuning for the loop, the output level may then be restored to maximum.

The Techniloop is not difficult to use, and after a little practice, most people become proficient at getting the most out of it.

Performance

Most of the testing of the loop was carried out using the Sony ICF-7600D PLL Synthesised Receiver as shown in the photographs. This receiver has a

Where to buy the kit

A full kit of parts for this project is available from: Technikit Mail Order Dept., 69 Sutherland Rd, Armadale, Vic. 3143. Telephone (03) 500 9064.

The kit comes complete with a pre-punched case, a screen printed front panel, and a single set of loop coil components with sufficient cable for either a one or two layer coil.

The price for the kit is $A59.00 plus $A5 for post and packing (within Australia). Payment may be made by cheque with mail order or by Bankcard/Mastercard with telephone or mail order.

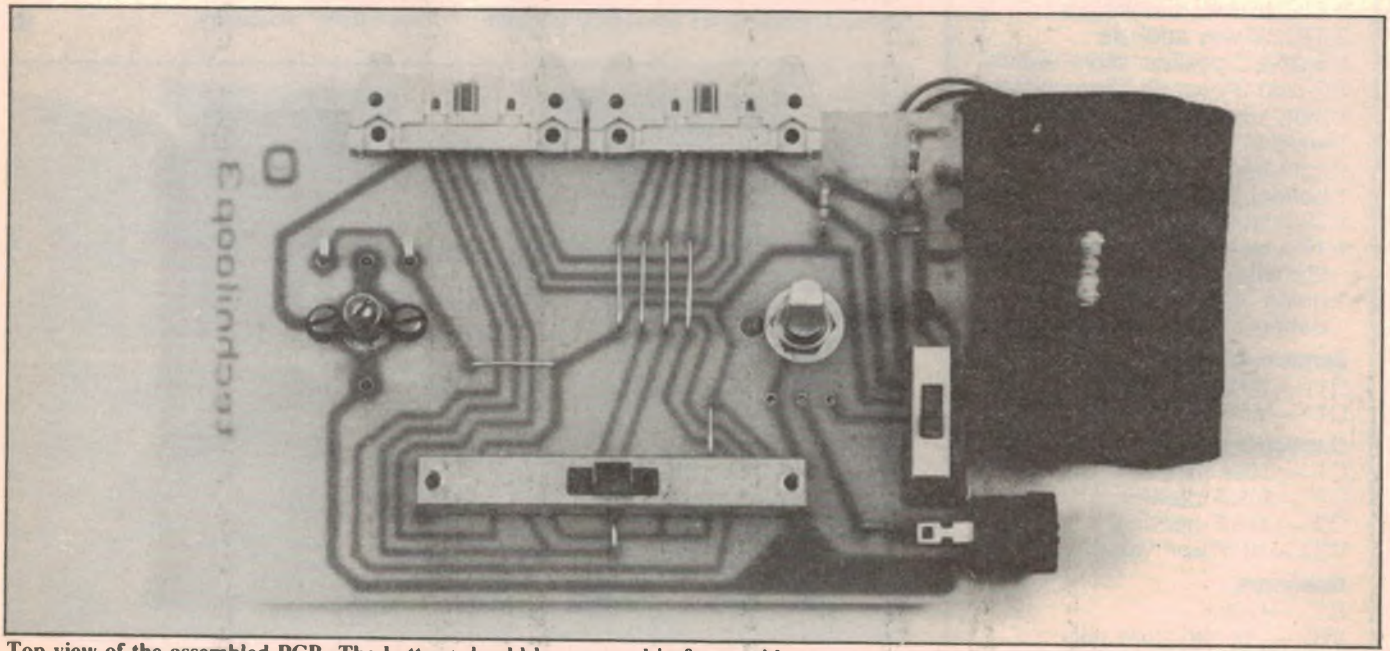
Extra loop coil components are available as follows:

Loop former strip (for up to 380mm loop) — $2.00 each.

16-way IDC connectors (two required per loop coil) — $3.30 each.

16-way flat ribbon cable (one metre per layer required for 300mm loop) — $2.10 per metre.

No further postage charges apply if extra loop coil components are ordered with the kit. Add $3.50 for post and packing if extra loop coil components are ordered separately.



Top view of the assembled PCB. The battery should be wrapped in foam rubber.

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A computer voice! Connects to any computer with a parallel port. Refer June A.E.M.

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passive mode or the short-circuit position. Note that diode D1 is included in the plugpack circuit to prevent damage due to accidental polarity reversal.

Construction

The kitset is supplied ready to assemble and no drilling or panel cutting is required.

The first job is to fit the components to the printed circuit board as shown in Fig.3. Fit the components to the top side of the board first. This done, fasten the connectors with the screws provided and insert the switches, ensuring that they are pushed right in before soldering.

The tuning capacitor and output level potentiometer are installed on the track side. Bend the potentiometer lugs 90 degrees towards the shaft before installing it on the board. The tuning capacitor should be secured using the two screws supplied.

The coax output socket is installed directly on the PCB. Locate the central lug squarely over its PCB track and solder it to the board along with the two small outer tags.

Next, anchor the 9V battery snap leads through the hole provided near the edge of the board and solder them to their respective pads (red to positive). This done, fit the plugpack wires and solder them to the 3.5mm socket provided (red to tip).

The dial can now be fastened to the panel with the screws provided. Set the dial to read zero, then rotate the tuning capacitor shaft to the fully anti-clockwise position. The front panel can then be secured to the band switch by means of two self-tapping screws. Check that the PCB and panel are parallel to each other before tightening the dial grubscrews.

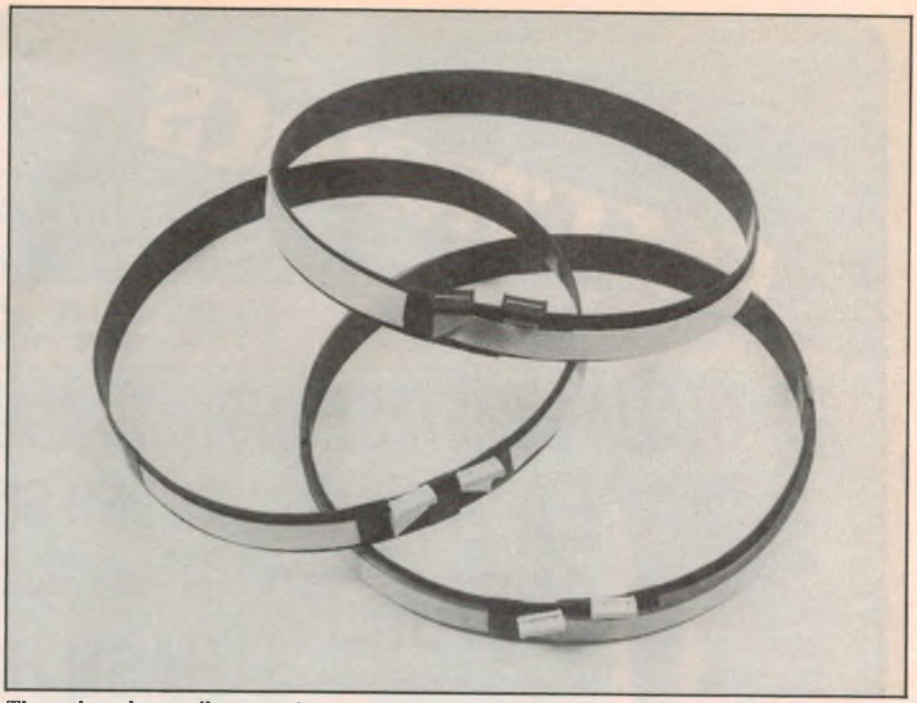
Finally, fit the output knob and clip on the battery. Wrap the battery in foam before installing the assembly in the case.

The Loop Coils

The basic kit contains one coil former strip, two cable connectors and sufficient wire for a one or two-layer loop based on a 300mm diameter coil.

A one-layer 300mm loop will tune from 1MHz to 13.5MHz, while a two-layer loop will tune from 500kHz to 5MHz. If you want to go lower down, extra cable, formers and connectors are available. A five layer loop, for example, will tune from 200kHz to 2MHz.

From this you can see that two coils, one of five layers and one of one layer will cover 200kHz to 13.5MHz, with a good degree of overlap between coils.



These three loop coils cover the range of frequencies from 200kHz to around 13.5MHz.

If your main interest is, say, broadcast band DX (distance reception) and/or the 80-metre amateur band, then a two-layer loop will probably be all you need.

The one-layer loop is suitable for the top end of the broadcast band right through the 80-metre and 40-metre amateur bands and into the international shortwave bands.

Note that the figures given are for a 300mm loop. For larger diameter loops, the frequency range for the same turns would be shifted down proportionately. Larger loops will give more signal capture but, in practice, the 300mm size is convenient and quite adequate for most applications, particularly with the FET buffer stage.

The top frequency with a single layer 300mm loop is 13.5MHz. To go higher with the existing circuit would mean reducing the diameter of the loop which would negate the advantages if taken too far.

Note also that the advantages of a loop tend to diminish with increasing frequency, with directionality becoming vague and the signal falling off.

Coil Construction

Begin by shaping the former strip supplied into a circle. To do this, overlap the ends by exactly 20mm (mark first with a pencil) and then bind the ends with two or three layers of plastic tape.

Next, fold one end of the cable at 90 degrees (see photograph), leaving at least 50 mm lead out. Tape this end to the former next to the fold so that the inner edge of the lead out runs along the line of one of the overlapped former ends.

Now rotate the former by hand while feeding the cable centrally on to it until you have the number of layers required. This done, fold the end of the cable in the same way as the start. Note that the inner edge of the lead out should run along the line of the other overlapped end of the former (ie, the two inner edges of the cable should finish 20mm apart).

Bind the end of the winding with two layers of tape and leave the same length of lead out as at the start (50mm). Once this has been done, tape the cable at the top and sides of the former.

With the loop now completed, it should be clamped onto the top of the control housing using the right-angle clamp supplied with the kit (see photograph). Adjust the positon of the coil so that the two lead outs run centrally through the PCB connector housings.

Next, position a ruler against the front of the connectors and draw a line across both cable lead outs with a ballpoint pen. Remove the coil from the housing and cut the cable carefully along the lines.

The 16-way cable connectors can now be fitted to the leadouts. To do this, locate the connectors over the cable with the keyway (a raised section) towards the front of the coil. With approximately 2mm of the cable end protruding

full unloaded loop output to be delivered into a typical low impedance receiver input. Buffering the coil in this way also significantly increases the selectivity.

The effective power gain provided by the buffer is very useful, especially for DX (long distance) work with very weak signals.

Output Level Control

This is used to adjust the loop output in both the passive and active modes and has proven indispensable in practice.

The AGC (automatic gain control) action of most good receivers tends to mask the tuning and directional maxima of the loop signal by compensating for a wide range of input levels. This is where the level control helps greatly. By initially adjusting the signal to just below the AGC threshold so that the signal is just audible, both the tuning and the direction of the loop may be accurately adjusted for maximum performance.

After that, it's simply a matter of bringing the output level back up again to apply full available signal to the receiver input.

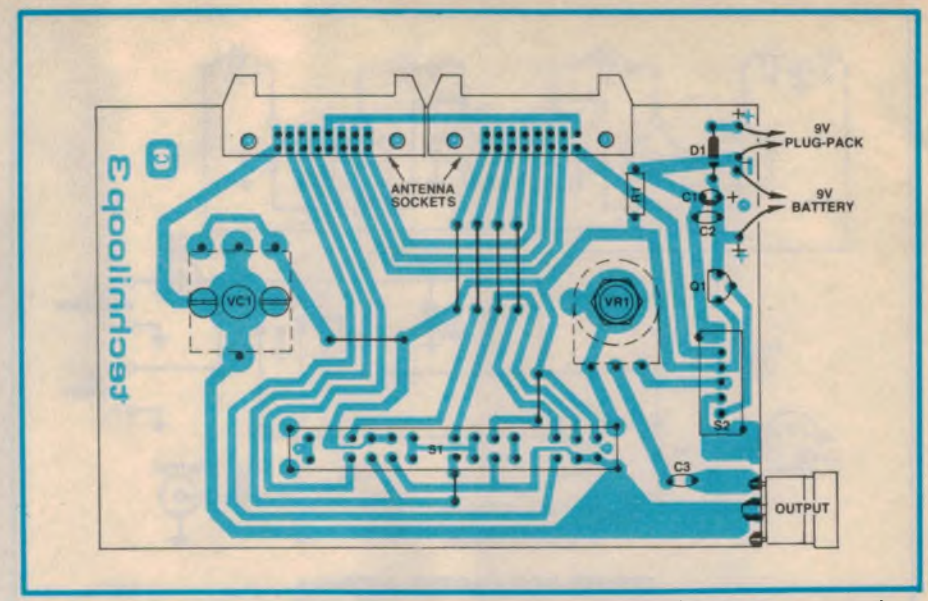


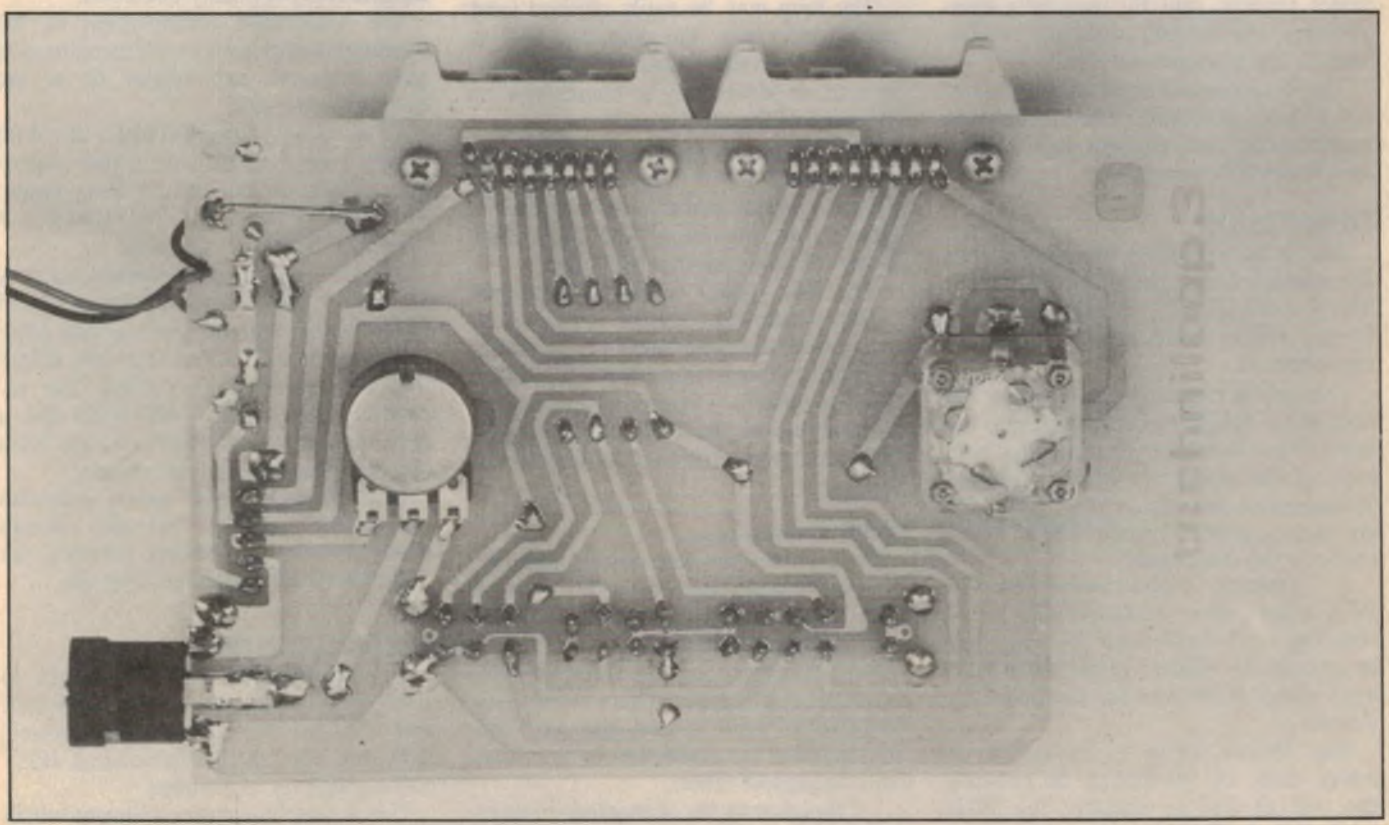
Fig.3: parts layout for the PCB. The tuning capacitor and potentiometer are mounted on the reverse (copper) side of the board (see photograph).

In cases of very high field strengths the loop output may also be reduced to prevent receiver overload.

Position 2 of S2 shorts the loop to prevent damage to the FET when the loop is placed in close proximity to a transmitter; eg, when the loop is used as the receiving antenna in an amateur station. A relay could be used to perform the same function automatically during transmit if desired.

Power

Power for the JFET buffer is provided either from a 9V (216 type) battery or from a 9V mains plugpack. Consumption is 2 to 3.5mA at 9V. The power is switched on when the loop is placed in the active mode and off in the



View showing how the coaxial socket, potentiometer and tuning capacitor are mounted.

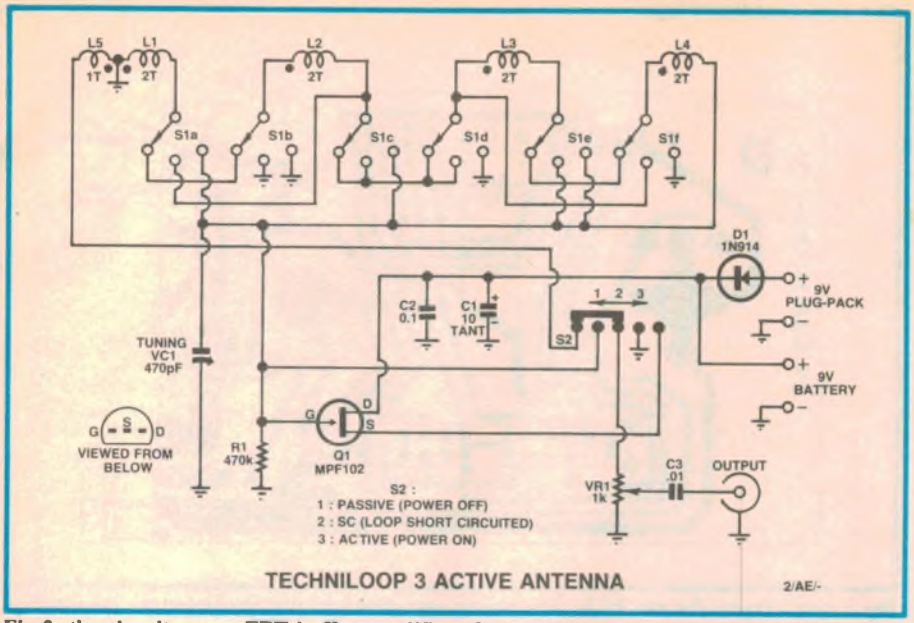


Fig.2: the circuit uses a FET buffer amplifier (Q1) and an output level control (VR1).

be worse, especially on weak signals due to the broadband noise.

An improvement in signal/noise ratio is the loop's greatest benefit, along with greater selectivity due to the fact that the loop is tuned to the frequency being received.

Despite its benefits the loop antenna has tended to remain fairly obscure. Reason: the cost and difficulty of mass producing wooden frames and coils under tension, and the generally cumbersome and not too attractive appearance of the conventional device.

The Techniloop was designed to overcome these problems. The result is an easy-to-build and efficient loop that is also reasonably attractive.

Description

As can be seen from the photographs the wooden frame has been eliminated. This is made possible by the use of flat 16-way ribbon cable as the winding of the loop coil.

The coil is formed by connecting the ends of the length of cable back into the starts. This is done by terminating both ends of the cable via IDC (insulation displacement connector) plugs and sockets into a printed circuit which cross-connects the cable ends.

A 3-position 6-pole switch on the PCB allows three series/parallel cross-coupling combinations to give all, half or quarter the number of turns while always using all the wire for maximum efficiency.

The 16-way cable is connected as 8-way cable by paralleling to increase the coil Q and to simplify the PCB track layout. There are actually seven pairs and one single wire used in the main loop, with the remaining single wire being used as the low impedance output coupling turn in the passive loop mode.

The flat cable coil is supported by a 30mm wide strip of black fibre material formed into a circle. The cable is fastened to this former using black plastic tape. This gives a self supporting circular loop which is still fairly light.

The loop may be easily plugged (and unplugged) into the housing and is clamped by a right angle bracket which, in turn, is secured by a thumbscrew on the back of the case.

The printed circuit board carrying the connectors for the loop, the tuning capacitor, output control and switches is fastened to the lid of the box which forms the front panel of the unit.

The front panel is silk-screened and carries a precision vernier dial for tuning, a 0-10 indicator output level knob, a 3-positon band switch and a 3-position function switch. A coaxial output socket is mounted on the PCB and protrudes through a hole machined in the side of the case.

How it works

Fig.2 shows the full circuit diagram. As can be seen, the coil is divided into four equal windings of two turns and one winding of one turn.

Note that there are two turns for each single layer of cable. Where more than one layer of cable is used, the two turns and one turn are multiplied by the number of layers of cable.

L1 to L4 may be connected in three different configurations by 3-position band switch S1 to give three different inductance values and hence three different tuning ranges. These are: —

(1). Band 1: L1-L4 in series; 8 turns/layer. Highest inductance; lowest frequency range.

(2). Band 2: L1-L2 in parallel, L3-L4 in parallel and the two parallel combinations in series. 4 turns/layer; medium frequency range.

(3). Band 3: L1-L4 in parallel; 2 turns/layer; lowest inductance; highest frequency range.

This method provides three inductance values from the coil and always uses all the wire. There are no "dead end" turns to absorb energy as with a tapped coil system.

As distinct from four separate windings, as with four separate coils wound along the length of a solenoid, L1-L4 are arranged in a "quadrifilar" pattern. This means that the first four wires at one end of the cable are the L1-L4 "starts" and the last four wires at the other end of the cable are the L1-L4 "finishes".

The remaining four wires on either end of the cable are cross-coupled on the PCB to give the two turns per coil (for each single cable loop) and the starts and finishes are routed via band switch S1 (3-pole, 6-position) to give the three different series/parallel turns arrangements previously discussed.

The quadrifilar arrangement of the windings was chosen by experiment as it gave less loss and higher Q at the higher frequencies.

L5 is a single turn (per layer of cable) which is used to provide a low impedance output in the passive loop mode. The loop is tuned by VC1 which is a "polycon" variable capacitor.

Most of these small polycons, as they are called, have maximum capacities of around 160pF (aerial section) and 60pF (oscillator section), totalling only 220pF with both sections in parallel. The capacitor used in the Techniloop has a maximum value of 470pF and has been obtained specially for the project.

Unfortunately, the more common smaller units just do not give enough tuning range for overlap between the three bands for any given loop size.

Active Circuit

Passive operation (S2 in position 1) gives good results under most conditions and uses no battery or other power. However, for best performance a JFET buffer amplifier is included

This is simply a source follower which buffers the loop and allows close to the

Pull in those distant radio stations. Build this

Active antenna for DX reception

This active loop antenna will dramatically improve reception on long wave, broadcast and amateur/shortwave bands. It is easy to build and comes as a complete kit of parts.

by DAVID WHITBY

The loop antenna has been around for a long time now. In fact it was one of the earliest forms of receiver antenna used back in the "wireless" days.

Over the years loops have been made in various shapes and sizes, the larger ones usually being made in the form of a spiral or solenoid coil wound on a wooden cross or box frame as shown in Fig.1.

At one time most portable and many domestic sets contained a built in loop antenna. The introduction of the ferrite rod or "loopstick" antenna as it was first known soon displaced the loop in portable and domestic radio sets.

The reason for this was not because the ferrite rod was necessarily a better signal capturing device but that it was smaller in size and easier to mass-produce.

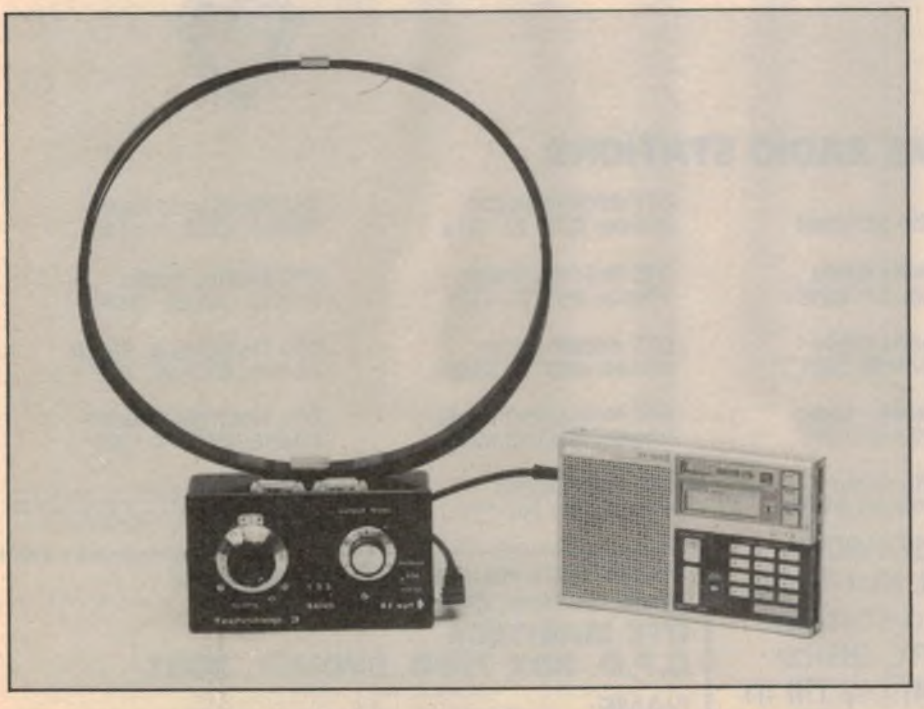
It can be readily demonstrated that the signal capture of a ferrite rod is approximately equal to that of a loop antenna of similar diameter as its length. Thus an average ferrite rod of say 150 mm length will produce about the same signal into the receiver input as a loop antenna of around 150mm diameter.

Given that loop antenna signal pickup is proportional to the square of the diameter, it is easy to see that it does not take a giant loop to outperform even the largest available ferrite rod.

Added to this, the loop has better efficiency at higher frequencies than the standard ferrite rod which exhibits increasing losses above 2 to 3MHz.

The loop antenna is usually tuned by a variable capacitor and its output coupled directly, or inductively by a second small winding, into the receiver input.

The main advantage of a loop antenna over the traditional long wire is a marked reduction in noise pickup. This reduction in noise pickup is due to the fact that a loop can be tuned, as in addition to its directional properties and smaller physical size. A long wire may pick up more signal but readability may



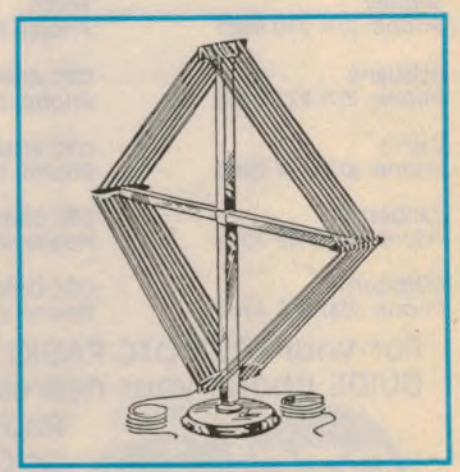


Fig.1: the conventional loop antenna.

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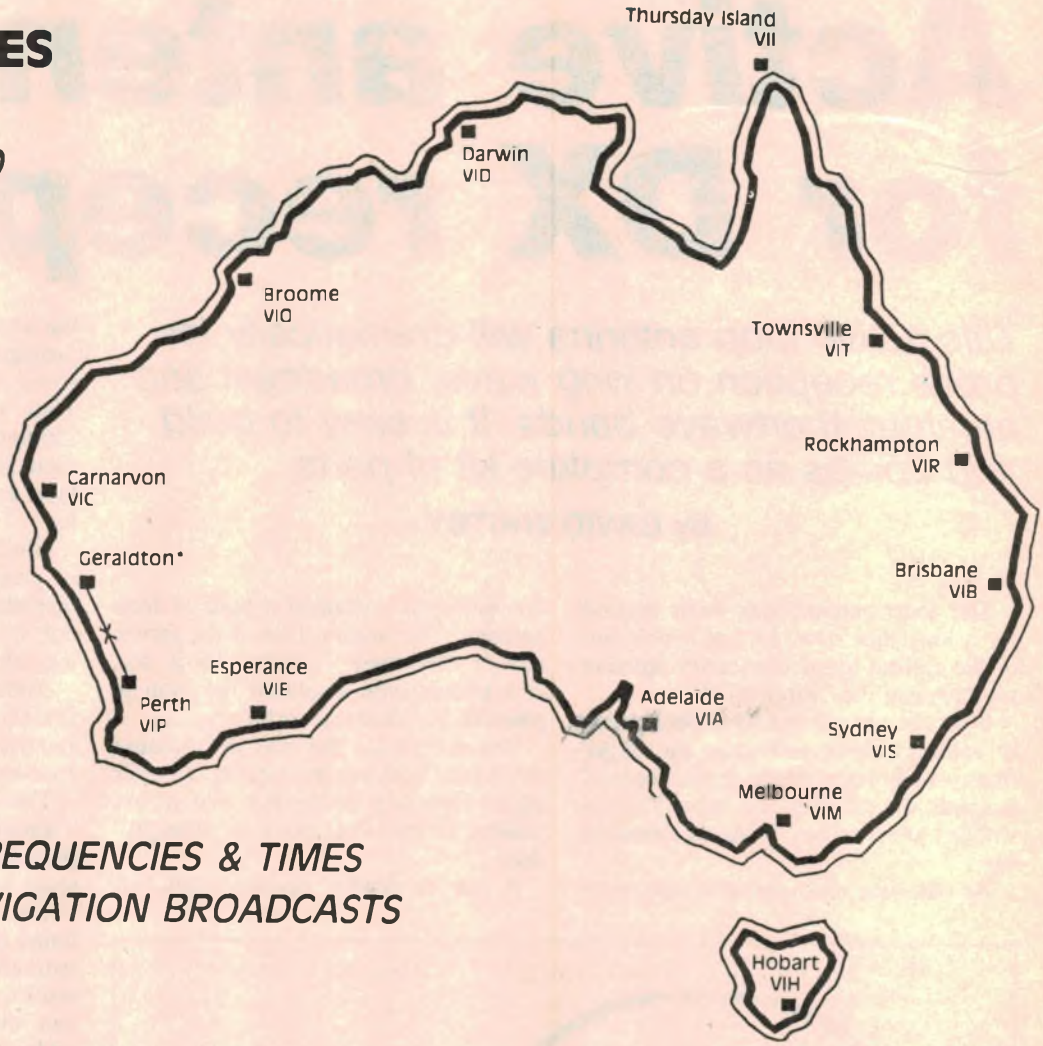

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announced by Disc Navigation AB of Sweden. Nautical charts for the whole world have been digitised and stored on 650 Megabyte laser discs. Routes between any two ports on the globe are covered by five discs. Information is displayed on a 48cm high definition monitor. Normally, a one degree section of any chart (about 60 nautical miles square) will be shown, but it is possible to zoom in on areas of special interest such as narrow passages, buoyed channels, light houses, etc.,

The correct chart is automatically selected and built up around the ship's position. A pre-programmed course and waypoints can be shown and compared with the actual course made good. Radar images can also be overlaid on the display to show uncharted obstacles, such as other vessels, etc.

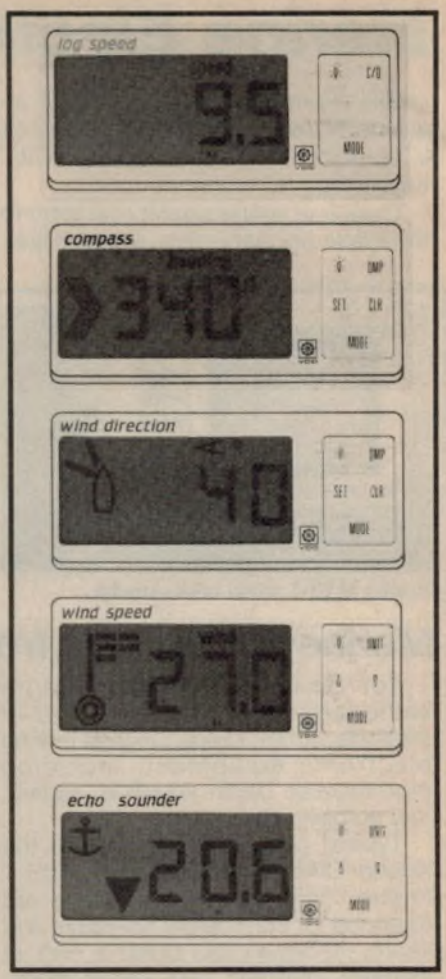
Several companies in the US are developing compact electronic chart systems with price tags which could make them attractive to the small boat end of the market. Data is stored on tape or floppy discs, which cannot rival the capacity of the Swedish laser disc, but does allow for the possibility of regular updating. Well established PCs such as the Apple Macintosh are being used at the moment, but ruggedised 12V systems specially engineered to withstand the ravages of damp, salt laden air are obviously desirable.

PCs have already moved into the marine communications area and our photograph shows the recently announced Shipcom Communications Centre from West Electronics and its companion Sharp PC5000 microcomputer with built-in printer and LCD display. This system is handled in Australia by Magna-Tech Marine of Sydney.

The Shipcom unit is literally a black box and provides an intelligent interface between the PC and the vessel's radio systems. Its main application is for sending and receiving telex messages and the PC gives all the normal text preparation, editing and automatic receiving facilities. In addition, there is a Weathermap option, which enables the full range of off air weather and oceanographic charts, broadcast regularly by stations around the world to be printed out.

The PC 5000 operates from 12V DC supplies and comes with 192K bytes of ROM and 128K bytes of bubble memory as standard. The LCD display gives eight lines of 80 characters and the printer can handle 1197 x 24 dots per character line which should give good facsimile reproduction. In addition to the special applications outlined, the PC5000 can also be used with a standard range of commercial software, providing all the normal PC facilities.

Clearly, we are just at the beginning of putting PCs to work on small commercial and pleasure craft. Efforts are being made around the world to develop and standardise interfaces and the VDO Navpak, Travacrest Seaway and B & G systems, mentioned earlier, all have facilities (usually RS232 based) to communicate with PCs. It can only be a matter of time before navigation, steering, engine management and communications are linked back to a PC which provides common CPU, memory, display and printer facilities.



The VDO Navpac system uses five display units to show all the necessary information.

The Shipcom Communications Centre and its companion Sharp PC5000 microcomputer.

It does seem that all the clean, dry and interesting jobs on board are being taken over by electronics, whilst the messy, boring jobs still have to be done by the human crew. What we could really use is a rustproof version of R2D2 from Star Wars, to take over cooking, washing up and sail changing when the decks are awash in a gale. I do hope somebody out there is working on it.

Acknowledgements

The author wishes to thank the following companies who generously contributed information and illustrations used in this article: AWA Marine-Aviation Division; Codan Pty Ltd; Greenwich Marine Electronics Pty Ltd; Glename Engineering; Magna-Tech Marine (Australia) Pty Ltd; Peter Green Shipchandlers Pty Ltd; E S Rubin & Co Pty Ltd; VDO Australia.

enable the memory bank to be read sequentially, producing a video signal which is used to modulate the display CRT brightness.

There is of course a great deal more to the whole operation than we have indicated, but this brief outline should give those interested a general idea of what is taking place.

Like most small boat radars, the GS930 operates in X band (roughly 9400MHz) with a peak power of 3kW. The antenna is a slotted waveguide type with a 4.5 degrees horizontal beam width and 23dB gain.

Most of the transmitter and receiver circuitry is mounted with the antenna and a 0.6-metre diameter radome, shown in our photograph, gives protection from the elements and prevents entanglements with ropes and sails, etc.

The equipment will run on 11 to 40V and consumes only 55 watts of power. This is made possible by a high efficiency switch mode supply circuit, which operates at 21kHz. A number of regulated positive and negative rails are produced and separate pulse transformers develop the 3.75kV 3A magnetron and 10kV CRT final anode supplies.

A new generation of still smaller radar units, using LCD display panels is just starting to appear. These can be viewed in direct sunlight and may even be mounted in the cockpit of a yacht, next to the helmsman, if required. The use of smaller antennas with broader beam width and simpler displays means that some definition is sacrificed, but these miniature units can still provide all the information needed to identify coastline features, avoid nearby ships and negotiate harbour entrances.

Koden MVS-1 mono mini-sounder.

Koden CVS-101 colour mini-sounder.

Marine Electronics from Echo Radar Pty Ltd

For South Australian boating enthusiasts, Echo Radar Pty Ltd of Adelaide carries a wide range of marine electronic equipment, including multi-function depth sounders, radars, and autopilots.

Typical of this equipment are the Koden CVS-101 (colour) and MVS-1 (mono) "mini-sounders". These are designed for commercial operators and sports fishermen and boast a host of features, including non-glare screens, protected touch-button controls and easy installation.

Both instruments derive their versatility from inbuilt microprocessors. The variable range market (VRM) control, for example, may be set to mark bottom and the VRM alarm will sound when the bottom goes above that selected depth. At the same time, the on-screen display will show the VRM line leading from an electronic scale, plus a digital display showing the precise depth of the fish. A range key offers selection of six ranges from 10 metres to 320 metres while a zoom key allows a designated area to be expanded onto the whole screen.

As well, a range of digital information can be optionally displayed on the left of the screen. This information includes VRM Depth, Screen Top Depth, Screen Bottom Depth, Normal Range Scale, Zoom Range, Zoom Indication Mark, Image Speed Indication, Vessel Position, Vessel Speed, Distance, Water Temperature, Bottom Depth and Measuring Unit (either metres or fathoms).

This information is all derived from integral equipment except for the vessel's position which must be derived from compatible navigation equipment hooked up to the sounder.

Also available from Echo Radar Pty Ltd is the Koden MDC-400 colour radar which features a very fine easy-to-see image in red-on-black. Separate colours are used to display range rings, alarm zones, plot tracks, VRM, EBL (electronic bearing line) and, if interfaced to navigation equipment, the vessel's position. Digital readouts in the corners of the CRT show the necessary auxiliary information.

Eight ranges from 0.25 to 24 nautical miles are selectable, with range rings to estimate target distances. The unit can indicate targets as close in as 23 metres. Other features include automatic rejection of interference from other radars, variable rain and sea anti-clutter controls, and a protective radome.

Finally, the AP-100 Autopilot from Echo Radar Pty Ltd will interest both professional and pleasure boat owners. This item comes from Robertson of Norway and features three simple twist controls to select mode (hand, power, autosteering and finally automatic navigation); rudder control; and course selector.

An LCD readout shows all the necessary information and the device can be linked to any navigational receiver that has an output interface conforming to the NMEA 180 format. A range of optional equipment is available including remote control units for pushbotton steering, a rudder feedback unit, compasses and an alarm unit.

For further information on any of the above products contact Echo Radar Pty Ltd, PO Box 12, Port Adelaide, SA 5015. Telephone (08) 47 1503.

On Board Personal Computers

PERSONAL COMPUTERS and intelligent VDUs have become a normal part of life ashore, but up to now have not had much impact on the leisure boating scene. This situation is starting to change however, and PC-based systems with applications in navigation and communications are now being offered by several overseas companies.

Perhaps the most dramatic changes to the mariners art resulting from PC technology will be in the pilotage and navigation areas.

From the earliest days of exploration and commerce, the marine chart has served as the sailor's road map. Traditional paper charts do have a lot of shortcomings however. They are cumbersome, especially in the limited space of a small boat, are easily damaged by water or folding, often cover only small areas so that lots of consecutive charts are needed for passage making and they need to be regularly updated by hand. With the increasing use of electronic systems like satnav, radar and navigational computers, it does seem pretty incongruous to still be drawing and rubbing out pencil lines on paper charts.

The world's first big ship system to tackle the chart problem was recently

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photograph shows a prototype unit with a 64 x 100 pixel LCD display, which they hope to start manufacturing in the near future.

A transducer, operating at 160kHz, is permanently located in a streamlined fibreglass fairing below the boat. Beam width is 9.6 degrees horizontal and 6.4 degrees vertical. A permanent 5 degree downward beam tilt is used to give optimum warning of obstacles in shallow water. The arc to be scanned can be varied from 45 to 220 degrees, centred on a line ahead of the boat, and the transducer is gimballed to keep the scanning arc level as the vessel pitches and rolls.

The Glename unit also incorporates an audible alarm system. This varies in pitch according to range, and volume according to echo strength. When a hazard such as a reef is being approached, the warning becomes both louder and more shrill, making it almost impossible to ignore.

The Glename scanning sonar uses a 64 x 100 pixel liquid crystal display.

Raster Scanned Radars

FOR A LONG TIME, marine radars were bulky, expensive and power hungry. None of these things mattered very much on a big ship, but they did hold back the use of radar by smaller pleasure craft.

Another disadvantage of conventional radar systems for small boat use was the lack of display brightness. Most readers will be familiar with the 'polar' type radar display, where the CRT phosphor is illuminated by a scanning line turning clockwise around a point in the screen centre, in synchronism with the antenna rotation. The antenna speed is usually about 25 or 30rpm which means that the CRT phosphor is only re-activated by the electron beam once every two seconds or less. Despite the use of high efficiency short and long persistance phosphor combinations, light output is poor and displays usually need contrast enhancing filters, elaborate light shields and often, fully enclosed viewing tunnels for daylight use.

Television type raster scanning does not suffer from lack of brightness, even in daylight conditions, because each illuminated phosphor area is re-activated by the CRT electron beam 25 or 30 times per second. The breakthrough in small boat radar was achieved by using solid state memory devices as a kind of polar to raster scan standards converter.

Radar video signals are written into memory at slow polar scan rates, until all the information for a full 360 degrees image has been assembled. The memory can then be read repeatedly 25 or 30 times per second, giving a video signal suitable for raster scanning and daylight viewing. A little extra jiggery-pokery with the memory addresses during read and write can also effectively convert the polar scanned input to a rectangular or XY scanned output.

One of the first raster scanned small boat radars was the UK manufactured Vigil RM unit. This became available in Australia towards the end of 1985 and the importers, AWA Marine, say that it has proved to be very popular.

The trend towards smaller, more compact radar systems started by Vigil has continued and one of the very latest units to be unveiled is the Gold Star GS930 unit from GME. As our photograph shows, this display unit is about the same size as a small portable TV set. It uses a 228mm diagonal (9-inch) CRT with a green P31 phosphor.

Checking through the GS930 Service Manual gives the following outline of how the polar to raster scan transition is achieved.

The first step is to digitise the receiver's analog video output signal, which represents echoes from objects at various distances. Fig.4 shows how this is done.

A complication arises because the unit has seven switchable positions giving from 0.5 to 16 nautical miles maximum range. After each transmitted pulse, the receiver picks up returning echoes and this listening period between pulses is divided into 128 'range cells'. On the shortest range of 0.5 nautical miles, the echoes will all be back very quickly (about 6 micro seconds) and to divide this into 128 range cells a fast sampling clock rate of about 16MHz is needed. On the 16 nautical mile range, the round trip for outgoing pulse and returning echoes takes much longer (up to 200 microseconds) and the range cell sampling clock rate is reduced to about 0.5 MHz.

As Fig.4 shows, short, weak echoes may be represented by only one range cell after digitisation, but stronger signals will often take up several consequentive cells. After being digitised, the received video is ready to be fed to a bank of RAM ICs, where it will undergo polar to rectangular scan conversion.

The antenna is rotated at about 25 rpm by a geared down electric motor. A slotted disc, which turns with the antenna, interrupts the light passing from an LED to a phototransistor and an associated circuit generates 1800 pulses per antenna revolution. These are fed to a bearing pulse counter circuit, as shown in Fig.5.

The Gold Star GS930 marine radar from Greenwich Marine Electronics Pty Ltd.

The bearing pulse counter develops an 11-bit antenna position code which is used to address the conversion ROM. In addition, a quadrant control signal is produced to indicate which of the four quadrants shown in Fig.6 the antenna is currently passing through. The conversion ROM is a key part of the polar/XY converter and contains a look-up table with sines for all angles from 0 to 90 degrees.

Output from the ROM controls two 256 step up/down counters X and Y, which each generate an 8-bit address for the main video memory RAM.

Referring now to Fig.6 assume that the clockwise rotating antenna beam has just entered the first quadrant by moving through the 0 degree point. Both the X and Y address counters will be set or preloaded to about midway, which corresponds to screen centre. The first string of range cells will be written into memory addresses corresponding to the top segment of the Y axis, so the Y counter operates from mid-point down to zero. As the antenna bearing is zero, sine X also equals zero and the X counter is not advanced. Whilst the antenna beam turns between 0 and 90 degrees, sine values from the ROM look up table progressively reduce the excursion of the Y counter and increase the excursion of the X counter. At 90 degrees (sine 90 degrees = 1) the X counter is selecting addresses from midway up to full count, but the Y counter remains at centre screen value.

From 90 to 180 degrees the quadrant control signal ensures that both counters count up from mid value to limits determined by data from the conversion ROMs sine tables. In the third quadrant, X counts down from mid point but Y still counts up and in the fourth quadrant, both X and Y count down, as shown in Fig.6.

The net result of all this activity is that the polar signals are written neatly into locations in the video memory bank which have a rectangular or XY relationship to each other.

A 6MHz clock is used to generate TV type horizontal and vertical scanning frequencies which produce a 529-line 30-field fully interlaced raster on the display CRT. The same clock also generates X and Y addresses which change linearly from 0 to 1 in step with the horizontal and vertical scanning rates. These addresses

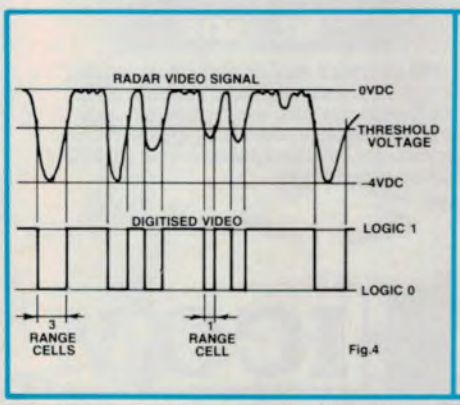

Fig.4: how the video signal is digitised.

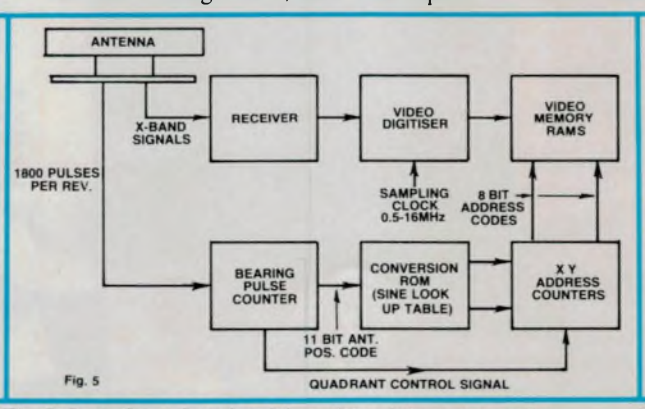

Fig.5: how the polar signal is written into memory for ultimate display.

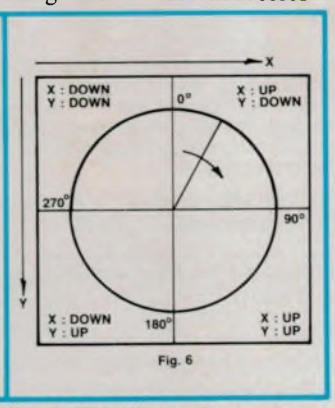

Fig.6: the display is based on rectangular coordinates.

ICOM M5

ICOM's New 5 Watt All-Channel Marine Handheld

ICOM introduces the M5 5 Watt all-channel VHF marine handheld transceiver. The M5's compact, water resistant design, and features not available in other units, add up to an easy-to-operate and reliable hand-held.

Talk to your friends on other boats, make marine telephone calls from the cockpit of your sailboat, listen to the latest weather information, scan your favourite frequencies, talk from your dinghy to the boat, or contact the Coast Guard. The go-anywhere rugged M5 helps keep you in touch. And its compact size makes it convenient to carry with you at all times.

M5 Top Panel

All Channels. The M5 has all International channels, Channel 87A and ten weather channels.

Ten Memories. Ten memory channels, owner programmable, allow instant access to most-used frequencies. An Internal long-life battery maintains the memory channels.

Scanning. ICOM's three built-in scanning systems allow you the ultimate in knowing what is going on in the marine band. Scan the 10 memory channels, scan all channels, or the weather channels.

Sea Watch. Monitor channel 16 and one other channel of your choice at the same time. This allows you to communicate on one channel while listening for calls on channel 16.

ICOM's Water Resistant Sealing. Case sides, the top panels, knobs, buttons and battery connectors are sealed for protection against moisture. When the protective cover for the external connectors and the belt clip are in place, the M5 can survive a splash anytime. Moisture won't bother its custom mylar speaker either.

ICOM M5, M2 & M12 are DOC and Seaphone approved.

Dealership enquiries invited
Phone (03) 51 2284,
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Lifetime Warranty. The M5 is backed up with a lifetime warranty after the one-year limited warranty has expired. With a lifetime guarantee of charges not to exceed $37.50 per repair for those items that would have been covered under the one-year warranty.

Easy to Operate. The ICOM M5 is easy and convenient to use as a primary source of communications or as a backup system in the dinghy or fly bridge. Slide-on batteries simply lock into place.

Digital Readout. ICOM's custom digital readout is easy-to-read in bright sunlight. A switchable lamp is provided to illuminate the display at night.

Ready to go. Each ICOM M5 comes ready to use with an IC-CM7 battery pack, flexible rubber antenna, belt clip, earphones and IC-CM16U wall charger, at no additional charge. You are ready to communicate with your complete standard M5 package.

Optional Accessories. ICOM offers the most complete line of accessories available today for handheld transceivers. See them at your local marine electronics shop. Ask about the new IC-CM8 long-life battery pack. IC BC36 rapid charger, RB-1 protective floating holder, and HS-10/HS-10SB headset.

M2 and M12 Handhelds. The rugged M2 (all channel) and M12 (12 channel) handhelds are also available. Choose the ICOM handheld that is right for you. Accessories are compatible with all ICOM marine handhelds.

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Phone (03) 51 2284. Telex AA35521 ICOMAS.

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50 and 25 years ago...

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

Wireless Weekly

December 1936

Sunday Advertising: (letter to the editor) I am taking this opportunity to express my sincere disgust at the manner in which the B stations advertise on Sundays (2CH included).

Six days in the week is ample time for these stations to advise the public of oustanding features, bargains etc., so why not allow the remaining day just for music?

Summer shortwaves: there is greater interest in dual-wave receivers during the summer months, due to the improved reception of overseas stations and the more convenient times in which they can be listened to. What is more, pleasant reception can be had on shortwave staions when static may spoil broadcast reception.

Aerial surf patrol: everybody is familiar with the green streamer that signals OK and the red Verey light for "pick-on-the-first-shoot-and-go-for-your-life-to-the-beach" — the signals of the Surf Patrol that cover the beaches every Saturday afternoon.

We went up in the Surf Patrol. The plane is a low wing Monospar; twin engines, cruising speed 105 mph. There is room in each plane for pilot, announcer and one passenger. No. 2 plane covered Palm Beach to Manly. No. 1 did Cronulla to Bondi.

RADIO, TELEVISION and HOBBIES

December 1961

Driverless Vehicles: electronic control of driverless vehicles is no longer a mere possibility. Experience in England has indicated the possibilities of driverless vehicles in both industrial and agricultural situations and showed the way to their wider use.

Recent successful applications of electronic control to farm tractors and industrial trucks may be indicative of developments in the fairly near future of far reaching importance to the road vehicle industry.

Man-made quartz: after 50 years of research man is able to mass-produce quartz crystals, which are used in radio and television transmitters as well as telephone communications, radar and sonar.

The man-made quartz crystals are being produced at the Merrimack Valley works of the Western Electric Company in the United States.

The new factory grows crystals of superior size and quality in a sort of scientific rock garden under tremendous pressure and heat.

Biological drug: interferon, a newly-discovered substance manufactured inside the living cell, may soon become important in the treatment of the virus diseases as the penicillins and other antibiotics are today in curing diseases caused by bacteria.

Electric car: a leading British manufacturer of electric battery road vehicles recently demonstrated at the Dairy Show what they claim as a revolutionary development, which will outdate most of the 40,000 electrical road vehicles now operating.

The company's new Transitruck incorporates for the first time a transistorised semiconductor method of control through silicon control rectifiers.

Incompatibility needn't end in divorce

We've all heard about the customer who has been landed with a faulty appliance and can obtain no satisfaction from either a service organisation or the manufacturers. Such complaints surface in the media from time to time and the complainants can be pretty vocal — understandably so — with the organisations concerned scoring a black mark. How does it happen, and who is to blame? For the perfect scenario read on.

When video recorders first appeared on the Australian domestic market there were some initial technical problems regarding the compatibility of certain model TV sets with these new devices. Most readers will be familiar with the main reason; time constants in the horizontal flywheel circuits which, while perfectly satisfactory with the high stability signals from a TV station, were often too long for the somewhat less stable signals from a VCR.

The realisation of this brought forth fears and dire predictions from some people, fears that they could buy a VCR which was incompatible with their particular TV set, and predictions that, if this happend, they could become the meat in the sandwich with the TV set manufacturer blaming the VCR, and the VCR manufacturer blaming the TV set. Some people even suggested that the only safe approach was to ensure that the TV set and the VCR were both the same make.

The latter suggestion came up in Neville William's "Forum" column on one occasion and, after detailing the technicalities involved and dispelling most of the aforementioned fears, he concluded by suggesting that there seemed to be little to support the idea that both machines needed to be of the same make. But he added that it would certainly give the customer an edge if trouble was experienced. He could say to the manufacturer, "you made them both; you make them work together". Or words to that effect.

In the event, few of these dire prognostications were substantiated. By and large the TV set manufacturers accepted that some models created problems and, in most cases, were able to recommend modifications which would solve or alleviate them. I say "alleviate" because, in a few cases, the results could only be described as "acceptable" rather than "perfect".

All of which is leading up to a problem I encountered recently where a video recorder and a TV set, both of the same make, simply refused to work satisfactorily together and I really feared that I would have to say "You made them both; you make them work together". As it turned out, it didn't come to that but, if it had, I doubt whether it would have achieved anything.

But let's start at the beginning. The customer owned an early model HMV colour TV set, one of the first Australian made models to be produced when colour was introduced. I have serviced it on a number of occasions over the years but, overall, it has performed very well. More recently, the owners bought a video recorder, a National model NV300.

This was where the story really began because that particular model HMV set was never renowned for its performance with VCRs. Modifications were issued by makers, and these were duly carried out by yours truly, but I was never really happy with the results. In spite of every trick I knew I could never completely eliminate a tendency to flag-waving at the top of the picture; an effect which tended to vary from cassette to cassette.

A new set

Thus it was that, when the lady of the house called me out recently to service the set, I felt bound to advise her that this might be a good time to think about a new set. Apart from the VCR compatibility problem the picture tube was obviously on its way out, and performance generally was pretty grotty. Granted, a new tube and a general overhaul would have restored the set's performance, but only at considerable cost and without solving the compatibility problem.

The owner seemed to accept my ruling — probably because I wasn't trying to sell them a set in the process — and having attended to the minor problem in the set, I went on my way. I heard nothing more from them for several weeks and had almost forgotten about the situation, when the lady of the house was on the phone again.

She opened the conversation by saying that they had taken my advice and invested in a new TV set, a National TC2697. Well, I thought, they've certainly done themselves proud. The TC-2697 is a very impressive set. It is housed in a large lowboy type cabinet, with speakers at each end, full stereo decoding, and all the little luxury features that go with modern top-of-the-line sets.

Unfortunately, it wasn't quite living up to this impression, which was why she was on the phone. While it performed well enough with off-air signals, results from the video recorder were far from satisfactory. More specifically, she described a jagged black line from top to bottom of the screen and about 10cm in from the left hand side.

In answer to my question she confirmed that this happened regardless of whether the tape was one they had recorded off-air, or a pre-recorded one from the video shop. Well, that at least narrowed the field somewhat. Then I asked her whether this effect occurred when the set was on a blank channel, either with the antenna connected or with it disconnected. Naturally, she had

not looked for anything like this but promised to check it out and ring me back. (They live some distance from the shop and I was trying to avoid the cost of a service call, particularly as the set would be under warranty at this stage, and out of my jurisdiction).

Anyway, the lady rang back the next day and reported that she and her husband had made the checks I had suggested. The report was that, yes, when on a blank channel, with antenna connected, the black line was in evidence. On the other hand, this vanished when the antenna was disconnected — which she immediately interpreted as indicating a fault in the antenna! Not an unreasonable mistake, I suppose, but I diplomatically corrected this impression.

But they hadn't let the matter rest there, and I must give them full marks for trying to gather as much information as possible before making a formal complaint to the dealer. They had taken the video recorder to a relative's house, connected it to their TV set, and obtained a perfect picture.

Not content with that, they had then borrowed a video recorder from another relative, taken it home, and fed it into the new National TV set. Result: another perfect picture. So where did that leave us? Inasmuch as the VCR performed perfectly on another TV set, it would appear that there was nothing wrong with it. But equally, since the TV set performed perfectly on another VCR, there was nothing wrong with it either.

Nevertheless, there had to be a fault somewhere and my bet was that it was in the set, in spite of the test with the other VCR. More specifically, I suspected radiation, probably from the line output stage, which was somehow finding its way into the system when the NV300 recorder was being used, but not when another recorder was being used. But, having reached that conclusion, there wasn't much more I could do. It was really up to the dealer and I could only assure my customer that they had done the right things and they had every right to take it up with the dealer and ask him to straighten things out.

To give the dealer his due he didn't muck about. He had another set of the same model in stock and immediately offered it in exchange. The only problem was the new set had suffered some minor cabinet damage, and this still had to be fixed. But it was in full working order and should at least serve to clarify whether it was an individual set fault, a design fault, or a faulty VCR.

So the replacement set was duly delivered and installed. But, as the lady subsequently related to me by phone, it was not one whit better; the black line was there exactly as before. By now I was really intrigued. While it was still theoretically not my responsibility — unless the fault should prove to be in the VCR — I had a strong feeling that I would be involved sooner or later, if only as an arbiter. In any case I wanted to know what was happening for my own technical background.

Modification Note

So I took it upon myself to contact the National service department, advise them that I was likely to be involved in what looked like a radiation problem, and enquire whether there was any history of such a problem with this model set. Sure enough, it transpired that there was such a history. But it wasn't radiation from the line output stage; it was from the switched mode power supply, and a modification note had just been issued to cover the problem.

At the same time the technician in the service department was just as mystified as I was when I related the sequence of events up until that time, with their seeming contradictions. So his parting remark was, "try the modification, but if that doesn't fix it you better let me know".

In the meantime the customers, acting on my suggestion, had made another attempt to clarify the situation. Learning that the dealer now had another set of the same model on his showroom floor they had taken their VCR to the showroom and had the salesman try it on the new set. It worked perfectly, so they said, "Right, that's the set we'd like". And again the dealer didn't quibble. And, since the set with the faulty cabinet had to be repaired anyway, another swap was made.

This took a couple of days to organise but the third set was duly delivered and installed, with everybody confident that it just had to be right this time. But it wasn't. The black line was there exactly as before, and it was a somewhat despairing lady who rang to tell me the bad news. I must confess that I was pretty much taken aback, since nothing seemed to be making sense.

The only glimmer of hope was the modification, details of which had just come to hand. Regardless of all the contradictions there was obviously no point in going back to National with the problem until the modifications had been tried. If that didn't work, it was a job for the boffins. But first there was the matter of protocol. The set was still under warranty and, even with the best intentions in the world, I couldn't go barging in without the dealer's approval.

Fortunately, I know him well enough and, as soon as I explained that all I wanted was to make an official modification, he was only too happy to agree. After all, he was just about at his wits end over the whole affair. And thus it was that I finally came face to face with the monster. And I must say

National TC-2697 Power Supply Radiation Reduction

Matsushita Electric Co. (Aust) Pty Ltd suggest the following modifications to the TC-2697 power supply to reduce radiation. It is anticipated that all sets made after July 1986 will have been modified in production.

The modifications involve the S-board and the E-board.

On the S-board:

- change C814 from 470pF/2kV to 1000pF/2kV (ECKC3D102KBN)
- change C852 from 100pF/2kV to 220pF/2kV (ECKC3D221KBN)
- Remove C823 and refit on the print side between the junction of T801/L821 (ie. as before) and the junction of D820/L820, (ie. move one end of C823 to the opposite end of L820).

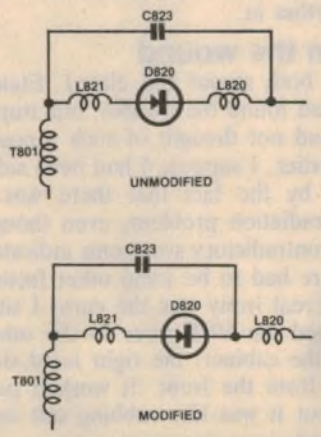


Fig. 1 E-BOARD MODIFICATIONS

On the E board:

- Add a .01μF/50V ceramic disc capacitor (ECKW1H103ZF5) in parallel with R611 from the print side of the circuit board.

it all looked impressive. In addition to the set itself the customer had bought a video cabinet which, while not made by National, was designed to suit this set.

More specifically, it was the same width as the TV set and about 45cm high. It was fitted with two glass doors in the front and was divided by a vertical support in the centre. In addition, there were a couple of shelves, adjustable in height, one on each side of the divider. The general idea was that the video recorder would go in one side, cassettes in the other side, and the TV set rested on the top.

As I say, all very impressive, but I was more interested in the fault. This was easily demonstrated and I had to admit it was quite intolerable. So then it was into the back of the set to find the appropriate boards and components involved in the modification. This took a little while because it was my first encounter with this set, which is a relatively recent model.

Looking into the back of the cabinet revealed several boards. One of the main ones, carrying the line and frame circuits, video etc, was in the centre of the cabinet, under the picture tube. On the left hand side was a vertical board carrying the decoder circuitry etc. The power supply board, the "S-Board", on which most of the modifications were required, was over on the right hand side close to the floor of the cabinet.

Having sorted out the boards I set to and made the modifications. Then, with everything back together I crossed my fingers and switched on. The best way to describe the result is to say that it was marginally better, which is another way of saying that, to the casual observer, it was virtually no different. Which seemed to write "Finis" to the story as far as I was concerned. It looked like a job for the boffins.

I went through the motions of checking the power supply radiation with the portable CRO which I had brought along and, while it was pretty solid, it was no more so than from many other similar systems. I also looked for any abnormal spikes on the waveform but found nothing. Then I checked the set on blank channels, but it was only on the lowest frequency channels that there was any sign of the problem. This seemed to conflict with the lady's original report and I assumed that the mods had at least had some effect.

And that seemed to be that. It was now Friday afternoon and I had decided that I would ring National first thing on Monday morning and put the ball in their court. In the meantime I would take the video recorder back to the shop and see whether I could re-create the fault with any other sets I had on hand. I packed up most of my gear, then pulled the recorder out of its cabinet and began disconnecting its leads. As I did so it occurred to me that it might just be a lead dress problem. It was a long shot but I would look a bit silly if I was asked if I had tried it and had to say no.

I re-connected the leads and, with the recorder on the carpet in front of the cabinet, prepared to move the leads around while the recorder was playing and observe whether this changed the pattern. So I pushed in a tape, pressed the play button, and waited. And up came a perfect picture; not a trace of a black line or any other aberration. I'm afraid I just sat and stared in disbelief for several seconds.

Then suddenly, from somewhere, someone hit me with a 5kg sledgehammer — metaphorically that is. When the VCR was in the cabinet it was sitting directly under the switched mode power supply near the bottom of the TV cabinet above it; the gap would not have been more that about 75mm. I confirmed that this was the fault by slowly pushing the VCR back into its cabinet, whereupon the black line reappeared, faintly at first then stronger as the VCR went further in.

Salt in the wound

I felt both stupid and elated. Elated that I had found the trouble, but stupid that I had not thought of such a possibility earlier. I suppose I had been sidetracked by the fact that there was a known radiation problem, even though all the contradictory symptoms indicated that there had to be some other factor. But the real irony was the cure; I simply moved the VCR over to the other side of the cabinet, the right hand side looking from the front. It worked perfectly, but it was like rubbing salt into the wound.

And now, of course, it was easy to backtrack and explain the seeming contradictions of the various tests involving other recorders and TV sets. In the first instance, when a video recorder had been borrowed and connected to the suspect set in the customer's home, they had not bothered to install it in the video cabinet, but had simply sat it on top of the TV set. Similiarly, when they had taken their own recorder to the retailer's store, to select the third set, it had been placed on a convenient shelf a metre or so away from the TV set.

All of which adds up to a rather sobering story. It demonstrates just how easily a simple and perfectly innocent installation fault can snowball into the most complex situation. Both the customer and the retailer were forced to spend a lot of time and effort chasing the problem, to say nothing of yours truly on the sidelines trying to solve it by remote control.

But it could have been worse. Imagine the shemozzle and frustration which would have resulted had I not found the fault — and that very nearly happened — and sent the TV set, and possibly the VCR, back to National. Because, quite obviously, they would not have been able to find anything wrong with them, and would have had to throw the problem back to the retailer and myself, with the customer in the middle.

Fortunately, in this case, the customers were very patient and understanding. But it is easy to see how customers can become frustrated to the point where they accuse the maker, the retailer, and the trade generally — and often publicly, in the media — of being incompetent and downright dishonest.

And that's the kind of publicity we can do without.

On the bright side, I suppose, is the fact that now the problem has been encountered and diagnosed — and published in these notes — it may save someone else from similar frustration. And it could happen again because the video cabinet is a popular item, designed for use with this TV set. Once such a combination is set up it is a fifty-fifty chance whether the recorder goes in the left hand side or the right hand side of the cabinet.

The National TC-2003

To change the subject this is the first chance I have had to clarify the situation regarding the National TC-2003 story I related in the September issue. Not to put too fine a point on it, I was caught out on this one. As readers will realise, the actual events occurred some months before I wrote the notes. Also, because of the long lead times required in magazine production, the notes were written and submitted some eight weeks before the magazine appeared and, in fact, well before the August issue appeared.

Immediately I received my August issue and referred to the "TETIA Fault of the Month" I realised its significance. (These notes go direct to the EA office and the first I see of them is when they appear in print.) Immediately I read the note I contacted the EA office in the hope that there might be time to at least draw attention to the August panel.

Unfortunately, it was too late. The pages had been laid out and their position in the magazine allocated. And I can assure readers that, at that stage of production, no editor is going to pull a magazine to pieces for anything short of a national calamity. So the best we could do was prepare a note for the October issue, which duly appeared.

In the meantime other readers were quick to note the significance of the August "TETIA" note and the September story, and put pen to paper to draw our attention to it. There were also those who had actually encountered the fault and found the true solution, and they were equally helpful. Some even went so far as to send photocopies of the circuit with the appropriate component, C857, marked.

In particular, I would like to acknowledge and thank the following readers for taking the trouble to write to me: Mr R.A. of Winton, Queensland. Mr G.R. of Tenambit, NSW (he calls it the "Ayres Rock" effect). Mr I.W. of Bateau Bay, NSW. Mr L.F. of Edithvale, Victoria and Mr J.L. of Geilston Bay, Tasmania.

I am sincerely grateful for all these offers of help, plus any others that may come to hand. And I must emphasise the helpful tone of all the letters; nobody laughed, nobody pointed the finger of scorn. They simply wanted to help. Naturally, steps have been taken — diplomatically — to gain access to the sets in question and set things right; ie. restore the correct zener and replace C857.

So everyone should be happy.

Wire Sizes

Another letter to hand this month concerns the continuing saga of D.P. of Mudgee, NSW, and his voltage drop problems in a home lighting system. The letter is from G.C. of Mt. Burrell, NSW and is on similar lines to that of D.A. of South Australia, published in the Septebmer issue. After asking that a letter from him be passed to D.P., he writes:

Incidently, the wire size is likely to be ten millimetres square. This gives the resistance over 100 metres as 0.17 ohm (near enough) and ten millimetres square is generally the size sold for 12V installations by the solar trade.

The main thing that struck me about this letter — and also D.A.'s in retrospect — is the reference to the wire being "ten millimetres square". Apart from the fact that there now seems to be a cult which has abandoned the normal metric wire gauge in favour of an area measurement — for what reason I can't imagine — I am prompted to ask just what this phrase means. (I assume that both D.A and G.C. are quoting the solar trade when they refer to these figures.)

When I went to school the term "ten millimetres square" would have meant a square having 10mm on each side and an area of one hundred square millimetres. A circular cable with an equivalent area would have a diameter of some 11.3mm and a resistance far below that quoted by G.C.

On this basis I can only assume that what the trade is trying to say is ten

square millimetres — and that, as they say in the classics, is an equine quadruped reflecting visible radiation of an entirely different wavelength! By my calculations a ten square millimetre conductor would have a diameter of approximately 3.57mm and a resistance very close to that quoted by G.C. (on the other hand, these figures don't seem to tally with those suggested by D.A. in the September issue. I suspect that D.A. has confused diameter with radius in his calculations).

All of which serves only to emphasise the horrible mess and confusion which the trade seems to have created by their adoption of an area system. Not only was it totally unnecessary in the first place but, having attempted it, they can't even get their terminology right. (It is even conceivable that they could be accused of false advertising if they describe a wire as ten millimetres square when, in fact, it is only ten square millimetres).

And that, I feel, will have to be the last word on Mr D.P.'s problem, except to reiterate what I said when he first raised the problem; that I believe he would be better off with the batteries located at the house, preferably with short separate runs to each light or appliance, rather than with it 50 metres away at the solar panel.

And finally, here is an interesting short story from J.L. of Tasmania which, as he suggests, describes the weirdest piece of technical logic I have heard for a long time. He calls it:

A study in black and white

Since colour TV came to Australia, the number of monochrome sets being repaired has steadily diminished. Today, one is just as surprised to see a monochrome set in for repairs as one once was to see a colour set.

Nevertheless, there are still a few such sets about and, if the customer is not in a desperate hurry, I will repair a set during a slack period. This gives me a small profit and the customer an economical repair.

One such set came in the other day and the job would have been a snip if the man in the striped apron had not been there before me. It was a Thorn R1 chassis, a 43cm semi-portable set that was very popular back in the early seventies. The customer's complaint was "no vertical hold".

Before I start work on any of these old monochrome sets, I put the tester on the tube. It makes no sense to spend even a few minutes on repairing a set that can never give a good picture anyway. In this case the picture tube tested 100% so I started work.

When the picture came up it really was a mess. As well as the rolling, it was suffering from low height and quite severe foldover. The first problem was to decide whether the basic problem was low height, non-linearity or lack of hold.

A voltage check around the 6GV8 vertical valve socket was inconclusive. The voltages were only slightly out — the differences could have been caused by the fault without being in any way significant in themselves.

The next check was with the scope and here I found a more convincing answer to the problem. The vertical oscillator output was only one tenth of its correct value, and it was split into two similar but uneven patterns. It seemed that the oscillator was running fast but sync was trying to pull it back to the proper speed.

I've seen this problem before, in various degrees. It is caused by reduced feedback from the output stage, due to lack of capacitance in C82, a .047μF capacitor. I have found this to be as low as 100pF before the customer finally demands justice.

Low height is the first symptom and this can be corrected with the height control. Then the linearity starts to go, and this too can be corrected. Then the height goes down even further and we run out of adjustment at which time the true cause of the problem should be attacked. But he of the striped apron chose to pursue a different course.

He decided that, if maximum height equalled minimum resistance in the height trimpot, and if minimum resistance was not minimum enough, then he would change the 2.2MΩ trimpot for something less, like 4.7kΩ. It's crazy logic, I know, but some people think like that. Anyway, he did an excellent job of replacing the trimpot. It was properly soldered in and looked as though it had always been there.

But it didn't cure the fault.

I replaced the capacitor and the picture came back to three times its normal height. This is when I found the trimpot trick because there was no height adjustment available. The control looked perfect but measured low resistance. I pulled it out and found that it both marked and measured 4.7kΩ.

I fitted a correct value trimpot and recovered full adjustment over the height and linearity. The new capacitor had cured the lack of hold so the set was virtually as good as new.

The old Thorn is now delivering a perfect picture and will do so for many years yet. But if the butcher's work had not been uncovered, it would surely have been a tip job. EA

TETIA Fault of the Month

Sony KV1800AS

Symptom: Very narrow, out of sync picture. Line drive normal and none of the usual signs of output stage overload.

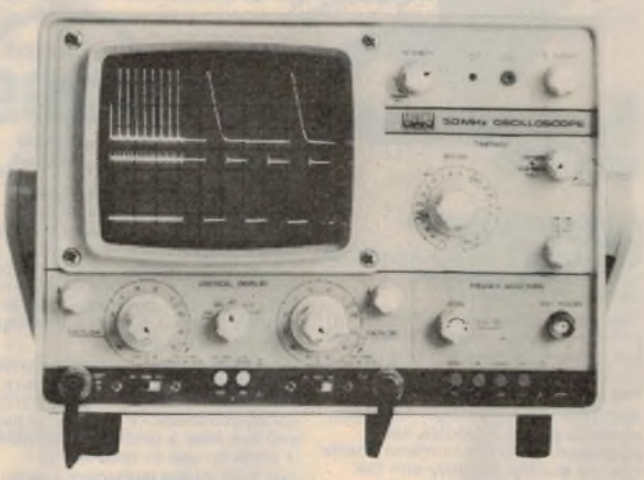
Cure: R622 (10 ohm, 0.25W fusible resistor) open circuit. This resistor feeds the pincushion correction signals to the line output stage.

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

YEN PROOF

MADE IN AUSTRALIA

bwd



Here's a solution to the Yen/Dollar see-saw. Because BWD CROs are made right here in Australia, the price won't change every week. And with the currency fluctuations of the last few months, BWD CROs have gone from being good value to absolute bargains.

Take a look at the BWD 821 50MHz dual trace scope. At about 2/3 of the price of Japanese equivalents ($1150 + tax inc. probes) it sounds good right away. And for power and facilities it's hard to match. 1mV to 20V sensitivity; 7ns rise time; triggering to 75MHz; 20ns/div sweep. Plus our unique MIX-MAG which lets you magnify a portion of the trace by ten. It's like delayed sweep without the complexity (or price). Electronics Australia said 'We have yet to see a trace as fine and as clear...'*

So why buy a 20MHz CRO when you can buy a 50? And with local factory support no other oscilloscope can offer.

To get the full story on the BWD 821 and our other CROs, call Parameters today.

*If you'd like a copy of EA's review of the 821, please give us a call.

Portable 50MHz for $1150 + tax

Sold in Australia by Parameters Pty Ltd. A BWD Industries Ltd Company.

For your nearest dealer call Parameters:
SYDNEY: Centrecourt, 25 Paul Street Nth., North Ryde 2113. (02) 888 8777
MELBOURNE: 1064 Centre Road, Oakleigh South 3167. (03) 575 0222.

PARAMETERS PTY LTD
PERFECTION IN MEASUREMENT

Get a $10 or $20 Bonus Coupon This Month

As a special thank you to the many 1000's of our Valued Altronics Customers, we will include without charge a $10 coupon for orders received of minimum $50 value and a $20 coupon for orders of $100 or more. The only conditions are that we ask you to tell us where you saw this offer and that the coupons be redeemed with any **subsequent** Mail Order, Phone Order or Shop purchase of $50 minimum value not later than 31/1/87

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

One of the finest Credit Card Size Pocket Calculators in Australia costs just $5 more than the average - Why? - read on.

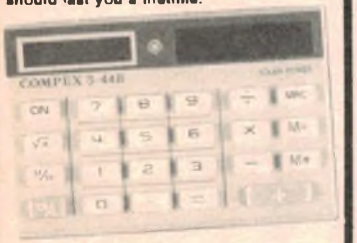
Cat. X 1050

Solar Pocket Calculator With Real Keys

$14.95

Two or three years ago the era of the Credit Card Calculator dawned, they looked fantastic, just the same size as a Credit Card and almost as thin fantastic eh? — Well not really, the damned things were so slow and fiddly to operate most have since ended up in the junk bin.

So when we saw the Compex Credit Card Calculator with positive feel rubber keys we were naturally delighted — the rectangular keys are extremely comfortable and quick to use and being **solar powered** you'll never need to buy a battery! **This fine product should last you a lifetime.**



• 8-digit calculator • Standard four function (+,-,x,—) • Full memory calculation • Chain multiplication and division • Auto-constant calculation • Square root key • **Size:** 56x84.5 x 4.6mm • **Weight:** 25g.

New Generation Calculators Direct from the Importer

• 10 Digit LCD printing calculator • 9 entry key buffer memory • Adding machine calculation • Chain and mixed calculation • Full memory calculation • Round-off/down calculation • Percent key with add on discount calculations • Use normal paper (57.5mm width) • **Size:** 193 x 172 x 35mm • **Weight:** 480g X 1060

Uses 4 x AA Batteries or Altronics Adaptor M 9001 **$9.95** Additional

Superb Printer/Display Calculator for the Office

Amazing Price

X 1070

$69

Solar Desk Calculator

Runs forever without batteries equally well under sunlight or office lighting. **Cat. X 1060**

Full Desk Size Calculator with Superb "Posiaction" Keys

$19.95

Out around the Pool or by the Fireside in Winter, you have total Phone Freedom with the Exclusive *INPHONE* Cordless Telephone from Altronics

Tired of being tied to the phone when you've better things to do? Wouldn't it be wonderful if you could take the phone to where you want to be around your home, office or factory. You could be getting on with other things instead of worrying about missing a call! Now you can with the new generation cordless phone **INPHONE**

Cat A 0338

$269

Telecom Permitted

ALTRONICS INPHONE IS MICROPROCESSOR CONTROLLED WITH A RANGE OF UP TO 250 METRES AND ABSOLUTE CLARITY.

There have been many attempts to provide cordless phones in the past but either they have not been to Telecom specifications or the price has been far too high.

INPHONE is quite simply the finest cordless phone Altronics has appraised. No other cordless phone has the quality, security and the features at anywhere near the affordable price of **INPHONE**

YOU CAN USE THE INPHONE HANDSET UP TO 250 METRES FROM THE BASE UNIT.

AT HOME you can keep in touch around the swimming pool.(Please note the equipment is not water proof) In the garden. Under the car. While watching T.V. In the bathroom. In bed. Or next door when you're playing cards or having a Barbeque with your neighbours.

AT WORK a busy executive can take the **INPHONE** around the factory, warehouse, showroom, sales yard or construction site, or into the car park, and not miss a deal! Also **INPHONE** is ideal for use in restaurants.

ON THE FARM **INPHONE** can be invaluable in the rear paddock, stables, dairy etc.

IN SPORT on the field, or track, the gym, around the swimming pool, Lifesavers on the beach, etc.

Altronics INPHONE is phone freedom in hundreds of your every-day situations.

Features:

- Simple to use and easy to install—just plug it in.
- Operating range up to 250 metres (800 ft).
- Security Code system with 16,348 combinations.
- Call function at base unit to alert handset.
- Power "On/Off" switch and "Standby/Talk" switch on handset.
- Reset button for hanging up and recalling dial tone.
- Pulse dialling with audible tone feedback at the touch of a key.
- LED indicator on handset for low battery indication.
- Built-in overcharge protection for the handset unit.
- Handset switched automatically from "Talk" to "Standby" mode when it is placed on base unit.
- Hearing aid compatible.
- 6 Months Warranty.

Security:

- The Security Code System built into the quality Altronics **INPHONE** prevents any unauthorised use of your telephone line.
- Several channels are available with **INPHONE**,so when your neighbour buys his, he can select channel Model 2 or 3 to alleviate the interference of crossed lines.

Specifications:

The range with the 39/30 MHzRX/TXFM System is really powerful when compared to the very short range of cordless phones of yesterday.

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

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

Handset:		
RX Sens:	luV	luV
RX Freq:	30.175 MHz	30.125 MHz
S/Noise:	45db	45db
TX Power:	Max Permitted	Max Permitted
TX Freq:	39.875 MHz	39.825 MHz

Bicycle Computer

Incredible 12 Function

For a few dollars more than a digital speedo this superbly accurate computer provides every activity readout the enthusiast cyclist is ever likely to require. Cat.D 2050

- Instantaneous Average & Peak Speed Readouts
- Measures Calories Used per Trip • Measures Distance
- Clock Stopwatch and journey time (whilst Mobile)
- Miles or Kilometres • Pacer Tone and Performance Monitor • Dual Display • Easy Removal for Security
- Fits to Bike in minutes.

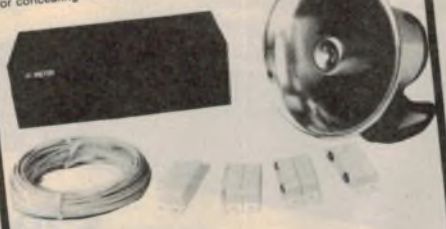
Why Pay $90 **Now $49**

FOR DESPATCH P&P CHARGES AND ADDRESS DETAILS PLEASE REFER TO OUR AD. ON PAGE 79

Altronics Deliver Next Day With Jetservice
Phone Your Order Now

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

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



Look At The Features:

Exit Delay	30 - 35 secs.
Entry Delay	10 secs
DC Source	
Battery Backup	9V Nicad rechargeable (additional Cost S 5024 $14.50)
Auto Reset	3 minute operate cycle and auto reset.
Range	Reliable to 30ft. (9M)
Low Battery Indicator	Included.

Accessories included for the one Low Price
4 Sets Reed Switches for Window/Doors
1 Roll fig "8" cable
1 External Type Horn Speaker
1 AC/DC plug pack adaptor

Now there is no excuse for not Protecting yourself, your family and all your hard earned possessions!

S 5310 Only **$99.00**

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

Strobe Signal Lamp

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

Two Colours Available

S 5455 Blue

S 5450 Red

$24.50

Reed Switch and Magnet Sets

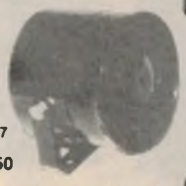
3 Types (Surface Mount)

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

High Energy Siren with Swivel Bracket

(As illustrated except white colour)

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



Cat. S 5177 **$22.50**

Universal Monitor Stand

With Pan & Tilt Adjustment

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

Why Pay $50

Last chance to stock up

MICRON NICADS

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

Why Pay $4 ?

9V Nicads

150maH

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

S 5024 **$15.95 ea**

Why Pay over $20?

Desk Mounted Lamp Magnifier

Only **$169**

If you have trouble with fine PCB work or component identification but still want both hands free, this is for you. We thoroughly recommend this quality Australian made product.
TECHNICAL INFORMATION Illumination: 22W Fluorescent **Weight:** 8.16kg **Lateral Extension:** 254mm **Vertical Extension:** 254mm **Fixing:** Heavy table base (grey & Ivory) with two chrome plated flexible arms. Cat A 0980

Toroidal Power Transformers

Great Savings Over Conventional E.I. Transformers

Why a Toriod?

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

Dimensions and Weight

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

160 Watt Models

Cat.No.	SEC.V	
M 3050	12 + 12	$49.95
M 3055	18 + 18	
M 3060	25 + 25	
M 3065	30 + 30	
M 3070	35 + 35	10 Up $46.00 ea
M 3075	40 + 40	
M 3080	45 + 45	

300 Watt Models

Cat.No.	SEC.V	
M 3085	12 + 12	$59.95
M 3086	18 + 18	
M 3088	25 + 25	
M 3090	30 + 30	
M 3092	35 + 35	10 Up $56.00 ea
M 3100	40 + 40	
M 3105	45 + 45	

Up to Incredible 1KM Range

Professional Megaphone PA

A 1990 **$109.50**

SPECIFICATIONS:

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

Huge Savings on Popular D Range Connectors.

Items marked • are less than 1/2 Price

		Were	Now
DB9			
P 3000	Male 9 Pin	2.75	1.75
P 3010	Female 9 Pin	3.25	1.60•
P 3020	Male PCB Rt/L	3.75	2.40
P 3030	Fmale PCB Rt/L	4.50	2.20•
P 3040	Male PCB mnt	2.95	2.00
P 3050	Fmale PCB mnt	3.95	3.00
P 3090	Backshell cover	1.95	.95•
DB15			
P 3100	Male 15 Pin	3.25	1.60•
P 3110	Female 15 Pin	3.85	2.40
P 3120	Male PCB Rt/L	4.35	2.15•
P 3130	Fmale PCB Rt/L	5.50	2.75•
P 3140	Male PCB mnt	3.85	2.75
P 3150	Female PCB	4.85	2.95
P 3190	Backshell cover	2.20	.95•
DB25			
P 3200	Male 25 Pin	4.95	2.45•
P 3210	Female 25 Pin	5.50	3.95
P 3220	Male PCB Rt/L	4.95	3.95
P 3230	Fmale PCB Rt/L	6.95	4.95
P 3240	Male PCB mnt	4.95	3.95
P 3250	Fmale PCB mnt	6.25	5.25
P 3290	Backshell cover	2.20	.95

100 Amp Jumper Leads

Superb Quality

A 3011 **$17.50**

The Superb Micron T 2440 Soldering Station

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

Excellent For Production Soldering

T 2440 **$99.50**

Build These Fantastic New Playmaster HiFi Loudspeakers

See Electronics Australia Sept '86

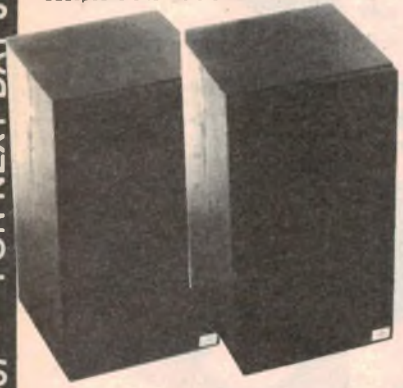
$449 full kit K 5090

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

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

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

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



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

'Sixty-Sixty' Integrated Amplifier Kit

(EA May,June,July '86)

Features:
• 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.*

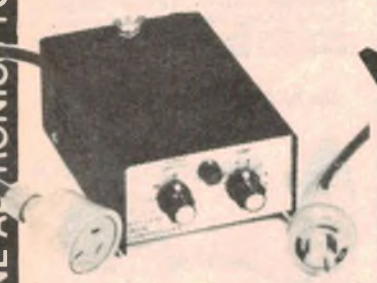
Beginner constructors can Build this Amplifier Kit — it looks terrific and will last you a lifetime.

Save $200 or more on comparable performance commercial units

More Exciting Kits to Build

Temperature Controlled Soldering Station (EA Sept 86) $35.00

Controls the temperature of your standard soldering iron. Suitable for irons rated from 20W—75W—Standard soldering iron plugs straight in no need for modification.
The Altronics Kit comes complete—pre-punched and silk screened **Cat.K6400**



Prescision time your Processing with this low cost Project

Digital Photo Timer K 1850

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

See EA Aug.'86

New

Great Value

$79.50

Bench Top Power Supply

$79.00

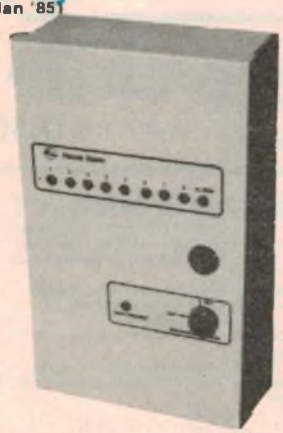
FEATURES:
• Output 3 to 30V at 1A • Short circuit protected • Load switching • Current limiting. Dual scale meter • Housed in our Deluxe "ABS" instrument case.

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

Super Low Price on Famous EA 8 Sector Alarm System Kit

(See EA Mag.Jan '85)

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



K 1900 (without Back Up Battery)
S 5065 (12V 1.2AH Backup Battery)

$139.50
~~$22.95~~

240V Mains Power From Your 12V Battery

300 Watt Inverter with Auto Start

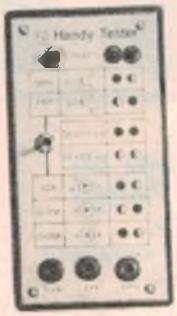
(See EA Sept.'85)

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

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

Transistor Tester

For In Circuit Testing



$17.50

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

FEATURES:
• Tests both NPN and PNP transistors in circuit at the touch of a switch • Test Diodes and SCRS as well • No need to switch between NPN and PNP — it's automatic. Two LED indicators are used to show condition of device being tested.
Altronics Kit Features - "ABS" jiffy box and test leads supplied. **Cat.K 2530**

Save Up To 30% With These Prices

A RARE OPPORTUNITY

NATIONAL SEMICONDUCTOR DATA MANUALS

EXCLUSIVE OFFER FROM ALTRONICS

Sold Separately or by the set

BONUS OFFER
THE ENTIRE SET FOR JUST $75
PLUS $10 EXPRESS DELIVERY ANYWHERE IN AUSTRALIA
ATTENTION: UNIVERSITIES, COLLEGES, SCHOOLS, DESIGNERS & ENTHUSIASTS
An Outstanding chance to purchase the entire set of 10 books at a significant saving.
SAVE OVER $21
COMPLETE SET ORDER NO B9996

INTERFACE

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

Pages: 1520 **Year 1983**

B 1005 . . . **$13.50**

DATA CONVERSION ACQUISITION DATA BOOK

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

Pages: 1232 **Year 1984**

B 1007 . . . **$13.50**

HYBRID PRODUCTS DATA BOOK

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

Pages: 792 **Year: 1982**

B 1045 . . . . . **$9.95**

LINEAR DATA BOOK

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

Pages: 1952 **Year:1982**

B 1010 . . . **$21.50**

LINEAR APPLICATIONS HANDBOOK

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

B 1012 . . . **$15.00**

LINEAR SUPPLEMENT

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

Pages: 568 **Year: 1984**

B 1011 . . . . . **$7.50**

MOS MEMORY DATA BOOK

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

Page: 256 **Year: 1984**

B 1025 . . . . . **$7.50**

TRANSISTOR DATA BOOK

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

Pages: 558 **Year: 1982**

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

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

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

VOLTAGE REGULATOR HANDBOOK

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

Million Diode Sellout! From 1.5¢ each

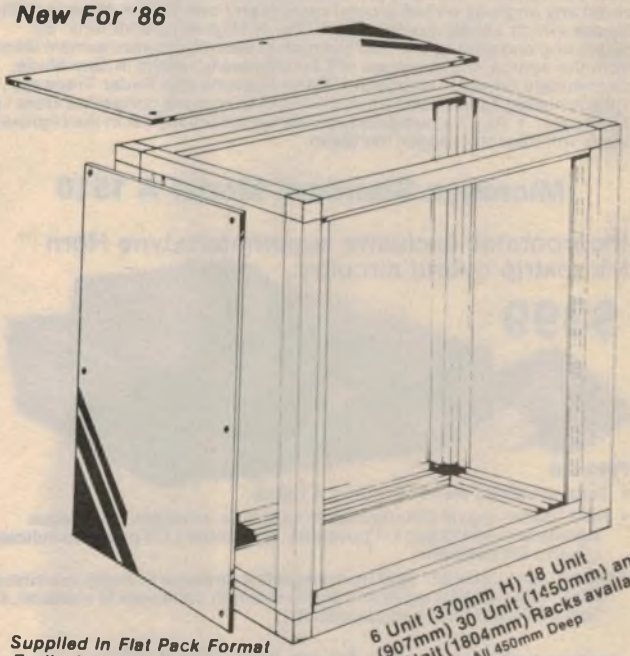
Altronics have just purchased around 1 Million (yes million) factory fresh premium quality IN914/IN4148 diodes. These became surplus to Fairchild Australia as the factory supplied bulk, loose pack diodes instead of the tape/reel diodes ordered. So unless you are a manufacturer with automatic component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

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

RACKS

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

New For '86



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Invisible from outside your vehicle - these fantastic high spec Radar Detectors Detect X and K band Radar up to an amazing 13KM.

These super compact "Sunvisor clip on" Microeye Detectors are virtually invisible from the outside of most vehicles at normal eye height hence its very unlikely yours would attract the attention of a thief **(or the Gendarmes for that matter)** However, please remember that use of Radar Detectors is not permitted in some States.

Detects X Band, 10.525Ghz and K Band 24.150Ghz to an incredible range of 13KM. Gives both audible and visual alarms with a built-in Automatic Mute Control that decreases the volume after six seconds of activation.

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Microeye Standard Model A 1510

Incorporates exclusive superheterodyne Horn Microstrip hybrid circuitry.

$399

Features:

- Separate audio alerts for X and K bands.
- RSD (Radar Signal Discriminator) switch to eliminate extraneous signals with an LO and LR positions. The amber LED pulses to indicate LO and LR positions.
- Alarm: Red LEDs will light up in sequence as signal strength increases. When all Red LEDs are lit and signal strength continues to increase, all Red LEDs will flash simultaneously.

Accessories Included - Visor Bracket, Velcro, Lighter Plug.

Specifications:

Size: 3/4" H x 3-1/8" W x 4-1/2" L
Operating Frequencies: X band: 10:525 GHz
K Band: 24:150 GHz + 110 MHz
Antenna Type: Microwave Horn, single ridge waveguide
Power Requirements: 12V DC nominal, 10-14V limits
Current: 190mA
Temperature Range: 12 deg.C to + 70 deg. C

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3db extra sensitivity and reduced interference

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Quite simply, GaAs diodes increase the sensitivity of the Microeye Vector.

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- Alarm: Red LEDs will light up in sequence as signal strength increases. When all Red LEDs are lit and signal strength continues to increase, all Red LEDs will flash simultaneously.

Accessories Included:

- Visor bracket
- Velcro
- Cigarette lighter plug

Specifications:

Size: 3/4" H x 3-1/8" W x 4-1/2" l.

Operating Frequencies:	X Band: 10:525 GHz K Band: 24150 GHz +110 MHz
Antenna Type:	Microwave Horn, single ridge waveguide.
Power Requirements:	12V DC nominal, 10-14V limits.
Current:	**190 mA**
Temperature Range:	-12 deg. C to +70 deg.C (+10 deg.F to +158 deg.F)

A 1530

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1392/EA

Getting the Fax on Facsimile machines

Over the last year there have been dramatic developments in facsimile machines, both in the numbers now available and in their capabilities. In this article we discuss the workings of facsimile machines and explain some of the jargon.

by LOUISE UPTON

Facsimile machines have been around for a long time and have been used by newspaper publishers to transmit photographs around the world for many years. These machines used radio transmissions to send pictures but the machines now being heavily advertised as suitable for home and office generally operate on different principles and use the telephone lines to transmit information.

Nor are they confined to sending photos. They are equally well suited to sending documents, drawings and graphs or any information which can be conveyed on paper. Such documents can be sent anywhere in the world, in less than a minute, via the standard telephone line.

In recent years it has been the Japanese who have raised facsimile machines to the present high state of development. The reason: they needed fax to transmit the ideographs which form their written language.

Of the many brands that are sold in Australia the majority are made in Japan and distributed in Australia by the Japanese principal or an agency. There are 14 major distributors: 3M, AWA, Canon, Fujitsu, GEC, Mitsubishi, Mitsui, NEC, National/Panasonic (Matsushita), Delairco/Ricoh, Sharp, Voca Communications, Rank/Xerox and Me-Too Industries for Marinefax.

Facsimile Standards

Before we can get into the nitty gritty of how a facsimile machine works, we should point out there are four different classifications of facsimile equipment, as made by the CCITT (the International Telegraph and Telephone Consultative Committee).

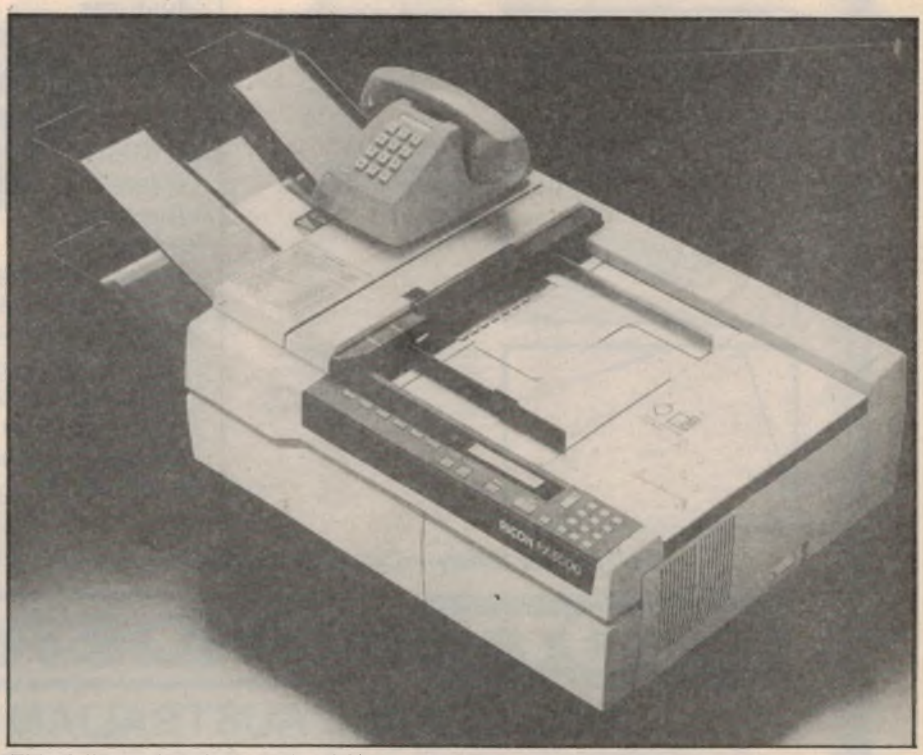
We'll list the four groups of machines later in this article but for the purpose of a general description, we'll be talking about Group Two and Group Three machines which are the ones most commonly used and available in Australia.

The facsimile process can be summarised by the following steps:

(a) The document is scanned by an optical system to change the areas of light and dark on the page into a digital information stream.

(b) This information is sent down the telephone line by a modem.

(c) At the other end of the line, the



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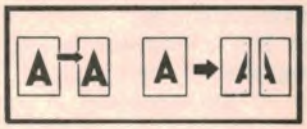

Vertical split image or central section transmission now means A3 or B4 documents can be sent without image reduction.

Operating costs are kept to a minimum with 11 second transmission for a typed A4 sheet

Personal security passwords ensure complete confidentiality between sender and receiver.

A printed docket advises you that the transmission has arrived correctly or of any errors caused through line quality

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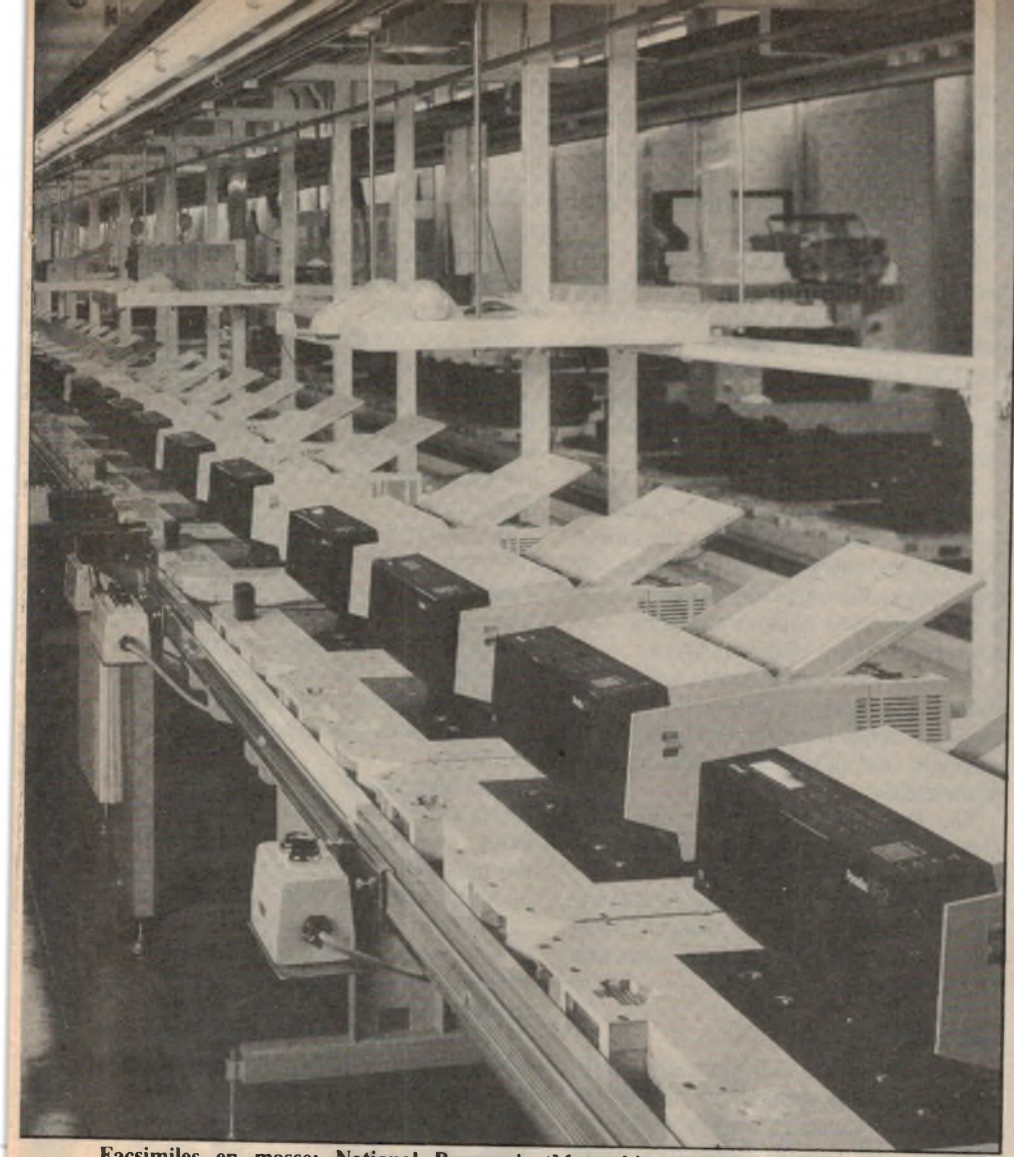

Facsimiles en masse: National Panasonic (Matsushita) cater for the needs of the small and the large.

Classification of Fax Machines

Group 1 machines have no special measures to compress the bandwidth of the transmitted signal and are suitable for the transmission of A4 size documents at nominally four lines per mm in about six minutes via a telephone-type circuit.

It is a non-specific category which is applied to machines designed before the acceptance of the first international standard of 1976.

Group 2 machines eventuated from this plenary meeting of the CCITT in 1976 and exploit bandwidth compression techniques in order to achieve a transmission time of about three minutes.

This compression includes encoding and/or the use of one sideband, but it does not include processing of the document signal to reduce redundancy in the information that is being sent.

In Australia, the most commonly used facsimile is a Group 3 machine, many of which are compatible wth Group 2. These machines make use of digital transmission techniques incorporating a built-in modem running at 9600bps. They are an 'intelligent' machine with the ability to agree on a slower baud rate if the line cannot maintain a full 9600bps.

Group 3 machines also use digital coding techniques to reduce redundancy in document information (prior to modulation) allowing them to transmit at much faster speeds.

The final class of facsimile is the Group 4 machine. These transmit via a Public Data Network and have a transmission time of 4s/page. At present, they are not compatible with the standard Telecom telephone network.

Fax machines

digital information is decoded and turned into a replica of the original document by a thermal printer.

So in essence, a facsimile machine contains an optical scanning and encoding system to turn a document into a digital data stream, a modem to transmit or receive that data stream, decoding circuitry, and a thermal printer. Some machines also incorporate a telephone dialler or incorporate a telephone handset.

Scanning

The first step in sending information by facsimile is to scan it. Probably the most common scanning technique is photoelectric conversion. The picture information on an original document is converted into an electric signal using the following procedure.

The document is illuminated by a bright light and scanned horizontally by an optical sensor, in very narrow lines left to right, in almost the reverse of the way a television picture is built up, line by line. Modern machines use charge coupled devices (CCD) as the sensing element as these have good light sensitivity and high resolution of up to 2048 bits per line. Putting it another way, the typical resolution of a CCD for an A4 page is about 4 pixels/mm (pixel means picture element).

Basically, a line image scanner (CCD) is composed of a row of image sensing elements (photosites), two analog transport registers and an output amplifier. Light energy (from the bright lamp) falls on the photosites and generates charge packets proportional to the light intensity.

The charge packets are then transferred to two analog transport registers, which are clocked by 2-phase clocks. The packets are then delivered to an onchip output amplifier where they are converted to proportional voltage levels.

So the output for each line scan is a series of pulses which have an amplitude which is proportional to the amount of light reflected from the page. Older scanning methods have the document to be transmitted attached around a cylindrical drum rotating at a constant speed. This system employs optics and a photocell contained in a scan headset parallel to the length of the cylinder. The image is reflected through a point aperture where it is picked up by a photoelectric cell. These older scanning techniques are commonly used in low-volume operations.

The CCD and photodiode arrays which are used in the popular office machines of today offer a much higher quality than the earlier systems, as well as giving a saving in power.

Two other techniques which are becoming standard are the CRT flying spot scan and the laser. The former method takes advantage of the raster scanning format of a cathode ray tube (CRT), and in concept is quite similar to the scanning technique of a television tube.

The electron beam of the CRT creates a point source of light which sequentially scans a stationary document on a flat-bed platen. Through the use of lens optics, the reflected beam of light is focussed onto a photomultiplier and converted into an electrical signal.

Because this system boasts high resolution and employs a stationary, flat-bed platen, it lends itself to stack feeding of originals and unattended high quality transmission.

The laser system relies on the light produced by a low-power helium-neon laser. The document is roller fed and the narrow beam is regulated by a rotating galvonometer mirror, which directs the beam across the scanning area one line at a time.

Encoding

Most documents will generally consist of mainly white areas. This means that the picture signal is usually highly redundant and can be transmitted much more quickly if the white portions of the signal are compressed.

For a Group 3 facsimile machine, the scan resolution is 3.85 lines per millimetre, which for an A4 page requires 1145 scan lines in total. At the recommended 1728 samples per line almost two million samples would be needed per page. If these were transmitted as an uncompressed data stream of 1's and 0's (representing black and white), at say 4800 bits/sec, it would take seven minutes to transmit a page.

This data can be reduced by a factor of 10 or more, making it possible to transmit a page in about 40 seconds. The actual reduction factor and transmission time depend on the detail in a document and on the compression technique used.

In Group 3 machines the "Modified Huffman" code is used. In this a run-length coding replaces all continuous runs of black and white picture elements with an appropriate code word. To minimise the number of these needed to encode a maximum of 1728 pixels in a line, two types of code words are used.

Run lengths of 0 — 63 picture elements (pixels) are encoded with terminating code words while run lengths in the range 64 — 1728 pixels are encoded by a makeup code word and a terminating code word. The former representing a run length which is equal to or shorter than that required while the terminating code word makes up the rest of the run length. The conversion table which converts this large number of picture outputs to a smaller amount of data was decided upon by the CCITT in 1984.

In order to ensure that the receiver maintains synchronisation, all data lines begin with a white run length code word. If the scan line happens to begin

The NEC/NEFAX 22 is representative of NEC's range of popular middle-of-the-road high speed facsimiles.

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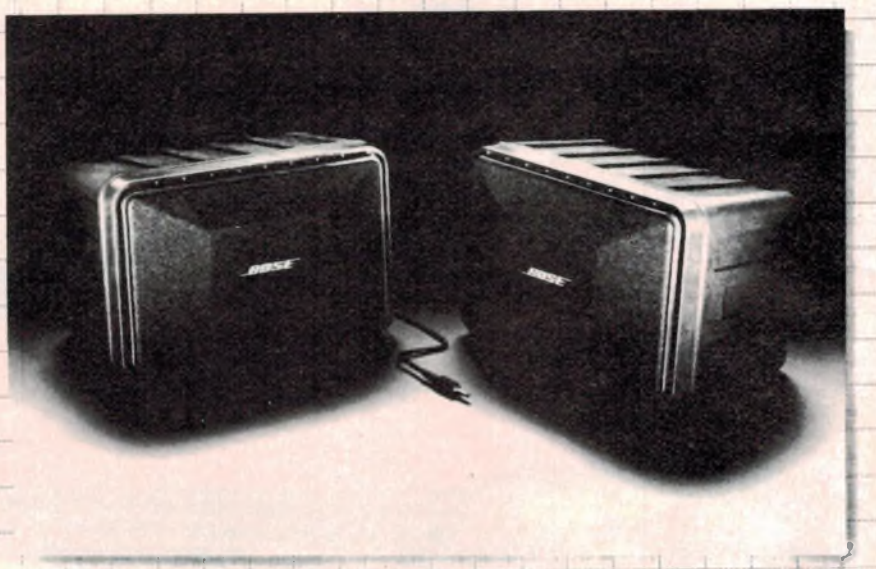
An audio studio system that requires very little space. *The RoomMate system fits almost anywhere, because each cabinet measures only 6" x 9" x 6". When used with a portable studio, personal stereo or portable CD player, the RoomMate system becomes an ultracompact, complete audio system.*



The Bose RoomMate system — high-fidelity powered speaker system in a very small package.

Sophisticated, tasteful design. *The RoomMate system is available in black cabinets with matching grilles. The result is a piece of high technology that looks good in any setting.*

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with a black run a white run length of zero is sent.

Each encoded scan line is followed by an end of line (EOL) code or format. As a unique code word it allows re-synchronisation of lines of data after an error burst.

Transmission

Having been encoded, the serial data must be transmitted down the telephone line by a modem. Group 2 fax machines use an amplitude modulated transmission, where a carrier of 2100Hz represents white document areas and the absence of a carrier represents black areas; ie, the carrier is modulated on and off.

Group 3 machines use a method known as Quadrature Amplitude Modulation (QAM) whereby the phase changes are used to represent sets of binary digits which represent the original.

In this system there are two possible modems, V27t or V29, with carrier frequencies of 1700Hz and 1800Hz respectively. Transmission can take place at four different speeds: 2400bps, 4800bps, 7200bps and 9600bps. The speed is chosen automatically, depending on the quality of the line and the receiver.

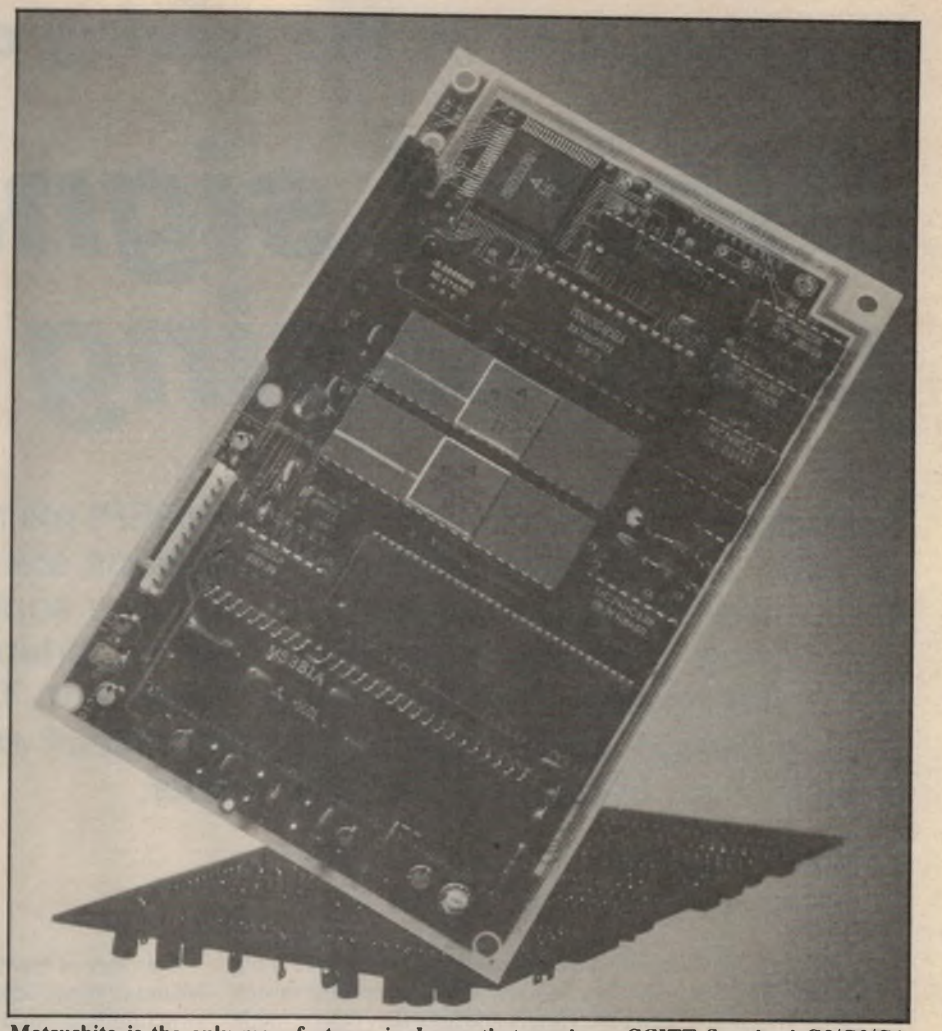
Synchronisation

All this encoding, modulating, demodulating, transmitting and receiving is well and good but how can you be sure that what you send is what will be received and not some garbled "gobble-de-gook"? The answer lies in ensuring that the scanning speed and the starting position of both the transmitter and receiver are matched.

There are two ways to synchronise the speed and one to synchronise the start position. These are independent synchronisation, transmission synchronisation, and phase synchronisation.

In the first, the transmitter and the receiver have a sync device to match the scanning speed of Group 1 and Group 2 facsimiles. The second method requires the transmitter to send both the picture signal and a sync signal at the same time. The receiver separates the two, and matches the scanned speed and start position. This method establishes phase synchronisation at the same time.

In phase synchronisation, the transmitter sends a start signal, which the receiver recognises, and then the picture signal is sent. This start signal is called the phase signal.



Matsushita is the only manufacturer in Japan that produces CCITT Standard G3/G2/G1 compatible modems.

Printing

In most office machines, thermal printing is the norm. This requires special thermal recording paper which has been treated to be sensitive to a heated print head. The print head consists of a line of resistive heating elements corresponding to one scan line across the width of the copy paper. The incoming signal activates selected elements in the print head to construct an image on the moving copy paper.

Operating facilities

While the above descriptions paint the facsimile machine as a fairly simple device, as it essentially is, there has been a tendency by the manufacturers to build in a lot of features. Even the more simple machines, like the Panafax UF-400 from National/Panasonic, sports the ability to automatically reduce a document size. A G3/G2 compatible machine, it can transmit an A4 size document in a maximum of 30 seconds and has a basic polling function built-in which allows the machine to request transmission from a predetermined set of stations, activating the facsimile machines at those locations.

Encryption

The fax machine, as the press releases never tire of saying, is the most efficient means of document exchange developed and certainly one of the most secure. But, as with every other form of information exchange, sensitive data can be prey to the unscrupulous.

This threat can be countered with encryption. This is achieved with a device such as the facsimile encryptor which is distributed by Visnet. This "scrambles" the data just before it is fed to the modem and unscrambles it at the other end, making it unintelligible to any phone tapper.

Acknowledgements

Our thanks to the Service Departments and Technical staff of Matsushita (National/Panasonic), 3M, AWA, Mitsubishi, Mitsui, Rank/Xerox and NEC for their help in putting this article together.

Another nail in the analog coffin

Digital signal processing Pt.3

Specialised digital signal processing (DSP) microprocessors capable of implementing complex systems are now appearing on the market. Falling prices and the more sophisticated processing functions afforded by DSP (ie, adaptive systems) will make op amp circuits a thing of the past. Traditional analog design will be confined to the difficult areas of small signals, high frequency and high power.

by MIKE FAULKNER*

**Lecturer at the Footscray Institute of Technology*

Perhaps the above is going a bit far but DSP does have a big future. This final article in the series on DSP considers the design of FIR (finite impulse response) filters and how they can be made adaptive. It also discusses hardware implementation of real time DSP systems. In particular, the Texas Instruments TMS32010 microprocessor is described in some detail.

Finite impulse response filters

It is normal to use a constant coefficient difference equation to implement a digital filter. In this equation the present output value is the sum of weighted values of the present input, previous inputs, and previous outputs. Finite Impulse Response (FIR) filters use a constrained version of this algorithm, as shown below, where there is no contribution from the previous outputs (ie, no feedback).

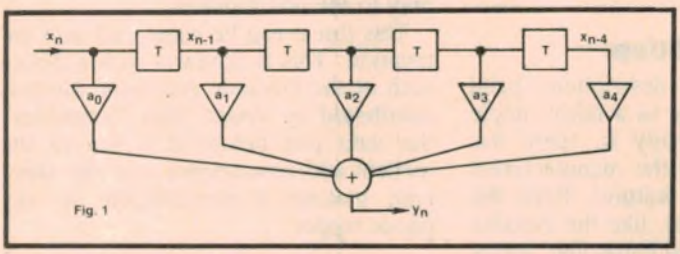


Fig.1: implementation block diagram for a five-tap (coefficient) FIR filter.

Fig.1 shows the FIR implementation block diagram.

$$Y_n = a_0 x_n + a_1 x_{n-1} + a_2 x_{n-2} + \ldots\ldots$$

This lack of feedback means that FIR filters are always stable whatever the coefficient values. It is for this reason that the FIR structure is so popular in adaptive applications, since varying the coefficients will never produce an unstable system. The main advantages and disadvantages of FIR filters are shown below.

Advantages

- stable
- linear phase (constant group delay possible)
- 90 degree phase shifter possible

Disadvantages

- High processing requirement for a given selectivity
- 90 degree phase shifter possible

In the FIR structure the coefficients directly represent the impulse response of the filter. The frequency response of the filter is related to its impulse through the inverse Fourier Transform.

One of the common design approaches to this type of filter is illustrated in Fig.2. The approach starts off with the ideal brick-wall characteristics of the filter and then obtains its impulse response by taking the inverse Fourier Transform. The impulse response is not suitable for direct implementation because it continues for infinite time. To make it suitable for direct implementation it must be truncated, delayed, and sampled.

This, of course, degrades the frequency response by producing ripples in the pass and stop-bands and reducing the selectivity of the transition band.

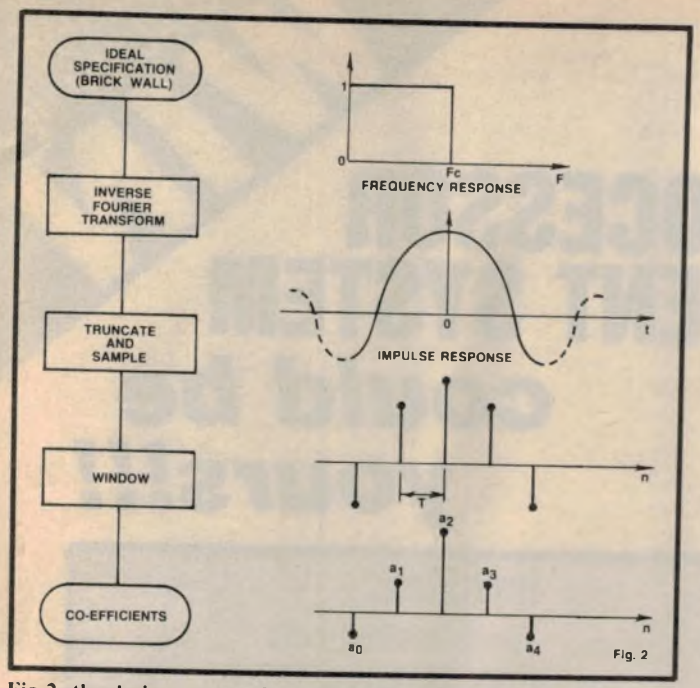


Fig.2: the design process for an FIR filter (window method).

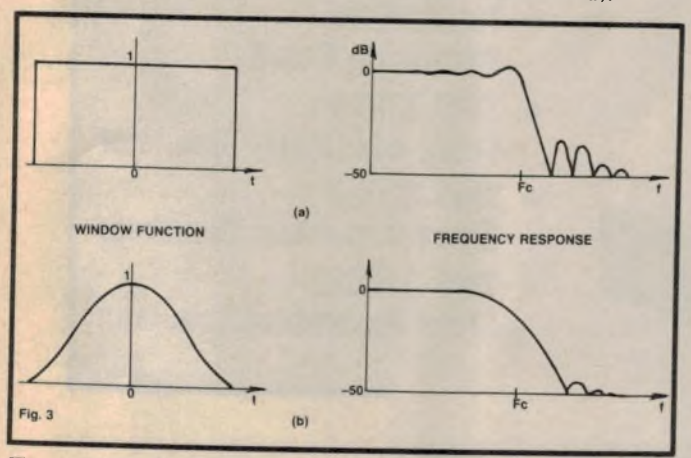


Fig.3: the window weighting function and how it affects filter response. Ripple reduction is achieved at the expense of filter roll-off. (a) Rectangular window (or truncation of the impulse response); (b) Hanning window (or raised cosine).

The ripples produced by this method can be very large and it is normal to reduce them (at the expense of further increasing the transition bandwidth) by "windowing" or weighting the coefficient values. Window functions normally act to reduce the amplitude of the outer coefficients (a_0, a_4 and to a lesser extent a_1, a_3 of Fig.2). Fig.3 illustrates the improvement of a Hanning window weighting function on a low-pass filter.

Adaptive Systems

Adaptive systems are becoming popular. For example, many modems now use adaptive equalisers to compensate for the differing characteristics of telephone lines. Noise cancelling systems are now also using adaptive techniques and, of course, sophisticated control systems have used these techniques for some time.

Adaptation is performed by changing the coefficient values to produce an optimum output. How to distinguish between an optimum and a non-optimum result is the main problem in adaptive systems. Usually another signal is required — the desired signal (d_n). The output of the filter (Y_n) is subtracted from this signal to give an error value (e_n) which the adaption algorithm seeks to minimise (Fig.5). Coming up with the desired signal is the problem, since if it is known there is no point in having an adaptive system in the first place! Modems overcome this problem by first transmitting a known training sequence. The desired signal can therefore be generated internally by the receiver.

Noise cancelling systems require two inputs, one input containing the desired signal (S) and the corrupting noise (Nc), the other containing just noise (N) (Fig.6). The two noise signals (N and Nc) are related but still differ in amplitude, phase and spectral make-up, due to the geographical separation of the microphones, and the possible presence of baffles or other objects. Therefore, a straight subtraction of the two signals produces little or no cancelling effect.

An adaptive canceller tries to reduce the error signal by making the noise estimate (Nc) exactly equal to Nc. The desired signal component (S) is not cancelled because it has no correlation with the filter input signal (N). The adaptive filter is therefore adjusted so that it has the same transfer function as the acoustic path A to B.

DSP Implementation

DSP algorithms can be implemented in many, many ways varying from surface acoustic wave (SAW) devices to specialised VLSI designs. However, it is the advent of specialised DSP microprocessors that has had the greatest impact in popularising the DSP approach.

The number of manufacturers now offering DSP microprocessors is still growing and currently includes, among others, Motorola, Texas Instruments, Analog Devices, NEC and Philips. Many of these microprocessors have similar features so this article will describe just one of the more popular devices (the Texas Instruments TMS32010) in detail.

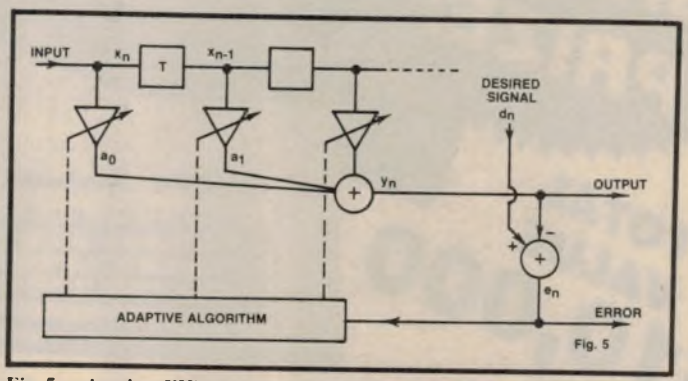


Fig.5: adaptive FIR structures require two inputs (x_n and d_n). Two outputs are available: the filter output (Y_n) and the feedback error signal (e_n). The application determines which is used.

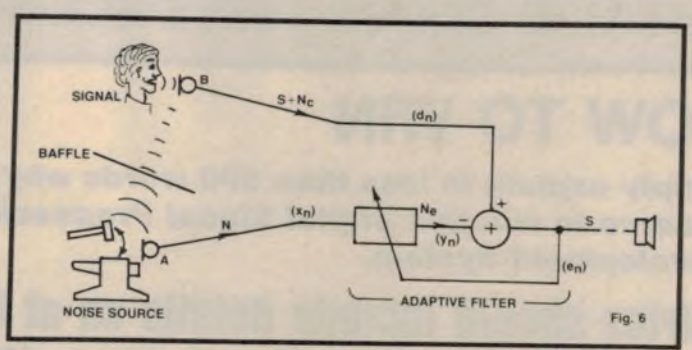


Fig.6: adaptive noise cancelling. The adaptive filter's feedback error signal (e_n) forms the output.

CAD of FIR Filters

These days, it is normal to design FIR filters with the aid of a computer package. For those readers who do not have access to a commercial CAD package a BASIC program, suitable for IBM-PCs and compatibles, is included in Fig.4a. The program uses a Hanning window to give low ripples in the stop-band.

The program works by first designing a low-pass filter with cut-off frequency, Fc (line 170), applying the Hanning window (line 180), and then, if required, using transformations to obtain a high-pass (line 230) or bandpass (lines 250 to 290) response. The variables H and G provide gain normalisation.

The remainder of the program (lines 340 onwards) uses the Discrete Fourier Transform to obtain the filter's frequency response up to Fs/2 (half the sample rate). All the frequencies are normalised to the sample rate (Fs). Fig.4b shows the ideal specifications for the three types of filter. The high-pass response cuts off at a frequency of (Fs/2 — Fc), while the band-pass filter has a bandwidth of 2Fc and a centre frequency of Fo.

The program of Fig.4c simulates the response of an FIR filter to a sinewave input.

```
100  DIM A(100),B(100),D(100):FOR I=1 TO 40 :A(I)=0:NEXT I
110  PI = 3.1415926550:G=0:H=0
120 INPUT "NORMALISED LOW PASS CUT-OFF FREQ (MAX 0.5)";FC
130 INPUT "NUMBER OF TAPS, N ";N
140 REM****INVERSE FOURIER TRANSFORM OF BRICK-WALL LPF IS SINC FUNCTION****
150 FOR I=0 TO (N-1)
160     IF I = (N/2-.5) THEN A(I) =1:GOTO 180
170     A(I)=(SIN(2*PI*FC*(I-(N/2-.5))))/(2*PI*FC*(I-(N/2-.5)))
180     A(I) = A(I)*(1-COS(2*PI*(I+1)/(N+1)))/2
190     G=A(I)+G
200 NEXT I
210 INPUT "CONVERT TO HIGH-PASS(2),BAND-PASS(3) OR LEAVE(1)";T
220 IF T=1 OR T=2 THEN H=1
230 IF T=2 THEN FOR I=0 TO (N-1) STEP 2: A(I) = -A(I): NEXT I
240 IF T=3 THEN 250 ELSE 300
250     INPUT "RELATIVE CENTRE FREQUENCY (MAX 0.5)";FO
260     FOR I=0 TO (N-1)
270             A(I) = A(I)*SIN(2*PI*FO*(I-(N/2-.5)))
280             H=H+((SIN(2*PI*FO*(I-(N/2-.5))))^2)/N
290     NEXT I
300 PRINT:PRINT "A(I)  COEFFICIENTS"
310 FOR I=0 TO (N-1)
320     A(I) = A(I)/(H*G): PRINT "A(";I;")  =  ";A(I)
330 NEXT I
340 REM **** DFT TO CALCULATE FREQUENCY RESPONSE ****
350 IF N<20 THEN N=20
360 PRINT:PRINT "H( J ), FREQUENCY RESPONSE AT NORMALISED FREQUENCY = (J/";N;")*
FS"
370 PRINT:PRINT TAB(23);"-50DB     -40DB     -30DB     -20DB     -10DB     0DB"
380 PRINT TAB(25)"I---------I---------I---------I---------I---------I"
390 FOR J=0 TO N/2
400     X=0:Y=0
410     FOR I=0 TO (N-1)
420             X=X+A(I)*COS(2*PI*I*J/N)
430             Y=Y-A(I)*SIN(2*PI*I*J/N)
440     NEXT I
450     H=(X*X+Y*Y)^.5 :D =20*LOG(H)/LOG(10):IF D<-49 THEN D=-49
460     PRINT "H(";J;") = ";H;TAB(25);"I";TAB(75+D);"*"
470 NEXT J
480 END
```

```
NORMALISED LOW PASS CUT-OFF FREQ (MAX 0.5) .2
NUMBER OF TAPS, N  5
CONVERT TO HIGH-PASS(2),BAND-PASS(3) OR LEAVE(1) 2

A(I)  COEFFICIENTS
A( 0 )  =  -.0259607
A( 1 )  =   .2520318
A( 2 )  =  -.444015
A( 3 )  =   .2520318
A( 4 )  =  -2.596068E-02

H( J ), FREQUENCY RESPONSE AT NORMALISED FREQUENCY = (J/ 20 )*FS

                    -50DB     -40DB     -30DB     -20DB     -10DB     0DB
                    I---------I---------I---------I---------I---------I
H( 0 ) =  8.127261E-03  I       *
H( 1 ) =  6.627244E-03  I     *
H( 2 ) =  5.226354E-02  I                 *
H( 3 ) =  .1316892      I                       *
H( 4 ) =  .2462455      I                             *
H( 5 ) =  .3920936      I                                   *
H( 6 ) =  .5577739      I                                     *
H( 7 ) =  .7242516      I                                       *
H( 8 ) =  .8678556      I                                         *
H( 9 ) =  .9654132      I                                           *
H( 10 ) =  1            I                                           *
```

Fig.4a

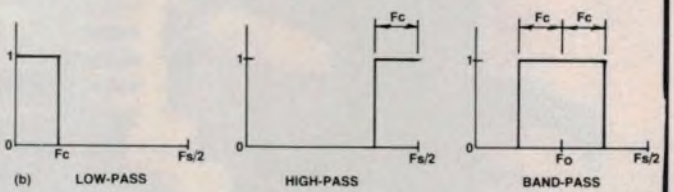
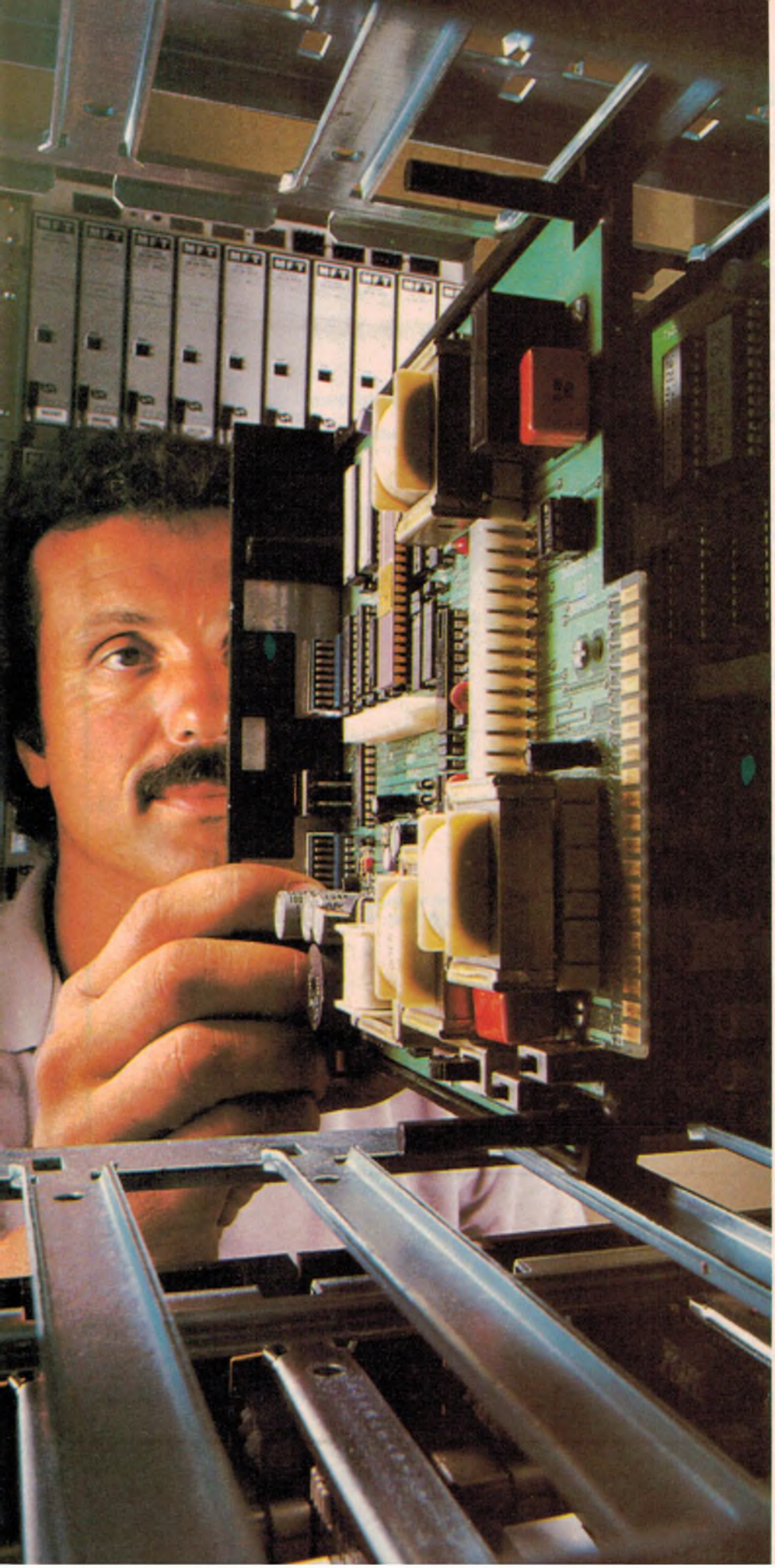


Fig.4b

```
100 REM PROGRAM TO SIMULATE THE ACTION OF A DIGITAL FILTER
110 REM READ "NO. OF TAPS (N)","A0","A1","A2".....,"AN"
120 READ N
130 FOR K=0 TO (N-1)
140     READ A(K)
150 NEXT K
160 REM RUN **** SIMULATE INPUT ****
170 INPUT "ENTER INPUT FREQUENCY WRT SAMPLE FREQUENCY (MAX 0.5)",F
180 FOR J= 1 TO 40
190     X(0)= SIN(2*3.14159*J*F)
200     REM ****EXECUTE ALGORITHM  Y=A(0)*X(0) + A(1)*X(1) + ... ****
210     Y=0
220     FOR K=0 TO (N-1)
230             Y=Y+X(K)*A(K)
240     NEXT K
250     REM  **** DISPLAY ON SCREEN ****
260     PRINT TAB(INT(19*(1+X(0))+1.5)) "*" TAB(INT(41.5+19*(1+Y))) "Y"
270     REM  **** IMPLEMENT DELAYS ****
280     FOR K = (N-1) TO 1 STEP -1
290             X(K)=X(K-1)
300     NEXT K
310 NEXT J
320 PRINT TAB(18) "INPUT" TAB(58) "OUTPUT"
330 END
340 DATA 5,-0.0260,0.2520,-0.4440,0.2520,-0.0260
```

Fig.4c

Fig.4: (a) Basic program to design low-pass, high-pass and BP FIR filters. (b) Input frequency specifications for the program. (c) Basic program to simulate an FIR filter. Input data format is 1000 DATA (no. of coefficients), (a_0), (a_1),...



TEXAS TMS320

OVERVIEW

TI's TMS320 family comprises six high-speed digital signal processors (DSPs) — the broadest family of these devices available today. All are capable of implementing complex, numeric-intensive algorithms in real time. Among them you can find the device to meet a wide range of price/performance goals. While family compatibility reduces development costs and speeds time to market.

TI's DSP family is a reliable, flexible replacement for analog systems, and it provides designers with high-performance alternatives to conventional microprocessors and microcontrollers.

The Harvard architecture of TI's TMS320 family increases parallelism for higher throughput; and these economical, programmable, general-purpose DSPs can accomplish many tasks that formerly required expensive custom or bit-slice solutions. As the industry standard, TI's TMS320 family minimizes your design risk.

APPLICATIONS

DSP is finding applications as varied as:

- Telecommunications
- Voice/speech processing
- Graphics/image processing
- Control systems
- Instrumentation

And benefiting users in such fields as:

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- Consumer goods
- Automotive
- Medical
- Military

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- Applications software
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INSTRUMENTS DIGITAL SIGNAL PROCESSORS

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TI's TM320 FAMILY OVERVIEW

	MEMORY				CYCLE-TIME				PACKAGE				I/O				
	ON CHIP		OFF CHIP		ns				DIP	PGA	PLCC		SER	PAR	INSTRUCTIONS	TECHNOLOGY	SMJ MILITARY
	RAM	ROM	PROG	DATA	200	160	125	100	40	68	44	68					
TMS32010	144	1.5K	4K		✔	✔			✔		✔			8x16	60	NMOS	✔
TMS32011	144	1.5K			✔				✔				2	6x16	60	NMOS	
TMS320C10	144	1.5K	4K		✔	✔			✔		✔			8x16	60	CMOS	✔
TMS32020	544		64K	64K	✔					✔			1	16x16	109	NMOS	✔
TMS320C25*	544	4K	64K	64K			✔	✔				✔	1	16x16	133	CMOS	✔

*In development. Contact your nearest TI Field Sales Office for availability or further information.

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Signal Processing

The Texas Instruments TMS32010

This device has probably done the most to popularise DSP in Australia. It was the first member of a family of such devices which now includes both first and second generation processors.

The TMS320 is a 16/32 bit microprocessor designed to operate either in a stand-alone environment or as a coprocessor. Although designed primarily for digital signal processing and number crunching applications, it retains some of the functions found in normal microprocessors such as logical instruction, and an ability to support program branches and subroutines. It can also address off-chip memory.

The TMS320 obtains its high speed (200ns cycle time) by employing a modified version of what is called the Harvard architecture. This separates the program and data memories and

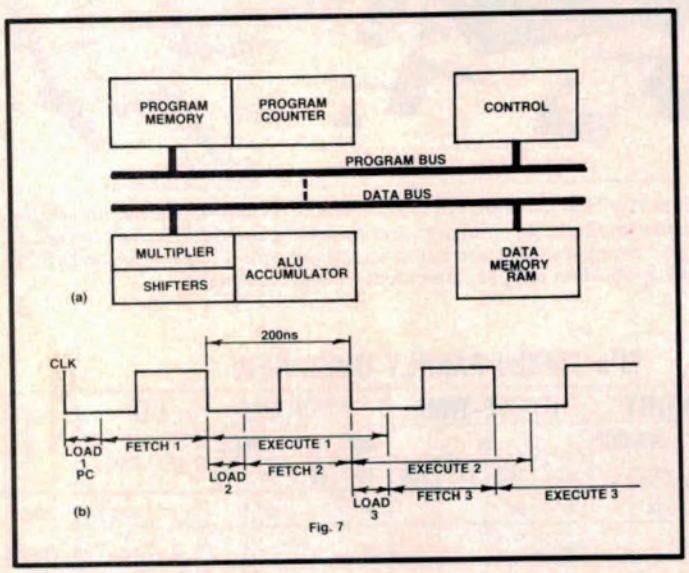

Fig.7: (a) modified Harvard architecture and (b) execution and fetch.

uses two internal busses within the chip (Fig.7). This configuration permits fetching information from both program and data memories in parallel; thus the execution time of an instruction overlaps the fetch cycle of the next instruction in a pipelined manner. The more popular microprocessors (Z80, 6809, 8085 etc) use a single internal bus for both data and instructions.

In the TMS320, modifications on the conventional Harvard architecture include a special feature that allows communication between the program and data sections.

Fig.8 shows the complete block diagram of the device. The two major busses (program and data) are each 16 bits wide as are both memories. The accumulator, however, is 32 bits wide which helps reduce noise build-up when implementing digital signal processing (DSP) algorithms.

Major Features

The key features of the TMS320 are listed below. Two versions of the chip are available, TMS320M10 with on-chip ROM and the TMS32010 which uses off-chip program memory only.

(1). *Data memory*, 144 x 16 RAM. This is used for storing variables such as X_n, X_{n-1}, X_{n-2} etc and, if necessary, the algorithm coefficients. It has a limited data movement capability which implements the z^{-1} operation by shifting the data to the next location. Either direct or indirect addressing modes are available.

(2). *Program Memory*, 1.5K x 16 on-chip ROM or 4K x 16 off-chip. The instructions and coefficient values are contained in this memory. Capabilities exist for transferring data (such as coefficient values) to and from the data memory section. The 'on-chip' ROM is mask programmable at the factory, and therefore only suitable for large quantity orders. The 'off-chip' option requires external memory and is suitable for prototype and small production runs.

(3) *Arithmetic elements*. These perform the number crunching task on the data. The three main elements are described here:

- ALU and accumulator have 32-bit resolution and operate using a 2's complements number system.
- A 16 x 16 = 32-bit multiplier which operates in 200ns. The multiplier requires an operand to be loaded into the T register prior to multiplication. This takes a further 200ns giving a total of 400ns.
- A 0-15 bit barrel shifter, useful in double precision arithmetic.

Internal Data Flow

In broad terms, processing is performed by the following sequence. Input variables (from the A/Ds etc.) are read into the internal data RAM via the data bus. These variables are then processed a number of times. This processing involves reading data from the RAM into the ALU via the multiplier or barrel shifter and then returning it to the RAM. Finally, data signals are outputed from the RAM to the external peripheral devices (D/As, etc).

Interfacing

The TMS32010 is housed in a 40-pin package and has 12 address lines, 16 bi-directional data lines, three control lines, a reset and

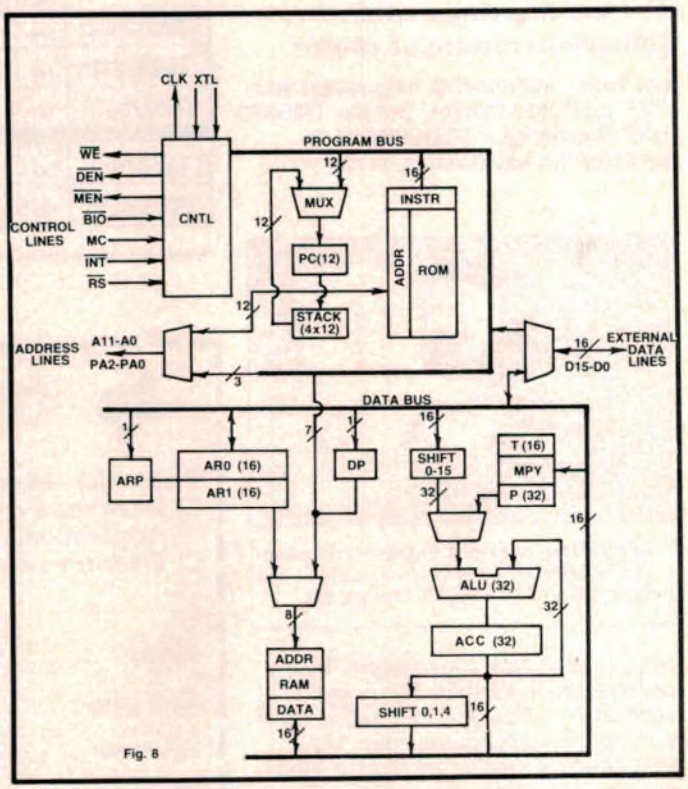

Fig.8: internal architecture of the Texas Instruments TMS32010 (courtesy Texas Instruments Inc).

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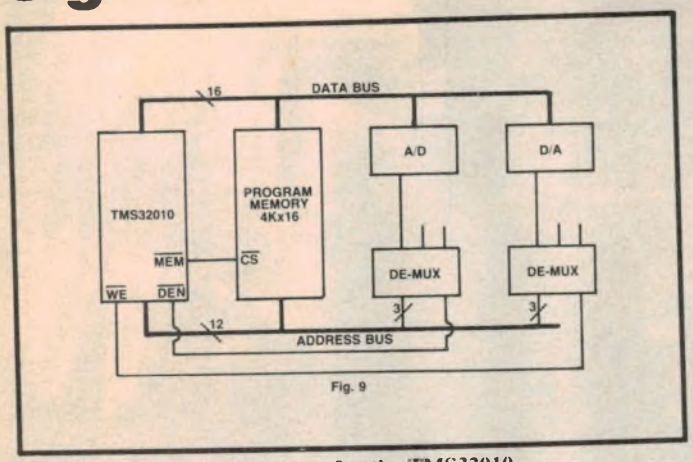


Fig. 9

Fig.9: interfacing requirements for the TMS32010.

two interrupt lines. The external bidirectional data lines are multiplexed to either the internal program bus (for reading in instructions) or to the internal data bus (for communicating with A/Ds and D/As etc). The movement of data into and out of the chip occurs under the control of three enable lines and the address lines.

- Data input from A/D or peripheral device. Up to eight ports can be addressed using three address lines (AO, A1, A2) and the DEN line. These lines are activated by the IN instruction.
- Data output to the D/A or peripheral device. Up to eight ports can be addressed using 3 address lines (AO, A1, A2) and the WE line. These lines are activated by the OUT instruction.
- Data input from the program memory. 4K of memory can be addressed using the full 12 address lines and the MEN line. This occurs during the normal instruction fetch cycle or using a TBLR instruction.
- Data output to the program memory. If parts of the external program memory are RAM, then it is possible to use a TBLW instruction to store data in this memory. The 12 address lines and the WE line are activated.

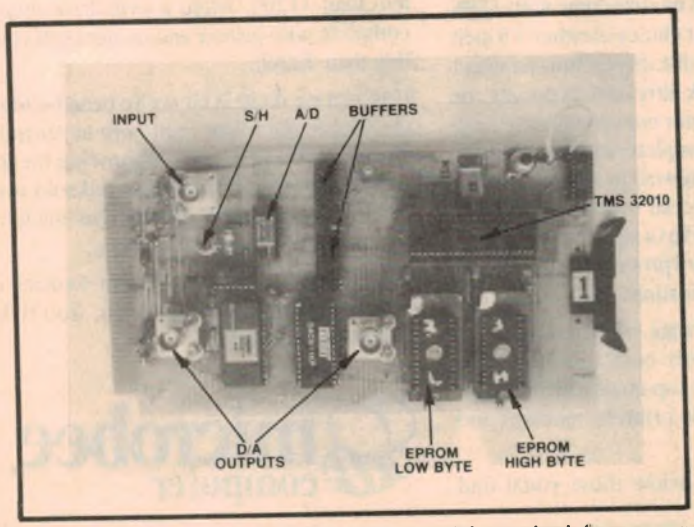


Fig.10: external components and 'glue logic' required for a near minimum system of one analog input and two analog output channels.

The external blocks required for system operation are shown in Fig.9. To operate successfully at the fastest 200ns instruction cycle time, external interfacing logic should have access times of less than 85ns. Fast memories are required (normally expensive static RAM) and buffering is also required for most A/Ds and D/As because their microprocessor interfaces are too slow. The situation is improving though; static RAM is becoming more widely available, and the new second generation of DSP chips (Texas Instruments TMS32020) provide a capability of interfacing to slow memory (dynamic RAMs).

Fig.10 illustrates the components required for a minimum system. The system contains one analog input channel (S/H and 10-bit A/D) and two 12-bit D/A outputs. Two 2732A EPROMS (8-bit x 4K) are connected in 'parallel' to provide the necessary 16-bit x 4K external program memory, and there are four glue chips (buffers, gates etc). The whole system is run at reduced speed because of the slow memory access time.

The TMS32010 in a DSP Context

The majority of DSP applications are characterised by a sum of products calculation and a series of data moves. For example, take the FIR structure of Fig.1. The output y_n is a sum of the products of the coefficients (a_0, a_1,...) and the delayed input samples x_{n-k}. The accumulator acts as the summing node for the

```
****** 5 TAP FIR FILTER ******
START   IN 6,0          read A/D into data RAM 6
        ZAC             zero accumulator
        LT 10           load T register from RAM 10
        MPYK -106       multiply by the value -279
        LTD 9
        MPYK  1032
        LTD 8
        MPYK -1819
        LTD 7
        MPYK  1032
        LTD 6
        MPYK -106
        APAC            add to accumulator
        SACH 5,4        store accumulator to RAM 5
        OUT 5,0         output RAM 5 to D/A channel 0
        B   START       loop back to START
```

Fig.11: assembler program to implement a five-tap FIR filter. The coefficient values (−106, 1032 etc) represent the values obtained in Fig.4, but adapted to the TMS320 number format.

products. After y_n has been calculated the values of x_{n-k} must be shifted one place to the right to make way for the next input sample, x_{n+1}. To do this using the TMS320 the following instructions are required for each coefficient:

LT 10	loads the T register from data memory location 10
MPY 20	multiplies with coefficient value (from data memory 20)
APAC	adds the result to the accumulator
DMOV 10	moves data from 10 to 11 (ie $x_{n-3} = x_{n-2}$)

The delayed input variables x_{n-k} are stored in consecutive memory locations 8, 9, 10, 11, etc so that the DMOV instruction can implement the sample delay function.

Each instruction takes 200ns, giving a total of 800ns. The use of the LTD instruction reduces this time still further because it combines the LT, APAC and DMOV instructions

```
LTD   10
MPY   20
```

The TMS32010 therefore takes 400ns for each additional coefficient of an FIR filter. The second generation processor, TMS32020, reduces this time to 200ns by only requiring one instruction per coefficient; and the improved TMS320C25 drops this to 100ns by operating off twice the clock speed (equivalent to 10MIPS — 10 million instructions per second!)

Second generation devices from other manufacturers offer similar performances. It goes without saying that the signal processing power of these devices is immense.

Coming back to earth, however, a program listing for a five coefficient FIR filter using the slower (only five MIPS!) and considerably cheaper TMS32010 is shown in Fig.10. Note the use of the 'immediate mode' multiply (MPYK) which includes the coefficient value in the program instruction (rather than the address of the coefficient in the internal data memory). This instruction saves on data memory but at the expense of reduced coefficient resolution (13-bits instead of 16-bits).

The program requires 18 instruction cycles (IN, OUT and B instructions require two instruction cycles each), and would therefore operate with a sample rate of 263kHz ($1/(19 \times 0.2 \times 10^{-6})$). Slower sample rates can be obtained by adding NOP (no-operation) instructions, using an external interrupt, or implementing a timing loop.

Use Your Own PC or Microprocessor

DSP algorithms can be implemented on a personal computer provided it has an A/D or D/A interface. Implementation speeds are, however, very slow as the table below shows.

Table 1 — Sample Rate Comparison (fourth order IIR filter)

Device	Clock Speed	Approximate I/O Overhead	Est.Sample Rate
IBM-PC	4.7MHz	1ms	400Hz *
TMS32010	20MHz	1μs	122 kHz

* Using a high level language (PASCAL) with 8087 co-processor.

An increase in speed (by a factor of two or more) can be obtained by using assembly language programming. The multiplications are performed by using a sequence of shift and add instructions. For example, shifting the data one bit to the right can be considered as multiplication by 0.5, while shifting three bits to the right performs a multiplication by 0.125. The sum of these two produces the coefficient 0.625. Any coefficient can be implemented using this technique.

Special care is necessary for eight-bit processors to stop overflows, and to utilise the limited available dynamic range effectively. Processing noise can also become a problem if high Q sections are implemented.

Second article has construction details

High-power HF Linear Amplifier

Last month, we introduced DSE's new high power HF linear amplifier and described the circuit operation. In Pt.2 this month, we give the full construction and alignment details.

by GREG SWAIN

The HF Linear Amplifier is available as a kit of parts from Dick Smith Electronics (see panel) and is supplied complete with pre-drilled metalwork.

Construction mostly involves the assembly of two printed circuit boards. The booster parts are all mounted on a double-sided PCB coded ZA-1500. This in turn is mounted on a large finned heatsink (220 x 136 x 38mm) which provides substantial heatsinking for the two RF power transistors.

The second PCB is coded ZA-1501 and carries the low pass filter, VSWR and carrier operated relay circuitry.

Let's build the booster first. Because this part of the circuit operates at HF, traditional RF construction techniques are employed. This means that all the parts are mounted on the copper side of the PCB.

The first job is to install the through-board links as shown in Fig.4. There are nine links in all and these should be installed using 1.6mm-diameter tinned copper wire.

With the through-board links installed, the next step is to assemble the two transformers (T1 and T2). Fig.5 shows the details. Note that T1 uses two F16 ferrite rings on tubes made from copper shim while T2 uses four ferrite rings arranged in two pairs on longer copper shim tubes. The copper shims should be formed into tubes by wrapping them around a 6mm drill bit.

The transformer assemblies are held together by soldering the ends of the copper shim tubes to the PCB end pieces (after the ferrite rings have been placed over the tubes). Once this has been done, the two assemblies are soldered to the booster PCB as shown in Fig.6. Installation of the windings comes later.

Note that one end-piece on each transformer has its two copper areas electrically connected together by the PCB. Although not strictly necessary, it is a good idea to bridge the pads of these two end-pieces using spare shim material and generous amounts of solder. These shorted end-pieces, together with the copper shims, effectively form the one-turn windings of T1 and T2.

The copper areas of the opposite end-pieces thus form the terminations of the one-turn windings. Care should be taken to ensure that these are each soldered to their respective pads and are not shorted.

Now for the windings. In the case of T1, this job simply involves threading four turns of insulated hook-up wire through the copper tubes to form the primary. Note that the leads should emerge

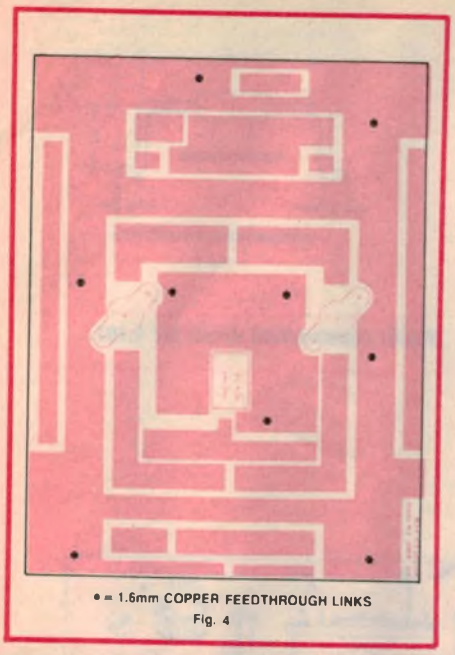


Fig.4: the through-board link locations.

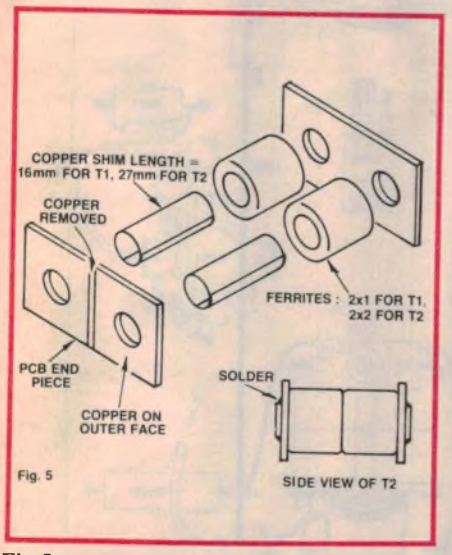
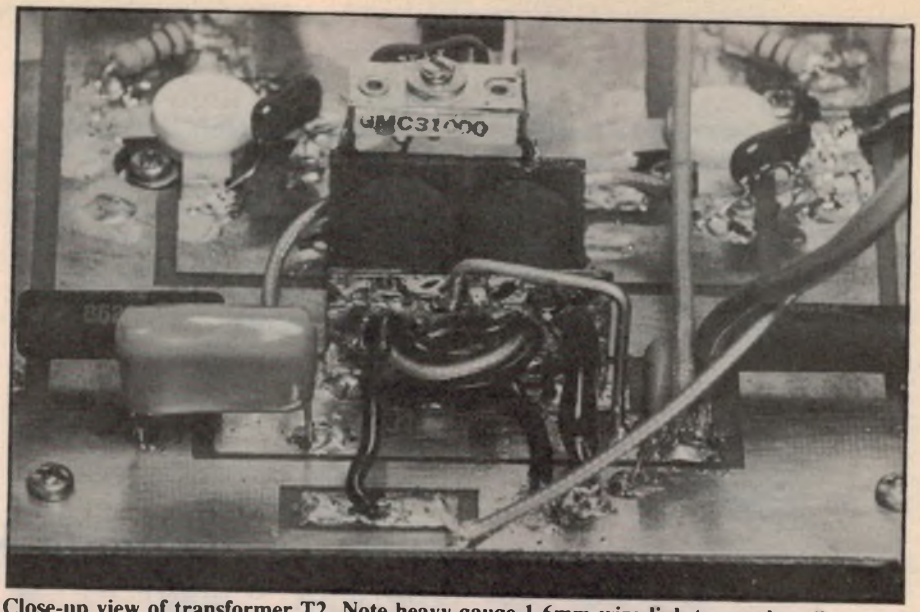


Fig.5: construction details for T1 and T2.



Close-up view of transformer T2. Note heavy-gauge 1.6mm wire link to supply rail.

Close-up view of transformer T1. C101 is soldered directly to the PCB end piece.

from the end of the transformer adjacent to the edge of PCB. Terminate the leads as shown in Fig.6.

The secondary of T2 is wound and terminated in exactly the same manner. Once this has been done, the one-turn feedback winding can be threaded through. Its leads should emerge from the opposite end of the transformer to those of the secondary (ie; the feedback leads should emerge from the end nearest the centre of the PCB).

The real job of installing the parts on the amplifier PCB can now be tackled but don't mount the transistors at this stage. It is a good idea to stand the resistors off the board by 3-4mm to allow for efficient air circulation. Apart from that, keep all component leads as short as possible.

Fig.6 shows the amplifier PCB with the optional attenuator components in position. These components are mounted on five-way tagstrip which is secured to one of the corner mounting points of the PCB. Check to ensure that there is good contact between the tagstrip mounting terminal and the amplifier PCB earth pattern — in fact, it is a good idea to tin the earth pattern around the mounting hole before installing the tagstrip.

If you don't need the attenuator, simply leave the four resistors out of circuit and solder the shielded input lead directly to the primary terminals of T1. Be careful — the shield of this input lead must go to the earth track on the PCB.

Capacitor C101 is soldered directly to one of the end pieces of T1. Similarly, TC101 and C106 are soldered directly to T2 (see Fig.7) while C102 and C103 are soldered directly to the leads of R103 and R104 respectively.

The only other capacitor requiring comment is C107. This has one of its leads soldered directly to the adjacent end piece of T2. The other lead is terminated on the PCB.

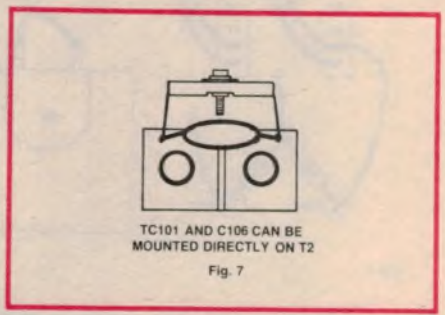


Fig.7: mounting details for TC101 and C106.

HF Linear Amplifier

Wire links

Three wire links must be installed on the amplifier PCB and these are run using 1.6mm tinned copper wire. As shown in Fig.6, one of these links doubles as inductor L101 and requires the installation of two ferrite beads. These beads are secured with epoxy adhesive and should sit about 10mm proud of the PCB (Fig.8).

The long link between the positive supply and R107 is also mounted about 10mm proud of the PCB. This link is 123mm long and should be covered with spaghetti insulation to prevent accidental short circuits. The remaining link connects the end piece of T2 to the adjacent positive supply rail.

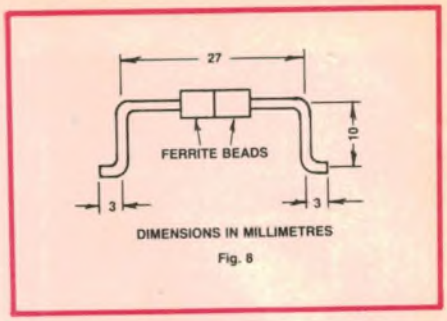


Fig.8: construction detail for L101.

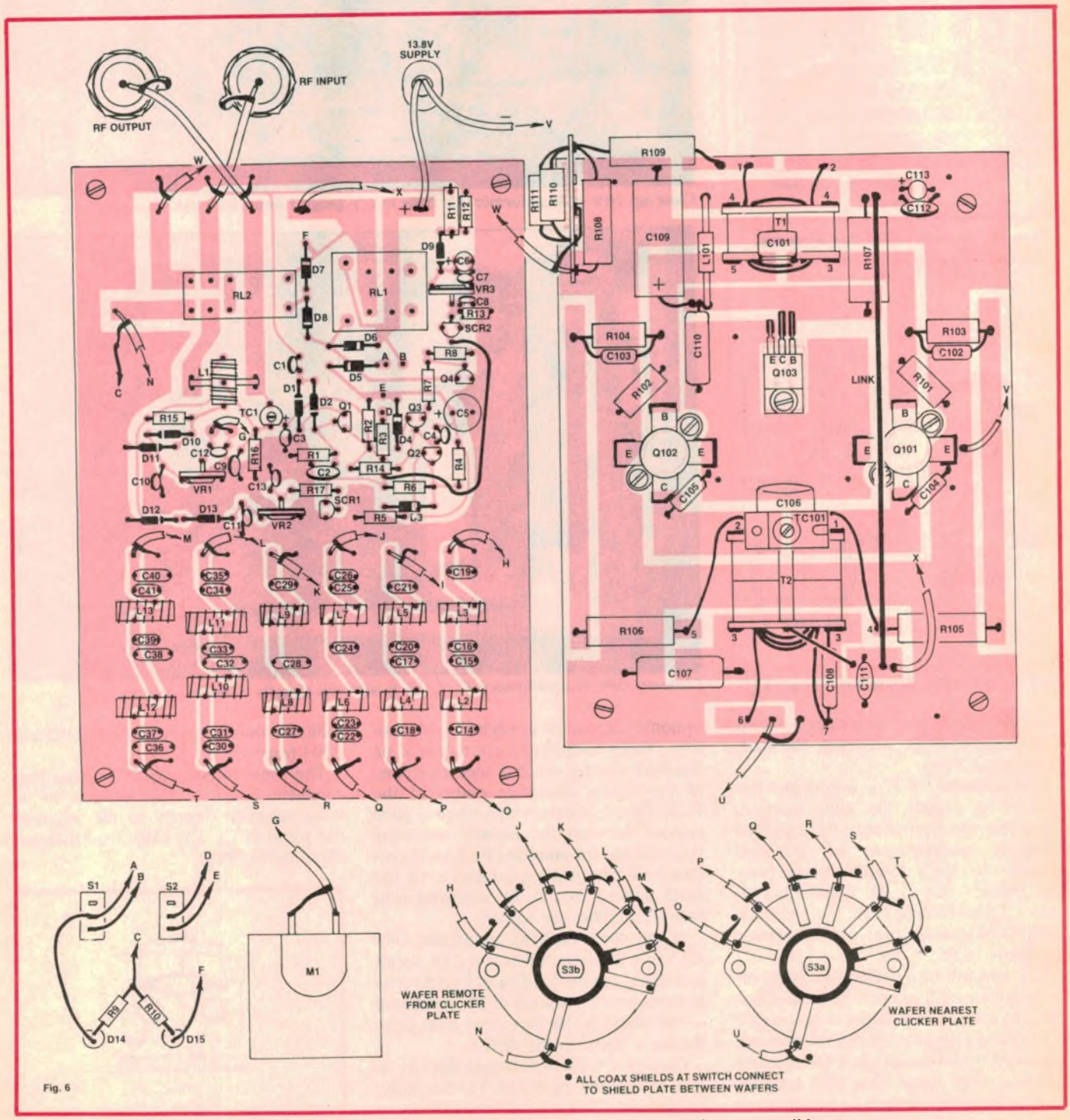


Fig.6: parts layout and wiring diagram. Follow the layout carefully and keep all leads as short as possible.

RF transistors

The amplifier PCB should now be mounted on the heatsink using 3mm spacers and machine screws. This done, you are ready to mount the RF power transistors.

First, tin the transistor leads and the corresponding pads on the PCB, then smear thermal grease on the underside of each transistor. The RF transistors can then be bolted to the heatsink and their leads soldered. Check to ensure that each transistor is correctly oriented before soldering — the collectors go to either side of the primary of T2.

Assembly of the amplifier PCB can now be completed by installing bias transistor Q3. Note that the metal tab of this transistor must be electrically isolated from the heatsink using a mica washer and insulating bush assembly. Fig.9 shows the details.

As before, smear all mating surfaces with thermal grease before bolting the transistor to the heatsink. Finally, use your multimeter to check that the metal tab is indeed insulated from the heatsink.

Carrier operated relay PCB

By comparison with the amplifier PCB, assembly of this PCB is quite straightforward. Begin by installing PC stakes at all external wiring points, plus an additional four PC stakes to support the heavy-gauge lead which passes through L1. Note also that two PC stakes are used to terminate the incoming positive supply lead, while another two stakes are used to terminate the supply lead at the take-off point to the amplifier PCB.

The remaining parts can now be installed on the PCB as shown in Fig.6. Take care with the orientation of the semiconductors and the electrolytics.

Fig.10 shows the winding details for current sensing transformer L1. This coil is wound bifilar on a yellow Amidon ferrite core using 0.6mm enamelled copper wire. To do this, fold the wire in half, then wind on 10 evenly spaced turns by passing the looped end through the ferrite core. When this is completed, cut the looped

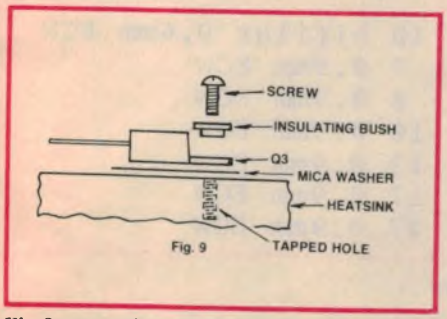
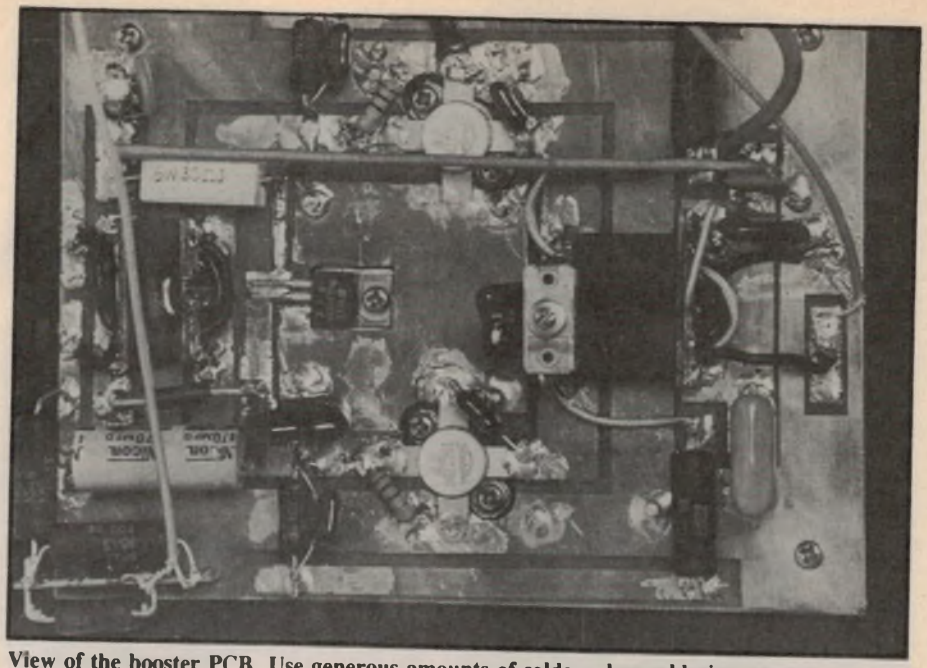
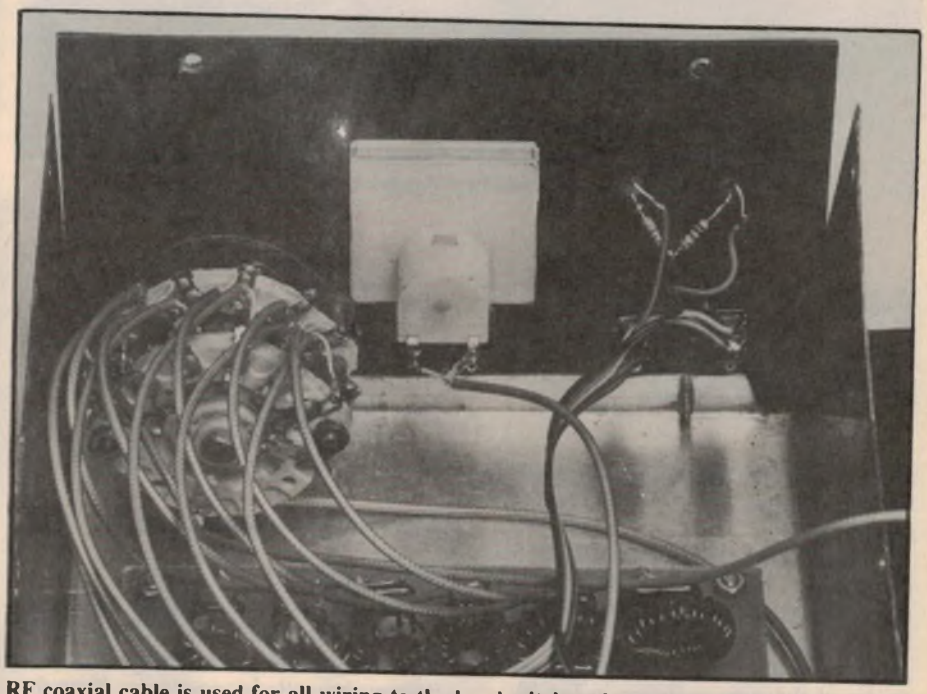


Fig.9: mounting details for transistor Q3.



View of the booster PCB. Use generous amounts of solder when soldering component leads.



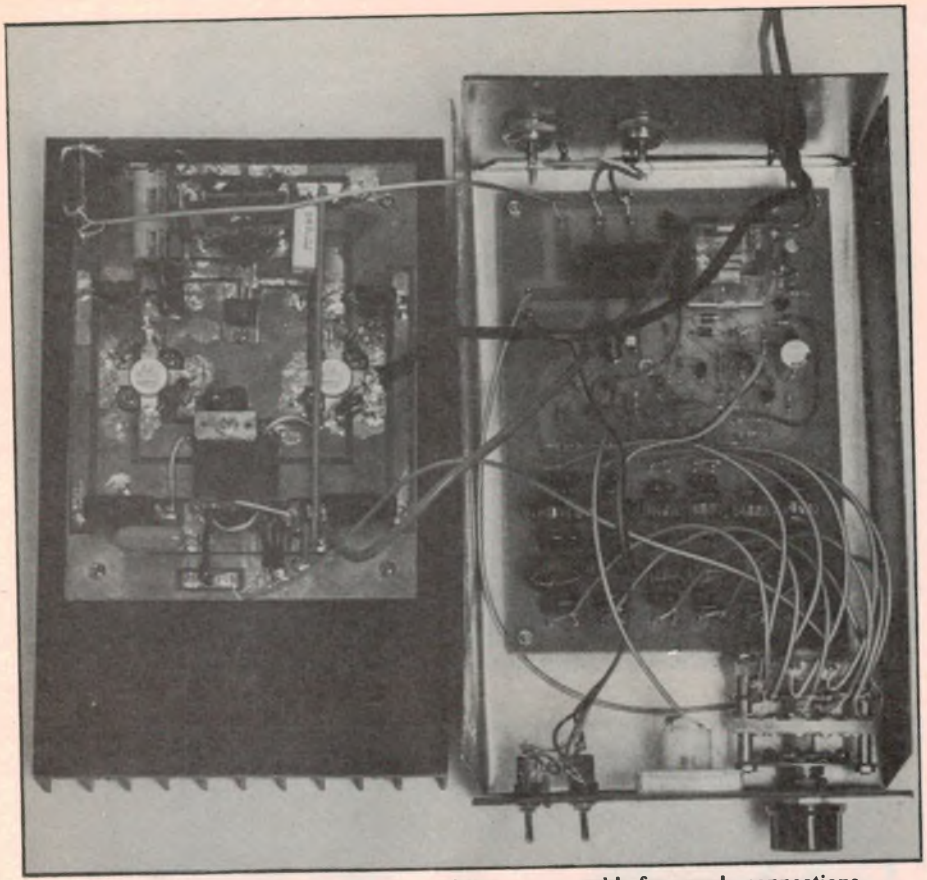
RF coaxial cable is used for all wiring to the bandswitch and to the power meter.

Where to buy the kit

This project was developed in the Research and Development Department at Dick Smith Electronics Pty Ltd. It is available as a kit of parts only and can be purchased by mail order or from your nearest Dick Smith Electronics Store.

The kit comes complete and includes fibreglass PCBs, predrilled metalwork, and prepunched front and rear panels with screened lettering.

Mail orders should be addressed to: Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde 2113. Phone (02) 888 2105.



View inside the completed prototype. Note heavy-gauge cable for supply connections.

HF Linear Amplifier

end and use your multimeter to identify the correct ends to be joined to form the centre tap.

Clean and tin the leads from L1 before installing it on the PCB. Construction of the current sensing transformer can then be completed by installing the heavy-gauge (1.6mm) copper lead through the centre of the core as shown in Fig.10.

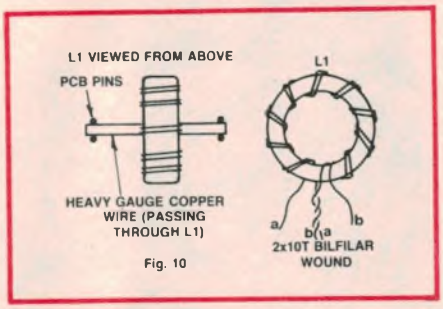


Fig.10: construction details for L1.

Filter coils

Table 2 gives the winding details for the filter coils (L2-L13). These are all wound on Amidon ferrite ring cores using 0.9mm enamelled copper wire. Note that L2-L9 are wound on the smaller yellow cores while L10-L13 are wound on the red cores.

Keep the windings on each core as evenly spaced as possible and install each coil as it is completed to avoid possible confusion. Finally, install the assembled PCB on 6mm spacers in the U-shaped base section and secure using machine screws and nuts.

Final assembly

Now for the final assembly. First, secure the meter to the front panel using epoxy adhesive, then mount the switches, LEDs and BNC sockets. The remainder of the wiring can then be installed as shown in Fig.6.

RG-178 RF coaxial cable is used for all wiring to the bandswitch, power meter and BNC sockets, and to the input of the main amplifier PCB. The wiring to the toggle switches and to the LEDs can be run using rainbow cable.

The two power supply leads must be run using the heavy-duty 20-amp insulated cable supplied with the kit. These leads pass through a cable restraint fitted to the rear panel. Following this, the positive lead is terminated directly to the carrier operated relay PCB while the negative lead is terminated on the amplifier PCB adjacent to the emitter of Q1.

Note that the positive lead is fitted with an in-line fuseholder and 30-amp fuse. Note also that heavy-duty 20A cable is used for the positive supply lead to the amplifier PCB. Do not use conventional hook-up wire — its current-carrying capability is not good enough.

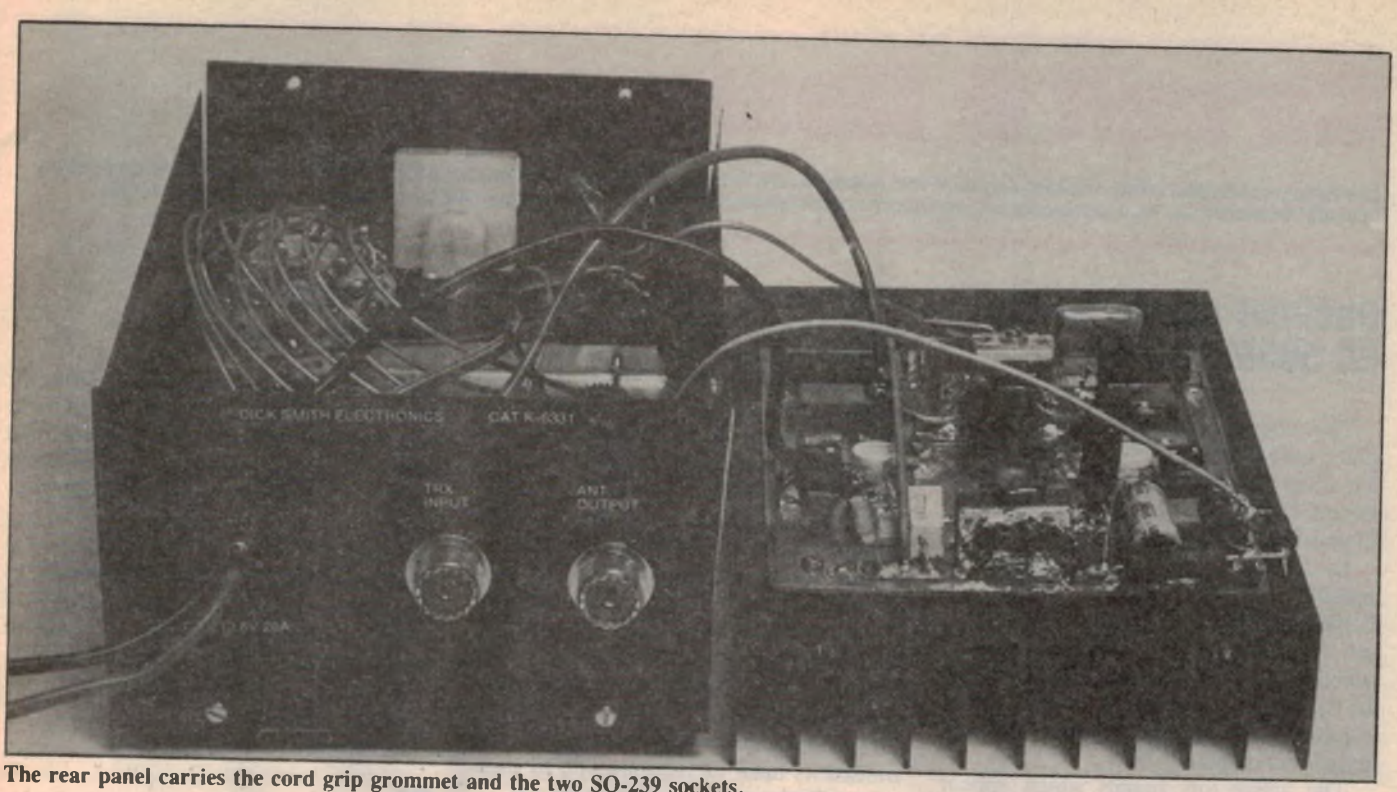
Once all the wiring has been completed, the front and rear panels can be fastened to the aluminium chassis using self-tapping screws. The project is now ready for alignment but first go back over your work and carefully check the wiring.

Alignment

Following construction, the HF Power Amplifier should be left open to allow for alignment. This process is quite easy but

Inductor	Core	Turns
L1	Amidon yellow	10 bifilar 0.6mm ECW
L2, L3 (0.4uH)	Amidon yellow	7 0.9mm ECW
L4, L5 (0.5uH)	Amidon yellow	8 0.9mm ECW
L6, L7 (0.7uH)	Amidon yellow	10 0.9mm ECW
L8, L9 (1uH)	Amidon yellow	13 0.9mm ECW
L10, L11 (3uH)	Amidon red	17 0.9mm ECW
L12, L13 (5uH)	Amidon red	27 0.9mm ECW
ECW = enamelled copper wire		

Table 2: winding details for current transformer L1 and filter coils L2-L13.



The rear panel carries the cord grip grommet and the two SO-239 sockets.

you do need access to some test equipment: (1) a 200W RF power meter; (2) a 200W dummy load; (3) a 13.8V 25A power supply; and (4) a HF transceiver.

Before commencing alignment, there are a few precautions to be observed. First, take care to avoid RF burns by keeping your fingers away from the output stage circuitry during transmit. Second, always use an insulated tool when making adjustments. And third, don't initially apply too much drive to the amplifier until the input protection circuitry has been adjusted.

The step-by-step alignment procedure is as follows:

(1) Set VR1, VR2 and VR3 on the carrier operated relay PCB fully clockwise.

(2) Connect the transceiver to the input socket of the amplifier. Check that the attenuator circuit has been included if the transceiver output is from 10-15W.

(3) Connect the output of the amplifier to the 200W dummy load and to the RF power meter.

(4) Set the band switch to coincide with the transceiver frequency.

(5) Connect the amplifier to the 13.8V power supply.

(6) With the power switch off, operate the transceiver and observe the RF power meter. Note: if the transceiver has a variable RF power output, then set this to either 5W (no attenuator) or 10W CW (with attenuator).

(7) Switch the amplifier on while maintaining transmission. The relays should operate and the RF output meter should indicate an increase in power.

(8) Switch the amplifier off and repeat steps (4), (6) and (7) for different bands. Check that there is a power increase in each case.

(9) Transmit and adjust TC101 on the amplifier PCB for maximum RF power output. Repeat this procedure for other bands and adjust TC101 for best compromise.

(10) Continue transmitting into a dummy load and adjust VR1 until the relative output meter on the amplifier reads half scale. Now adjust TC1 for maximum deflection on the relative power meter. Finally, adjust VR1 for full scale deflection.

(11) Disconnect the dummy load and RF power meter. Transmit and slowly adjust VR2 until the relays trip and disengage the amplifier. Reconnect the dummy load and reset the amplifier by switching off briefly, then on again. Check that the unit now operates normally again.

Note: this adjustment should be carried out at the low frequency end of the transceiver's range. Also, if an SWR meter is available, VR2 can be adjusted so that the unit trips for a given SWR.

(12) Switch the HF Linear Amplifier off and set the transceiver to the high-frequency end of its range. Adjust the power output of the transceiver (where possible) to a suitable maximum — eg, 10W without the attenuator option and 17W with the attenuator option.

(13) Switch the amplifier on, transmit and adjust VR3 until the relays trip. If a transceiver with a fixed power output of less than 10W (no attenuator) or less than 17W (with attenuator) is to be used, then this adjustment can be ignored.

Stability

As with all other HF linear amplifiers, instability can be a problem if the unit is operated incorrectly. In particular, problems will be encountered if the amplifier is driven into a mismatched load, if there is too much RF drive, or if the filter setting is incorrect.

Other possible causes of instability include poor soldering around the feedthrough holes and poor ground connections. These poor ground connections can occur at the main negative supply termination on the amplifier PCB, and at the earth braids of the coaxial cables.

If instability is noticed, first check the low pass filter setting and the antenna. If these are OK, then either reduce the drive level somewhat or detune TC101 on the amplifier PCB until the instabilitity is eliminated.

Once the adjustments have been completed, the heatsink and case can be screwed together. The front and rear panels are fastened to the heatsink using self-tapping screws while machine screws are used to secure the sides. That completes the project — it may now be connected to a suitable HF antenna and used normally. EA

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.

Decimal points for the EA 500MHz DFM

This circuit obviates the need to replace gating switch S3 and range switch S1 when retrofitting the decimal point circuit (July 1982) to the EA 500MHz digital frequency meter.

In addition, this circuit drives the missing decimal point when the 0-10MHz range and .01s gating is selected. The circuit is particularly useful when retrofitting the Dick Smith version of the kit as replacing S1 and S3 would require major modifications to the front panel and display PCB.

The active low signals which appear on terminals 1-4 of range switch S3 are NOR'd with the wiper of S3 by IC1 (4001). The multiplexing pulses from the ICM7216B appear only at the output of the NOR gate selected by S3. These pulses are integrated by the 0.47uF capacitor and 47k resistor to drive the appropriate S3b terminal feeding the 4008 adder in the decimal point circuit.

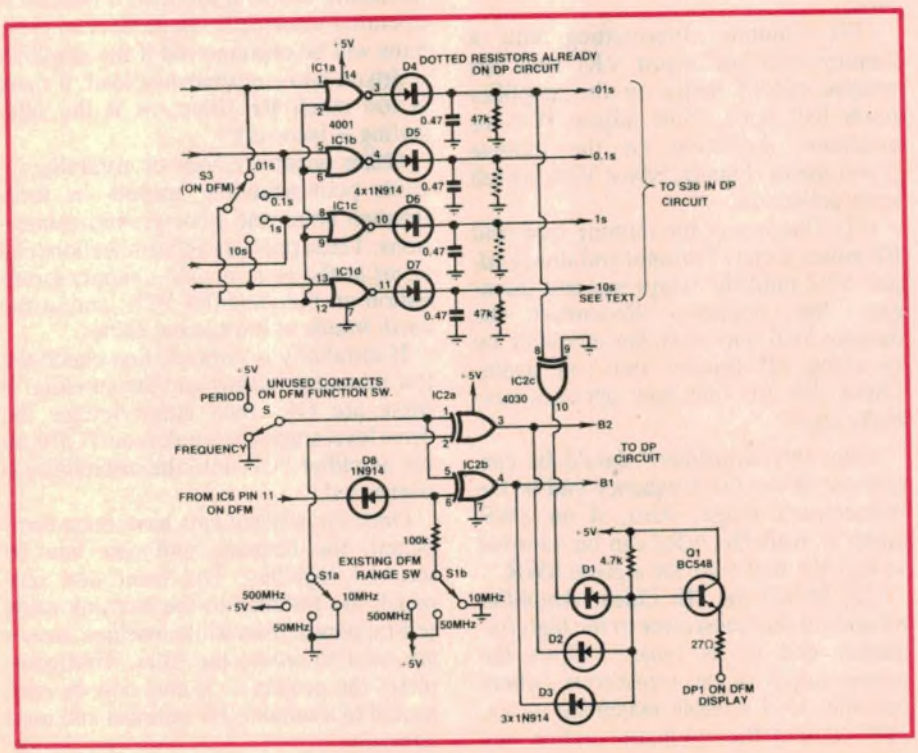
The unused contacts on function switch S4 turn XOR gates IC2a and IC2b into buffers when frequency is selected and into inverters when period is selected. In addition to feeding the B1 and B2 inputs on the 4008 adder, the outputs of these XOR gates feed the 3-input diode AND gate (D1, D2, and D3) in conjunction with the buffered output of the .01s NOR gate (IC1a).

The output of the diode AND gate drives the base of Q1 which in turn drives decimal point DP1 when the 0-10MHz range and .01s gating time are selected. Note that for a common cathode display (as in the Dick Smith version of the kit), the decimal point driver transistors must be reconfigured to common collector mode as shown for Q1.

The output from the 10s NOR gate (IC1d) is presently unused but could be used to generate a flashing kHz decimal point in the missing 1-10MHz/10s position.

M. Glass,
Gloucester, NSW

$25



Low-cost radio remote control

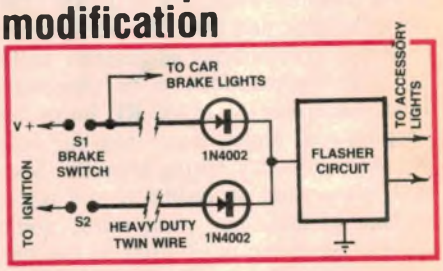
For a cheap but effective radio remote control unit, try junking a low-cost radio-controlled toy car. These can be obtained for around $10 and usually feature forward, reverse and turn controls.

Inside the car you will also find a relay which is used to switch power to the motor. This can be used to control another relay, for example, to switch mains power to a hifi system, TV receiver or some other appliance.

David Timmins,
Randwick, NSW.

$5

Brake lamp flasher modification



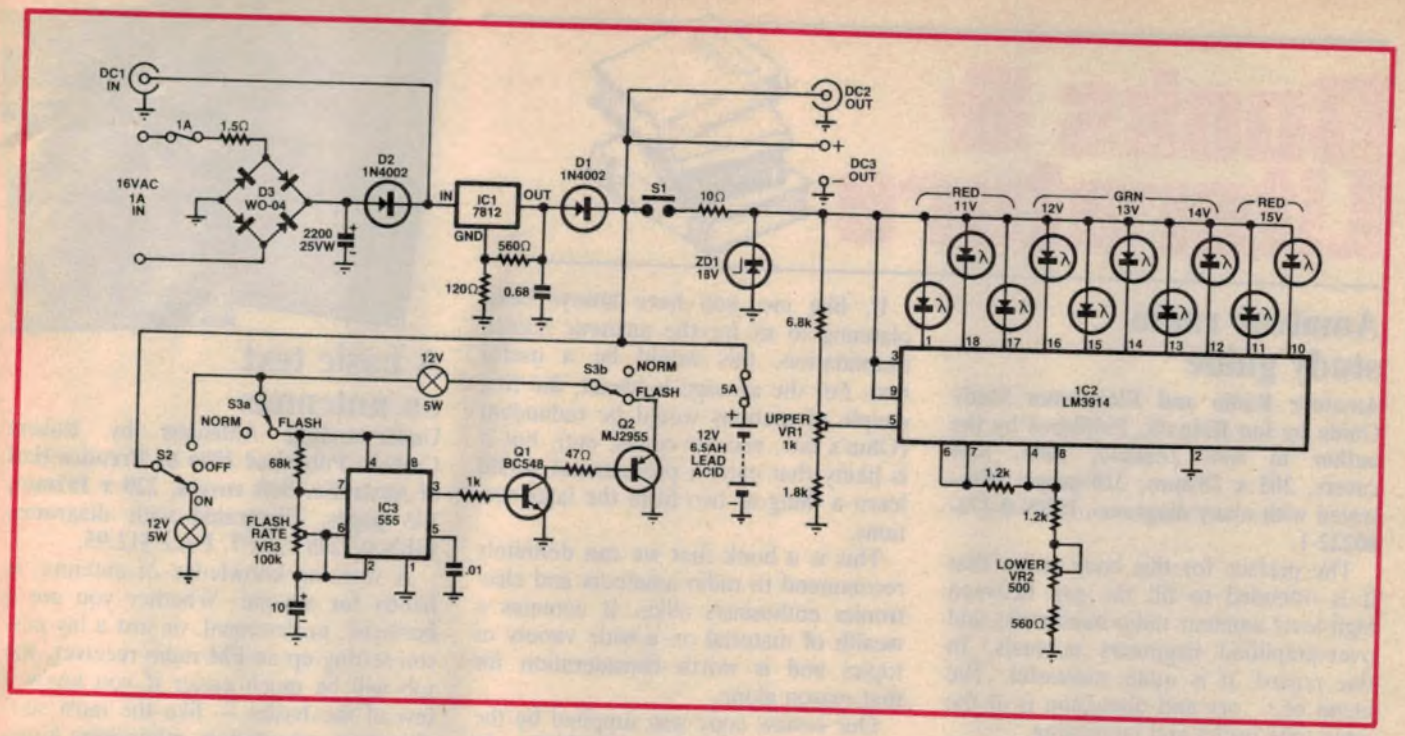
This modification can be made to the Brake Lamp Flasher (EA Nov. 1984) to cure the problem of excessive voltage drop along the existing brake light wire (nearly 4V).

Rather than effecting the circuit modifications suggested in Notes & Errata published in May 1985 and June 1986, this involves connecting the circuit direct to the brake pedal switch using a 5-metre long heavy-duty wire. This solves the problem and also results in a much brighter output from the accessory lamps. The modification also appears to make the suppression choke unnecessary.

A separate wire can also be run from the ignition switch via a pushbutton so that the circuit can be activated independent of the brake light system when the driver behind comes too close.

S. Kamaldeen,
Hobart, Tasmania.

$10



Rechargeable 12V torch

This rechargeable 12V torch is ideal for use with solar power systems. In addition to the normal spotlight, it also features an optional flashing "toplight" for emergency use and a built-in LED voltmeter to indicate the state of the battery.

As a bonus, the unit can be recharged by both AC and DC supplies and includes optional DC power outputs for driving external devices (spotlights, two-way radios etc).

The DC input can be used with a solar panel or with any DC source of about 17V. This is fed to 3-terminal regulator IC1, which provides a regulated 14.5V supply, and then passes via diode D1 to recharge the battery.

D1 prevents the battery from discharging via the 560 ohm and 120 ohm biasing resistors when the external supply is disconnected.

The AC input can be used with a 16V AC plugpack supply. The output of this is rectified by the diode bridge and passes to the regulator via blocking diode D2. This then charges the battery as before. Socket DC2 and banana posts DC3 provide separate DC output connections.

IC2, an LM3914 display driver, forms the voltmeter. It drives LEDs 1-10 to indicate the battery voltage when S1 is pressed. VR1 and VR2 provide adjustment of the voltmeter range. This adjustment will have to be repeated several times as the two controls interact.

Finally, 555 timer IC3 and transistors Q1 and Q2 form a simple flasher circuit. VR3 permits adjustment of the flash rate while S3 selects the flash position.

R. Sommerhalder,
Mudgee, NSW.

$20

Loudspeaker switching circuit for car radio/cassette

Here's how to add a cassette player to a car so that it shares the existing loudspeakers used with the car's radio. The circuit uses three low-cost PNP transistors.

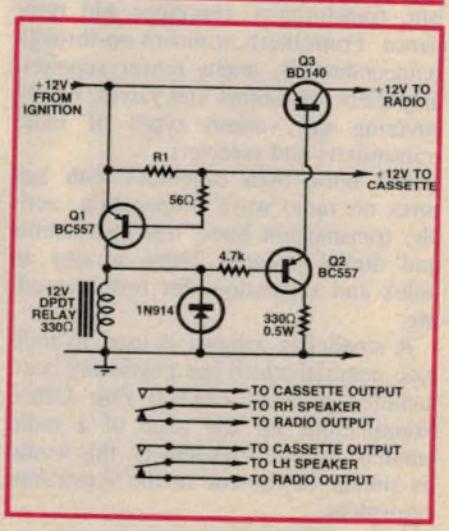
When the cassette deck is not in use, base current for Q2 flows via the relay coil and the 4.7k resistor. This turns Q2 and Q3 on, and thus power is supplied to the radio. Note that this base current is insufficient to energise the relay.

When the cassette deck is turned on, Q1 is forward biased by the voltage across R1. This, in turn, energises the relay which switches the loudspeakers from the car radio to the cassette. At the same time, the base of Q2 is taken to +12V. Q2 and Q3 thus switch off and remove power from the radio.

Resistor R1 (nominally 2.2 ohm 2W) should be selected to suit the particular cassette player. The voltage across R1 should be as close as possible to 800mV when the cassette deck is on.

Peter Prause,
Kewdale, WA.

$15



Books & Literature

Amateur radio study guide

Amateur Radio and Electronics Study Guide by Ian Ridpath. Published by the author in New Zealand, 1985. Soft covers, 205 x 289mm, 210 pages. Illustrated with many diagrams. ISBN 0-473-00222-1.

The preface for this book states that it is intended to fill the gap between high level amateur radio handbooks and over-simplified beginners manuals. In this regard, it is quite successful. The blend of t' ory and discussion is at the same time useful and interesting.

The author is an amateur license holder of some 25 years standing and an electronics tutor at the Manukau Technical Institute in Auckland, New Zealand. The tutor's style is quite evident in the text, with most of the typical student questions already anticipated. In addition, the book is printed in a handwritten format so that it virtually takes on the appearance of a series of lecture notes.

The text is also fully illustrated with large clear drawings and diagrams. This, combined with the handwritten style, makes the material appear far less daunting than would otherwise be the case.

The range of material covered in the book is quite comprehensive. It begins with lectures on resistors, DC and AC basics, capacitors, inductors, magnetism, transformers, reactance and resonance. From there, it moves on through semiconductors, mains power supplies, amplifiers, oscillators and valves, before covering the various types of radio transmitters and receivers.

The book then concludes with lectures on radio wave propagation, aerials, transmission lines, test instruments and digital circuits. There is also an index and suggestions for further reading.

A small flag insignia is used to indicate material which has previously been included in New Zealand Post Office examinations for the issue of a radio amateur license. Presumably, this would be similar in content to the Australian equivalent.

If, like me, you have always been planning to sit for the amateur license examination, this would be a useful text. For the average hobbyist, the first couple of sections would be redundant (Ohm's law, resistor codes, etc), but it is likely that even a professional would learn a thing or two from the later sections.

This is a book that we can definitely recommend to radio amateurs and electronics enthusiasts alike. It contains a wealth of material on a wide variety of topics and is worth consideration for that reason alone.

Our review copy was supplied by the author: Ian Ridpath, ZL1BCG, 50 David Avenue, Manurewa, New Zealand. (CRD).

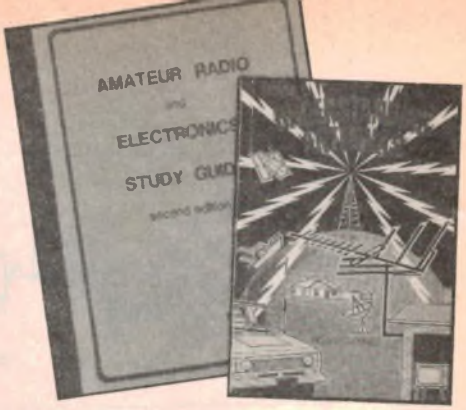
Level II Radio and Electronics Theory by Ian Ridpath. Published by the author in New Zealand, 1986. Soft covers, 155 x 218mm, 178 pages. ISBN 0 908749 00 7.

Intended as a follow on to the book reviewed above, this text is presented in much the same format but is somewhat more advanced. This text is also somewhat more theoretical in content and has much greater emphasis on digital logic circuits.

A good idea of the contents can be gauged from the chapter list: Single phase power supplies; Power supply filtering; Switchmode regulators; Class A, B and C amplifiers; Single sideband modulation; Phase lock loop synthesisers; Waveform analyses, bode plots and clippers; Digital circuits, logic and Boolean algebra; Microprocessors; Answers to problems; and Index.

For the student, the chapters on switchmode regulators, amplifier classes and phase lock loop (PLL) synthesisers should prove particularly handy. Rather than aim for a comprehensive treatise, the author has presented the material in short form manner in order to get the message across. The book is thus a valuable reference source for the hobbyist and student alike and makes an ideal follow on to the previous book.

Once again, our review copy came from the author: Ian Ridpath ZL1BCG, 50 David Avenue, Manurewa, New Zealand. (CRD).



A basic text on antennas

Understanding Antennas by Robert Comrie. Published 1986 by Prentice-Hall of Australia. Soft covers, 220 x 151mm, 143 pages. Illustrated with diagrams. ISBN 0 7248 1237 7. Price $12.95.

A working knowledge of antennas is handy for anyone. Whether you are a hobbyist, professional, or just a lay person setting up an FM radio receiver, the job will be much easier if you know a few of the basics — like the most suitable type, orientation, minimising losses and interference, and mounting schemes.

This book carries the Tandy logo, a fact which initially gave rise to some misgivings. Was this simply a re-covered American book with little relevance to the Australian scene? Fortunately, no. Where the information is specific — as in the listing of FM radio station frequencies — local data has been used.

Naturally, the prospective reader would be curious to know what level of understanding the book aims to establish. Essentially, you will be able to make a well informed choice of the antenna to be used and be able to install it properly after reading this book. If you are not particularly interested in the theroretical aspects, you will find the book quite acceptable.

A problem faced by any technical writer is the level of knowledge which may be assumed for the reader. In this instance, the assumed knowledge is minimal. Fair enough, but for my money "Understanding Antennas" tends to labour some points a little.

There are thirteen chapters in all: Generation of Radio Waves, Antenna Fundamentals, Television Antennas, FM Antennas, CB Antennas and Installing Mobile Antennas. If you are having trouble receiving SBS, or wondering what type of antenna to use for other UHF stations, this book would be handy. If the book prevents you from buying the wrong type of antenna, it could easily pay for itself. Our copy was supplied by the publisher. (CRD).

New Products...

Product reviews, releases & services

New Multitech computer range

Dick Smith Electronics has added two new IBM-compatibles to its computer range — The Multitech PC-700 and PC-900. Both feature large memory capacity and fast operating speeds and are aimed at commercial and private users alike.

The PC-700 is intended for the smaller business or personal user market and has an impressive 640K memory capacity. It can be fitted with an internal hard disc drive and has selectable operating speeds. At the touch of a button, the processing speed can be almost doubled from 4.77MHz to 8MHz.

An enhanced version is available fitted with an internal hard disc drive.

For larger data processing tasks or networking situations, there is the DSE Multitech PC-900. This has a 20Mb internal hard disc drive with a single built-in 1.2Mb floppy disc drive. The unit comes complete with Open Access 2 (a fully-integrated business program which combines word processing, spreadsheet analysis and graphics), and is ideal for computer aided design (CAD).

The PC-700 is priced at $4,595 while the PC-900 is priced at $6,995. Included in these prices are free installation and 6-month on-site servicing (mainland capitals only).

For further information contact Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde, NSW 2113. Telephone (02) 888 3200.

JVC's new camera-recorder

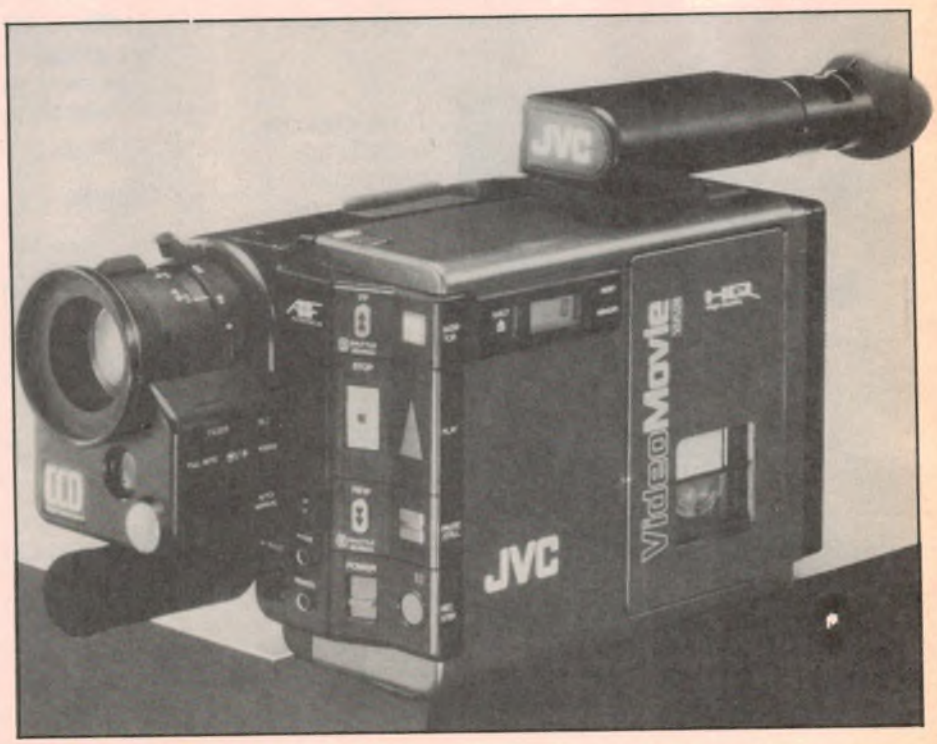
Hagemeyer (Australasia) B.V., the JVC distributor in Australia, has announced the release of the world's smallest and lightest VHS camera-recorder — the GR-C7EA.

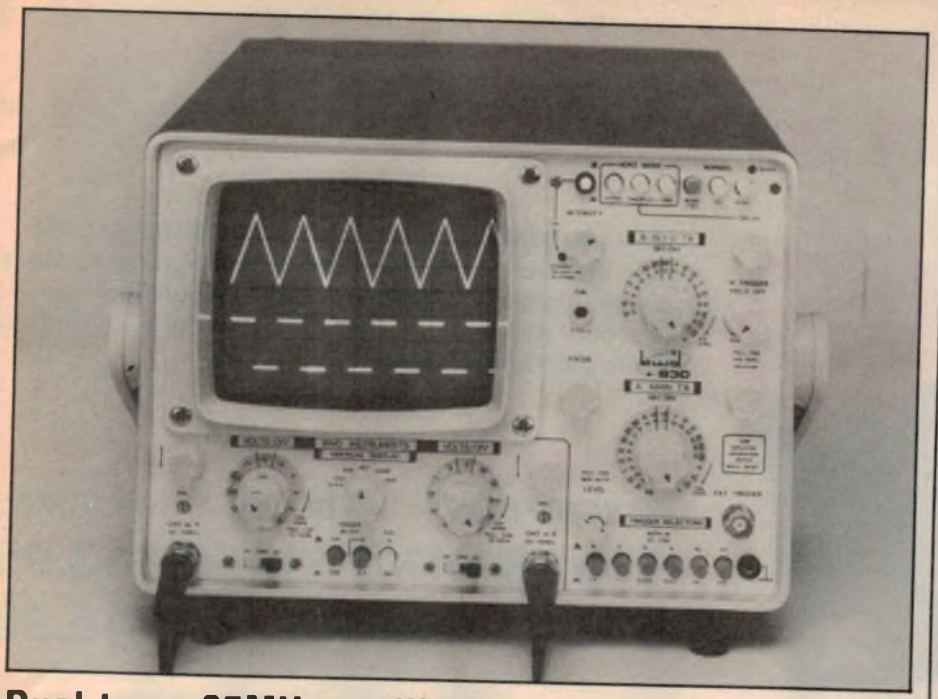
The unit weighs 1.4kg. It includes a 12.5mm CCD (Charge Coupled Device) pick up element, provides continuous 60 minutes recording, and includes HQ (High Quality) picture improvement technology.

It also includes automatic focus, full-auto colour tracking for white balance and a 6X power zoom and is totally compatible with the VHS format.

The GR-C7EA is available as a complete package with all essential accessories including a 60-minute battery pack, AC power adaptor/battery charger, shoulder strap, VHS cassette adaptor, A/V output cable and VHS compact cassette.

For further information contact Hagemeyer (Australasia) B.V., 5-7 Garema Circuit, Kingsgrove, 2208. Telephone (02) 750 3777.





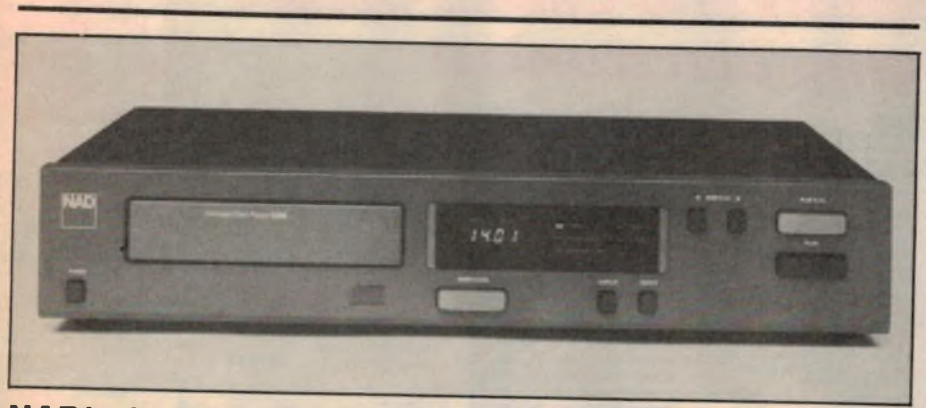
Dual trace 35MHz oscilloscope

The BWD Model 830 is a 35MHz field-portable oscilloscope that's just right for TV and video servicing, as well as general laboratory applications.

One important feature of this oscilloscope is a multi-turn delay control that enables any viewed pulse to be selected and measured on the delayed timebase. All the user has to do is press the "intensified" button, select the section of the trace to be viewed, and press "delayed sweep" for continuous control of the section. Alternatively, the user can press the "delayed trigger" button for a locked display

For video or TV service work, the delayed trigger facility permits any line to be selected and triggered. In the dual beam mode, lines from alternate frames can be displayed simultaneously. In addition, the TV sync circuit can be used as a low pass filter to obtain stable displays of noisy waveforms or to lock to the modulation envelope of AM or SSB waveforms from radio transceivers.

For further information on these features contact Parameters Pty Ltd, Centrecourt, 25-27 Paul Street North, North Ryde, NSW 2113. Telephone (02) 888 8777.



NAD's budget CD player

Overwhelmed by the array of controls on most compact disc players? If so, then take a look at the no-frills model 5330 from NAD. The real engineering is behind the easy-to-use front panel and includes new LSI circuit chips, a solid metal chassis, a compact new low-inertia laser, refined error correction circuits, and a new servo system that provides "superior tracking" of scratched or flawed discs.

For further information contact Falk Electrosound Pty Ltd, 28 King Street, Rockdale. Telephone (02) 597 1111.

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- All pins wired straight through (removable terminals)
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- 15 pin 'D' plug to 15 pin 'D' socket
- All pins wired straight through (removable terminals)
- Length 3 metres

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- 25 pin 'D' plug to 25 pin 'D' plug
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 1.5 metres

Cat. P19011 — $26.95

CL11
- 25 pin 'D' plug to 25 pin 'D' plug
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 3 metres

Cat. P19009 — $23.50

CL12
- 25 pin 'D' plug to 25 pin 'D' plug
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 7.5 metres

Cat. P19037 — $25.95

CL13
- 25 pin 'D' plug to 25 pin 'D' socket
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 3 metres

Cat. P19020 — $29.95

CL21
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- All pins wired straight through (removable terminals)
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- Length 3 metres

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- All pins wired straight through
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- Dual 10 pin (20 contacts) connector to Centronics 36 pin plug
- Length 2.4 metres

Cat. P19025 — $29.95

CL28
- Apple III with universal parallel interface card
- Dual 10 pin (20 contacts) on Apple end to Centronics 36 pin plug
- Length 2.4 metres

Cat. P19026 — $29.95

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- Tandy II/12/16/16B/2000, with dual 17 pin female on computer end to Centronics 36 pin plug (Equivalent to 26-1323)
- Length 2.4 metres

Cat. P19027 — $33.95

CL31
- Tandy I/III/4/4P, with 34 pin edge connector on computer end to Centronics 36 pin plug (Equivalent to 26-1401)
- Length 2.4 metres

Cat. P19028 — $37.95

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- IBM PC, XT and look-a-likes with 25 pin 'D' plug on computer end to Centronics 36 pin plug
- Length 2.13 metres

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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
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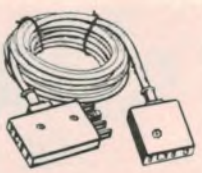

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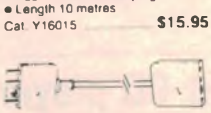
- Length 10 metres

Cat. Y16015 — $15.95



TELECOMMUNICATION EXTENSION LEADS

Cat. Y16010 — 5m $12.50
Cat. Y16012 — 10m $14.95

TELEPHONE CURL CORD

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

Cat. Y16022 — $7.95

TELEPHONE ADAPTOR

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

Cat. Y16026 — $6.95

TELECOMMUNICATION EXTENSION LEADS

Cat. Y16010 — 5m $12.50
Cat. Y16012 — 10m $14.95

TELEPHONE EXTENSION CABLE

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

Cat. Y16024 — $8.95

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

POSTAGE FOR ORDERS OVER $75 & UNDER 3kg

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

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

JUMBO 5¼" DISK STORAGE

If you've got lots disks, you'll appreciate the extra capacity of this disk storage unit when it comes to locating "that" disk!

Features...

- 100 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- 9 Dividers/spacers

Cat. C16027 ..... **only $24.95**

COMPUTER PAPER

Quality paper at a low price! 2,500 sheets of 11 x 9½", 60 gsm bond paper.

Cat. C21001 **Normally $44.95**

SPECIAL, ONLY $37.95

TTL MONITORS

Fantastic resolution! Enjoy a crisp sharp image with the latest Ritron TTL monitor! IBM* compatible, green display, swivel and tilt base.

Green Cat. X14510 **Normally $289**

Amber Cat. X14512 **Normally $289**

SPECIAL, ONLY $269

IBM* COMPATIBLES from $895*

Assembled & Tested in Australia!

Incredible deals to suit everyone including special package deals!

256K RAM: Colour Graphics, Disk Controller Card, 1 parallel port, 2 disk drives and 3 months warranty. **only $1,195**

640K RAM: Colour graphics, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports, 2 disk drives and 3 months warranty. **only $1,295**

CENTRONICS GENDER CHANGERS

- Female to Female
- Saves modifying or replacing non-mating Centronics cables.
- All 36 pins wired straight through.

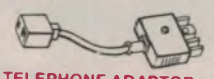
Cat. X15660 **Male to Male**

Cat. X15661 **Male to Female**

Cat. X15662 **Female to Female**

Normally $33.95

Our Price $24.95



TELEPHONE ADAPTOR

- Australian plug to U.S. socket
- Length 10cm

Cat. Y16026 ..... **$6.95**

5¼" DISK SPECIALS!

All prices 10 disk boxes!

	1-9	10+
XIDEX		
S/S D/D	$29.95	$29.95
D/S D/D	$38.95	$36.95
High Density	$99	$90
VERBATIM DATALIFE		
S/S D/D	$27.95	$26.95
D/S D/D	$34.95	$32.95

3½" DISK SPECIALS!

STOP PRESS!
PRICES SLASHED ON 3½" DISKS!
SAVE $10 PER BOX!!

Verbatim S/S	$54.95
Verbatim D/S	$59.95
Xidex S/S	$55.95
Xidex D/S	$79.95

5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!

Features...

- 50 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- Dividers/spacers

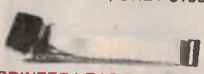
Cat. C16030 ..... **only $19.95**

PAPER TAMER

- Restores order to the top of your desk or work area
- Made of white plastic coated steel
- Stores up to 900 continuous sheets
- Allows perfect paper feed
- Allows easy examination of print out

$44.95

(Printer and paper not included)



PRINTER LEAD FOR IBM*

- To suit IBM* PC XT and clones.
- 25 pin "D" plug on computer end to Centronics 36 pin plug
- Length 2 metres

Cat. P19029 R.R.P. $44.95

SPECIAL, ONLY $19.95

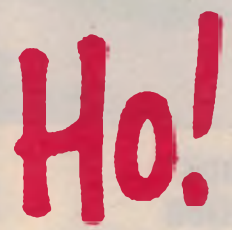
IBM* AT COMPATIBLE!

Assembled & Tested in Australia!

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

All this for just $3,995

(Monitor not included)



TELEPHONE CURL CORD

- U.S. plug to U.S. plug
- Replacement hand set cord
- Length 4.5 metres

Cat. Y16023 ..... **$7.95**

CANON A-40 PRINTER

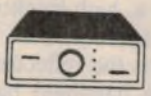
- Serial Impact Dot Matrix
- 140 C.P.S.
- Near Letter Quality Mode
- 1.4K Buffer

Cat. C20040 ..... **$525**

3½" DISK STORAGE UNIT

- Holds up to 40 x 3½" diskettes.
- Lockable (2 keys supplied)
- High impact plastic lid and base.

Cat. C16035 ..... **only $19.95**



2 & 4 WAY RS232 DATA TRANSFER SWITCHES

If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.

- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector

2 WAY Cat. X19120 ..... **$125**

4 WAY Cat. X19125 ..... **$145**

RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through.

Cat. X15650 **Male to Male**

Cat. X15651 **Male to Female**

Cat. X15652 **Female to Female**

Normally $19.95 each

Our Price $14.95

TRACKBALL

Durable, accurate and reliable and with dual fire buttons, these new trackballs are suitable for use with the Commodore VIC-20, Atari home video game, Atari 400 and 800 home computer and Sears Arcade Game.

Cat. C14225 ..... **$39.95**

IBM* COMPATIBLE DISK DRIVES

Tired of paying up to 100% more for Japanese Disk Drives? We now have "direct import" Taiwanese disk drives at much lower prices!

Cat No.	Description	Price
C11801	500K	$199
C11803	1 M/Byte	$239
C11805	1.6 M/Byte	$259

INTRA RGB COLOUR MONITOR!

Size: 14 inch
Sync. Horiz. Scan Freq: 15.75 KHz
Sync. Vert. Scan Freq: 50 Hz
Band width: 18 MHz
Dot Pitch: .31mm
Resolution: 640 x 200 dots
Display Format: 80 x 25 Characters
Display Colours: 16 colours
Input Connector: 9 pin D type

Cat. X14520 ..... **only $695**

RS232 MINI TESTER

- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

T.D. Transmit Data
D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
R.T.S. Request to Send
D.T.R. Data Terminal Ready
C.T.S. Clear to Send

Cat. X15656 **Normally $39.95**

SPECIAL, ONLY $32.95

JOYSTICK FOR IBM

Features Selectable "Spring centering" or "free floating" Electrical trim adjustments on both axis. 360 degree cursor control.

Cat. C14205 ..... **$49.95**

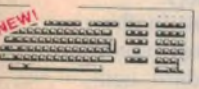
20 M/BYTE HARD DISK DRIVE FOR IBM* AND COMPATIBLES

Includes hard disk controller card.

Cat. X20010 **WAS $1,250**

SPECIAL, ONLY $995

*IBM is a registered trade mark



IBM* XT & AT COMPATIBLE EXTENDED KEYBOARD (105 KEYS)

These new keyboards are both XT and AT compatible!

- 20 Dedicated function keys
- Enlarged "Return" and "Shift" key
- Positive feel keys
- Low Profile Design. DIN standard
- Separate Numeric and Cursor control keypads
- Additional Functions. Key-in-lock, Audio Beep, Previous Word, Next Work, Fast Repeat, Line Feed, Pause, Clear Screen, Reset.

Cat. X12022 ..... **only $249**

RS232 MINI PATCH BOX

- Interface RS232 devices
- With male to female 25 pin inputs
- 25 leads with tinned end supplied
- Complete with instructions

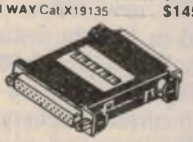
Cat. X15654 **Normally $25.95**

SPECIAL, ONLY $21.95

APPLE JOYSTICKS

Ideal for games or word processing. Fits most 6502 "compatible" computers.

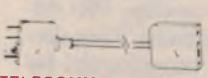
Cat. C14200 ..... **$39.95**



RS232 INLINE SWITCHING BOX

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

Cat. X15662 ..... **$32.95**



TELECOMMUNICATION EXTENSION LEADS

Cat. Y16010 5m **$12.50**

Cat. Y16012 10m **$14.95**

NEED HIGH DENSITY DISKS FOR YOUR IBM AT?

"Buy your High Density disks at below recommended retail prices from Rod Irving Electronics and SAVE"!!

R.R.P. $113 **Our Price $99**

Rod Irving Electronics
48 A'Beckett St. MELBOURNE
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425 High St. NORTHCOTE
Phone (03) 489 8866
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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

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3KG!!

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

MasterCard VISA

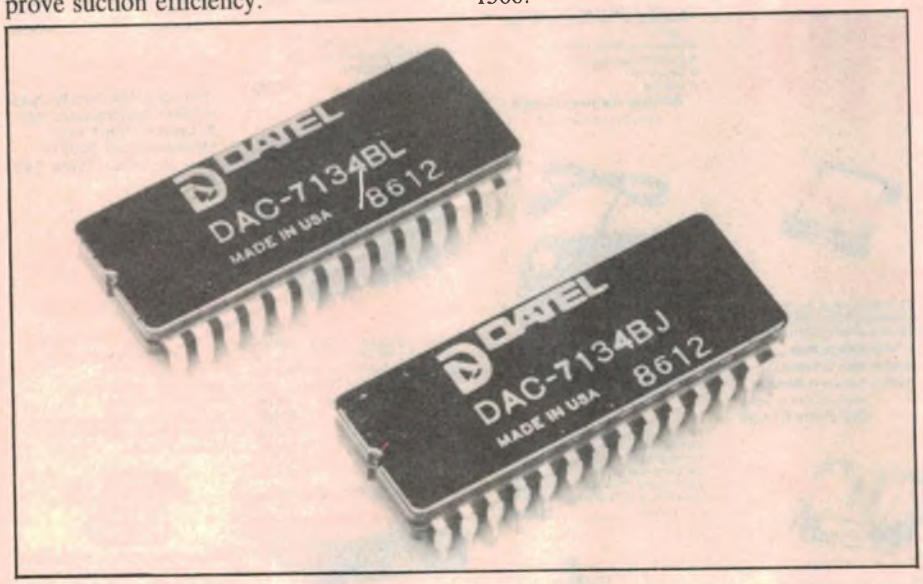
FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

Double 'O' rings for better suction

Scope Laboratories in Melbourne have a new version of their mid-sized desoldering tool. This model features dual neoprene 'O' rings designed to improve suction efficiency.

The new tool also features self-cleaning replaceable nozzles, a metal crush resistant body, and replaceable seals for the piston.

For further information contact Scope Laboratories, 3 Walton Street, Airport West, Vic. 3042. Telephone (03) 338 1566.



Microprocessor compatible 14-bit D/A

A true 14-bit (1/2LSB) microprocessor-compatible D/A converter, Datel's DAC-7134 is suited for applications such as servo loop systems in process control and robotics, automatic gain/attenuation control circuits in insrumentation, or digitally programmed current sources of ATE.

The DAC-7134 achieves its true 14-bit linearity by combining a four quadrant multiplying DAC with on-chip, PROM-controlled correction circuits. Two versions are available, one programmed for unipolar operation and the other for bipolar applications.

Microprocessor bus interfacing offers no hitches as the chip uses standard memory write cycle timing and control signals. The DAC-7134 is specified for operation in the commercial 0 to +60°C temperature range and is packaged in a 28-pin CERDIP package.

For further information contact Elmeasco Pty Ltd, 15 McDonald St, Mortlake, NSW 2137. Telephone (02) 736 2888.

Handheld auto bar code scanner

A lightweight, handheld, auto bar code scanner has been released by Amtex Electronics. Instead of using the traditional HeNe laser, the new HR5000 uses a high-brightness red LED as a light source. A CCD image sensor then detects the reflected image.

The handheld bar code reader has a convenient configuration for easy operation and will read all types of bar coded labels. Because the unit automatically scans the label, there is no need for the

New range of battery testers

Power Plus Batteries Australia Pty Ltd has launched a new range of solid-state battery testers onto the Australian market under a collaborative licensing agreement with the CSIRO.

There are three models in the range, with the two up-market models expected to become standard equipment with battery manufacturers. The third, and less expensive, model is aimed at the general public.

The new testers fill a much-needed void in battery testing — a cost-effective, fast and reliable method for indicating the condition of a battery under high current discharge.

The largest of the new testers is appli-

operator to use a sweeping motion.

Other features include: the ability to read a wide range of bar codes (eg, UIPC, EAN, and JAN) from 0.8 of normal size to twice normal; the ability to switch the unit to read other codes including NW-7, Code 39 and two of 5 interleave; and an in-built decoder which provides an RS-232C output with various selectable baud rates up to 9600.

For further information contact Amtex Electronics, 36 Lisbon Street, Fairfield, NSW 2165. Telephone (02) 728 2121.

cable mainly to the battery manufacturing industry and will test all types of 6 to 12V lead acid batteries at a rate of 500/hr. It is capable of testing batteries at currents from 0-2000A DC.

The mid-range model was designed as an assessment tool for battery distributors, auto-electricians and staff at point-of-sale outlets. This fully portable unit is suitable for use in remote locations and in situations where it may be necessary to test heavy batteries in situ. It can test 6 or 12V batteries with DC current ratings of 330-1000 amps without being connected to an external power source (it derives its power from the battery under test).

For further information contact Power Plus Batteries Australia Pty Ltd, 4 Market Road, Sunshine, Vic. 3020. Telephone (03) 312 1111.

'New' New Zealand

Dick Smith Electronics offers every single product available to Aussie customers (subject to licence) at the best possible price in New Zealand.

Trading for 6 years

Our Stores are at:

1. Fort & Commerce Streets, **Auckland City (09)38 9975**
2. 1795 Great North Road, **Avondale (09)88 6696**
3. Cnr Khyber Pass & Park Rds, **Newmarket (09)396 495**
4. 26 East Tamaki Road, **Papatoetoe (09)278 2355**
5. 450 Anglesea Street, **Hamilton (071)39 4490**
6. 289 Cameron Road, **Tauranga (075)87 071**
7. 16 Lydney Place, **Porirua (04)37 6854**
8. 440 Cuba Street, Alicetown, **Lower Hutt (04)66 2022**
9. 154 Featherson Street, **Wellington (04)73 9858**
10. Victoria Road & Bealey Avenue, **Christchurch (03)50 405**
11. Manse & Stafford Streets, **Dunedin (024)74 1096**

DICK SMITH ELECTRONICS

If you have any suggestions to improve our service drop us a line at Private Bag, Newmarket.

New Products...

Mains filter for computer gear

When selecting a computer system a number of considerations are necessary. One of the most important, and one that is often overlooked, is the quality of the mains power available to the equipment.

In an effort to keep PCs small, designers face a dilemma in incorporating effective RFI protection within the same package. As a result, RFI protection is often inadequate and data is often lost due to mains spikes or glitches.

The Westinghouse "Computer Protector" mains filter is designed to overcome power supply hassles. It plugs directly into a standard 3-pin 10A wall socket, or a variety of distribution boxes currently available in Australia.

The unit incorporates a potted two stage line filter complete with earth line choke and a metal oxide varistor. The filtered output goes to a 10A 3-terminal

mains socket mounted on the front panel.

The Computer Protector is available in 1, 3, 6, and 10A versions. It can handle operating voltages up to 250V at 400Hz (max.) and has a temperature range of –25°C to +55°C.

For further information contact Westinghouse Brake & Signal Company (Australia) Ltd, 80-86 Douglas Parade, Williamstown, 3016. Telephone (03) 397 1033.

Ultra-wideband spectrum analyser

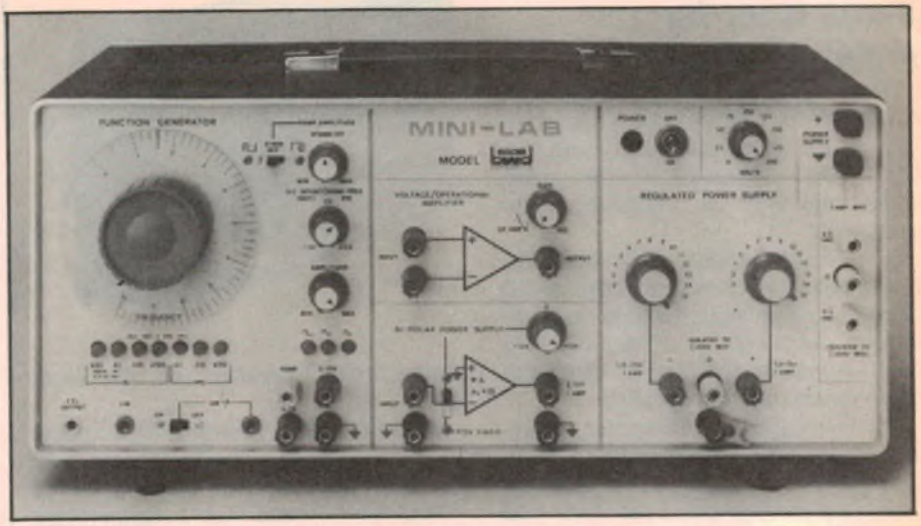
The Anritsu MS612A is a high-performance spectrum analyser that covers from the audio region to the microwave region. A synthesiser-type local oscillator has been used to ensure stable measurement with high resolution bandwidth.

The analyser is designed to minimise the generation of spurious signals and provide high sensitivity.

All functions are controlled by a microprocessor and measurement is further simplified by such functions as Auto Range and Auto Tune which captures the largest spectral peak of the input signal and enlarges it to the specified span while automatically establishing the level.

For further information contact Standard Telephone and Cables Pty Ltd, 58 Queensbridge Street, South Melbourne, Vic. 3205. Telephone (03) 615 6677.

New Products...



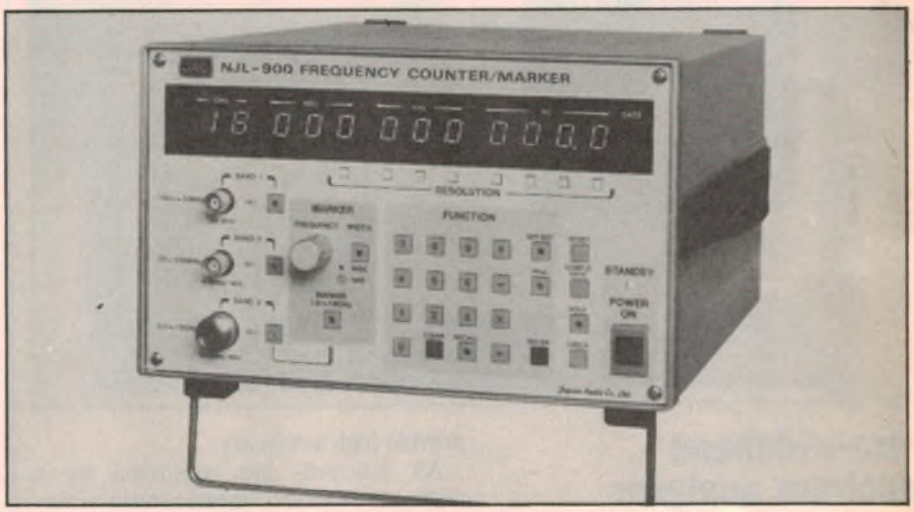
Multifunction test instrument

If you instruct or work in the fields of electronics, physics, electricity or chemistry, the BWD model 603B Mini-Lab may be just what you are looking for.

It features a function generator, selectable power source, voltage/operational amplifier, low and high voltage power supplies, AC supply, swept output, FM and AM modulation at line frequency, a modulated power supply and a built-in power amplifier.

It's also "student-proof". For example, any output can be coupled to any input without damage.

For further information contact Parameters Pty Ltd, Centrecourt, 25-27 Paul Street, North Ryde, NSW 2113. Telephone (02) 888 8777.



10Hz-18GHz frequency counter

ACL Special Instruments, a division of Associated Calibration Laboratories, has released the JRC Model NJL-900 microprocessor based frequency counter.

A 12-digit, 10Hz to 18GHz counter, it features not only automatic frequency measurement but also four-rule arithmetics and PPM (part per million) display.

The optional GPIB (IEEE-488) bus makes all functions of the unit programmable, allowing the unit to interface with various automatic instrument systems.

For further information contact ACL Special Instruments, 27 Rosella Street, East Doncaster, Vic 3109. Telephone (03) 842 8822.

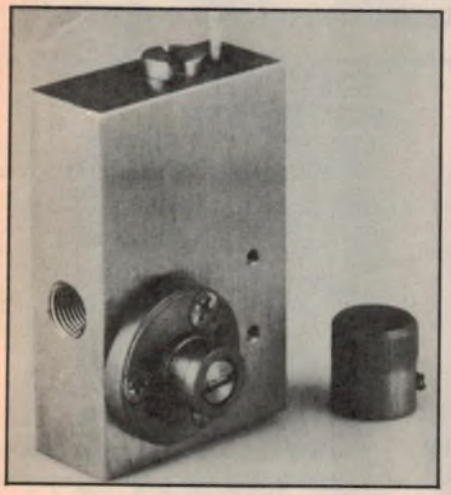
Adjustable flow monitor

Novatech Controls has released the Chem Tech CTE125 adjustable flow monitor which monitors liquid and gas flow in process and control systems. The device signals when the flow deviates from a preset norm.

The CTE125 can be adjusted over the range from 30 to 16,000cc per minute for air at 100kPa and one to 500cc per minute for water. The maximum working pressure is 7000kPa and the hermetically sealed reed switch operates in temperatures from –40 to 420 degrees C.

The monitor is designed to interface with a microprocessor, data logger, or annunciator, it can provide direct control of electrically operated machinery to prevent equipment damage or system failure.

For further information contact Novatech Controls, 429 Graham Street, PO Box 240, Port Melbourne, Vic. 3207. Telephone (03) 645 2377.



Switch mode power supplies

Setec has introduced a new 150W, four-output rail switchmode power supply. Designated, the model SP1502, it features built-in line filtering designed to meet international requirements for isolation and EMI/RFI specifications.

The SP1502 can handle input voltages from 180-280V AC and from 90-140V AC. Input/output isolation is greater than 3750V AC. The output rails are as follows: +5V at 20A; +12V at 2A (4A peak); –12V at 2.0A; and –5V at 0.5A.

For further information contact Setec Pty Ltd, 6 Holloway Drive, Bayswater, Vic. 3153. Telephone (03) 762 5777.

3½-digit panel meter

Novatech Controls has released MetraByte's Model 700 which is a 3½-digit, microprocessor controlled, digital panel meter (DPM) with a red LED display.

The 700 has been designed to measure and display analog inputs like a standard DPM, but also has the capability to communicate with computers or process controllers over an RS-232C interface.

The RS232 interface has been designed to be 100% compatible with most standard serial interface systems including the IBM PC/XT/AT's RS-232 interface board and the MetraByte COM-422 board. Baud rate is switch selectable at 110, 300, 1200 or 9600 baud with odd, even or no parity check.

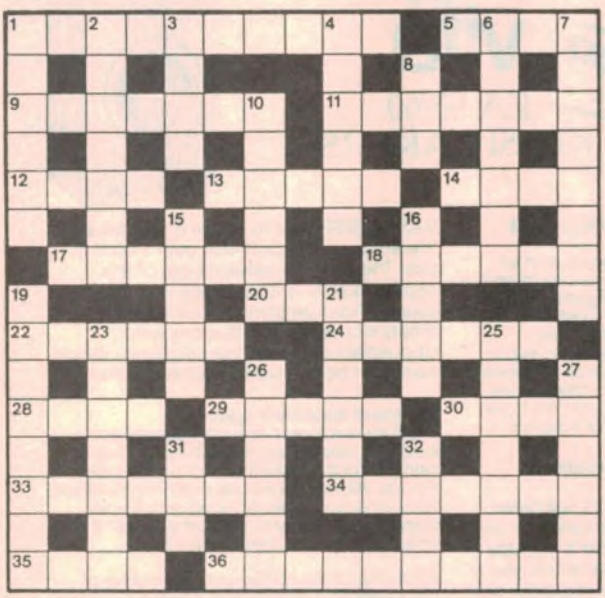
The Model 700 has a variety of operating modes. Selecting the Free Run mode causes the DPM to take readings and transmit data at fixed intervals. A host computer-controlled mode can also be chosen where the DPM transmits data only on request. Other selectable items include decimal point position and two self-test routines.

For more information contact Novatech Controls, 429 Graham Street, PO Box 240, Port Melbourne, Vic. 3207. Telephone (03) 645 2377.

DECEMBER CROSSWORD

ACROSS

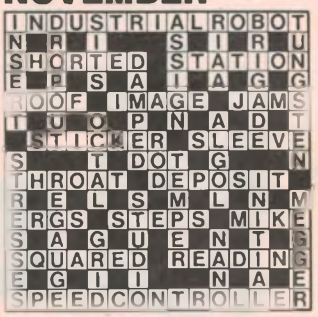
1. Testing aid. (10)
5. Connector. (4)
9. Type of lamp cap. (7)
11. With addends they produce sums. (7)
12. Wiring harness. (4)
13. Sent a facsimile. (5)
14. Capital word for the phonetic alphabet! (4)
17. Generate a current, etc. (6)
18. Sign of dangerously poor insulation. (6)
20. Type of plug. (1,1,1)
22. Word associated with iron powder ring core. (6)
24. Name of alphanumeric code. (6)
28. Unrecognised airborne bodies. (4)
29. Action between magnets. (5)
30. Amplification of a signal. (4)
33. Type of charging process. (7)
34. Tested a horn. (7)
35. Part of a taping system. (4)
36. Such are the charges one can summon for the trials of EA project builders! (10)



DOWN

1. Type of radio station. (6)
2. In the vernacular, to record (a track). (3,4)
3. Charged particles . (4)
4. Part of the ionosphere. (1-5)
6. Phase when potential moon-walkers are retarded! (7)
7. Early microwave source. (3,5)
8. System predating the S.I. (1,1,1)
10. Useful radioactive substance. (6)
15. Radioactivity unit. (5)
16. Name of symbol indicating polarity. (5)
19. Circuit device. (8)
21. Early hard-wired calculator. (6)
23. An electric spark can do this to air. (7)
25. How a too-sensitive burglar alarm seems to the neighbours. (2,3,2)
26. Surname of astonomer noted for Jodrell Bank radio telescope. (6)
27. Said of a certain electrode. (6)
31. A reflection from 4-down is a ——— wave. (3)
32. Rough edge left by a hacker? (4)

SOLUTION FOR NOVEMBER



Gas powered soldering tool

Weller's Pyropen, distributed by Cooper Tools, is a liquid butane gas powered 'cordless' service tool with an adjustable temperature facility which can be effectively used for a wide range of soldering, brazing or shrinking jobs.

Comparable in size to a conventional soldering iron, it contains sufficient gas for up to three hours operation and is refilled using a liquid butane gas cylinder.

The Weller Pyropen offers a choice of 17 different long-life tips and hot-air nozzles for soldering or shrinking. These incorporate a catalyser to generate the necessary hot-air temperatures (200-400 degrees C for soldering and up to 700 degrees C for shrinking tubing or for fusing or melting acrylic and vinyl materials).

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Compact Disc Reviews

by RON COOPER

STRAVINSKY BORODIN

The Firebird Music from Prince Igor.
Robert Shaw and the Atlanta Symphony Orchestra and Chorus.
Telarc CD-80039 DIDZ-10014
Playing time: 42 min 7 sec.

PERFORMANCE 1 2 3 4 5 6 7 8 9 10

SOUND QUALITY 1 2 3 4 5 6 7 8 9 10

With Diaghilev's first season of the 'Ballet Russes' in 1909 being an overwhelming success it seemed like trying to surpass the unsurpassable to plan a new ballet for the 1910 season. Among the plans was a ballet based on the legend of the Zha-Ptitsa, the magical bird with wings of flame.

After trusting Liadov to write the music and finding that six months later he had hardly written a note, Diaghilev handed the work to the 27 year old Stravinsky who was virtually unknown outside Russia.

As far as the disc is concerned, it is stunning and I feel as close to perfection for these works as you will ever come.

The sound is well balanced, nothing predominates, but when there is tympani and bass drum you really feel it!

The Borodin is a bonus as this disc is worth the money just for the 'Firebird'.

The playing and tempos leave no room for criticism, and the big sound of the orchestra and chorus in the Borodin shows just what CD can do for this marvellous music. This disc is not just recommended, it is an essential, a complete showpiece. (R.L.C.)

DEBUSSY

La Cathedrale engloutie
Estampes La Fille aux cheveux de lin
L'ile Joyeuse
Des pas sur la neige
Suite bergamasque
Paul Badura-Skoda piano
Harmonic Records CD 8505 ADD.
Playing time: 46 min 9 sec.

PERFORMANCE 1 2 3 4 5 6 7 8 9 10

SOUND QUALITY 1 2 3 4 5 6 7 8 9 10

This delightful disc covers a broad selection of the piano works of Claude Debussy and combines sensitive playing with a fine technical recording. The acoustics are 'different' being somewhat on the close side, but only because we are usually given a brighter acoustic environment for solo piano.

There is a slight but constant amount of background hiss, possibly due to the analog recording, but this becomes less noticeable with serious listening. What is really quite obvious though, is the big open bass sound of the lower strings on the Bosendorfer when demanded.

The very familiar Clair-de-Lune, is played with tender feeling which possibly only a very experienced master such as Badura-Skoda can convey. One minor curiosity with the cover notes is that they are all in French with only the section that explains each of the pieces translated into English. However, there is an address to write to and obtain a full translation, and it's better than all being in Japanese. (R.L.C.)

BERLIOZ

Symphonie Fantastique, Op. 14.
Orchestre symphonique de Montreal conducted by Charles Dutoit.
Decca CD 414 203-2DH, DDD.
Playing time: 53 min 57 sec.

PERFORMANCE 1 2 3 4 5 6 7 8 9 10

SOUND QUALITY 1 2 3 4 5 6 7 8 9 10

This work was inspired by the composer's passion for an actress in a visiting theatrical company which was performing Hamlet. The infatuation makes it a deep, dramatic, serious work conveying many moods, with the melody of the first allegro appearing in all five movements.

I find it a most exciting symphony and if it is unfamiliar to you, be daring - buy it.

This is the first CD I have heard of this work and again it is the silence of CD that can transform works such as this. The eerie solo cor anglais, at the beginning of the third movement, is most delightful.

I was a little disappointed to find a lack of low brass detail in the 'March to the Scaffold'. On some recordings, this can sound quite sinister. (R.L.C.)

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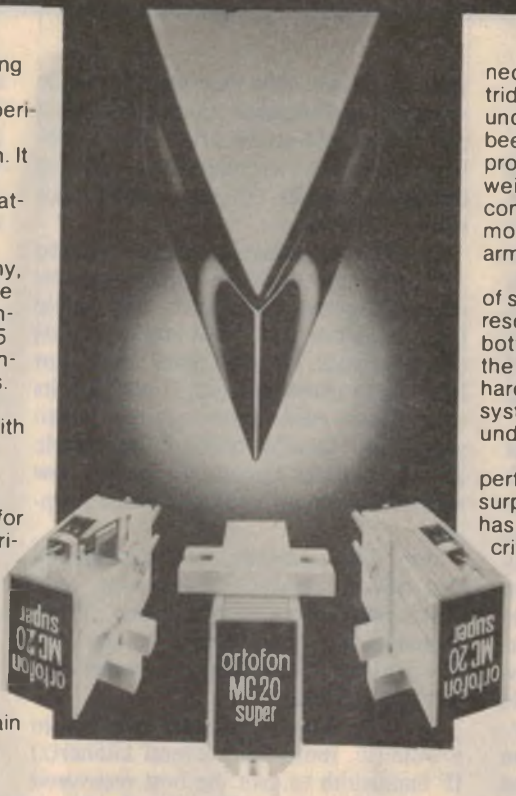

Carbon Fibre Plate. The problem of static electricity from records has been resolved by introducing a carbon fibre to the bottom of the MC 20 Super. At the same time the plate, which is constructed from a very hard material, connects the basis of the moving system to the housing. This too prevents undesired resonances.

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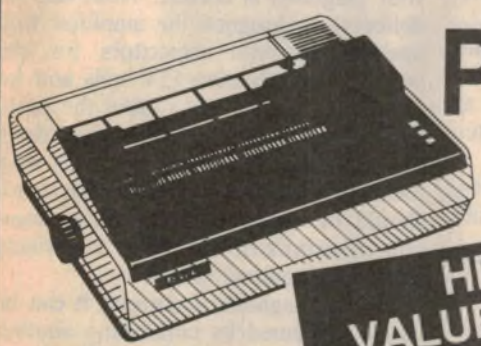

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Information centre

Problem with AM stereo decoder

Some time ago, I built your AM stereo decoder based on the Motorola MC13020 chip. The unit was fitted to a commercial stereo AM/FM hifi tuner but its stereo locking mode was erratic and finally the unit could not be made to function correctly. All attempts to adjust input voltages and so on, failed to achieve reliable stereo performance from this Motorola-based unit.

From the number of letters in your Information Centre concerning this add-on unit, it seems a considerable number of other readers have experienced the same difficulties. You will no doubt say that the stereo AM/FM tuner is not suitable and I would accept your statement. Nevertheless, there is an enormous attraction to your readers to convert existing AM/FM tuners to provide stereo AM by fitting a suitable decoder.

I refer to your News Highlights on page 6 of the September 1985 issue which mentioned two new automatic processors developed by Sony for universal demodulation chips for AM stereo reception. Would either of these Sony ICs be more tolerant of the performance of existing hifi tuners? If so, could EA consider developing another add-on AM stereo decoder unit using one or both of the Sony devices, or any other manufacturer's device which is more tolerant of the operating performance of existing AM/FM tuners? (B.H., Heathmont, Vic).

● We have no data on the Sony devices but doubt that they would provide superior performance to the Motorola chip in an add-on situation. The problem is that the vast majority of existing tuners are simply not good enough for stereo conversion.

In order to receive satisfactory stereo AM, the tuner must be capable of precise tuning and must have very stable local oscillator and front-end bandpass characteristics. If the tuner does not have these characteristics, it will add its own phase modulations to the stereo signal and thereby make it impossible for any decoder circuit, no matter how refined and complicated, to work properly.

For these reasons, we recommend that readers consider converting only synthesised tuners to AM stereo. These automatically give precise tuning and low drift but, even then, the results cannot be guaranteed.

It is also desirable that the tuner have a wide (ie, more than several kilohertz) IF bandwidth to give the best recovered stereo separation. Wide bandwidth is also desirable for a wide audio frequency response. Very few AM tuners can boast this characteristic.

One tuner that does feature wide bandwidth is the Playmaster Hifi AM Tuner described in December 1982. This tuner also features a very stable front end and balanced inputs for a noise-cancelling loop-antenna. It is a good candidate for conversion despite being manually tuned.

We don't have a great deal of information on successful conversions of commercial tuners. The attraction of the add-on converter is that it does not cost a lot of money, and if successful, is an easy and rewarding project. Perhaps other readers can help with information regarding successful conversions.

Switch-off thump from 60/60

Initially, I did not notice a small problem with my amplifier because I usually operate it with the tone defeat switch activated. However, when the amplifier is switched off when IC3 is in circuit, I get a thump from the loudspeakers.

I notice that, apart from filters in the 15V power supply, the positive rail has a 1000uF serving both IC2 and IC3. However, the negative rail has only one 100uF capacitor for both IC2 and IC3 and the LED.

Do you think the problem is that the negative rail is being drained more quickly than the positive rail, causing the ICs to latch up? The tone controls work so it would appear that IC3 is OK. (R.A., North Epping, NSW).

● This is the first time we have heard of this problem and it could be that your diagnosis is correct. However, we deliberately designed the amplifier with unequal reservoir capacitors for the positive and negative 15V rails and incorporated diode D4 to avoid the problem of having the relay circuitry drain the positive 15V rail more quickly than the negative. So the circuit as it stands should be correct, provided the reservoir capacitors do not differ too widely from their nominal values.

If your diagnosis is correct, it can be easily confirmed by connecting another 100uF capacitor across the –15V rail.

It is also possible that IC3 is in fact faulty. We have had some experience of 5534 op amps partially failing whereby they appear to operate more or less normally but their noise and distortion performance is severely degraded. Combined with this could be a similar degradation in the power supply rejection ratio which would lead to the thumps you observe. Note that this is only a hypothesis but, we think, a reasonable one.

Modifying the CD compressor

I have only recently become aware of the CD Compressor circuit published in your May 1986 issue and I am extremely interested in the concept.

I have for some time been trying to find a circuit for a wide range compressor for public address work but so far have found only circuits for up to 2:1 compression based on the NE570 and NE571. Your circuit would seem to be ideal for my requirements if it could be made variable and I would welcome your suggestions on this.

I imagine that it would only involve alteration of the signal input to the rectifier and/or delta G sections of the NE572. (J.B., Brooweena, Qld).

● It should be possible to make the circuit variable by installing a dual-gang potentiometer in series between the 2.2k resistor and pin 3 of IC2a for the left channel, and between the 2.2k resistor and pin 13 of IC2b for the right channel. We suggest that you try a 10k potentiometer initially but be prepared to experiment.

Note that we haven't tried this modification so we cannot vouch for it.

Short range ultrasonic ruler

I recently had the good fortune of purchasing a number of back issues of EA in binder form and instantly became interested in building the Ultrasonic Ruler from the August 1982 issue.

PCB fabrication and construction was no problem but on power-up I was disappointed to find that although a display appeared (alternating 000-888), some time elapsed before a reading was displayed.

After much adjusting and readjusting as described in the text, I found that a display of only 23cm to 54cm was the best result, depending on the position of VR3. Peaking VR1 resulted in a 0.6V AC reading.

Having checked PCB tracks and soldering thoroughly, I subsequently replaced all ICs (except for the 4-digit counter) but to no avail. I would greatly appreciate any help on this project as I am stumped. (V.F., Duncraig, WA).

● Your problem is most likely due to the fact that there is a fault in the PCB artwork published with the article. This has a track missing between the cathode of the 3.9V zener diode and the adjacent 33k resistor at the base of Q5. This fault will stop the amplifier in the receiver from working.

If this is not the problem, you will need access to a CRO to check the circuit operation. First, check for bursts of 40kHz signal at the collector of Q1. This will verify that the transmitter is working correctly.

Next, check for bursts of 40kHz signal on pin 6 of IC3b. If there is no signal, then there is a fault in the amplifier stage (Q2-Q5). You could have a faulty transistor or you may be using a wrong transistor type number.

Finally, you can use the CRO to check for a 166kHz signal at the output of the clock (IC2c and IC2d), and to check the reset signal to IC6. You can also check for the 3ms inhibit signal at the output of IC1d.

Problem with EA car alarm

I recently purchased the Deluxe Car Burglar Alarm (EA, May 1984) and found some parts either missing or the wrong values supplied. The problem that I have come across is that, once triggered, the alarm sounds continuously and does not reset.

Using a logic probe, I found that there is a bad level present at the junction of D18 (anode) and capacitor C2. It will not achieve the high I think necessary to trip IC5a and thus reset IC3a.

I also found that the signal from the horn speaker is distorted due to what appears to be overdrive. Could you please assist me with these small problems? (J.S., Brunswick, Vic).

● Your problem with the alarm not resetting is due to the fact that the leakage current from C2 is greater than the charging current. It can be solved simply by reducing the value of R3. Try a value of 470k initially, but be prepared to go lower if necessary.

The 8-ohm horn speaker is driven by a square wave so a fair amount of distortion is to be expected. We're not looking for the ultimate in fidelity. Instead, we just want the alarm to be as loud as possible so that it attracts attention.

Notes & Errata

MULTI-SECTOR BURGLAR ALARM (January, February 1985, File 3/MS/112): There have been several reports from readers whereby the even-sector inputs do not work. To avoid this problem the XOR gates IC1 and IC2 must be buffered CMOS devices, ie 4030Bs.

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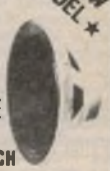

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This audio recorder has no tape. Instead, it stores up to 15 seconds of audio in RAM (random access memory) for instant replay at the press of a button. It's just the shot for use with a shop display or as a novel doorbell.

'Note: although these articles have been prepared for publication, circumstances may change the final content.

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