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Electronics Australia

Volume 49, No.11

November 1987

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

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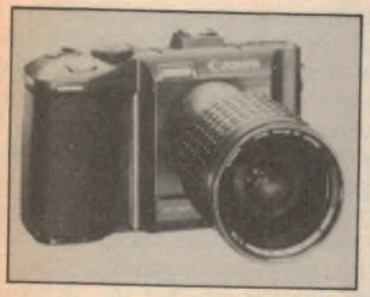

Well-known camera maker Canon has just released a revolutionary new camera which uses magnetic floppy disks, not film. See our story on page 22 . . .

Projects, projects

Our construction projects this month include a stylish metronome for musical types, a voice-operated relay, an electronic fuse and a simple voltage/continuity checker.

Marine electronics feature

Our annual survey of electronics afloat. New developments in satnav, radar, communications, EPIRBs — catch up on it all, in our feature starting on page 112.

ON THE COVER

The telephone transceiver unit for Canon's new "still video" photography (Courtesy Canon Australia). Also shown is the new GME-Goldstar GS951 Turbo marine radar (Courtesy Greenwich Marine) See our stories on pages 22, 112.

Features

Entertainment Electronics

Projects and Technical

News and Comment

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Letters to the editor

Australian School of Electronics

I would be grateful if you or any of your other readers or staff could help me.

Last year in response to an advert in EA I undertook a "Practical Electronics Course" offered by the Australian School of Electronics, by correspondence. I had almost finished but have heard nothing from the school since paying my final instalment, and have been unable to contact anyone associated with it. I can only assume that it is now defunct.

I would still like to finish the coursework however, and would appreciate any assistance anyone could offer i.e., access to manual and study information and advice on completing the Learnakit oscilloscope. Please write or phone.

I imagine there may be other people in the same predicament and would be happy to pass on any information received.

Robert Brownlie,
102 Watson St.,
Camphill Qld 4152.

Comment: To the best of our knowledge, the Australian School of Electronics is no longer in business. We hope another reader may be able to help.

Low distortion oscillator

I have been a follower of EA and its predecessors for the past 40 years, but this is the first time that I have been stirred to write to you.

I refer to a letter from N.V. of Parramatta, NSW, which appeared in Information Centre on p.124 of the September 1987 issue. Having constructed the "Ultra Low Distortion Oscillator" of December 1986, N.V. reported some difficulty in correctly calibrating the frequency control pot to agree with the supplied scale.

Despite your comment that no other similar reports had been received, I can heartily support N.V. as I have had exactly the same problem — also, but probably coincidentally, with a kit from Altronics. No amount of fiddling with shunt resistors or substitution with another "linear" scale pot has brought the tuning range within coo-ee of the claimed characteristic. The effect was generally similar to that described by N.V., that is a very broad and minor frequency change up to about mid scale, followed by severe compression as maximum frequency was approached.

The problem is so bad that I have found it necessary to set the oscillator frequency with a counter when checking frequency response characteristics. In other respects, by the way, the oscillator performs very well indeed, but its utility is severely eroded by the calibration problem and the difficulty of setting to a prescribed frequency.

One wonders whether the prototype in fact used a relatively rare "inverse log" characteristic pot; a type in the catalogues, but not generally found on hobbyist suppliers shelves. If not, maybe a built-in Digital Counter is really the only way to go?

Anyway, keep up the good work! This note is more for support of your previous correspondent, (who seemed like a voice in the wilderness) than a complaint!

D.E. Graham,
Wembley Downs, WA.

Comment: Although the original is no longer available to check we doubt if it could have been fitted with an anti-log pot, or there would have been many more complaints besides yourself and N.V. We've asked Altronics to contact you, to see if they can help track down the cause.

Appliance Control Systems

I refer to your article in the September 1987 edition of *Electronics Australia*, concerning the fate of Appliance Control Systems.

In summary, this article could read "Small Australian Battlers lose every-

DROP US A LINE!

Are you concerned about something to do with electronics, and believe that others ought to know about it? If so, feel free to put pen to paper, or fingers to keyboard, and send us a Letter to the Editor. If it's clearly expressed and on a topic of interest, chances are we'll publish it — but we do reserve the right to edit those that are overlong, or potentially libellous.

thing due to foul play of banks and other finance companies".

Now, I am too a small battler in a very similar field. I do not like nor trust banks and financial institutions either. However, in all fairness, I think the coin has two sides.

Whilst I do not know Mr Larsen, I can assure you that at least one of his Australian clients has a few unkind things to say about ACS.

On the financial aspect, I can only state that if ACS's order books were in fact full, and they had a 12-month cash flow projection with some reasonable figures, even our jaded trading banks would have lent against this cash flow.

I regret to say, but from the outset it rather looks that Mr Larsen may have over-optimistically invested too much into equipment and personnel, and his astuteness perhaps leaves something to desire in dealing with financial advisers.

D. Toth, Managing Director,
Communitron (Aust),
Gladesville, NSW.

Stereo AM/FM tuner problems

While visiting Sydney earlier this year, I purchased two Jaycar kits for the EA 60/60 amp and AM/FM stereo tuner. I have no formal technical training, just sheer enthusiasm and a basic understanding of circuit construction.

My decision to purchase the 60/60 and the tuner was spurred by confidence from having successfully completed, and unaided, your earlier 40/40 MOSFET amp.

Construction of the 60/60 amp has been successful, after your revised instruction in the May 1987 edition of EA. I did lose my MJ55003/MJ5004 pairs initially, until I performed the modifications prescribed. I agree that this is an exceptionally good amp, and I am very pleased — thank you.

Alas! (to put it mildly) the construction of the tuner is another story. Having spoken to local professional people, to fault find this circuit is considered a sizeable task. However I am determined to resolve my problems myself, if I can.

Initially I would prefer to liaise with another New Zealand constructor of the tuner and your assistance in finding him/her through your magazine would be appreciated. Please publish my address for this purpose. Anyone able to help could also phone me on (04) 366331, collect.

John Hartley,
12 Mapplebeck Street,
Titahi Bay, Wellington, NZ.

Editorial Viewpoint

DAT: Triumph or threat?

I've just had the opportunity to check out an advance sample of one of the new digital audio tape (DAT) decks, thanks to Pioneer Electronics. It's been too late to fit the story into this issue, unfortunately, so you'll be able to read all about it next month. But in a nutshell, DAT is simply superb — the closest thing to perfection in sound recording that most us are ever likely to hear.

Viewed as a development in sound recording technology, then, DAT is obviously a triumph — a true milestone in the relentless striving on the part of human beings to capture sounds faithfully. A striving that was first crudely satisfied with Thomas Edison's phonograph, and has promoted continuous evolution since then.

Sorry for the purple prose, but DAT really is impressive. There's no doubt in my mind that it's the beginning of a whole new era in recording, and the beginning of the end for conventional tape recorders. You'll see what I mean next month.

What worries me is the attitude of various sections of the music and hifi industries, which seem determined to prevent us from getting DAT — or at least delaying it as long as possible. There are strong whiffs of neo-Luddism in the air.

You can't blame the CD makers for being nervous, after they've just had to invest big sums of money into hi-tech CD pressing plants. But just how far should they and others be allowed to go in holding back technical progress?

I'm particularly concerned about the CBS moves to introduce its Copycode system to all future vinyl and CD recordings, to prevent copying via DAT. From what I can find out, this involves notching out a 300Hz band of frequencies, 60dB down and centred on 3.84kHz. The idea being that DAT makers would be forced to make their recorders look for this frequency gap, and refuse to record anything in which it is present. How's that for ruining the performance of CD recordings, just to stop DAT owners from copying them!

Although I'm by no means one of the audio purist brigade who swears by polarised speaker cables and gold-plated RCA sockets, there's no way I'd knowingly buy any recording with a ruddy great notch slap-bang in the middle of its spectrum. And I'm sure I won't be alone. I only hope CBS doesn't manage to convince the rest of the recording industry to adopt this crazy idea.

Jim Rowe

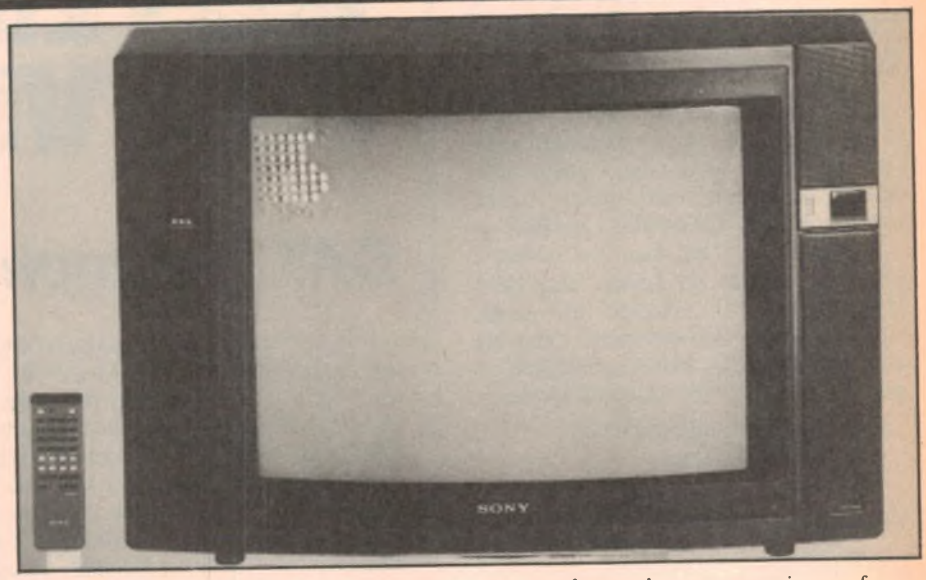
What's New In Entertainment Electronics

Sony releases 65cm stereo colour TV

The KV-27XS AS Trinitron 65cm (27") colour television from Sony graphically illustrates how far technology has come since colour TV was released here in Australia in 1975.

The Super Trinitron fine pitch tube is designed to meet today's needs for stimulating home entertainment. With both composite video and RGB inputs the KV-27 is compatible with a variety of sources such as home computers, VCRs or video disc players by way of the 21-pin SCART connector.

The KV-27 is supplied with a multi-function remote control for normal television operation plus access of the optional teletext facility, which can be installed if required. The built-in stereo tuner for TV reception can also decode bi-lingual broadcasts. The unit also has external speaker connection, for optional speakers, together with audio outputs allowing integration with an existing hifi system for enhanced stereo sound enjoyment.



It has a stylish European designed cabinet with a black finish, to blend in with the home audio/visual environment or to form the centre piece of any lounge or dining area.

The KV-27XS AS is available now through the Sony dealer network at the suggested recommended retail price of $2,199.

"Dynamic coil" magnetic cartridge

The new Garrott P-77 magnetic pickup cartridge features a dynamically balanced generator system, which is claimed to incorporate the best features of moving coil, variable reluctance and moving magnet systems. The new system is said to be capable of handling the highest groove modulation swings with full control, due to careful balancing of its pivoting system.

A further feature of the cartridge is a gem-quality, grain-orientated parabolic diamond stylus, polished to a mirror finish to ensure improved tracking of high frequency groove modulation and minimal groove damage.

Performance of the Garrott P-77 is said to be exceptionally clean and accurate, with fast dynamic response and excellent channel separation. The output is sufficient to feed directly into a normal magnetic pickup input.

Further details are available from Len Wallis Audio, Shop 9, "The Village", 43-45 Burns Bay Road, Lane Cove 2066.

Compact VHS-C camcorder

National Panasonic has released its NV-MC5, the "baby brother" to its already successful compact video camcorder, the NV-M5A. Overall size of the camera has been reduced by the use of the VHS-C video cassette. This still uses 1/2" tape, but recording length has been reduced to 30 minutes in SP or 60 minutes in LP mode — where NV-M5A offers up to a full four hours.

The new, super small model is ideal for the person who wants a simple, compact, lightweight model for "snap" shooting, the differences being in the length of the tape and editing functions. (The M5A allows extra editing functions such as dubbing and fade in/ fade out.)

The new VHS-C playback system can be operated either directly through a television set or, for LP mode, via a VHS cassette adapter, on any standard VHS VTR.

All accessories including carrying case, VHS cassette adaptor, rechargeable battery pack and VHS-C cassette tape come with the MC5, which weighs in at just 1.5kg.

In many ways, the NV-MC5A is very similar to its predecessor, employing the same CCD (charge-coupled device) image sensor which saves on space and weight, but still allows faithful reproduction of colour and resolution as well as virtually eliminating ghosting and after-imaging.

Other features include:

- Piezo auto focus system
- 1/1000 sec high speed shutter

- auto trace white balance
- 10 Lux (low light) shooting capability
- 6X power zoom lens with macro capability for wide angle to telephoto shots and close-ups of small objects.
- HQ (High Quality) picture

New VCR has simple, no-fuss timer

How many times have you wanted to record a programme on your video cassette recorder, but have forgotten how to set the controls so that the machine will start and finish at the right time, and you can't find the instruction book?

Sanyo claims to have come up with a solution to this problem by incorporating a feature called "QSR" in some of its new models. "Quick Start Recording" is a simple, two button control that lets you set the start time up to 24 hours in advance, to record up to four hours or until the tape finishes.

For example, on Sanyo's New VHF-3100 VHS video cassette recorder, all you have to do is press the "start" button and the time will go forward on the clock display until the button is released. The unit is then programmed to start at that time. The second "length" button is pushed and the time is displayed in minutes. Simply release this button and the recorder will automatically stop at that time.

The recorder's ability to be set in one minute increments is particularly useful when recording material off stations which do not necessarily run their programmes in neat 30-minute segments.

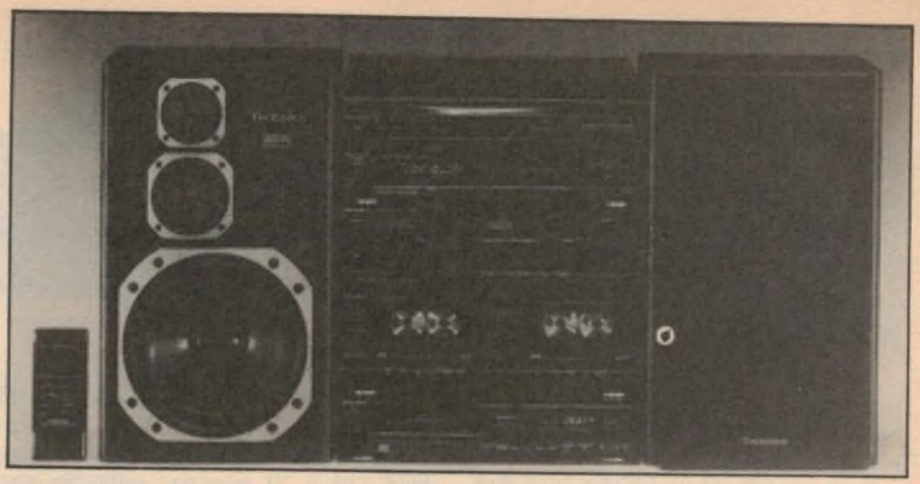
Apart from its QSR control, the VHR-3100 has a number of other attractions such as HQ (High Quality) picture technology, a 30 memory synthesiser tuner, and nine-times high speed colour picture search in forward and reverse, still and frame advance playback. Available from Sanyo dealers, the VH-3100 has a recommended retail price of $719.00.

Weatherproof speakers

Altronics in Perth has released a new range of Australian-made weatherproof loudspeakers and sound columns.

Branded "Redford", there are five models with power ratings from 10 to 40 watts. Each is available in either Black or White.

As home stereo extension speakers, the smaller 16-ohm models are considered ideal for paralleling across the main speaker 8 ohm lines. The higher powered models are fitted with multitap line transformers and are designed for professional sound and PA applications.



Enhanced "midi" system from Technics

Technics' new Midi Series has been further improved in response to a growing demand for hifi quality in the compact sound systems segment of the market.

One of the most notable differences is the change in width from 315mm to 360mm, providing not only more of a "hifi look", but also allowing more features to be added to these systems.

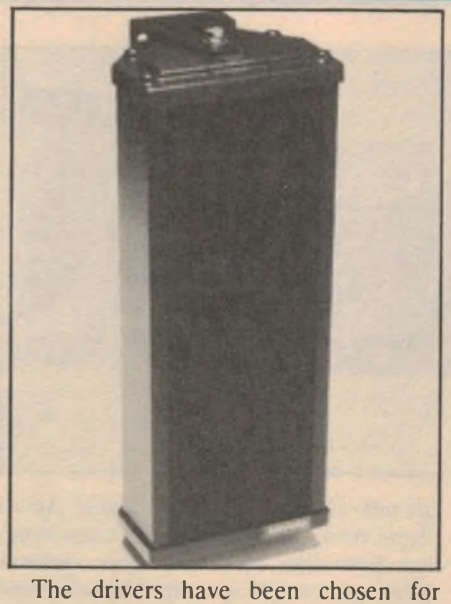
A number of other improvements can be found throughout the range. Three-way speakers have replaced two-way and new Class A circuitry in the amplifiers has been employed for cleaner, clearer performance. Also the top three systems feature Dolby B/C for greater noise reduction. Power output range has also been increased, now going from 20W up to 80W.

The new "Digital Response" speakers offer a number of advantages over the previous bookshelf speaker models. Firstly, laminated polyester is used to reinforce the speaker cone paper giving the woofer increased rigidity and more powerful bass response, often lacking in bookshelf speakers. Secondly, the cabinets' rounded baffle edges prevent diffraction to improve directional characteristics.

Other changes include digital volume displays, upgrading to digital tuners from analog tuners and 24-position station selection across all models.

All four models in the range, starting with the X800, the X830, the X840 and finally the X880 can be operated by infra red remote control.

Each model offers its own set of features, some including optional seven-band graphic equalizer and compact disc player.

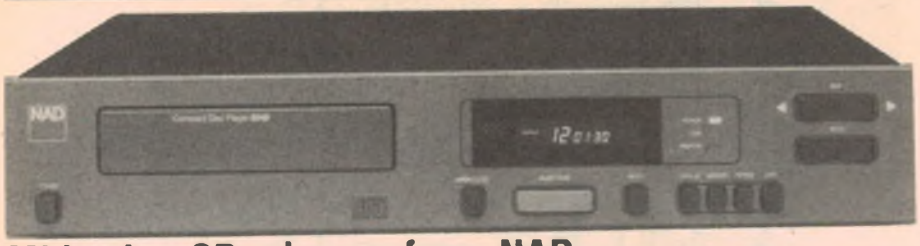


The drivers have been chosen for wide range, low distortion, mid range "presence" (essential for high grade vocal work) and high efficiency in general. For short term use, the drivers will safely handle 150% of rated power. Acoustic wadding is used to dampen bass resonance. Foam plastic and cloth are sandwiched between baffle and front grill to prevent water ingress. A first for "Redford" is the use of a patented cone moisture repellant process for all models.

The rugged vibration free enclosures are constructed from die extruded heavy gauge aluminium and finished with durable industrial black powercoat enamel. The speaker ends are sealed via gaskets and tough moulded "LURAN S" UV resistant end caps.

The end result is good looks, together with assured durability for the Australian environment.

Enquiries should be directed to Altronic Distributors, 174 Roe St., Perth 6000. Phone (09) 328 2199.



Mid-price CD players from NAD

NAD has released two new CD players, models 5220 and 5240, which continues this firm's tradition of no-frills high performance.

Both players are equipped with full-disc automatic repeat and programmable memory playback of up to sixteen selections in any order. The economical NAD 5220 adds a timer play feature that automatically plays a disc when the power is switched on. So, by plugging the player's AC power cord into a clock timer, you can provide your own choice of wake-up music in the morning instead of depending on a clock radio.

The mid-price NAD 5240 offers the convenience of wireless remote control, including remote volume control, plus NAD's new CDR (Controlled Dynamic Range) circuit. One of the basic virtues of the Compact Disc is its ability to convey the full dynamic contrast of live music, but in some situations that dynamic range is inappropriate. When listening late at night, when copying CDs onto cassette tape for car playback, or when you want to enjoy the CD's convenience and clarity in a playback system that has limited output power, wide dynamic range can be a liability.

NAD's new CDR circuit deals with these situations by monitoring and controlling the dynamic range of the playback signal. It operates smoothly and unobtrusively to raise the volume of low-level and average-level signals, while leaving the highest-level peaks alone. Thus it tames extreme dynamic contrasts, ensuring that the sound won't become either too soft or too loud, while having no other effect on the sound. The frequency range, tonal balance, and stereo imaging are unaltered. When not in use, the CDR circuit is completely bypassed.

Other features of the new players include a low-inertia three-beam laser pickup, a solid metal chassis for maximum stability, precise alignment and long-term reliability and an output circuit designed using the "less is better" approach, with only a handful of electronic components in the signal path.

Recommended retail prices are $499 for the model 5220, and $699 for the model 5420. Further details are available from Fred A. Falk, 28 King Street, Rockdale 2216.

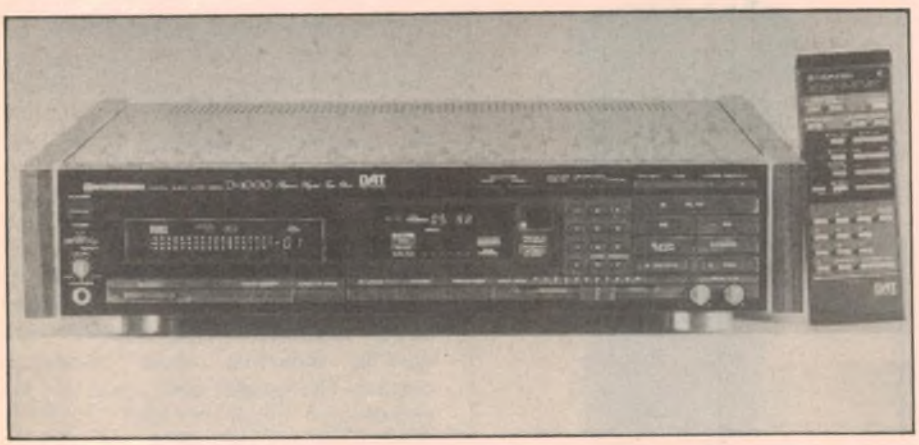
CD matching unit

Arista Electronics has extended its range of audio accessories with the new compact disc matcher Model No CDA-3.

Many amplifiers have only one auxilliary input, so as the home entertainment centre expands with the addition of a compact disc player and/or VCR, the inconvenience of having only a single auxilliary input arises.

The CDA-3 will allow the connection of both units to the amplifier and allow switching between either unit. The other advantage of utilizing the CDA-3 is its signal matching capabilities. The majority of compact disc players have an output voltage of 1.6 or 2 volts, whereas the input voltage of an average auxilliary input on an amplifier is 750 millivolts. The CDA-3 matcher will optimise the balance between input and output by allowing you to select between several different voltages.

For further information and the name of your nearest stockist contact Arista Electronics, 57 Yore Street, Silverwater 2141.



Pioneer demonstrates its DAT recorder

Pioneer Electronics has thrown its hat into the DAT ring, with the release of its new D-1000 Reference Digital Audio Tape deck in Japan. At the same time, its Australian office has been demonstrating a sample deck in Australia, and hinting that it may be released here "soon".

Important features of the new D-1000 include four direct-drive motors, double digital filtering on recording and playback for extremely low distortion, separate digital and analog power supplies and transformers, a heavy-duty construction to minimise vibration and resonance, and copper-plated chassis to provide better shielding. It uses a single rotary head and 16-bit linear quantization at 48kHz for record/play, with the ability to also replay tapes recorded at 44.1kHz and 32kHz.

Quoted frequency response is 3Hz to 22kHz within 0.5dB, with 95dB signal to noise ratio, distortion below .003% and wow/flutter virtually unmeasurable. In short, mouth-watering performance — even better than CD.

We're hoping to get hold of the sample machine shortly, to give you a test report next month.

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An efficient, easily rechargeable and maintenance-free battery, conceived and developed by a lady researcher at the University of New South Wales, could prove to be what many people have been trying to find for a long time.

by PAUL GRAD

As important as batteries are in many applications, they still possess several serious limitations, such as low power and a short life.

To overcome those limitations, a lot of research has been done lately throughout the world. It seems a real breakthrough has been achieved at the University of New South Wales, where a new type of battery has been developed.

In this new battery type the EMF is created by two liquid solutions, each of a salt of vanadium but at different levels of oxidation, separated by a membrane.

The brainchild of Dr Maria Skyllas-Kazacos, a senior lecturer at the University's School of Chemical Engineering and Industrial Chemistry, it is based on the "redox cell" concept.

"Redox" stands for reduction and oxidation, which refer to the absorption or donation of one or more electrons by a substance involved in a chemical reaction. Oxidation and reduction always occur together, because they refer to reactions in which substances exchange electrons. The expression "redox cell" is used because these cells use redox couples — two substances exchanging electrons in an oxidation-reduction reaction — in solution.

While in a conventional storage battery cell, such as in a lead-acid or nickel-cadmium battery, the EMF is created by two solid electrodes immersed in an electrolyte, in a redox cell the EMF is created by two solutions, or in other words, two substances dissolved in an electrolyte. The redox cell also has two solids immersed in the electrolyte but, instead of creating the EMF as in the case of a conventional cell, in this case they are inert and act solely as electrical contacts.

Each cell of the new battery is made up of two half-cells, one positive and one negative. Both contain a solution of vanadyl sulphate ($VOSO_4$) and sulphuric acid in water. Each half-cell is connected, via a pump, to a tank containing additional quantities of the vanadyl sulphate solution (see diagram).

The battery's terminals are two carbon-sheet collector plates.

Conventional batteries

For the benefit of those readers who are not familiar with the structure and the workings of conventional, commercially-available batteries such as the lead-acid and nickel-cadmium batteries, we will backtrack here.

We will try to explain briefly how those conventional batteries work. It should then be possible to understand how the new battery differs from them and what advantages it may have over them.

This will probably interest most readers, because the chemical reactions within such batteries are extremely complex and in some cases still not completely understood.

The conventional lead-acid and nickel-cadmium batteries are so-called secondary storage batteries. These have to be charged before they can develop a voltage difference between their terminals. Charging them, by passing a DC current through them, causes them to store energy as chemical energy which is delivered back as electrical energy during discharge.

To set up a battery we need two electrodes, one positive and one negative, which provide the battery's voltage, and a conducting medium — the electrolyte — between the two electrodes, which allows a current to flow through the battery and through an outside load connected across the battery's terminals.

It is the movement of ions in the electrolytic solution, attracted by either of the electrodes, which constitutes the current through the battery. (Ions are atoms or groups of atoms which have an electrical charge. While normally atoms are electrically neutral, possessing an equal number of electrically-positive particles called protons and electrically-negatively particles called electrons, they often acquire or lose electrons, becoming negatively or positively charged. They are then called ions.)

In a lead-acid battery both electrodes are initially of lead sulphate ($PbSO_4$) and the electrolyte is distilled (pure) water. Charging the battery produces several complex chemical reactions, finally resulting in a fairly stable system in chemical equilibrium. There will then be a voltage of 2V across the battery's terminals.

The charging current causes some of the water molecules to break down into ions. Each molecule of water that breaks down provides one negative ion of oxygen with two excess electrons (O^{2-}) and two positive ions of hydrogen each lacking one electron ($2H^+$).

The positive hydrogen ions then start breaking down both electrodes, by attracting negatively charged sulphate ions (SO_4^{2-}) out of them. This leaves the electrodes with positively charged lead ions (Pb^{2+}).

On the negative side of the charging source, electrons supplied by the source are attracted to the positive lead ions and neutralise them, producing ordinary soft lead, also called spongy lead. While

the battery is charging, then, the electrode connected to the negative terminal of the DC source is transformed from lead sulphate to a mixture of lead sulphate and lead and finally to pure spongy lead when the battery is fully charged.

On the other electrode, which is connected to the positive terminal of the DC source, the same positive lead ions are created initially, but instead of acquiring electrons these electrodes donate electrons which are attracted to the DC power source. Thus here the positive lead ions (Pb^{2+}) donate further electrons becoming even more positive (Pb^{4+}). Their charge is then strong enough to attract negative oxygen ions from the (water) electrolyte and combine with them to become electrically-neutral lead peroxide (PbO_2).

Thus this electrode begins as lead sulphate, becomes a mixture of lead sulphate and lead peroxide while the battery is charging, and becomes pure lead peroxide when the battery is fully charged.

The combination of the water's positive hydrogen ions with the negative sulphate ions from the electrodes produces sulphuric acid (H_2SO_4). Therefore, as the charging of the battery takes place the electrolyte is transformed from water to a mixture of water and sulphuric acid. When the battery is fully charged the electrolyte contains a high percentage of sulphuric acid.

When the battery is fully charged, the negative electrode (which is connected to the DC source's negative terminal) no longer contains any sulphate ions to combine with the positive hydrogen ions, and the positive electrode (which is connected to the DC source's positive terminal) no longer absorbs the negative oxygen ions.

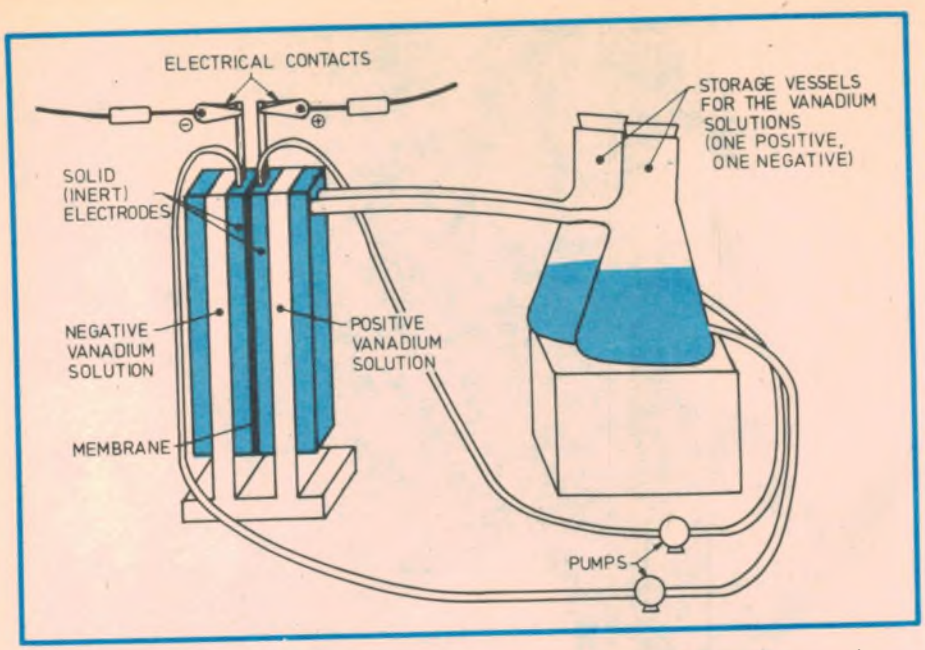
If we now continue to supply a charging current, the hydrogen ions continue being attracted to the negative electrode due to the electrons supplied by the charging DC source, even though the negative electrode no longer contains sulphate ions. And the oxygen ions are still attracted to the positive electrode, because electrons continue being extracted from it by the DC source and it retains a positive charge, even though the electrode no longer contains the strongly-positive Pb^{4+} ions.

Electrons supplied by the charging current leave the negative electrode and combine with the hydrogen ions to produce ordinary, electrically neutral hydrogen gas bubbles. The negative oxygen ions give up electrons to the positive electrode but, instead of combining with positive lead ions which are no longer available, they combine among themselves to become ordinary electrically neutral oxygen gas bubbles.

These gas bubbles rise and leave the battery through vent holes. If we continued to charge the battery we would not change the water into more sulphuric acid. Instead, the water would be lost as hydrogen and oxygen gases, and the acid concentration would become excessively high, damaging the electrodes. Also, the escaping gases are dangerous because they are explosive.

But assume that we have not overcharged, or at least not significantly overcharged, the battery.

Dr Maria Skyllas-Kazacos and Dr Miron Rychcik with an experimental vanadium redox cell.



This sketch of an experimental redox cell is somewhat unclear, because the University of New Wales' researchers working with the cell don't want to reveal too much about it.

As soon as the charging current stops the sulphuric acid starts a reverse chemical action. The negative sulphate ions from the acid react with the spongy lead in the negative electrode and the spongy lead gradually changes back to lead sulphate. However, now the excess electrons originating from the sulphate ions (two excess electrons for each ion SO_4^{2-}) remain in the electrode as free electrons, and there is an accumulation of negative charge in the electrode.

When enough negative charge is built up, the acid's negative sulphate ions are repelled from the electrode and there is no further chemical action.

The acid's negative sulphate ions also attack the positive electrode. They cause each lead peroxide molecule to break down into two negative oxygen ions and one positive lead ion. The oxygen ions are attracted into the electrolyte by the acid's positive hydrogen ions. When enough oxygen ions leave the electrode a positive charge is built up by the lead ions left behind. Thus the positive electrode also gradually changes back to lead sulphate.

Again, when this positive charge is high enough the acid's positive hydrogen ions are repelled from the electrode and there is no further chemical action.

Therefore, some time after charging has stopped, the negative electrode is a negatively-charged mixture of spongy lead and lead sulphate, and the positive electrode is a positively-charged mixture of lead oxide and lead sulphate.

During these reactions hydrogen and oxygen ions combine to produce water again, so that the sulphuric acid becomes more diluted.

The battery is now in a (fairly) stable equilibrium, with a voltage of about 2V across its terminals.

When a load is connected across the battery's terminals, electrons leave the negative terminal to go to the load and the charge on the negative electrode decreases, allowing the sulphate ions of the acid to again react with the electrode, again producing the electrode's original lead sulphate.

When electrons leave the negative electrode to go to the load, the same number of electrons are attracted from the load to the positive electrode. Here they combine with the positive lead ions which then combine with the sulphate ions from the electrolyte, also resulting in the formation of the positive electrode's original lead sulphate. Also, the sulphuric acid becomes still more diluted.

The net result of the chemical reactions involved is that while the battery is being discharged most of both electrodes change back to lead sulphate and most of the electrolyte changes back to water.

After a while the battery cannot generate sufficient voltage between its terminals and is said to be discharged (nominally when the voltage across its terminals has fallen to about 1.75V). It can be recharged over and over again, however.

These lead-acid batteries have seen wide application and have been enormously useful but they have serious limitations. Probably the most important is the relatively short time during which a useful current can be drawn from them.

A battery is rated in ampere-hours. This is the product of the current drawn from the battery and the number of hours during which the current is drawn. For example, if a battery is rated at 100 ampere-hours, this means that it will supply, for example, 5A for 20h, or 10A for 10h, before its EMF drops to the discharge level (1.75V per cell).

Storage batteries are usually rated for 20h. Thus, if the battery is rated at 100 ampere-hours, this means it will supply 5A for 20h.

The physical size of the battery does not affect its EMF, but it does affect the amount of current the battery can supply. The larger the area of the electrodes, the more current the battery can supply. Of course, the less current the battery is made to supply, the longer it will last before reaching the discharge level.

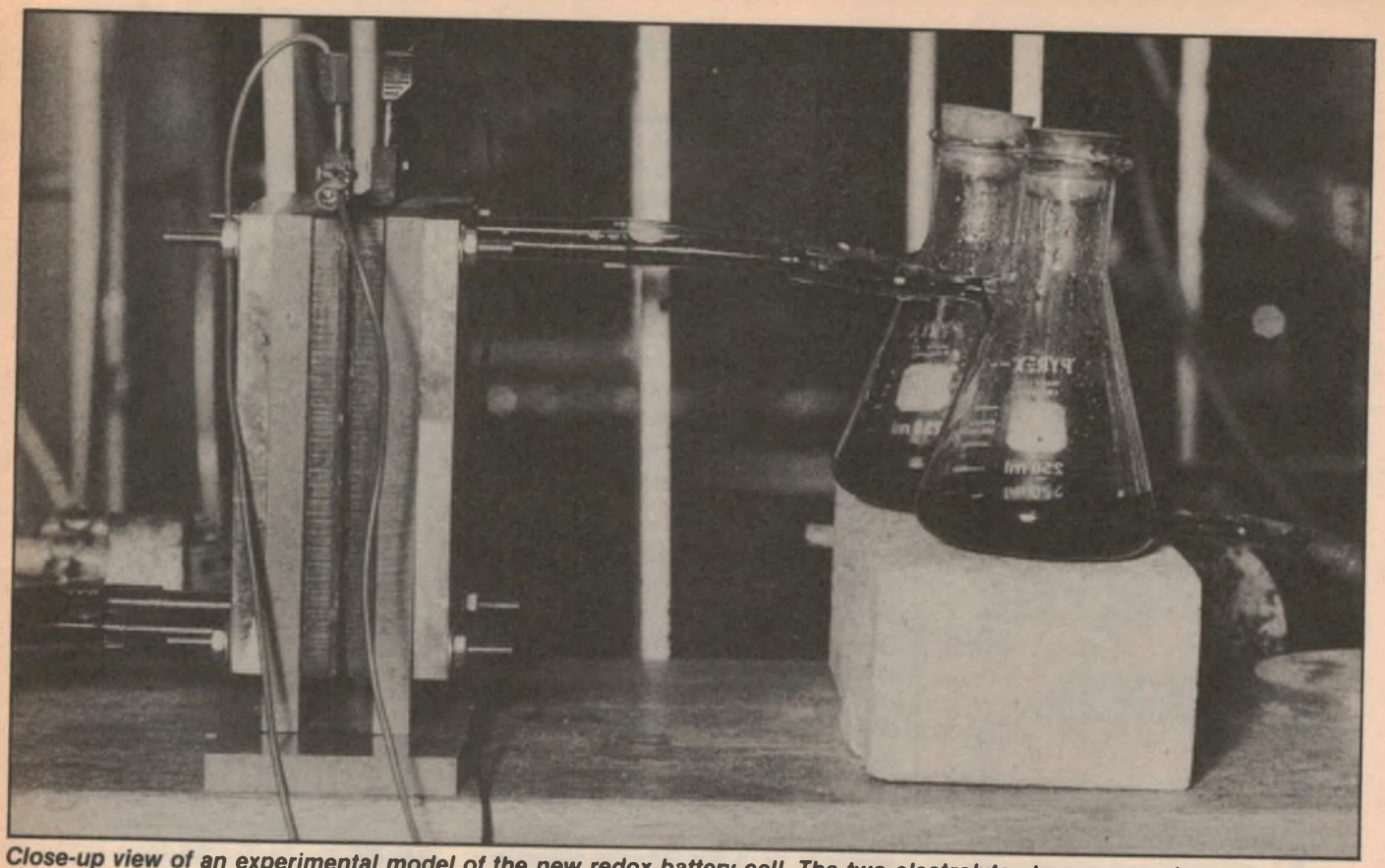
By connecting various battery cells in series we can obtain a voltage equal to the sum of the voltages of all cells in the series connection. We can thus obtain high voltages from a battery installation, even though each battery cell provides only a small voltage.

Large battery installations are used as backup power systems in various applications. Usually, however, battery installations are suitable only as a short-term backup, for example, during a mains power failure.

Another disadvantage of lead-acid batteries is that the electrodes tend to deteriorate if the battery is allowed to remain partially discharged for a long time.

Also, even when the batteries are carefully recharged, some water is usually lost in the form of hydrogen and oxygen gases and the acid content gradually becomes high enough to cause "sulphation". This is a process by which areas of the electrode become hard and brittle and do not react properly with the electrolyte.

Nickel-cadmium (Ni-Cd) batteries, which are of a type called alkaline batteries, work similarly to the lead-acid batteries. Each cell of a Ni-Cd battery has a positive electrode of nickel dioxide (NiO_2) and a negative electrode of pure cadmium (Cd). The electrolyte is



Close-up view of an experimental model of the new redox battery cell. The two electrolyte storage vessels on the right will be replaced with storage tanks in any commercial version of the battery. On the left are both half-cells separated by a membrane.

potassium hydroxide (KOH) mixed with distilled water.

In these batteries, while the electrode materials change during charging and discharging, the electrolyte does not change.

Redox differences

A redox battery's basic difference from the conventional batteries such as the lead-acid and nickel-cadmium types is that the voltage between its terminals is created, not as a consequence of chemical reactions between one or two electrodes and an electrolyte, but by a change in the level of oxidation (an exchange of electrons) between two adjoining solutions separated by a membrane.

The redox battery is charged by means of a DC source connected across its terminals, as in conventional batteries. This causes changes in the oxidation states of the vanadium salt ions in solution. All chemical changes brought about as a consequence of charging the battery take place in the solution.

When in solution the vanadium salt ionises, each vanadium atom donating four electrons and becoming a positive ion with a +4e charge, V^{4+}.

When the battery is charged, different oxidation reactions take place in each half-cell. These reactions are:

At the positive half-cell,

$$V^{4+} \underset{\text{discharge}}{\overset{\text{charge}}{\rightleftarrows}} V^{5+} + e$$

At the negative half-cell,

$$V^{3+} + e \underset{\text{discharge}}{\overset{\text{charge}}{\rightleftarrows}} V^{2+}$$

The vanadium salt solutions are deliberately prepared to undergo the reactions described, to obtain 1.5V between the terminals of each cell, and to avoid problems such as the deposition of metallic vanadium.

The solutions to which the vanadium atoms belong are fairly complex. The vanadium salts do not necessarily have the same charge as the vanadium ions in them.

The two half-cells are separated by an ion-selective or microporous membrane. Either a sulphonated polyethylene anion selective membrane (allows only negatively-charged ions through) or a polystyrene sulphonic acid cation selective membrane (allows only positively-charged ions through) was used in the University's experiments.

The main function of the membrane is to keep the two solutions in each half-cell separate, thus maintaining the voltage difference between the two half-cells. In the cells of conventional batteries the two solid electrodes are kept naturally separate but in the redox cell the absence of a separating membrane would cause the two solutions to mix, gradually eliminating the voltage difference between the cell's terminals.

The membrane must also permit free passage of the cell's current carriers to permit free flow of current through the cell. The current carriers in the University's redox cell are mainly the positive hydrogen ions from the sulphuric acid.

The membrane must therefore be permeable to the ions which carry the current in the solution, but must prevent diffusion of the active species (that part of the cell which gives up or takes on electrons) in solution which would result in self-discharge of the cell. The choice of membrane is thus crucial to the efficiency of a redox battery.

It should ideally do all those tricks while allowing high coulombic efficiencies to be achieved. (Coulombic efficiency is the ratio of the electric charge

New battery

which flows out of a battery during discharge, to the electric charge which flows into the battery during charging).

The membrane should also have a low resistivity to minimise losses in voltage efficiency, and good chemical stability for long cycle life.

Although good voltage efficiency has been obtained using a polystyrene sulphonic acid membrane, the resistivity of the membrane's material is still relatively high (1.2ohm.cm^2). Therefore, further improvements in the cell's efficiency can be expected with a less resistive membrane.

The product of the voltage efficiency — ratio of the average voltage during discharge to the average voltage during charging — and the coulombic efficiency is a battery's energy efficiency. A low coulombic efficiency means considerable self-discharge or high gassing rates (formation of oxygen and hydrogen).

Overall efficiencies of 80% are said to have been achieved with the vanadium redox cell at the University, which are similar to or higher than the efficiencies of conventional lead-acid or nickel-cadmium cells.

Dr Skyllas-Kazacos decided to try the redox cell concept with the vanadium salts after examining the electrochemical series table, listing electrochemical reactions (the chemical effects of electricity) of various substances. The vanadium salts appeared to her to be capable of satisfying all the requirements for a redox battery. The main reason for choosing vanadium was that it exists in various oxidation states.

The choice of a carbon felt as the material for both electrodes was arrived at after several tests, including charge-discharge experiments conducted by the University's team with various materials.

Skyllas-Kazacos said that after the initial tests proved her concept she and her group felt encouraged to proceed with their experiments. To her knowledge hers is the only group anywhere in the world currently engaged in research on vanadium redox batteries.

The University's researchers see several important advantages of the new type of cell over conventional types.

The solid-state reactions in the conventional-type solid electrodes lead to their degradation, a problem that does not apply to redox cells. In redox cells there are no capacity losses or failures due to shedding or shape change of the solids immersed in the solutions, because they are passive.

Another advantage of redox batteries is that the amount of charge they can supply during a certain time is determined by the solution concentration and tank volume, whereas in a conventional battery this is determined, as said earlier, by the battery's physical size and the areas of its (solid) electrodes.

It is thus possible to obtain any ampere-hour rating from a redox battery, simply by increasing the size of its storage tanks. Naturally this means that, for the battery to operate continuously, the solutions in the battery have to be drained when they reach discharge level and substituted by solutions from the tanks. The drained solution can then be recharged separately and later reused.

This is probably the greatest advantage of redox batteries over conventional batteries: instead of recharging a redox cell battery it is possible to simply refill its tanks with new amounts of charged electrolyte, the battery thus attaining its full power instantly.

Deterioration of the materials used in a redox battery still takes place, however. Dr Skyllas-Kazacos predicts a service life of 5 to 10 years for a vanadium redox battery, using optimised materials. This compares with a service life of 2-3 years for a lead-acid battery and of about 10 years for a nickel-cadmium battery. The vanadium solutions, however, have an indefinite life.

With an open circuit voltage of 1.5V and an energy density of 25W.h/kg (watt-hours per kilogram) the vanadium redox cell also compares favorably with lead-acid battery cells with the corresponding figures of 2V and 15-30W.h/kg, and with nickel-cadmium cells (1.3V and 10-35W.h/kg).

Dr Skyllas-Kazacos said that during the past 10 years the price of vanadium based on fused metallurgical-grade vanadium pentoxide has remained stable at US$14/kg.

Based on this price she estimated the costs of the chemicals in 1 litre of vanadium salt solution. This would contain 362g of the vanadium salt costing US$2.10, 188g of 98% solution of H_2SO_4 (US$0.40), and 750g of water (US$0.05), with a total weight of 1300g and a total cost of US$2.55.

The total cost of materials for a 1kW battery (excluding the storage tanks) would be about US$273, with the membrane and the carbon felt electrodes contributing about 40% of that. For a 5kWh system the solutions in the tanks would cost about US$390.

A typical 1kW vanadium redox bat-

tery would have 17 cells for a total voltage of 24.7V, and approximate size of 30cm x 33cm x 20cm (width x height x length) for a total volume of about 20 litres. The total volume of the vanadium salt solutions in the battery would be 2 x 6 litres. It would have 2 storage tanks, one for each of the two types of solution. For a 5kW.h storage system the total volume of the solutions in the tanks would be 2 x 74 litres.

In the battery's normal use the solutions are continuously circulated within the battery. The solutions are drained through one outlet and replacement solutions are pumped in from the storage tanks, at the same time, through another conduit. This continuous circulation takes place without interrupting the battery's operation.

It is possible to keep the drained solutions in separate tanks, but in the University's concept the drained solutions are taken back to the storage tanks. Thus the solutions in the tanks become gradually weaker, but greater efficiencies of operation have been obtained with this procedure than if the drained solutions were kept in separate tanks.

Of course, if the discharged solutions were kept in separate tanks, instead of being recirculated, the unused solutions in the storage tanks would retain their optimum concentration. However, apart from resulting in lower operating efficiencies, this would necessitate the presence of additional tanks to store the drained solutions.

According to Dr Skyllas-Kazacos only one storage tank would be needed for all positive half-cells and another one for all negative half-cells. However, for reasons of commercial confidentiality, no details are available as to how the researchers propose to avoid shorting the battery's half-cells and "sabotaging" the series connection in such an arrangement.

The redox cell concept had already been demonstrated with 1kW units by NASA in the US and the ETL group in Japan, using an iron/chromium system, i.e. iron compounds and chromium compounds separated by a membrane. However, according to Dr Skyllas-Kazacos, the poor reversibility of the chromium half-cell and cross-contamination of the half-cell solutions by diffusion of the cations across the membrane are still limiting the system's life and efficiency.

She said vanadium redox batteries are likely to find their first use as industrial batteries and in stand-alone, off-grid applications (used as power sources independent of the mains supply), where their size is not critical.

The independence between the redox system's power capacity and its storage capacity makes it attractive for long-term storage in remote areas where solar arrays or wind generators have been installed.

An attractive feature of the vanadium redox battery is that it can be fully discharged without suffering any damage and that it is virtually maintenance-free because there is no solution contamination due to cross-mixing.

Skyllas-Kazacos sees electric traction as one of the new battery's most promising applications, because she believes both its power and energy density, which already compare favorably with those of the advanced lead-acid and nickel-cadmium batteries, can be further improved as indicated by recent laboratory tests.

The fact that, instead of recharging, the redox cells can be ready for use again in a few minutes by exchanging the vanadium salt solutions at any specially-equipped refuelling station, is another factor making redox cells an attractive proposition for electric traction.

The solutions would, of course, not be discarded but would be recharged and later reused. At a refuelling station it would be possible to exchange the solutions, but pay a fee only for recharging the same amount of the solutions and leave immediately as soon as the exchange is completed.

Dr Skyllas-Kazacos came to Australia from Greece at the age of two. She earned a B.Sc degree with 1st class honours from the University of NSW's School of Chemical Engineering and Industrial Chemistry and a Ph.D. degree in 1979 from the same School. Her research team at the University of NSW includes Dr Miron Rychcik, originally from Poland, and professional officer Franz Grossmith.

She is very excited by the interest industry has shown in her invention. Unisearch, the University's R&D company, has negotiated a worldwide licence agreement with Agnew Clough Ltd to develop and market the invention.

The company told the University it is committed to seeing the battery commercialised, and will operate the battery's first full-scale test unit in the company's mines in Western Australia in about 12 months.

The University's research project has been supported by the National Energy Research Development and Demonstration Programme.

HIFI REVIEW:

Pioneer's PD-6050 compact disc player

Representative of the latest generation of middle-range CD players, the new Pioneer PD-6050 offers features previously only found on more expensive models. This has been achieved largely by refinements in production technology.

When the first cars appeared, each one was lovingly made by master craftsmen using only the finest materials. They were solid, reliable and *expensive*. Then a little while later, along came Henry Ford who showed that by taking advantage of mass production technology, you could crank out cars that would do almost the same job, but could be sold for a fraction of the price.

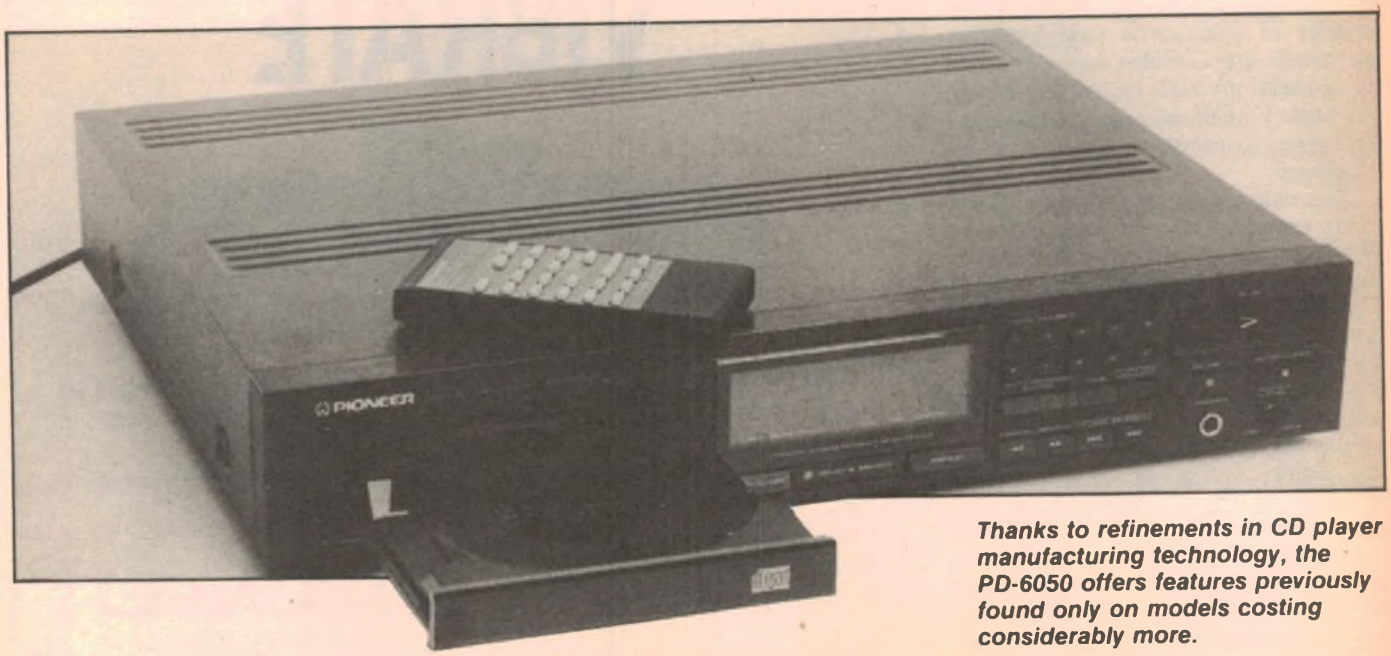
Much the same kind of thing now seems to be happening with CD players. The first pioneering players to appear had solidly made metal player mechanisms, using either castings or heavy-gauge pressings, and mounted in equally solid pressed cases. At the time, this seemed to be necessary in order to achieve the rigidity and stability required for maintaining focus and tracking of the laser beam, for reading those tiny pits. And needless to say, the cost of the early players reflected this necessarily conservative approach.

But over the last couple of years a lot of experience and knowledge has been gained, both in terms of the electronics used in CD technology, and in the production techniques and materials used in their manufacture. By applying all of this new experience in an integrated fashion, it is now possible to produce players which provide virtually the same performance as the original models, or better, but using much lower cost components and manufacturing techniques. As a result, we consumers are "reaping the benefits" in terms of a steady drop in player cost/benefit ratio.

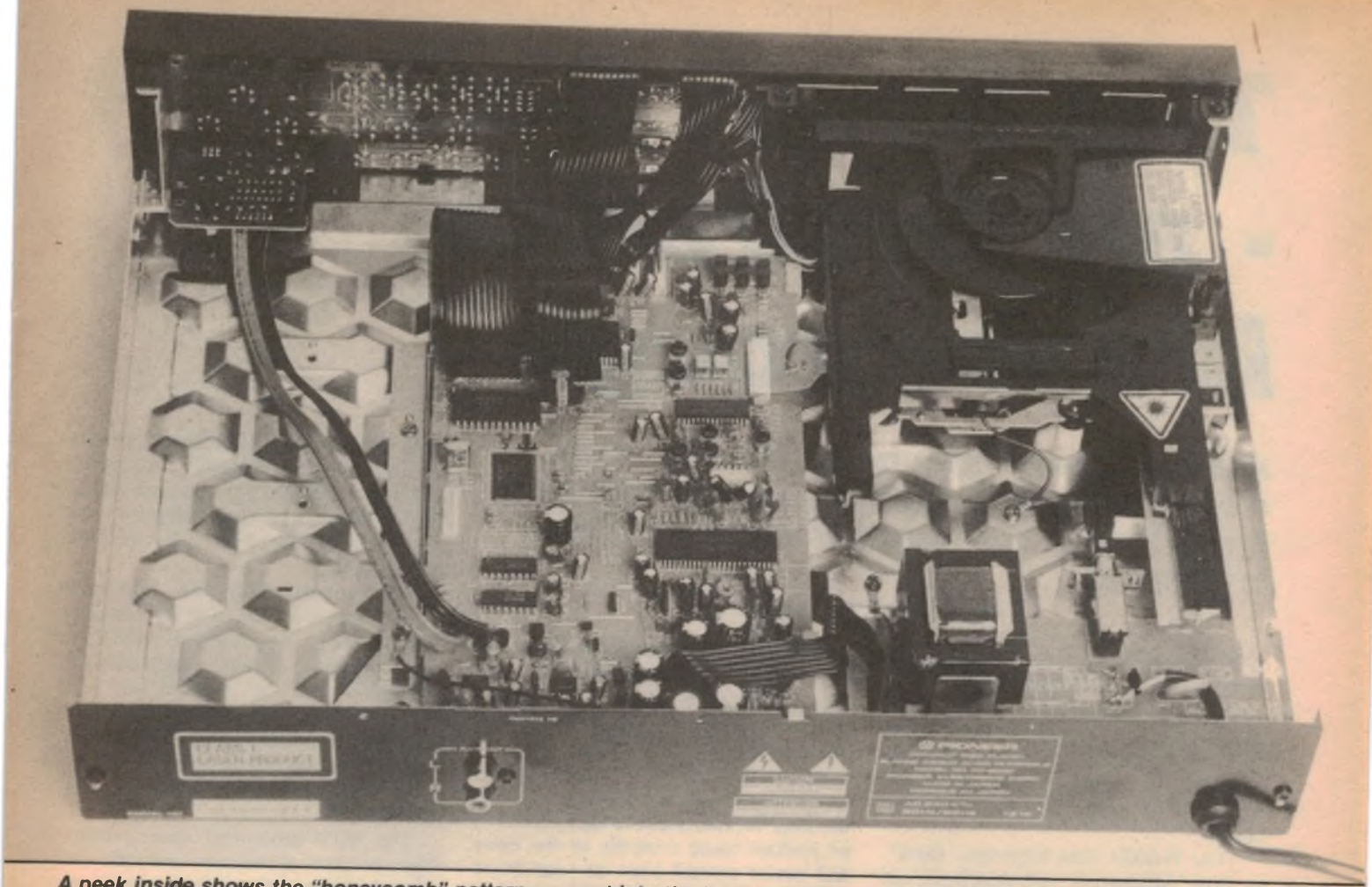
The new Pioneer PD-6050 is a good case in point. It offers full random play programming, a full function wireless remote control, direct track-select keys, a multi-function fluorescent display, two-speed manual track search, high performance digital filtering and a built-in stereo headphone amplifier. Until very recently these features would have cost the best part of $1000, but the PD-6050 sells for an RRP of only $599.00.

How has it been done? Well for a start, a high proportion of the player mechanism is now made from moulded resin-loaded plastic materials. Pioneer says that the parts of the new mechanism have all been developed using computer simulation techniques, to provide the same rigidity and dimensional stability as the aluminium castings formerly used. The moulding materials used have made possible mounting configurations that in fact would not have been possible with aluminium, allowing reduced use of adhesives. As a result, Pioneer claims that the mechanism should actually be more reliable than the metal version it replaces — while at the same time being significantly cheaper.

An interesting feature of the new design is an enlarged disc stabiliser. This is the boss which is lowered onto the CD when the carrier drawer is closed, to



Thanks to refinements in CD player manufacturing technology, the PD-6050 offers features previously found only on models costing considerably more.



A peek inside shows the "honeycomb" pattern pressed into the bottom of the case for stiffening, and also the redesigned player mechanism with its high proportion of plastic components.

press it against the drive spindle hub. Some of the earlier CD players had relatively small bosses, and apparently this could allow the discs to flex as they rotated — causing focus and tracking problems. It was for this reason that some aficionados started cementing "damper" discs to the top of their CDs, to stiffen them and dampen any flexing or vibration.

In this new mechanism Pioneer has increased the stabiliser diameter to about 80mm diameter, which should provide adequate damping and stiffening as it corresponds to more than half of the CD's own diameter. Certainly in our tests, of the PD-6050, we could detect no sign of vibration problems.

Pioneer also claims to have incorporated a novel system to ensure that the stabiliser is accurately centred. This uses an arrangement of four ball bearings, in a one-sitting-on-three configuration. As far as I can determine, the assembly is in the spindle hub, and the single top ball mates with a small hole in the centre of the stabiliser. Whatever, the stabiliser does seem to run very truly.

Other features of the new player mechanism include a smaller laser diode, nearly half the size of previous units, and a simpler optical system which uses no separate collimator lens and no cylindrical lens for the focus sensing. Instead, the focus servo makes use of the inevitable astigmatism of the main half-mirror, which is not corrected but carefully controlled. A very neat and efficient solution!

But perhaps the most obvious economy of all, when you peek inside the PD-6050 case, is the use of a pressed "honeycomb" pattern to stiffen the main case itself. This has allowed the case to be pressed from much lighter metal than the earlier units, no doubt achieving a worthwhile saving. Although the case seems fairly flimsy when the top is removed, it stiffens up somewhat when fully assembled. In any case the player mechanism, which is the crucial part, seems well isolated from any flexing.

Needless to say the player electronics takes full advantage of the latest technology, as well. All PCBs are single sided, and appear to have been assembled by automation. The decoder uses the Sony CXD1135Q chip, which includes built-in digital filtering. A single D-A converter is used, sampling each channel at 44.1kHz.

Our testing of the PD-6050 was not particularly rigorous, but consisted of trying it out on some of the more demanding tracks of the Denon test disc, plus extended listening with a variety of very familiar and often-played music discs. It came through without a murmur, showing that Pioneer has been very successful in its efforts to prune price without sacrificing performance.

About the only criticisms I can anticipate from "golden eared" types are the use of a single D/A converter, and the lack of volume control via the remote control. I have to admit that neither of these seems to me particularly important; for example I've never been convinced that anyone can actually hear the phase errors caused by the 11.34us mulitplexing delay. I certainly can't. But perhaps Pioneer might consider further refinements along these lines for next year's model.

For the present, the PD-6050 seems excellent value for money. (J.R.)

The Smart Book - an Australian breakthrough

Axemen, spare those trees! The age of the electronic book is dawning, and an important breakthrough has just been made right here in Australia . . .

by STEWART FIST

It is not often that Australia can claim a "first" in the area of high-tech consumer products. In fact, I can't think of one since the Hills Hoist! But a small text-based portable computer specially designed to substitute for reference books, could well take the world by storm.

"The World's First Electronic Book" is how Megaword, its developer, is promoting it. It is an Intel 8088-based text-processing computer about the size and weight of a reasonable hardback book, and with the total front surface a green liquid crystal display (LCD) screen. You plug in a text module about the size of a credit card (but a bit thicker) and you have the full text of a major reference book in machine searchable form.

The idea is called "Smart Book" and it has the backing of the publisher Weldons (who brought you the Macquarie Dictionary) and the James Hardie Group. The two have jointly formed a new company called Megaword, and are about to launch this technology on the world publishing scene.

I've only had a chance to play briefly with a prototype, and it works well. There were three on show at a recent press launch, all larger than the final product which was also shown in mock-up form. So the following details apply more to how the final product will look, when it goes on sale later this year.

For instance, the mock-ups had horizontal format screens with double text columns, but the final products will be book-shaped with a vertical screen format. The character generator inside the Smart Book can handle up to ten different fonts, and so chapter headings, etc. can be displayed in large font sizes. This immediately gives you the feel of using a Videotex screen, although the system doesn't yet allow for graphics.

Across the bottom of the screen are six buttons which correspond roughly to the keys on your cassette tape recorder, or perhaps more correctly to the entry and cursor control keys on your home computer. Basically they let you go forward, backwards, up and down through your text, and to select and play information.

There's a bit more to them than this, because they are soft-keys, and in certain circumstances they are redefined by the program to perform other functions. For instance you can use them to select letters of the alphabet to build a word for key-word searching. The screen displays the alphabet in groups of five, and you go up, down, and across until you find the letter, then select it. The lack of alpha keys makes keyword entry a bit laborious, but it is acceptable.

The idea behind the design is to make the machine less formidable to computer illiterates. Megaword is planning to introduce a plug-in keyboard as an optional extra, and I would predict that this will be essential if you plan to use the Smart Book for dictionaries and reference material. Since Weldon owns both the Macquarie Dictionary and the Thesaurus, I would say that this was a certainty.

The unit is battery powered, using four AA-size rechargeable cells which will give about four hours of reading time. This is probably enough, since you'll probably use it most of the time with a mains pack which can simultaneously recharge the cells. The power drain is relatively high because of the back-lighting of the LCD screen — and yet this is necessary for clarity in these type of screens.

The software for this "electronic book" comes in the form of a plug-in module which at present is about the size of a audio cassette, but which will eventually will be reduced to thick credit card size. It is actually a vastly expanded Smart-Card, filled to the brim with electronic components — mainly mask programmable ROM or EE-PROM chips.

The ROM cards hold about 1 megabyte of data at present, but this will soon improve; two or three megabytes will be commonplace within a few years. With CD-ROM and high-density magnetic storage, we tend to get blase about the odd megabyte or two of memory, but the present prototype ROM modules are holding the complete text of the Bible, together with the retrieval software and indexing required for key-word searching and for constructing a Concordance.

This is probably all you really want in one unit. CD-ROM with its 400 to 600 average-sized books on each disk is actually a bit of overkill. A box full of credit cards, each with one reference book, is probably just as convenient — especially if the whole unit is portable, which CD-ROM is not (as yet, at least).

The prototype software module on show had the full text of the Bible. There are a number of different versions of the Bible, but the average text length is about 800,000 words, or 3.5 million characters, according to the Bible Society.

This makes for a minimum requirement of, say, 4 Megabytes (I don't think they've counted spaces as characters), plus an overhead for indexing key words and for the retrieval software. It is hard to see how you could get away

with an uncompressed length of less than about 5Mb.

Megaword has compressed this down to 956 kilobytes on the prototype card, which means that they are achieving better than 5 to 1 in their text compression ratio. They say that the trick is in using special redundancy compression techniques, developed by Roger Purcell of Techway. These work on a "word" basis, rather than on "characters", Purcell says.

He claims to be able to reduce a text file size by a factor of five (worst case) and seven (best case). Good text compression is usually taken to be ratios of about three to one — so Purcell's achievements are quite remarkable. He won't talk about them — which makes the search for an explanation even more interesting.

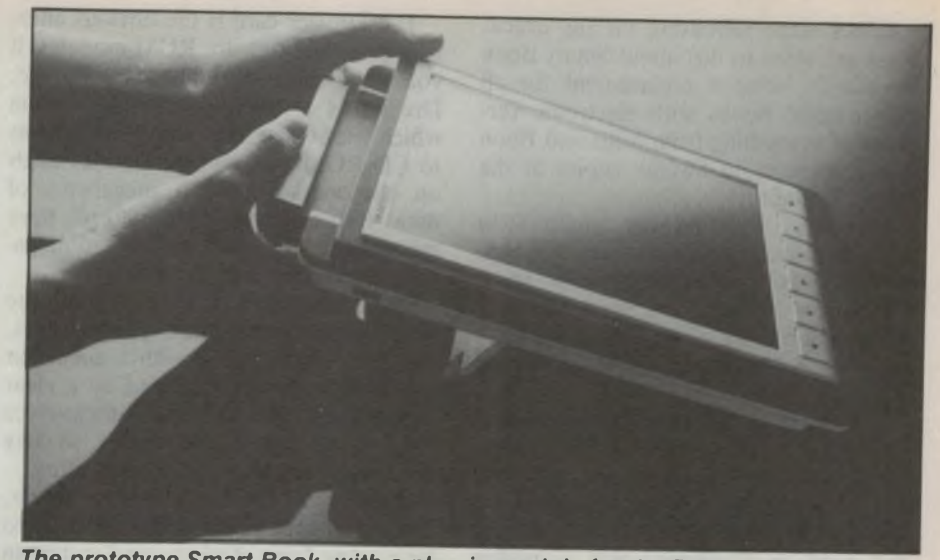
There are three compression techniques in common use today, and two of these, Run-length and Huffman coding are both character-based. Purcell says that they don't use these techniques, nor do they use the standard word-based compression system known as Zev-Lemple coding.

Zev-Lemple coding handles commonly used words, prefixes and suffixes (such as "and", "of", "pre", "ing", etc.) as single 10-bit "tokens". It also has the ability to point back to a previous occurence of a word — and since a large number words are used repetitively in any writing, the combination of these two processes greatly reduces the character storage needed.

Probably the best compression you could expect with Run-length, Huffman and Zev-Lemple coding techniques being applied simultaneously is about 3.5 to 1. They work much better with database material, of course, where the main problem is "air" — blanks in unfilled fields.

Purcell's system must be compressing at nearly twice the usual rate, and so it is a considerable achievement. He says that it is a slow process and it needs a MicroVAX or other minicomputer at the minimum, although it may be possible to rewrite the algorithms for a PC application at a later time. The VAX requirement seems to indicate that there are multiple layers of algorithms — that he is compressing, then recompressing — but he says no.

The people at Megaword are all very cagey when telling you anything about the technical side of the Smart Book. They are afraid that they will be "gazumped" by the Taiwanese or the Koreans, before they can get their product into distribution — and they are probably wise to be suspicious.



The prototype Smart Book, with a plug-in module for the Bible being inserted.

They reluctantly revealed that the electronic book is based around the Intel 8088 processor, which makes it a cousin of the IBM PC — but that's all. They say that they have patents on the ROM-pack, the "box" and the interconnection techniques, but it is hard to see what is legally protectable apart from the compression algorithms and the text-pack standards.

People have made computers with LCD screens before, and computers with plug-in ROM games modules. Megaword seem to have done little more than take these old ideas to their logical extremes and concentrate on text only.

I don't say this to put down their achievement — but rather to place it in perspective. Smart Book seems to me to be the result of clever design work, rather than any true inventive processes.

The plug-in text modules are the key to the whole system of course, the rest is just a well packaged computer with a large screen. Eventually these modules will be mask programmable ROMS, which means that the information is inserted into the chips by a technique roughly analogous to the way patterns are silk-screened onto tea-towels — only in this case it is added in the micro-lithography phase of chip production. However they will need long production runs to justify the initial creation expense of the mask.

Megaword also intends to produce Electrically Erasable Programmable ROM (EEPROM) versions, so that data can be added to the module as required. The designers are thinking in terms of vending machines which would probably take the information already compressed from a CD-ROM and inject it into the module. This might also be the best way to handle stock in a retail outlet. The serious problem with bookstores is the huge amount of stock they need to keep on hand, so this could be a way of cutting these overhead costs.

It is hard to know how fixed the logical functions of the system are. The promoters talk about having voice recognition and voice synthesis modules at a later time, and also about the possibilities of linking the Smart Book to a keyboard, printer and other personal computer, but whether this was pie-in-the-sky hopes, or definite plans, is difficult to say. It does seem to indicate that beneath the screen you've got a full-functioning portable computer, however.

However, when I asked whether the de-compression algorithms were hard-wired into the system, or whether they could be switched out at will, no one was able to give me a firm answer. This seems to indicate that at least some parts of the logic is hard-wired into the system — more like a dedicated word-processor, rather than a personal computer — and this is an important consideration.

The Smart Book could well find a use by tradesmen and businessmen as a reference source, not only for fixed encyclopaedia-type data, but also for material extracted from on-line services and from their own business records kept on PCs. If all this data needs to be sent to Megaword for compression before it can be used, this market will evaporate: it must be possible to transfer data to the Smart Book by anyone at a moment's notice.

At the press launch the company ex-

ecutives were rabbitting on (as executives are wont to do) about Smart Book eventually being a replacement for all paper-based books with electronic versions of everything from Mills and Boon bodice-rippers, to Swahili copies of the Bible. I doubt it!

The use of ROM-type modules to store the data means that there is a high intrinsic cost associated with each "book" — quite apart from the text entry and royalty costs. You don't have these module costs to the same degree with other mass storage mediums.

It is hard to see how the production of a mask programmable ROM module could ever be less than an ex-factory price of say, $10, which translates to $40 or $50 retail. There is no escaping the need to accurately etch a million logic circuits, then to add the masked information, and finally to check the device — each one on an individual basis.

By comparison CD-ROM disks have an ex-factory price of about $4 each — and these contain roughly 600 times the amount of information. It is often quoted that a CD-ROM disk will hold between 400 and 600 standard-sized books — but these are *uncompressed* books: you could multiply by five if Purcell's algorithms were being used.

The Drexler card is the obvious alternative technology to ROM-modules if you want cheap portable mass storage. Drexler is a laser-optical card system which uses essentially similar techniques to CD-ROM, and current Drexler cards on the market hold 4 megabytes of data. Experimental Drexler Cards have managed to cram over a hundred megabytes onto one card.

The cards are made by impressing the "pits" and "lands" into plastic sheet, and then coating these with a molecular layer of aluminium followed by a clear protective surface. The cards themselves have no electronic components, so they are very cheap to produce in quantity.

Against the use of Drexler, however, is the fact that you would then need to have some form of mechanical system in the reader — even though it is only a laser-scanning device. The Smart Book has the advantage of having no mechanical systems whatsoever — a great plus for any portable device.

So it is hard to come to any firm conclusions on Smart Book. My guess is that it will find a place initially on the desks (and in the briefcases) of business men and women, as a handy portable reference — but that depends, to a degree on how easy it is for them to add their own information.

It might also find a use with the partially sighted, because of the large print option, and also with special groups like accountants and lawyers who might find it easy to distribute changeable information in electronic form.

But it is hard to see how Smart Book can break out into the wider community. Like all of these inventions, there is a chicken and egg problem in the mass-consumer markets — few people are going to outlay, say, $500 on a machine until hundreds of books are available, and a wide range of books won't be available until the machines are in wide use.

Add to this the problem that the software won't be cheap until large numbers of the modules are made by the mask method; the threat from alternative technologies like Drexler; and the likely problems the company is likely to face in protecting its design by patents, and you can see that life for Megaword is not going to be easy.

But they deserve to succeed. They've got the backing of a large industrial group, they have publishing and marketing expertise, and Smart Book is an excellent piece of design. It's also a market first- and I wish them well. EA

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New camera uses floppy disks, not film

World famous Japanese camera maker Canon has just released a radically new model. Instead of conventional film, this one uses electronics: a compact high resolution CCD image sensor coupled to an inbuilt recorder using tiny 2" floppy disks.

by JIM ROWE

I wonder what people thought when they saw the first demonstration of Henry Ford's first spluttering model T, or Tom Edison's first scratchy phonograph. Did they realise instantly that they were seeing history made, and that the gadgets in front of them were portents of whole new technologies and industries?

These thoughts crossed my mind because I suspect I've just seen a portent of the future direction of photography. It's the new Canon "Still Video Camera", or more accurately a complete new still video photography system based on the SVC. And it's very impressive — not just for its current capabilities, but even more importantly because of its future potential.

At the heart of the system is the new Canon RC-701 camera, which looks like a slightly larger than normal 35mm single lens reflex. It has interchangeable lenses like a typical SLR, a flip-up reflex mirror, a focal-plane shutter and through the lens exposure metering. Like many modern cameras it has a fancy LCD display showing the shutter speed, exposure setting and other parameters. There's even a built-in date/time encoding system, which can "date stamp" each shot.

But instead of the usual swing-out back for film loading, the RC-701 has a small flip-open door about 2" square. And instead of film it records on tiny floppy disks, which look like a bonsai version of the 3-1/2" microfloppies used in many of the latest PCs. All you do is pop in the disk, shut the door and it's ready to go — a little like one of those little disk film cameras to use, but otherwise very different.

Canon's new still video camera is a little larger than a 35mm SLR, and uses 2" microfloppy magnetic disks instead of film.

At the heart of the camera is a 2/3" CCD (charge-coupled device) electronic image sensor, similar to that used in the latest video camcorders but with higher resolution. It boasts 780-line resolution in the horizontal direction and 490 in the vertical direction, and uses an advanced colour stripe filter for precise colour registration and purity.

Like most of the modern video cameras it features automatic colour balance, to give accurate colour rendition in almost any lighting. However like all of its other "auto" functions, this can be overridden manually for creative effects. For the RC-701 is really intended for the professional photographer, not the amateur. As well as three new lenses specifically designed for it, it will also accept over 60 existing Canon "FD" professional lenses using an adaptor.

The camera provides 9 shutter speeds, from 1/8th to 1/2000th of a second. The RC-701's focal plane shutter doesn't use the traditional horizontal or vertical blinds, but uses a new rotating slit and "magnetic charge" system. Canon hasn't released details of this, but it sounds like a technique of dumping a charge from a capacitor into a driver solenoid. It's certainly very quiet.

Like other cameras intended primarily for professionals, it offers various shooting speeds. In this case there are four: single shot, two per second, five per second and a very impressive 10 per second. How's that for capturing the action! Any faster and it would be a movie camera . . .

I suspect that the main thing limiting the shooting speed is the ability of the floppy disk drive to step between tracks, because each image is recorded on its own track. Each floppy disk will record up to 50 images, each accompanied by its own date and time stamp information. The floppy drive is very quiet, even when you're taking shots at 10 per second.

Incidentally the images are recorded on the disk in analog fashion, using an FM system very similar to that in conventional VCRs. Each still picture occupies a single video field, encoded in the NTSC system used for American and

Japanese colour TV.

Power to run the RC-701's electronics comes from a rechargeable NiCad battery pack, which fits inside the handgrip "bulge" on the right-hand side of the case. The NiCad pack delivers 8.4V and will power the camera for between 200 and 250 shots when fully charged. According to Canon it can be recharged in an hour.

With battery pack and 11-66mm zoom lens, the camera weighs a fairly solid 4.18 pounds (1.9kg). Not exactly light compared with a typical SLR, but acceptable.

So much for the SVC camera itself — but what do you use to view the pictures? Actually there are a number of options.

One is a small "Still Video Recorder" or SVR, the RR-551, which looks like a smaller than usual VCR or CD player. Using this you can take the floppy disk from the camera, and play it back. The pictures can be viewed on a standard NTSC-system colour monitor or TV receiver.

The RR-551 offers front loading like a VCR, and features the ability to random access any desired shot on the disk simply by keying in its track number (like finding the tracks on a CD). Virtually all of its functions can be controlled using a cordless remote control unit. As well as being used to replay disks recorded by the SVC camera, the recorder can also be used to record "freeze-frame" shots from NTSC video recordings and TV transmissions — which may well interest TV stations and newspapers.

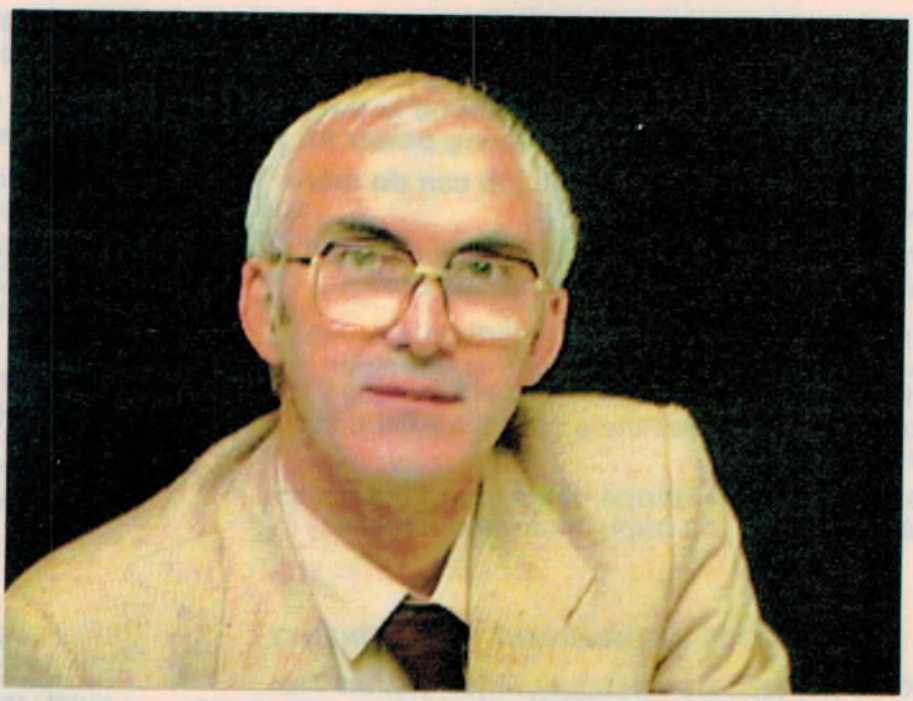
If you want "hard copy" versions of the SVC shots on paper, rather than viewing them on a monitor screen, Canon offers the RP-601 colour printer. This is a full-colour video graphics printer, which uses ink jet technology to produce pictures with an active area of either 122 x 92mm or 90 x 68mm. Printing a shot of the larger format takes around 4-1/2 minutes, and one of the smaller format 3 minutes.

The printer uses four inks, as in traditional four colour printing: yellow, cyan, magenta and black. Dot density is 6.7 per millimetre in both directions, or 170 per inch. Not bad at all, for halftone reproduction!

Paper feed is automatic, as is print colour and density control. A single load of paper provides sufficient for 50 prints.

A couple of sample larger-format shots produced by the RP-601 printer are reproduced here actual size, to give an indication of the quality obtainable

Above: The transceiver used to send the new still video pics over the telephone network. Below: Sample pics, shown actual size.



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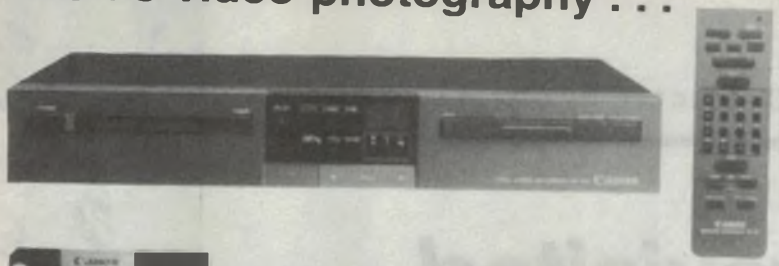
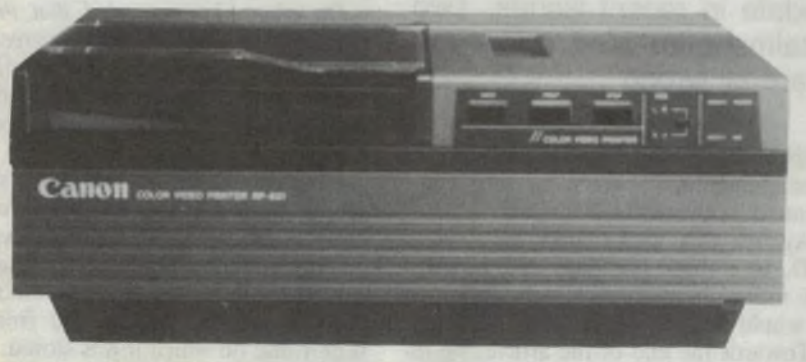
Canon's video photography . . .



Above: The RR-551 still video recorder and remote control. Left: One of the tiny 2" floppy disks. Below: the RP-601 video printer, which produces full-colour prints like those reproduced on the previous page in about 4-1/2 minutes.



at present. It seems to be roughly on a par with 16mm format.

There's a third option available with the Canon still video system: a transceiver, which can transmit the pictures to a similar transceiver anywhere in the world via a normal phone line.

The RT-971 transceiver contains a built-in still video recorder, and also a colour monitor with 94-mm diagonal screen. It uses AM transmission for low-noise phone circuits, or FM for noisy lines. A colour picture takes about 3 minutes to transmit, while a monochrome version takes only 1-1/2 minutes.

The transceiver will also send and receive captions and text from a standard computer, and has an interface for a Centronics printer. It can be used with a cellular radio phone for portable and mobile applications, when powered via an inverter.

By the way, the reproduced picture showing some pieces of fruit was actually transmitted from Japan over the phone lines, using a pair of RT-971 transceivers. I couldn't detect any degradation on this shot, compared with those shot "live" during the Canon demo.

There's also a small basic CCD colour camera module, the Ci-10, designed to hook up directly to the RR-551 recorder or RT-971 transceiver.

So overall, the new Canon still video system is very versatile. It's very convenient to use, and should have quite a few applications even as it stands. Security and law enforcement organisations will probably find it very interesting, and large real estate firms and international news gathering organisations should do too.

But price is likely to prevent the system from percolating down into the consumer marketplace, at least for a while yet. The indicated price for the RC-701 camera is $5800, and that for the RR-551 recorder $4000. The RP-601 is similarly $11,000 and the RT-971 transceiver a somewhat breathtaking $30,000.

Just at present, the cost/performance ratio of the new system isn't likely to have the film companies losing much sleep. But looking further down the track, I suspect it has a big future once it gets the benefit of emerging ULSI and HDTV technologies. Then we may well see consumer level products.

At the Canon demo, I had the distinct feeling that I was seeing the "model T" of a new era in photography. Only time will tell.

FORUM

Conducted by Neville Williams

TV colour revisited

Facing this November issue, we find ourselves with a number of letters, arising from earlier discussion, which we have simply not been able to accommodate in recent issues. Two of them have to do with the instalment for May under the heading "Television colour — hue are all wrong".

As you may recall, a correspondent (B.D. of Winnellie, NT) had criticised two of our writers in the January issue for describing red, green and blue — the basis of colour television — as "primary colours". He maintained that red, yellow and blue were true primaries and professed to be at a loss to understand how the system could operate without yellow as a primary, or be able to synthesise that colour in its absence.

Hence the whimsical title, under which his letter appeared: "Hue are all wrong"!

Very obviously, B.D. had not grasped the distinction between the "light-source" primaries used for television (green, red and blue) and what we described as the "pigment" primaries (yellow, magenta and cyan) commonly used by artists. Being a frequent source of puzzlement, it was this aspect on which our reply tended to concentrate.

We explained that there were two basic systems of colour mixing; or, if you prefer, two basic physical means by which colours can merge to produce a wide range of intermediate hues and chroma levels:

- ADDITIVE, applicable to the mixing of coloured light sources — in this case colour television, which normally involves luminescent phosphor dots or lines. Additive mixing uses green, red and blue as the primaries and these are, in fact, considered by physicists to be the true or basic primaries.
- SUBTRACTIVE, applicable to colour mixing involving light reflected from various pigments, inks and dyes. For this purpose, yellow, magenta (not red) and cyan (not blue) are most appropriate, being most commonly described in physics and other literature as "complementary colours" or the "complementary primaries".

Against this background, we invited B.D. to rethink his ideas and added a few more observations which we hoped he would find helpful in so doing.

Towards the end of the article, we indulged in a little deliberate "stirring" by raising the question of how colour photographic systems cope with the need to record a whole range of brilliant yellowish hues from a TV screen which, when examined with a magnifying glass, appears to be totally devoid of that colour, as such.

At the time, we were rather expecting that Phil Watson, a former colleague and a photographic guru, would come up with a definitive article on the subject and we hesitated, for that reason, to debate other follow-up correspondence in isolation. Things didn't work out that way, however, although Phil did, for his own satisfaction, check out the basic technicalities, as well as looking back over available historical references.

Without trying to translate our rather lengthy phone conversation into an article, it is sufficient to confirm here that, photographically, green/red/blue have always been accepted as the true primaries, but with complementaries yellow/magenta/cyan also having an essential role in the processes.

Coming to the letters

D.D. of Granville, NSW, takes no issues with the general thrust of the May "Forum" but he does examine the text somewhat clinically — an eventuality for which any technical writer must be prepared. One point I must concede forthwith. I quote:

On page 17, you stated that the approximate wavelengths of red, green and blue light were respectively 615um, 532um and 470um. The correct figures are 615nm, 532nm and 470nm. Note nanometres instead of micrometres.

I tried to check on whether I should accept personal responsibility for the error or blame a sub-editor or typesetter instead but, unfortunately, I had discarded my duplicate print-out after publication and deleted the file from the floppy disc on which it was stored.

As it happens, the book mentioned in the May Forum and to which I referred for the exact figures (Colour Television — the PAL system by Prof. G.N. Patchett) used the abbreviation "mu" followed by the explanation in brackets:

(a millimicron or nanometre is 10^{-9} metre).

I can't be sure now whether I used that same abbreviation "mu", which became inadvertently reversed, or the more recent "nm" which emerged from the system as "um". Sorry about that!

But that is not the main thrust of D.D's letter, which begins thus:

The human eye contains receptors (cone cells) of three different types, each type responding to a band in the electromagnetic spectrum. The three bands have their peaks respectively in the red (615nm), green (530nm) and blue (470nm) regions. The combined response band defines the visible part of the spectrum.

The presence of only three different colour receptors means that the colour information sent to the brain is in an RGB format, and the sensations produced thereafter are purely "subjective". Since both the red and the green receptors respond to the yellow part of the spectrum (560nm) the response of the eye to spectrally pure yellow light can be simulated with the correct combination of red and green light.

Perhaps because of the bracketed wavelength figures, the above statement comes across as being rather dogmatic, and I couldn't help but wonder whether, by implication, the writer was seeking to counter my suggestion on page 17 (col.1) of the May issue that primary colours, in general, are not as unique as many may have believed — a point made quite specifically by Professor Patchett.

Average visual response

While some textbooks may indeed carry an overall visual response curve for a "standard observer", and for the separate receptor groups, it is important to realise that such curves are not based on direct measurements, as for electro-optical devices. They can only be deduced indirectly, and by averaging the observations of many subjects. Individuals may react to, or see colours quite differently, with something like 10% of adults having sufficiently impaired colour vision to be considered at least partially colour blind.

(In his book "Colour Television Servicing" (Newnes-Butterworths, 1979) Gordon J. King mentions the possible difficulties which a partially colour blind technician might encounter in seeking to adjust the colour balance of a TV receiver.)

It would be surely stretching credibility to assert that the primaries have a unique and precise wavelength, determined by human vision, when the receptors in individual eyes have such an imprecise and overlapping response.

The wavelength figures mentioned in the May Forum and in the letter above actually relate to the so-called "illuminant C", adopted by the television industry in an effort to standardise, for their own convenience, the functional primaries and a white level, described in broad terms as "a rather blue white, corresponding to sky-scattered daylight". According to my information, they were chosen for their ability to reproduce a wide range of intermediate hues, consistent with the availability of suitably efficient phosphors.

The letter continues:

Having established the above facts, it becomes clear that the concepts of primary colours and mixing (whether additive or subtractive) are intimately connected with the nature of the human eye. For example, there are three primary colours (in both the additive and subtractive case) simply because the eye has three different types of colour receptors and the optimum choice for these colour primaries is determined completely by the response band of these receptors — an important point, essential to a true understanding of colour mixing, which is rarely mentioned in such discussions.

My unease persists about the "dogmatic" approach. I accept that the choice of optimum primary colours in "intimately connected with" the nature of the human eye, but "determined completely by" is a sweeping statement open to misunderstanding and debate.

Television is relatively unambiguous optical medium, in that the eye is presented directly with the primary source colours it needs to simulate a close approximation of the original scene: simple additive mixing. I have already suggested, however, that efficiency was a consideration in the choice of phosphors.

In the case of a photographic print, painting, or magazine illustration, the light energy reaching the eye is what remains after various wavelengths have been subtracted in various ways from the nominal white light, which illuminates the picture. By "various ways" I refer to complex reflection from surface particles, from within the coating structure and from the backing layer.

For sure, the eye needs an appropriate pattern of reflected light but the physical routines of photography, painting and printing go well beyond the mere use of three subtractive (or complementary) colours predictably located on an RGB diagram. Particularly in painting and printing, a wide range and an indeterminate number of pigments or inks may be used to obtain the desired end result.

How good is TV colour?

But, we are not yet done with sweeping statements:

The reproduction of colour images, by whatever means, therefore requires something which stimulates the eyes in the same way that the original image does. Colour TV receivers achieve this by the use of red, green and blue phosphors, which stimulate separately the red, green and blue receptors. The fact that each phosphor can act separately on each type of receptor means that any response of the eye can be simulated.

For emphasis, the writer underlined the word "any" in the last sentence. In fact, while most textbooks on the subject agree that the range of colours available from the television system is exceptional, some colours which occur in nature do lie outside the classic, textbook colour triangle. On that basis, D.D. may need to modify his reference to "any (underlined) response".

The same, only different!

But enough of what may be seen as mutual quibbling. D.D. concludes his letter with a couple of observations which you might like to think about. While professing little expertise in the area of photography, he has this to say:

You question how colour film "can present to your eyes colours which presumably did not exist in the first place".

To answer such a question, one must precisely define what is meant by "colour". The most practical definition is in terms of the response induced from the eye: i.e. two spectral distributions are the same colour if the eye responds to them in the same way. A consequence of this definition is that most colours do not have a unique spectral distribution. It follows from this that the spectral distribution presented to your eyes by the reproduction of the image does not have to be identical to that of the original image for it to be the same "colour".

From the definition of colour that I have adopted, a colour film does not need to reproduce the spectral distribution of the image in order to present the eye with a suitably "accurate" reproduction.

In the above statement, D.D. has the support of my dictionary, which confirms that the word "colour" refers primarily to the evaluation of transmitted or reflected light by the "visual sense". It goes on to explain that the determining factor for such evaluation is in the spectral composition, as expressed in hue, chroma (purity or saturation) and luminance (brightness).

It's interesting to ponder how different the world around us might look if, instead of those three relatively broad band sets of colour receptors, we were selectively sensitive to peaks in the spectral output, reflection or transmission of light sources, pigments, filters and window panes. It would be novel but it might also pose a few practical problems, as D.D. points out in closing:

If it was essential to reproduce spectral distributions accurately for successful colour reproduction, in most cases the reproduction of colour images would not be feasible — it would be too difficult. This sort of reproduction would be necessary if the eye had a large number of different colour receptors each having a narrow response band. It would increase the number of primary colours required

FORUM

to generate an acceptable colour image. Instead of three different phosphors, ten or twenty might be required.

Indeed, most of the colour reproduction we take for granted would not be practical if the eye was spectrally more discerning.

Many thanks, D.D. for so effectively stirring the communal mental pot!

From a keen photographer

Another NSW reader, who for personal reasons, requests that he not be identified, has addressed himself to the question of what happens when a TV colour image is photographed. He also draws attention to a slip in the text of the May Forum at the bottom of col.1, p.18, where we attributed subjective yellow to the "blue and green phosphors glowing brightly, side by side". Fortunately he says, the error was apparent as such from the text which followed. Sorry about that one, also!

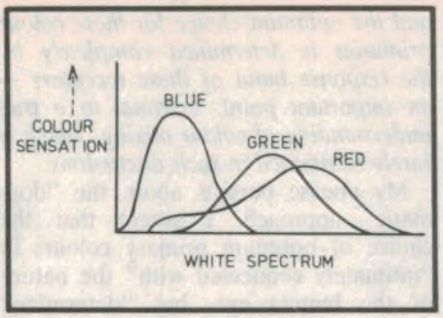
More importantly, in response to my admitted "stirring", he worked out what would happen in the various layers of a slide film after exposure, during the various processing steps, through to the finished transparency; this with the aid of blocks of little rectangles, all dutifully filled in with coloured crayon. For good measure, he took some slide photos, by way of verification.

He points out that it is possible to take a macro photo of the TV screen, such that the individual red and green dots or lines are resolved on the slide. If this resolution is retained during projection, the two colour sources may be visible as such or may tend to merge into yellow, depending on the viewing distance.

If the projector is deliberately defocused, the individual red and green sources will merge or overlap and will be accepted by the eye as yellow.

On the other hand, if the whole screen is photographed with a 35mm camera, it is likely that the lens will not resolve the individual picture elements. In that case, any given spot on the film will be exposed to (say) red and green light and this is where the writer's little coloured rectangles tell the story:

The diagram shows that the development of magenta dye is inhibited where the film is exposed to green light. Likewise exposure to red light inhibits the development of cyan. However, exposures to green light and red light result in the development of yellow dye in each case. The result is exactly the same as if the film had been exposed to yellow light.



Illustrating the colour response of the three sets of cone receptors in the human eye. The relative height of the curves may vary with individual eyes. Note that the green receptors are responsive to red light and to a lesser extent to blue.

The diagram also explains how white (clear film) is created if all three colours fall on the same spot, because of limited lens resolution. The result is essentially the same as photographing a white area, reflecting all three primary colours.

The above explanation suggests a parallel between the interaction of the colour elements with the broadly selective cones in the eye and the broadly selective layers in the film. It even sounds quite simple in a roundabout sort of way!

But, not to be outdone, this second correspondent finishes up with his own proposition for you to think about:

A partially colour blind person, with reduced red and green vision will see a colour TV picture with the red, green and blue primaries different to a printed picture, film or slide projection, which all utilise cyan, magenta and yellow colours. This difference of perception of various types of colour reproduction extends also to the white areas which, to them, may look tinted on TV.

Couple this with Gordon King's reference to partially colour blind television technicians and you have a topic for argument over that cup of morning coffee. Does impaired colour vision make it impossible for a technician to set up a colour picture, or is it likely to be right when it looks normal to him?

Go easy on valves!

By way of a complete change of subject, C.M. of Lugarno, NSW, was apparently disturbed by an article which he came across in a back issue (September '83) entitled "Valves are dead — but not forgotten".

The article described a rebuild of the ancient "Three-Band Two" regenerative receiver, originally featured (so the author said) in May 1957 and updated in October 1966. It used a 6U8 or 6BL8 valve, with the pentode section serving as a regenerative detector and the triode as an audio amplifier, to drive either headphones, or, alternatively, a loudspeaker at necessarily modest volume. The second valve was a 6X4 rectifier.

The idea behind the rebuild was to discover whether it was still practical or worthwhile for beginners to tackle such a project in late 1983, using parts that were available over the counter, as distinct from the left-overs in somebody's junk box.

By all accounts, the rebuild proved disappointing by current standards and a poor investment in terms of the dollars likely to be spent on parts, considering the results likely to be achieved. On the other hand, the author said, if you had a boxfull of left-over bits and the urge to build up such a receiver, by all means do so — but don't expect too much.

When he came across the issue C.M. didn't like the verdict one bit. As far as he was concerned, it was just one more example of the magazine's "habit of knocking valves".

His three page letter, to hand recently, claims that the receiver was a poor choice, anyway, and that a more favourable impression would have been gained had the author opted for the "Three-Band Three" from the November 1966 issue, using a recognised power valve in the output stage. But, in any case, the performance of the "Three-Band Two", 1983 version, could have been upgraded considerably with a few simple modifications which C.M. proceeded to suggest.

Having in mind that I had retired before September '83, and that there has since been a complete turnover in the EA staff, there was no prudent way of determining with what tender loving care the constructor or author had sought to optimise the performance of the rebuild and/or the conditions under which it was finally evaluated. Both aspects were, and still are, critical with these little regenerative receivers being, at the one time, a challenge and a liability.

It is entirely possible that C.M. could have tweaked things to better advantage. I might even have done so myself, given my background as someone whose first experience with wiring involved using a pair of round-nosed pliers to

form square-section tinned busbar to fit the binding post of a UV-200 bayonet socket!

I've talked in recent times about building or re-building simple receivers, if not for nostalgia, at least for the perception they can bring to matters electronic. But to commend and defend valves in terms of efficiency and practicality is something else.

Even small words matter!

While in the course of writing this article, I received a copy of the September issue and, while scanning through Forum, noted an amazing statement (p.27, col.1, par.3) to the effect that Technics had developed a CD error correction algorithm "so advanced that the chances of retrieving the correct data are an incredible once in 5000 years".

That would be even less than the famous "Buckley's" and one would wonder why Technics bothered!

However, mindful of slips mentioned earlier in the present article, I hastened to put the original text up on the screen. To my relief — mixed with a little frustration — it read "the chances of NOT retrieving the correct data . . . etc." I leave it to you to make the correction.

Admittedly, it may not be as important to do so as in a certain ancient edition of the Bible, from which a compositor is said to have omitted that same little word from the commandment that reads: "Thou shalt not commit adultery".

Tailpiece

In the *Sydney Morning Herald* pink Guide for August 10, David Frith reported on the introduction to the Australian market of the new, peak performance R852/MD loudspeakers from the Monitor Audio Group, of Cambridge, England. They were being demonstrated by Mo Iqbal, founder and managing director of Monitor, at Bartlett HiFi in Drummoyne, Sydney.

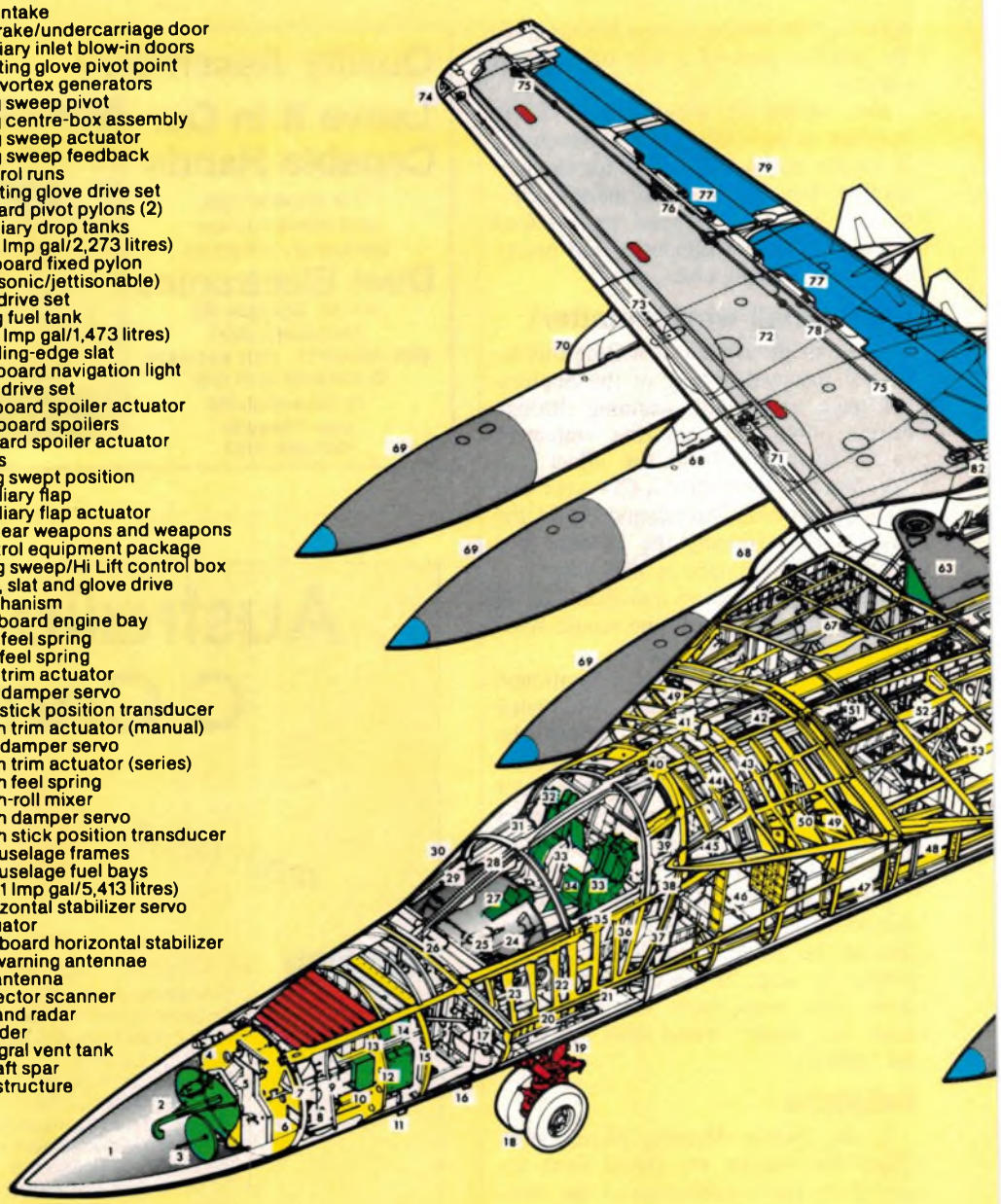
What caught my eye was the statement that the "gorgeous melange of sound" was all coming via compact disc. I quote:

"Mo Iqbal, who loves music and its fine reproduction, has little time for the diehards who insist that black vinyl LP is still the only way to listen to recordings".

I can't do it as well as Richard Carleton on television but, having in mind past exchanges between this column and Sydney's outspoken group of hifi conservatives, I might just be permitted a wry smile!

F-111 cutaway

1 Hinged nose cone
2 Attack radar
3 Terrain-following radar
4 Nose hinges (2)
5 Radar mounting
6 Nose lock
7 Angle-of-sideslip probe
8 Homing antenna (high)
9 Forward warning antenna
10 Homing antenna (low and mid)
11 ALR-41 antenna
12 Flight control computers
13 Feel and trim assembly
14 Forward avionics bay
15 Angle-of-attack probe
16 UHF Comm/Tacan No 2
17 Module forward bulkhead and stabilization flaps (2)
18 Twin nosewheels
19 Shock strut
20 Underfloor impact attenuation bag stowage (4)
21 Nosewheel well
22 LOX converter
23 Rudder pedals
24 Control column
25 LOX heat exchanger
26 Auxiliary flotation bag pressure bottle
27 Weapons sight
28 Forward parachute bridle line
29 De-fog nozzle
30 Windscreen
31 Starboard console
32 Emergency oxygen bottle
33 Crew seats
34 Bulkhead console
35 Wing sweep control handle
36 Recovery chute catapult
37 Provision/survival pack
38 Attenuation bags pressure bottle
39 Recovery chute
40 Aft parachute bridle line
41 UHF
42 Stabilization-brake chute
43 Self-righting bag
44 UHF
45 ECM antennae (port and starboard)
46 Forward fuselage fuel bay (2,340 Imp gal/10,638 litres)
47 Ground refuelling receptacle
48 Weapons bay
49 Module pitch flaps (port and starboard)
50 Aft flotation bag stowage
51 Air refuelling receptacle
52 Primary heat-exchanger (air-to-water)
53 Ram air inlet
54 Rate gyros
55 Rotating glove
56 Inlet variable spike
57 Port intake
58 Air brake/undercarriage door
59 Auxiliary inlet blow-in doors
60 Rotating glove pivot point
61 Inlet vortex generators
62 Wing sweep pivot
63 Wing centre-box assembly
64 Wing sweep actuator
65 Wing sweep feedback
66 Control runs
67 Rotating glove drive set
68 Inboard pivot pylons (2)
69 Auxiliary drop tanks (500 Imp gal/2,273 litres)
70 Outboard fixed pylon (subsonic/jettisonable)
71 Slat drive set
72 Wing fuel tank (324 Imp gal/1,473 litres)
73 Leading-edge slat
74 Starboard navigation light
75 Flap drive set
76 Outboard spoiler actuator
77 Starboard spoilers
78 Inboard spoiler actuator
79 Flaps
80 Wing swept position
81 Auxiliary flap
82 Auxiliary flap actuator
83 Nuclear weapons and weapons control equipment package
84 Wing sweep/Hi Lift control box
85 Flap, slat and glove drive mechanism
86 Starboard engine bay
87 Yaw feel spring
88 Roll feel spring
89 Yaw trim actuator
90 Yaw damper servo
91 Roll stick position transducer
92 Pitch trim actuator (manual)
93 Roll damper servo
94 Pitch trim actuator (series)
95 Pitch feel spring
96 Pitch-roll mixer
97 Pitch damper servo
98 Pitch stick position transducer
99 Aft fuselage frames
100 Aft fuselage fuel bays (1,191 Imp gal/5,413 litres)
101 Horizontal stabilizer servo actuator
102 Starboard horizontal stabilizer
103 Aft warning antennae
104 HF antenna
105 Detector scanner
106 X-Band radar
107 Rudder
108 Integral vent tank
109 Fin aft spar
110 Fin structure



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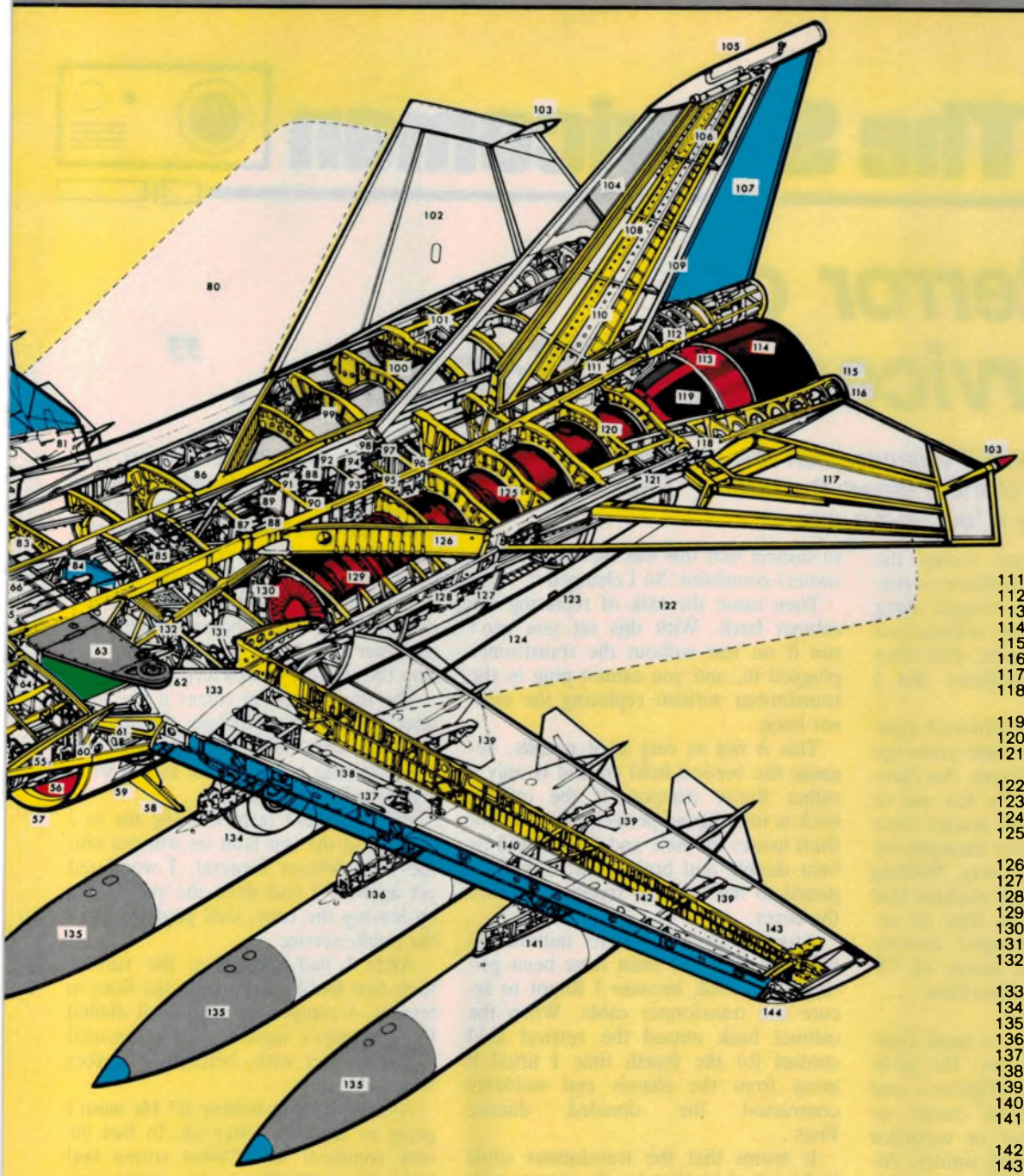

111 Fin/fuselage attachment
112 Rudder servo actuator
113 Variable nozzle
114 Tailfeathers
115 ECM antenna
116 ALR-41 antenna
117 Horizontal stabilizer structure
118 Horizontal stabilizer servo actuator
119 Free floating blow-in doors
120 Afterburner section
121 Horizontal stabilizer servo actuator
122 Wing swept position
123 UHF
124 Ventral fin
125 Fire detection sensing element loops
126 Cross frames
127 Engine access hatches
128 Engine accessories
129 Pratt & Whitney TF30 turbofan
130 Three-stage fan
131 Intake duct
132 Fire extinguishing agent container and nozzles
133 Wing box skinning
134 Port mainwheel
135 Auxiliary drop tanks
136 Pivot pylon
137 Pivot point
138 Pivot actuator
139 Flap racks
140 Fixed pylon strong point
141 Outboard fixed jettisonable pylon
142 Wing integral fuel
143 Wing box structure
144 Port navigation light

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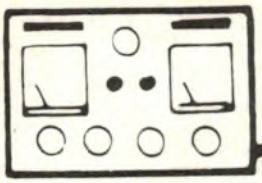
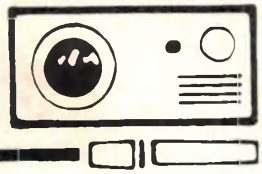


The Serviceman



That terror of TV servicemen: "Ftsss . . ."

Sooner or later, most TV servicemen are suddenly striken by something that all of them dread: the terrible "Ftsss" disease. It was my turn only a few weeks ago.

One of the problems facing the operator of a one man business is personal illness. Most of us struggle along through the most appalling sickness just to keep faith with customers, who often don't appreciate our sacrifices. But I have been fairly lucky.

Since I left the air conditioned comfort of the public service some years ago I have had very little illness. An occasional cold in the head, a few cut or spiked fingers and a few bruises once when an angry truck driver thumped me for not getting out of his way. Nothing dramatic — just the usual mishaps that befall most of us at one time or another. But all that changed recently when I contracted that terror of TV servicemen, the dread disease Ftsss . . .

It came about like this.

A customer brought in a small General portable colour TV set. The problem was uncontrollable brightness and retrace lines. This usually causes no problems. It's a resistor or capacitor open circuit, or something similar. Although I had no circuit diagram for this set I anticipated a relatively easy job. Until I tried to lift the back off.

Six screws secured the back and antenna panel and these were easily removed. But unknown to me the power transformer was attached to the inside of the cabinet back and made this all unbalanced and wobbly as I lifted it away.

At the same time, the leads from the transformer pulled at the chassis and threatened to tip the whole mess onto the floor. After such an inauspicious beginning, I didn't hold any further hope for an easy task.

One of those diodes leading from the line output transformer gave a suspect reading and as this supplied the second anode in the picture tube, I had reason to suspect that this was the cause of the owners complaint. So I changed it.

Then came the task of replacing the cabinet back. With this set you can't run it on test without the transformer plugged in, and you cannot plug in the transformer without replacing the cabinet back.

This is not as easy as it sounds, because the vertical hold control is only a rather flimsy trimpot. If the cabinet back is not aligned perfectly the trimpot shaft misses the hole and the pot will be bent double and broken off. This happened to me twice in trying to replace the cover.

After struggling for 15 minutes to refit the cabinet I must have been getting a bit tired, because I forgot to secure the transformer cable. When the cabinet back missed the vertical hold control for the fourth time I lifted it away from the chassis and suddenly contracted the dreaded disease Ftsss . . .

It seems that the transformer cable had hooked itself under the picture tube base board and lifted away board, base and tube neck in one horrible hissing "Ftsss . . . " Now most diseases have a typical prognosis — the symptoms are characteristic and predictable. The sore throat comes before the temperature and the runny nose afterwards. So it is with Ftsss . . .

The first symptom is the sick feeling in the stomach as the implications sink in. "How will I tell the customer? Can I get a new tube? And can I afford it if it is available?" This symptom might last from ten minutes to half an hour and can be accompanied by bouts of flinging — screwdrivers, pliers, soldering irons, or anything handy that is not nailed down.

The second symptom usually appears just before the customer answers your phone call. It is manifested as a severe nervous tremor and an acute anxiety about the possibility of the customer reaching through the phone to strangle you with your own necktie. The severity of this symptom can be lessened by two or three stiff drinks before dialling the customer's number, but nothing can stop the shaking completely.

The final symptom comes a few days later as you contemplate the sudden dramatic and violent contractions that convulse your bank balance as you write a cheque for the new tube.

With all these terrors facing me as I listened to the last faint sss whisper into the now defunct General, I wondered yet again if I had done the right thing by leaving the cosy, well paid world of the public service.

After I had picked up the various tools that had been flung on the floor in temper, I composed myself and dialled the customer's number. I had decided to get it over with, before the shakes took hold.

And would you believe it? He wasn't going to chop me after all. In fact his only comment was "What rotten bad luck! Oh well! Thanks for trying anyway. Will you get rid of the rubbish for me?" It's true. That's what he said.

None of the colleagues to whom I have related this story will accept it as the truth. This sort of customer is only a TV serviceman's pipe dream and doesn't exist in real life!

But there is just one of these imaginary customers, and amazingly he lives on my patch. I've still got the junked set to prove that at least once I've come out on top.

I didn't have nearly as much luck with another TV set this month, however — just to make up for things.

A television set is, to its owner, a complicated mass of electronics that only a genius could understand. A lot of TV technicians have a similar feeling to-

wards the sets they work on and they approach each fault as if it was a major exercise in obscure mathematics or physics.

Yet, when you know something about TV's, you realise that each set breaks down into logical circuit blocks. Although some blocks are complicated and hard to understand, other sections are basically simple and use techniques that are taught to young technicians in their first year at college.

For instance, the vertical amplifier, drive and output stages are not much different to an audio amplifier. When you think of it, the vertical stage has to handle a 50Hz signal with almost no distortion and this is just what a good audio amplifier has to do.

The sync separator and vertical oscillator are a bit out of the ordinary, as is the wave shaping network that follows. This network is required to deliver a sawtooth waveform to the output stage. But once the correct signal is developed, a good audio amplifier with low distortion and sufficient power handling capabilities should be quite able to handle the TV signals. And servicing the vertical output stage should be no more difficult than servicing an audio amplifier. Or so you might think!

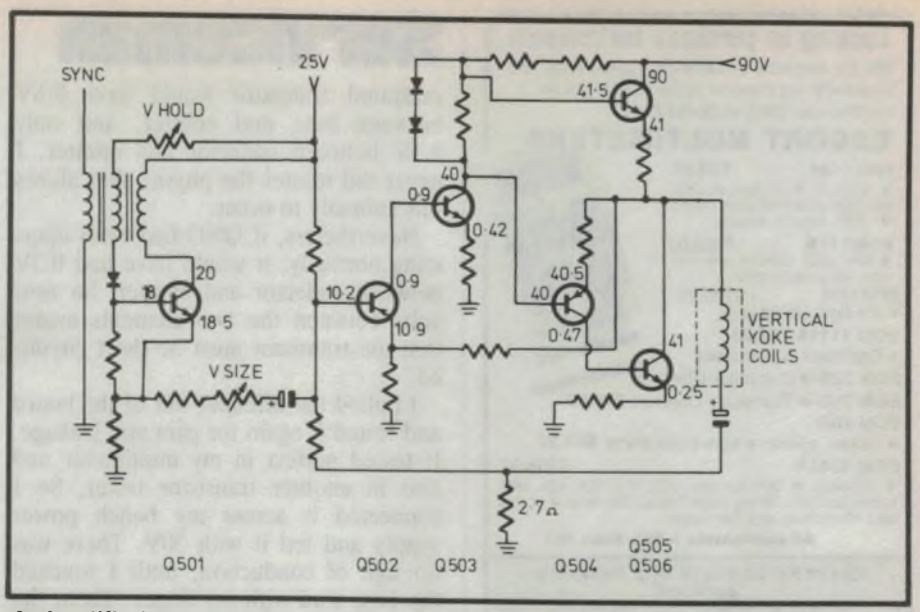
All of this preamble is a lead up to a story about a Sharp portable colour TV, model C-146X with no vertical scan. The picture had collapsed into a moving, coloured horizontal line. This fault is common to all brands of televisions and usually offers no real problem in finding the fault and restoring the set to normal.

Unfortunately, this Sharp circuit uses feedback from the output stage to provide not only linearity but also bias to the driver stage. So the driver can't get going until the output comes up, which doesn't happen until the driver gets going. Now, how do you get out of that one?

This kind of feedback is common in power supply circuits, where a pulse from the line output stage is used to drive the power supply chopper. But until the chopper is working, there can be no power to run the line output to supply the pulse.

In this situation, a kickstarter is provided to run the supply for a second or two, while the line stage starts up. This sort of feedback can be the dickens to sort out, since any part of the loop can be the source of the trouble. Even the kickstarter can cause trouble, even though it is logically outside the loop.

The first line of attack is to measure all the voltages that are accessible, and



A simplified version of the vertical sweep circuit in the Sharp C-146X receiver, as discussed below.

to compare them with those given on the circuit diagram. This sometimes points to the faulty part, but more often makes sense only after the fault has been found.

The vertical circuit in this Sharp TV consists of Q501, a blocking oscillator followed by a wave shaping network. This delivers a sawtooth wave to the base of the first driver, Q502, a PNP transistor which receives its base bias from the same source as the oscillator. This was the last place at which I was able to measure a correct voltage. From here on everything was haywire.

The emitter of Q502 should have on it about 10 volts, divided down from the 40 volt mid-point in the output pair. Its collector should deliver about 0.9V to the base of Q503, which doubles as an amplifier and voltage regulator to set the bias on the top output transistor.

The signal passes to a third amplifier Q504 which in turn drives the bottom transistor in the output pair. All of this, mark you, is direct coupled and of course, every component checked OK. The only problem was that it didn't work and all the voltages were quite wrong.

In fact, it's not right to say the voltages were wrong, because there weren't any to be wrong. Only the 120 volt rail to the top of the output pair was normal. Every other point except the base of Q502 was reading 0 volts.

If I had been wide awake, I might have seen the significance of the 0 volts on most of the transistor elements. It was a direct pointer to the cause of the trouble, but I missed it and spent hours removing and measuring all the components around the output and driver stages.

As far as I could see, the key to the puzzle was the mid-point in the two output transistors. When they were operating properly, the voltage at this point was fed back to the earlier stages to provide supply to Q502 and Q504, and indirectly to the bias Q503.

Quite obviously there was a faulty component in the system and as nothing I could think of would point to the culprit, there remained only the tedious and thankless task of removing each part and testing it individually.

Fortunately, most of the vertical system is on a small plug-in board and it was easy to work on this on the bench. The few remaining parts on the chassis offered no real problems in getting an accurate measurement. Except that every part — transistors, diodes, caps, and resistors all checked and measured spot on.

So, if there were no faulty parts in the circuit, why didn't it work? It was not until this point that I realised that the fault was probably not present until the circuit was energised. It wouldn't be the first time that a component only broke down under load.

And then the penny dropped. When I had measured voltages early in the exercise, I had found the collector, base and emitter of Q503, in particular all read the same 0 volts. In fact, they were all just a few millivolts above ground instead of the 420mV shown on the schematic.

From the dim mists of my memory I recalled a teacher once straining my intelligence by trying to explain that a

Serviceman

saturated transistor would have 0.6V between base and emitter, and only 0.3V between collector and emitter. I never did master the physics that allows this anomaly to occur.

Nevertheless, if Q503 had been operating normally, it would have had 0.3V between collector and emitter. So zero volts between the two elements meant that the transistor must be short circuited.

I pulled the offender out of the board and tested it again for gain and leakage. It tested perfect in my multimeter and also in another transistor tester. So I connected it across my bench power supply and fed it with 30V. There was no sign of conduction, until I touched the base lead with my finger. Then, the supply voltage dropped to almost zero as the current jumped to the supply's current limit point.

Further testing showed that the transistor worked perfectly up to 15 volts, but at any Vce above that it turned itself into an SCR and switched on with the slightest input on the base. What would you call it — a voltage dependent bipolar SCR? It's a real funny one and the whole job was nothing at all like any audio amplifier I've ever serviced.

This had been another of those jobs that makes the taxman doubt my honesty. It took something like five hours to sort this one out, and there is no way I could charge for more than one hour. I only hope I will find more of these faults so that I can recoup some of the time lost on this one.

And just to finish up this month, a little story which shows that it's not only the lowly technician that makes silly mistakes. Even the professional engineer can make a boomer (literally) at times.

A group of techs were recently being shown over the transmitters in a country radio station and the engineer doing the demonstration was relating some of the service problems that he had come across. Most difficulties are quickly solved by switched in the standby transmitter, after which the breakdown can be tackled in relative calm, late at night when the station is off the air.

One such problem concerned the 2.5kW standby transmitter itself, which was not delivering its full head of steam. Our engineer felt that perhaps the rectifiers feeding the 3kV to the anode of the output tube might be a bit weak, hence low anode voltage and low output. But how do you check 3kV at a couple of amps?

The problem was complicated by the fact that interlocks on the cabinet doors were very nearly foolproof. Bypassing them would have been a long job. It was far easier to put a meter inside the cabinet and close the doors. The meter scale could then be clearly seen through the windows in the panels.

So a small multimeter was securely mounted on a plastic stand inside the transmitter cabinet, alongside the big output tube. The leads were carefully routed to the anode and cathode terminals and firmly fixed in place.

When the cabinet doors were closed and the interlocks released the safety switches, the tube heater began to glow. Another interlock prevents the HT being applied until the tube is thoroughly warmed up, so our engineer spent the two minute waiting time checking his handywork.

It was just as he was pressing the HT switch button that he noticed that the meter was switched, not to 5kV as he intended but to the low ohm range.

It wasn't the blinding flash that worried him so much as the deafening "boom" as the meter disintegrated before his startled eyes. He pulled the main switch and drove a shaky course to the relative safety of his home.

His multimeter is still spread over the inside of the transmitter cabinet, as a smoky grey stain that will still be there when the station closes down for the last time. Now that the shock has worn off he says philosophically, "Oh well, it was only a $30 meter anyway".

TETIA Fault of the Month

Sony KV-1310E

Symptom: Thermal cutout continues to trip after replacing shorted chopper transistor. All transistors OK and set operates properly from independent 110V supply.

Cure: D609 (MZ-12) 12 volt zener open circuit. This causes error amplifier to sense low output and to open the mark/space in an attempt to compensate. If the zener was shorted, the supply would shut down harmlessly.

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.

3M DYNAMARK PHOTOSENSITIVE
(EX SCOTCHCAL)

All prices per box and include tax

8007 REVERSAL FILM
250 x 300mm (10 sheets) $39.95
300 x 600mm (5 sheets) $54.95

8005 BLACK ALUMINIUM
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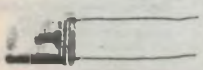
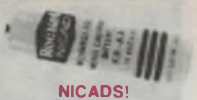


CRYSTALS SPECIALS!

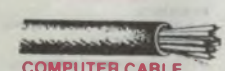
Description	Cat No.	1-9	10+
1MHz	Y11000	$7.50	$7.00
4.433618MHz	Y11023	$2.95	$2.75
8.867238MHz	Y11055	$2.95	$2.75
12MHz	Y11070	$2.95	$2.75
14.31818MHz	Y11072	$2.95	$2.75



NICADS!

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

Size	Desc	1-9	10+	100+
AA	450 mA.H.	$2.95	$2.75	$2.50
C	1.2 A.H.	$9.95	$9.50	$8.95
D	1.2 A.H.	$9.95	$9.50	$8.95



COMPUTER CABLE

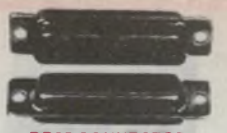
CIC6 6 conductor computer interface cable. Colour coded with braided shield. (to IE422 specifications). Copper conductor 6 x 7/0.16mm
1-9 metres $1.90/m
10+ metres $1.70/m

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

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

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

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



DB25 CONNECTOR SPECIALS!

We have just imported 50,000. So you get to save a small fortune!

DB25 MALE (P10900)

1-9	10+	100+
$1.00	$0.90	$0.80

DB25 FEMALE (P10901)

1-9	10+	100+
$1.20	$1.00	$0.90

ELECTROLYTICS (PCB MOUNTING)

16 VOLT

Cat.No.	Description	1-9	10+
R15461	10uF	$0.25	$0.20
R15481	22uF	$0.25	$0.20
R15511	33uF	$0.25	$0.20
R15521	47uF	$0.25	$0.20
R15531	100uF	$0.30	$0.25
R15541	220uF	$0.60	$0.50
R15551	330uF	$0.75	$0.65
R15561	470uF	$0.75	$0.65
R15571	640uF	$0.90	$0.80
R15581	1000uF	$0.90	$0.80
R15601	2200/2500uF	$1.20	$1.10

25 VOLT

Cat.No.	Description	1-9	10+
R15422	2.2uF	$0.25	$0.20
R15432	3.3uF	$0.25	$0.20
R15442	4.7uF	$0.25	$0.20
R15462	10uF	$0.25	$0.20
R15502	25uF	$0.30	$0.25
R15512	33uF	$0.30	$0.25
R15522	47uF	$0.30	$0.25
R15532	100uF	$0.40	$0.35
R15542	220uF	$0.70	$0.65
R15552	330uF	$0.75	$0.65
R15562	470uF	$0.75	$0.65
R15582	1000uF	$1.00	$0.90
R15602	2200/2500uF	$1.40	$1.20

35 VOLT

Cat.No.	Description	1-9	10+
R15443	4.7uF	$0.30	$0.25
R15463	10uF	$0.30	$0.25
R15483	22uF	$0.30	$0.25
R15513	33uF	$0.40	$0.35
R15523	47uF	$0.40	$0.35
R15533	100uF	$0.60	$0.55
R15543	220uF	$0.60	$0.55
R15563	470uF	$0.70	$0.60
R15583	1000uF	$1.20	$1.10
R15593	2200/2500uF	$1.50	$1.30

50 VOLT

Cat.No.	Description	1-9	10+
R15404	0.47uF	$0.25	$0.22
R15414	1uF	$0.25	$0.22
R15424	2.2uF	$0.30	$0.25
R15434	3.3uF	$0.30	$0.25
R15444	4.7uF	$0.40	$0.35
R15464	10uF	$0.40	$0.35
R15484	22uF	$0.40	$0.35
R15514	33uF	$0.40	$0.35
R15524	47uF	$0.50	$0.45
R15534	100uF	$0.60	$0.55
R15544	220uF	$0.90	$0.80
R15564	470uF	$1.00	$0.90

63 VOLT

Cat.No.	Description	1-9	10+
R15405	0.47uF	$0.30	$0.25
R15415	1uF	$0.30	$0.25
R15425	2.2uF	$0.30	$0.25
R15435	3.3uF	$0.30	$0.25
R15445	4.7uF	$0.30	$0.25
R15465	10uF	$0.40	$0.35
R15505	25uF	$0.50	$0.45
R15525	47uF	$0.50	$0.45
R15535	100uF	$0.60	$0.55
R15545	220uF	$0.90	$0.80
R15555	330uF	$1.20	$1.10
R15565	470uF	$1.40	$1.20

MINIATURE HOBBY VICE

- Lever operated suction grip base for instant mounting and portability
- Mounts on smooth non-porous surfaces.
- Ideal for holding components, and other small/light objects.

Cat T12458 ..... only $5.45

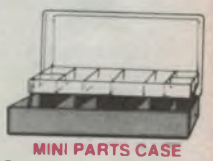
CODE KEY PAD

- 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

CANNON TYPE CONNECTORS SPECIALS

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



MINI PARTS CASE

Features a clear plastic lid for easy identification of contents. Up to five, adjustable lower compartments, plus a self elevating upper tray for smaller items.
Dimensions: 110 x 210x 43mm
Cat. H10087 ..... $9.95

NEW!

RS232 FAST CABLER

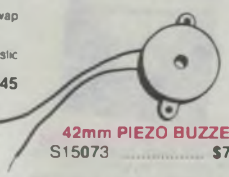
Makes RS232 interface configuration fast and simple. 3 slide switches enable line swapping functions, positive and negative voltages are displayed on 6 tricolour LED's.

SPECIFICATIONS:
Connector: DB25 plug on 100mm cable and DB25 socket on 100mm cable.
Indicators: Tricolour LED's for pins 2(TD), 3(RD), 4(RTS), 5(CTS), 6(DSR), 20(DTR).
Switches: 3 Slide switches to swap leads.
Power: Interface power.
Enclosure: Black, high impact plastic
Dimensions: 85 x 95 x 30mm
X15710 ..... $145

AUTOMATIC CABLE STRIPPER

- Strips cable with diameter of 1.16 2.26 3.2mm
- Fully automatic action. Squeeze grip will simultaneously strip and eject insulation.
- Length 180mm (7")

T11532 ..... $19.95



42mm PIEZO BUZZER

S15073 ..... $7.95

SPRING RETURN TOGGLE SWITCHES

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

BARGAINS!

SPECTROL MULTIDIALS MODEL 15-1-11

Number of turns: 10
Minor Scale Division: 1/500 turn
Shaft Bore: 6.35mm (1/4")
Finish: Satin Chrome
Body Size: 25.4 x 44.45mm (1 x 1 3/4")
Depth: 25.4mm (1")
Weight: 45.4g (1.6oz.)
Cat R14405 ..... $45.95

MODEL 16-1-11

Number of turns: 15
Minor Scale Division: 1/50 turn
Shaft Bore: 6.35mm (1/4")
Finish: Clear Anodize
Body Size: 22.2mm diameter (.875")
Depth: 22.2mm (.875")
Weight: 19.8g (0.7oz.)
Cat R14400 ..... $26.95

MODEL 21-1-11

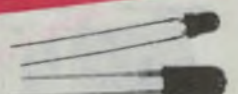
Number of turns: 15
Minor Scale Division: 1/100 turn
Shaft Bore: 6.35mm (1/4")
Finish: Satin Chrome
Body Size: 46.04mm diameter (1.812")
Depth: 25.4mm (1")
Weight: 85.g (3oz.)
Cat R14410 ..... $46.95

10 TURN WIRE WOUND POTENTIOMETER

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

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

1-9 $13.50
10+ $12.50

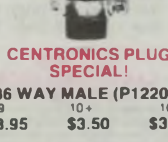


QUALITY LEDS

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

SOLDER BRAID

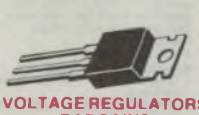
1.5 metres of specially treated braid for removing solder from PCB's etc. Simply place the braid against the solder and apply the soldering iron. The melted solder is drawn up into the braid!
T11320 1.5 metres $1.95



CENTRONICS PLUG SPECIAL!

36 WAY MALE (P12200)

1-9	10+	100+
$3.95	$3.50	$3.00

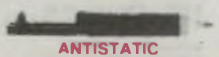


VOLTAGE REGULATORS BARGAINS

Description	1-9	10+
7805UC	$0.60	$0.50
7812UC	$0.60	$0.50
7905UC	$0.60	$0.50
7912UC	$0.60	$0.50

FREE STANDING, FOLD UP MAGNIFIER

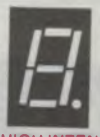
An economically priced "hands free" magnifier, lets you take care of all those tricky fine detailed jobs so often encountered in electronics, or any of many other practical uses such as home, work, hobbies etc.
Cat T10020 **Normally $14.95**
SPECIAL, ONLY $12.95



ANTISTATIC SOLDER SUCKER

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

Cat T11281 ..... $13.95



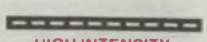
½" HIGH INTENSITY RED LED DISPLAYS

(Available in Common Cathode and Common Anode)

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

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

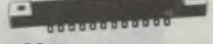
Cat No.	1-9	10+	100+
Z10190	$1.95	$1.75	$1.50



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



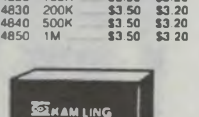
COMMODORE EDGE CONNECTOR

.156" spacing, 12/24 contacts

Cat No.	1-9	10+
P10973	$5.95	$4.95

BRIDGE SPECIALS

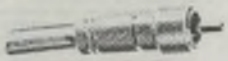
1-9	10+	100+	
WO2 1A 200V	Cat. Z11030		
$0.30	$0.28	$0.26	
WO4 1A 400V	Cat. Z11032		
$0.35	$0.30	$0.28	
SB604 6A 400V	Cat. Z11034		
$0.90	$0.80	$0.75	



10 AMP RELAY

S.P.D.T. 12V Coil, 240V (S14114)

1-9	10+	100+
$4.95	$3.95	$3.75



RCA GOLD PLATED PLUGS AND SOCKETS

For those who need the ultimate in connection. Essential for laser disc players to get that fantastic sound quality.
Plug Cat P10151 ..... $3.75
Socket Cat P10150 ..... $2.95

RCA GOLD PLATED CHASIS SOCKET

For the ultimate connection!
Cat P10229 ..... Normally $1.95

1-9	10+	100+
$1.00	$0.90	$0.85

SPECTROL 64Y MULTI TURN TRIMPOTS

Cat No.	Description	1-9	10+
R14700	10R	$3.50	$3.20
R14710	20R	$3.50	$3.20
R14720	50R	$3.50	$3.20
R14730	100R	$3.50	$3.20
R14740	200R	$3.50	$3.20
R14750	500R	$3.50	$3.20
R14760	1K	$3.50	$3.20
R14770	2K	$3.50	$3.20
R14780	5K	$3.50	$3.20
R14790	10K	$3.50	$3.20
R14800	20K	$3.50	$3.20
R14810	50K	$3.50	$3.20
R14820	100K	$3.50	$3.20
R14830	200K	$3.50	$3.20
R14840	500K	$3.50	$3.20
R14850	1M	$3.50	$3.20

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Impedance: 75ohm
Video bandwidth: 16MHz (-3dB)
Scanning frequency:
Horizontal: 18.432 +/- 0.1KHz
Vertical: 50HZ +/- 0.5%
Active display area: 216(H) x 160(V)mm
Display characters: 80 characters x 25 lines
Input connector: 9 pin connector
Controls:
Front: Power ON/OFF, Contrast
Rear: V-Hold, V-Size, Brightness
Internal: Vertical Linearity, Horizontal Linearity, Horizontal Width, Focus.
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Input Level: TTL Level
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Vertical: 60Hz
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FEATURES...

- At last a monitor with both TTL and Composite modes!
- High contrast, non-glare screen
- High resolution, 80 or 40 character display
- Swivel/Tilt base

SPECIFICATIONS...

Picture tube: 12" diagonal and 90° deflection
Phosphor: Green (P42)
Video input signal: Composite/TTL Switchable
Polarity: Negative/Positive
Level: 0.5 - 2.0Vp-p/4.0 + - 1.5Vp-p
Impedance: 75ohm, more than 6.8K ohm
Scanning frequency:
Horizontal: 15.75 KHz + - 0.1%/18.432KHz + - 0.1%
Vertical: 47-63Hz
Video bandwidth: 20MHz
Active display area:
Composite: 206(H) x 160(V)mm,
TTL: 216(H) x 160(V)mm
Display character:
80 characters x 25 rows
Input terminal: Phono Pin Jack, 9 pin D-Sub Connector
Controls:
Outside: Power Switch, Contrast, Brightness, Signal Select, V-Hold, V-Size.
Inside: H-Width, H/V linearity, Focus, H/V-Shift.
Power supply: 110/120V 60Hz, 220/240V 50Hz
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FEATURES...

- Flat, high contrast, non-glare screen
- High resolution, 80 or 40 character display
- Tilt/swivel base
- Compatible with Apple* and IBM* colour composite signal

SPECIFICATIONS...

Picture tube: 12" diagonal and 90° deflection
Phosphor: Available in Green or Amber
Video input signal: Composite Signal
Polarity: Negative Sync
Level: 0.5-2.0Vp-p
Impedance: 75ohm
Scanning frequency:
Horizontal: 15.734 KHz + -0.1%
Vertical: 50-60Hz
Video bandwidth: 20MHz
Active display area: 216(H) x 160(V)mm.
Display character: 80 character x 24 rows.
Input terminal: RCA Phono Jack.
Controls:
Outside: Power Switch, Contrast, Brightness, H-Shift, V-Size.
Inside: H-Width, H/V hold, H/V linearity, Focus.
Power supply: 110/120V 60Hz, 220/240V 50Hz
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- Speed and code transparent
- Two/Four position rotary switch on front panel
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- Switch comes standard with female connector
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- Smoked plastic cover
- Lockable (2 keys supplied)
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- Holds up to 40 x 3½" diskettes
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- Double sided, double density.
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- AT compatible

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Tandon drive with controller card.
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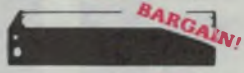

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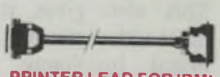

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SAMSUNG 12" 20MHz COMPOSITE MONITOR ONLY $149

FEATURES...
- High contrast, non-glare screen
- High resolution 80 or 40 character display

SPECIFICATIONS...
Picture tube: 12" diagonal and 90° deflection
Phosphor: Available in Green (P39) or Amber
Video input signal: Composite Signal
Polarity: Negative Sync
Level: 0.5V-2.0Vp-p
Scanning frequency:
Horizontal: 15.734 KHz +-0.1%
Vertical: 60Hz
Video bandwidth: 20MHz
Active display area:
216(H) x 160(V)mm
Display character:
80 characters x 25 rows.
Input terminal: RCA Phono Jack
Controls:
Outside: Power Switch, Contrast, Brightness, H-Shift, V-Size
Inside: H-Width, H/V hold, H/V linearity, Focus
Power supply: 110/120V 60Hz 220/240V 50Hz
Dimensions:
308(W) x 307(H) x 297(L)mm
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Shipping weight: 8.3 Kg

Cat No	Description	Price
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News Highlights

Aust team makes historic pulsar discovery

The first pulsar in the Small Magellanic Cloud, one of the closest galaxies to our own Milky Way galaxy, has been discovered by an Australian research team which includes Dr Peter Hall, Lecturer in Electrical Engineering at the University of Sydney.

Dr Hall, with colleagues from the University of Tasmania and CSIRO, also discovered the only other two pulsars (pulsating cosmic radio sources) known outside the Milky Way. They were found in the large Megallanic Cloud galaxy and were first detected by the team about three years ago. Both the Large and Small Magellanic galaxies lie about 200,000 light years away from the centre of the Milky Way.

Pulsars are thought to be rotating, magnetised, neutron stars which emit radio frequency energy in narrow beams. As the star rotates its radio frequency emission beam intersects the line of sight of an earth bound observer, causing a pulse to be received.

"Neutron starts are 'black stars' — that is they do not emit visible light," Dr Hall said. "These peculiar objects are thought to originate in supernovae: the catastrophic explosions which occur when some stars reach the end of their life. A neutron star is presumed to be the core of an exploded parent star and, in spite of being as massive as the sun, is only about 10kms in diameter. The resulting density is greater than that in any other known object, apart from a black hole."

Dr Peter Hall, member of the team which discovered the new pulsar.

The behaviour of atoms and molecules on neutron stars is quite different to that on earth, and the stars are of immense interest to scientists who use the properties of pulsar radiation to help establish the physics of neutron stars.

The discovery of the three pulsars outside the Milky Way will also be used to probe the medium between Earth and the pulsar. "Because it emits regular 'blips' it is like having a test generator on the other side of the test range," Dr Hall said. "In this case that means in another galaxy. By studying what happens to the radiation as it travels from that 'generator' through space we can look at the properties of the interstellar medium and the intergalactic environment.

The team discovered all three pulsars using the CSIRO 64m diameter radio telescope at Parkes in central western New South Wales. Four hundred pulsars have been found in the Milky Way since the first pulsar was discovered by a Cambridge researcher in 1968. Pulsars outside the Milky Way are much harder to find, however.

The team recorded data over a two week period for up to twelve hours a day at the observatory. The data were then fed into a computer with a specially designed, sophisticated signal processing software package which enabled the computer to search for the pulsar signals, which are buried deep in noise background.

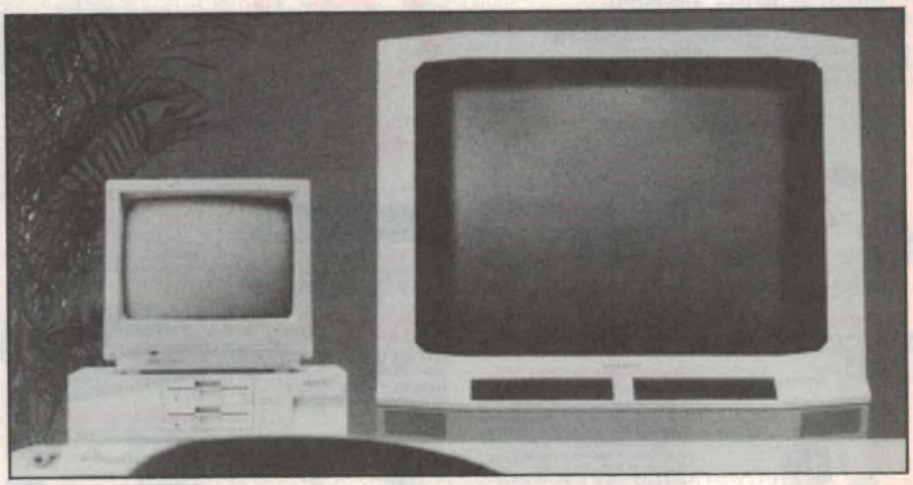
"Confirmation of the third pulsar popped out of the computer at three o'clock on a Sunday morning," Dr Hall said. "Usually we then reobserve and reconfirm, but with the third pulsar it was so strong that it was clearly a real object."

Having found the three pulsars the team was now busy "dreaming up sophisticated experiments to make some physical use of the pulsars," Dr Hall said.

World's largest CRT monitor

Mitsubishi Electric has announced the release of the largest CRT colour video monitor yet produced, with a screen measuring 92.5mm (37") on the diagonal.

The XC-3710/XC-3720 provides a display equal to a double-page spread of a tabloid newspaper, making is especially suited for CAD and display of computer information to large groups of people. As a result of the use of a CRT rather than projection techniques, the display is considerably brighter and sharper than conventional large-screen displays.



An autotracking (multi-scan) feature provides compatibility with any computer system with vertical scanning in the range 40 — 75Hz, and horizontal scanning between 15.0 and 31.5kHz. This also gives it compatibility with most video sources and systems. An optional intelligent graphics controller module gives the monitor the ability to generate graphics locally in response to 81 different primitive commands.

Further information from Mitsubishi Electric, 73 Epping Road, North Ryde 2113.

New Canon colour laser copier can copy slides, blow up 400%

The new Canon Colour Laser Copier is said to combine the high resolution, low running costs and fast speed of plain-paper output with the faithful colour reproduction and almost unlimited image-editing possibilities of digital input. Once the image has been scanned and before it is printed, you can edit it in many different ways.

The original is broken down into approximately 15 million elements for an A4 size copy, each represented by an electronic signal, and each available for manipulation. The image processor can then alter the image according to your command. For example, you can lengthen or widen an image, move text around the page, add or subtract images and change colour and format — all with automatic colour and density level variations — to faithfully imitate the original.

As a result of the Colour Laser Copier's three calculations with the image data — masking, under colour removal and edge enhancement — text in the final copy is sharp, photos have many density levels and colours are true to the original.

The digitalized operation is handled by two main components, a reader and a printer.

The reader unit consists of a light which scans the original and reflects onto a charge coupled device (CCD) line sensor with superhigh resolution (16 elements per millimetre). It is divided into 5000 elements, each in turn divided into three covered by Red, Green and Blue filters respectively which each allow only one colour to reach the sensor. The light is turned into electronic signals and sent to the printing unit.

The printing unit uses a semiconductor laser to print onto plain paper. The photo-sensitive drum builds up a uniform surface charge. As signals sent from the reading unit reach the printing unit they activate the laser, turning it on and off. When the laser is on it strikes the drum, partially neutralizing the charge, while areas not struck keep their charge. The partially neutralized areas attract toner which is then transferred from drum to paper to make the copy. This process is repeated four times, to individually pick up the four toner colours.

Creative copying is available through an operation panel and extensive help menu. This makes it possible to enlarge an image 400% for a wall-sized copy, using 16 sheets of A3-size paper; add colour photographs to black and white text; make your own colour overhead projector transparencies; highlight; change colours completely, or later the balance; and copy 35mm slides or negatives, or even 3-D objects.

Australia to host major artificial intelligence conference

Australia has bid successfully to host a major international conference on artificial intelligence.

The Minister for Industry, Technology and Commerce, Senator John Button, has announced that Australia had been chosen from several strong contenders, including France, Sweden and the Netherlands, to host the International Joint Conference on Artificial Intelligence (IJCAI-91) in Sydney during August 1991.

The decision, taken at IJCAI-87 in Milan, was a major step in international recognition of Australia's capability in artificial intelligence (AI) research and development.

"Artificial intelligence looks towards developing computers which can work more like people, rather than people having to think like computers. In the long term, computers will use natural language, be able to "see", to infer and reason under uncertainty, and to learn," Senator Button said.

"The Australian artificial intelligence community is doing world-class work in some of these areas, including robotics, knowledge-based system, speech recognition and logic programming."

"The bid to hold the conference here was made by the Australian Computer Society (ACS) National Committee on Artificial Intelligence and Expert systems, with the assistance of the Sydney Convention and Visitors' Bureau and with the active support of my Department.

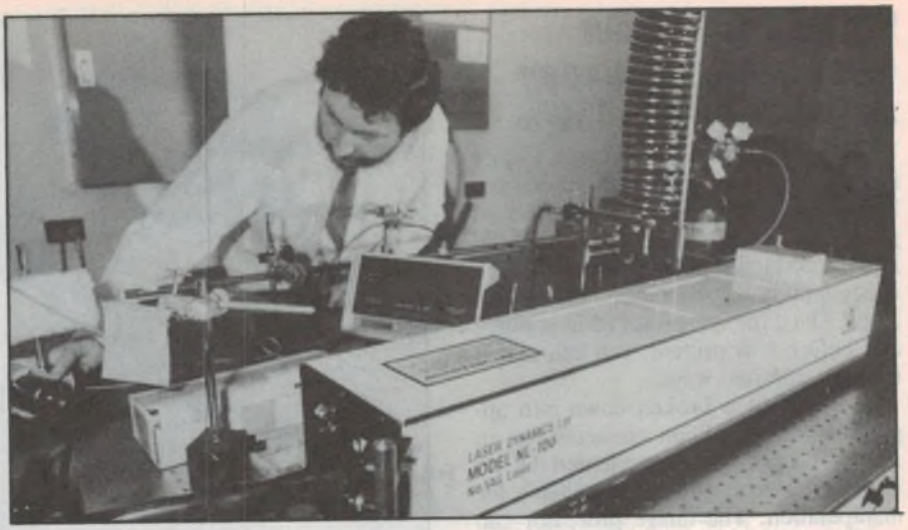
"The AJCAI conferences are the largest and most significant in the field of artificial intelligence and have been running biennially since 1969.

"They are usually attended by between 3000 and 5000 people. A major international trade exhibit is associated with each conference."

IJCAI-91 will be held at the new Darling Harbour Convention and Exhibition Centre in Sydney.

News Highlights

Laser checks for methane



Gold Coast laser manufacturer Laser Dynamics has supplied a laser to BHP for a new gas sensing system to protect its fleet of ocean going liquid natural gas (LNG) tankers. The $30,000 LDL specialised Nd:Yag laser has been bought by BHP's Central Research Laboratories in Newcastle.

BHP senior research scientist Dr Chris Scott said the LDL laser was a central element in a new system being developed to monitor methane gas concentrations on the company's LNG tankers. BHP is taking delivery of new tankers to transport LNG from Australia's North West Shelf to Japan.

Dr Scott said that methane levels are currently monitored by a multitude of localised sensors. BHP Central Research Laboratories is developing a new semi-automatic system to measure methane levels over a wide area at pre-programmed intervals. The system could also have wide ranging applications in all LNG transport and storage situations, Dr Scott said.

The advanced LDL Nd:Yag laser was competitive with imported products, Dr Scott said. It also offered the advantage of immediate access to its Gold Coast manufacturer. Dr Scott said this was particularly valuable as the BHP development called for the laser to be used at a non-standard wavelength, allowing use of spectroscopic techniques to examine atmospheric concentrations of methane.

Australian-made batteries for Telecom

Pacific Dunlop Batteries has won a multi-million dollar contract to supply batteries for Telecom Australia. It is the biggest order for batteries ever placed in Australia.

The batteries, which will be made in Australia, will have a combined capability of delivering a massive 10MVA (10 million volt-amperes) for 10 minutes. This amount of power output is equivalent to the energy expended getting a fully loaded Boeing 747 airborne by its engines' combined 100,000 horsepower.

Telecom's national media officer, Ms Andrea Gash, said that it was Telecom's policy to support Australian manufacturers and equipment suppliers wherever possible.

Ms Gash said, "We were very pleased to find Australian-made batteries which could meet our requirements, in terms of both technical performance and delivery schedules.

"From a technical point of view, placing this order with an Australian company has significant advantages. It means we can get replacements immediately if we need them, and it is important for us to have locally based technical product expertise.

"Telecom's special requirements meant we needed a company that could provide up-to-the-minute technology. The largest of the batteries will have to handle very high rates of discharge — an average of 1700 amperes," she said.

By way of comparison, the average home appliance would draw 10 amperes, and even the giant batteries driving 20 tonne locomotives underground at Mount Isa mines only draw 600 amperes.

TI LAN Development System Contest

Although we planned to announce the winner of the LAN contest in this issue, a surprisingly high proportion of the entries arrived right on the final deadline. Perhaps this was because of the hi-tech nature of LAN technology and need to include details of at least one proposed application with each entry. But whatever the reason, we have been forced to defer announcement of the winner until the December issue — in order to do justice to all of the entries received, and give each one due consideration.

So to all those who sent in entries, thank you for participating and please bear with the judges a little longer as they wade through them all. By the time you read this, the winner will have been notified, and will be announced next month.

STC subsidiary to bid for Tasman 2 cable

STC PLC of the UK has formed an Australian subsidiary, Stantel Submarine Systems, which will transfer submarine fibre optic technology to this country. Stantel will set up manufacturing operations in Australia in a joint venture with Australia's AWA, if STC PLC is successful in its bid to manufacture and lay the Tasman 2 fibre optic submarine cable between Australia and New Zealand.

The 2500km Tasman 2 cable will be the first international submarine fibre optic link in the Southern Hemisphere. The $120 million contract will be let in 1988 for completion in 1991. Tasman 2 is a joint project of New Zealand Telecom and Australia's OTC.

"We are an Australian company, and from our base here we intend to win a considerable share of the Asia/Pacific submarine fibre optic market — worth around $2 billion over ten years," said Stantel's Mike Hall.

Stantel's parent, STC PLC, has a global reputation for fibre optic submarine cable systems. Its contracts include the world's first international fibre optic link, Belgium 5, operating between Britain and Europe and the 7000km trans-Atlantic PTAT-1 which will link Britain and the United States with a spur to Bermuda.

$500,000 R&D contract to Pulsar

Melbourne based electronic engineering and manufacturing firm Pulsar Electronics has been given a major research and development contract by Silicon Valley based drive manufacturer Cybernex Advanced Storage Technology (CAST). The contract follows Pulsar's recent release of its ESDI 5202 controller card, which enables the high speed Winchester drives previously used in mini computers to be harnessed to personal computers and Local Area Networks (LANs).

CAST, which is a subsidiary of the large Century Data group, was the first overseas company to place an order for the Pulsar developed product after it was released in June.

"Under the contract Pulsar is to develop a highly enhanced multi-function controller exclusively for CAST. Pulsar is to receive development fees and a royalties package estimated at $500,000 in the first 12 months," said Pulsar managing director Mr Philip Delacretaz.

Pulsar also has the right to tender for the manufacture of the controllers.

"If we do well with this — and we will — further R & D contracts are guaranteed. In fact CAST is pressing us to accept a contract to develop a version of our controller for the OS/2 PCs. And some other projects they have been talking about will require the transfer of large slabs of technology to us."

"We were extremely pleased to be singled out by a company which has such an advanced technology base itself," he said. "Apparently CAST were impressed with the dynamic way we had got the ESDI product to market so far ahead of the competition."

The Pulsar ESDI controller incorporates an AMD chip which was only released to US manufacturers three weeks before Pulsar began manufacture of the product.

Mr Delacretaz said he had negotiated the right to tender for manufacture, which would turn the deal into millions of dollars. "I did this more out of national pride, than any belief that we could win it," he said.

"The major reason is that the Australian PCB board manufacturing industry is still at the fencing-wire stage. We designed the ESDI controller as a two layer board to get around this."

"But the US market is insisting on four-layer boards to overcome the new "noise" standards for the reduction of electro-magnetic radiation. We just can't build them here, and to subcontract to Taiwan goes against everything we are trying to achieve," he said.

Govt. defines key areas for telecomms policy review

Commonwealth Minister for Transport and Communications Senator Gareth Evans has identified the four principal policy questions that will be addressed by the Government in developing a comprehensive statement of national telecommunications policy over the next few months.

In an address to the International Institute of Communications Conference in Sydney, Senator Evans said the major issues were:

- What should be the nature and extent of the monopoly powers granted to our telecommunications carriers?
- To what extent should private sector involvement in the provision of telecommunications equipment and services be allowed or encouraged.
- To what extent should the telecommunications carriers be restructured or relieved of Government constraints to enable them to perform their functions more effectively, and in particular compete in open commercial markets?
- How should the industry be economically and technically regulated?

Senator Evans stressed that neither he nor the Government were committed to any particular outcome in the review.

NEWS BRIEFS

- A new professional audio company called ***Rebel Audio*** has been launched to cater for the audio installation and contracting market. Behind the new name are well-known audio identities Ian Woodhouse, former MD of Electro Voice, and former national marketing manager for Klarion Enterprises Andrew Horman. Among the lines to be distributed by Rebel are Bel Electronics, Tanktek, Nemesis, Sescom, MicroAudio and Audio Digital.
- ***George Brown Group*** has been appointed Australian distributor for the semiconductor products of Korean based company Samsung Semiconductor & Telecommunications. GBG will focus initially on the Samsung range of dynamic RAM chips, covering 64K, 256K and 1M bit product. GBG has also been appointed Australian distributor for California-based maker of power hybrid circuits, New Era Electronics.
- Gold Coast-based laser maker ***Laser Dynamics*** has secured one of the leading US medical and industrial laser specialists, Mr Phurpa (Phil) LadenLa, as its US marketing consultant. Mr LadenLa, who heads LadenLa Associates in Palo Alto, was VP marketing for 11 years at leading US scientific laser firm Lexel Corporation.

Electrical Accessories has moved from its long-time West Ryde address to new and larger premises at Suite 8/9 Foamrest Avenue, Newport 2106, phone (02) 997 8544. The firm has also appointed Peter Mellor as product specialist for transmission line hardware.

- ***Audio Telex*** has moved to larger premises at 120-124 Beaconsfield Street, Auburn 2144. Phone (02) 647 1411, fax 648 3698.
- The Sydney office of ***Vicom Australia*** has also moved, to Suite 803, 8th Floor, GBC Building, 8 West Street, North Sydney 2060. Phone (02) 957 2766, fax 957 3821.

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News Highlights

Barry Jones signs space agreement with US

Minister for Science and Small Business Barry Jones has signed an agreement which will permit the United States to launch and recover sounding rockets in Australia for scientific non-military, non-commercial purposes over the next 10 years. Mr Jones signed the agreement with the United States Ambassador, Mr Bill Lane, in Canberra.

The sounding rocket program will be conducted by the US National Aeronautics and Space Administration (NASA) and the Space Projects Branch of the Department of Industry, Technology and Commerce (DITAC). The Department of Defence will conduct the launches as DITAC's agent.

NASA previously launched sounding rockets from Woomera between 1961 and 1977.

HP and Sony to develop 1.3Gb DAT drives

Hewlett-Packard and Sony have announced an agreement to jointly develop and market a revolutionary new computer back-up storage medium based on the controversial Digital Audio Tape (DAT) technology. The companies said that under their agreement they intend to use DAT technology to develop what they call a "Digital Archival Storage System" for computers which will be capable of storing as many as 500,000 pages worth of data (1.3 gigabytes) onto a cassette the size of a business card.

In the entertainment industry, digital audio tape recorders have run into stiff opposition from the recording industry which fears that consumers will use them to make perfect copies of records and compact discs. This could cut deep into sales of records and compact discs, they fear. Moves are currently under way to force DAT manufacturers to incorporate a chip into their system that would make it impossible to copy from compact disc players.

HP and Sony don't expect any opposition to their use of the technology, as the DAT storage systems could not be used to make audio recordings.

The DAT storage systems will be aimed mostly at the back-up storage market as they offer major advantages over current tape-based and optical storage systems. For one, tape drive capacity has had a hard time keeping up with the rapidly increasing storage capacity of hard disk drives. DATs would eliminate the capacity problem with their 1.3 gigabyte storage capacity.

One of the most promising applications for the DAT storage devices, according to HP program manager Bert Vermeulen, is in desktop publishing. Unlike tape drives, DAT systems can store both data and images in digital form and can access any data or image in less than 20 seconds. Still, DATs will have to battle it out with optical storage systems, which offer the same features plus a much shorter access time. But data on optical disks cannot be erased or altered, which is a major disadvantage.

Hi-tech ID system goes back to fingerprints

A new personal identification system developed by a Californian engineer could revolutionise the operation of security systems and bank ATMs (automatic teller machines), by using automatic fingerprint scanning instead of hard-to-remember ID numbers.

The system has been developed by Randall Fowler, a spacecraft engineer who worked on the project in his home garage while working by day at TRW. Now Fowler has set up his own company in Palo Alto, called Identix, to manufacture and market the system.

Already Identix has signed a $US5 million contract to sell its technology to Omron Tateisi Electronics, the $US1.5 billion Japanese company that makes ATMs and point of sale terminals. Omron is expected to use the Identix fingerprint technology in its new bank ATMs, so before long bank customers may be sticking their finger into an ATM scanner rather than having to key in their PIN number.

Above: Randall Fowler, president of Identix, who developed the fingerprint scanner (left) in his home garage.

Fowler's device optically scans the pattern on a finger, and generates from the scan a unique digital code. As police have known for many years, fingerprints are very stable — they don't change with temperature, age, nervousness or room acoustics.

At present a self-contained fingerprint scanner costs around $US7000. However Fowler says that the basic technology could be integrated into an ATM or POS terminal for only $US500.

Bow Electronics buys ACS assets

As noted briefly last month, Bow Electronics of WA has purchased all of the major business assets of Sydney hi-tech manufacturer Appliance Control Systems, for more than $1 million.

Bow Electronics is a rapidly expanding contract electronics manufacturer, with ongoing contracts with government departments, Telecom, DOA and various local firms. Recently 60% of the company was acquired by Palantronics, a subsidiary of UTC Ltd.

The new equipment gives Bow Electronics high capacity automated production for SMD technology, capable of loading 20,000 components per hour. When merged with existing WA operations, this will give the company a leading position in electronics manufacturing, according to UTC managing director Mr Bill Henderson.

The company is also nearing completion for accreditation to AS1821, which will allow it to compete for defence and offsets manufacturing contracts. It is expected to be the first WA electronics manufacturer to achieve this status.

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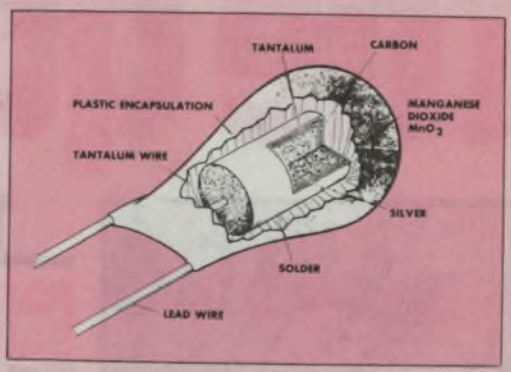

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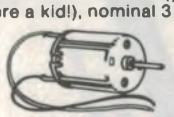

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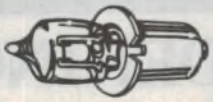

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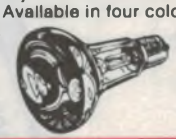

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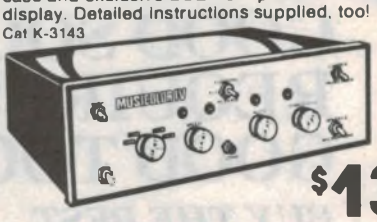

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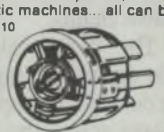

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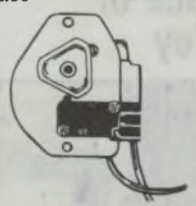

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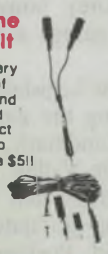

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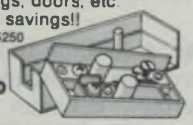

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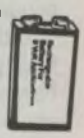

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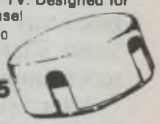

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Silicon Valley NEWSLETTER . . .

National wins battle for Fairchild

In a deal that ends the existence of the company that virtually founded the semiconductor industry in the late fifties, National Semiconductor announced it has agreed to acquire most of Fairchild Semiconductor for $122 million in cash and stock.

"We believe this acquisition provides complimentary strengths — broadening our product offerings, customer base and technology — and further enhances our competitive position," commented National president Charlie Sporck.

In acquiring Fairchild, Sporck continued, "National becomes America's best technologically balanced semiconductor supplier with leading-edge capabilities in CMOS and bipolar products across a broad line of proprietary offerings."

Industry analysts praised the move by National. They said National is paying a bargain-basement price as it is acquiring an estimated $650 million worth of plants, equipment and other assets, including Fairchild's state-of-the-art research facilities in Palo Alto and the gate-array custom chip operation in Santa Clara which even uses a Cray supercomputer for chip designs.

After briefly giving up its position as Silicon Valley's largest chip company to Intel, and even AMD following its acquisition of Monolithic Memories, National will once again be the area's biggest chip maker with some $US1.5 billion in chip sales. National will also be the third largest chip maker in the US behind Texas Instruments and Motorola, and the sixth largest in the world.

The Fairchild acquisition will help boost National's position in several key segments of the semiconductor market, including logic chips, analog and digital devices, military semiconductors, and custom-made products.

While it is acquiring most of Fairchild's useable assets, National is not taking over any of Fairchild's underutilised plants in Germany and Japan. Also excluded is Fairchild's former MOS facility in South San Jose where a huge chemical spill polluted the drinking water of a nearby neighbourhood. Fairchild recently settled a huge lawsuit by the residents of the neighbourhood who claimed the spill resulted in a large number of still-births, miscarriages and birth defects.

The sale to National also ends an eight-year nightmare for Schlumberger, as the Fairchild subsidiary has cost the French oil-drilling equipment leasing firm as much as $2 billion in investments and operational losses.

The birthplace of Silicon Valley

Since 1939, millions of people have driven by the house pictured on 367 Addison Avenue in Palo Alto. Except for some employees of Hewlett-Packard who regard it as something of a shrine, few bypassers have ever taken much notice of the two-storey house and the modest 12x18-foot garage at the end of the driveway.

But the California Legislature has approved a bill making the garage a permanent historic landmark, as "The Birth place of Silicon Valley".

It was in this garage that two young Stanford engineering graduates, William Hewlett and David Packard, encouraged by their professor Frederick Terman, started their electronics company. In the garage, Hewlett and Packard built their first product, an audio oscillator for Walt Disney which was used in the production of the classic "Fantasia" movie.

With the decision to make the garage an official historic landmark, a bronze and brass plaque will be placed at the garage which was built in 1905.

While a number of different factors led to the explosive growth of the electronics industry in Silicon Valley, most historians and Valley insiders agree that the formation of Hewlett-Packard provided perhaps the biggest stimulus. This is because H-P became the first to build its facilities on the property which Stanford University again at the suggestion of Terman, had designated for industrial development.

The close proximity between the university and industry provided a unique environment for new companies to start-up and flourish. Later, as the industrial area around Stanford filled up and roads, housing, and other infrastructure improved elsewhere in Santa Clara County, companies moved south to Mountain View, Sunnyvale, Santa Clara, and San Jose.

Atari buys retail chain

Most major US consumer computer and electronics retail store chains have refused to carry Atari's ST line of personal computers. To catch up with Apple, IBM, Compaq and others in this vital distribution channel in the low-end of the personal computer market, Atari has taken matters into its own hands by buying one of the fastest growing of those chains.

The Sunnyvale computer company has agreed to pay $US67 million for the Federated Group, a chain with some 66 stores across the US.

For employees of Federated, the move is undoubtedly a mixed blessing. On the one hand, the sale to Atari will ensure the survivability of their company which has been losing millions of dollars in the past two years. On the other hand they will now be working for Atari chairman Jack Tramiel, who is expected to apply some of his well known cost-cutting traits to the Federated organisation in an effort to return it to profitability.

The move, analysts agreed, will give

Atari a much-needed boost to the effectiveness of the firm's US distribution channels. While Atari's STs are selling well in Europe, its US sales account for only about one-third of the company's revenues, due mostly to Atari's inability to penetrate the domestic retail market. As a result, Atari's share of the US personal computer market has remained around the 2% level.

Fujitsu to build ASIC plant in US

In a move that could further intensify competition in the ASIC marketplace, Fujitsu announced it will invest some $US70 million in a new 100,000 square-foot chip manufacturing facility to be built in Gresham in Oregon.
Fujitsu said it hopes to begin manufacturing customer-tailored chips at the facility as early as next fall.

The Gresham move is the latest effort by Fujitsu to increase its presence in the United States. Back in 1984, Fujitsu announced plans to build a chip facility in the United States and bought the Gresham property. But reconstruction plans were halted when the chip industry, suffering from the deadly combination of overcapacity and slow demand, fell into a severe two-year slump.

Earlier this year, Fujitsu tried to buy its way into the US through the proposed acquisition of Fairchild, a move that was blocked by the Reagan Administration. That failure prompted Fujitsu management to take another look at building the Gresham facility.

Already, Fujitsu is the world's largest manufacturer of ASIC chips with annual sales of close to $US400 million in 1986. Apparently the firm wants to expand its custom chip expertise into the United States where the ASIC market has already been suffering from the presence of too many competitors, each offering slightly different approaches to the ASIC dilemma.

How Sculley ousted Jobs from Apple

It is late-May 1985: Apple co-founder Steve Jobs has been greatly upset for six weeks, ever since John Sculley, the president he headhunted from Pepsi-Cola, took the Macintosh division away from him.

But Jobs is ready to strike back and return Sculley to sodaland. The following day, Jobs knows, Sculley will be off to China to meet with that country's vice premier to talk about getting Apple II computers into PRC classrooms.

Secretly, Jobs has been plotting with some of his loyal following among Apple's executive staff about firing Sculley while he's away.

Somehow, the word about the forthcoming revolt reaches Jean-Louis Gassee, a free-spirited Frenchman who was appointed to replace Jobs as head of the Macintosh group. In his heavy, but pleasant French accent, Gassee tells Sculley: "Zhere are forces zrying to zhrow you out of zhe company . . . " Sculley takes immediate defensive action. He cancels the trip, and instead walks into the executive meeting at which Jobs was planning to pull off the mutiny.

Sculley wastes no time and confronts Jobs, accusing him of plotting a coup. Jobs still thinks he has enough support to pull off his scheme. He attacks, charging that Sculley was hurting Apple by not understanding manufacturing and losing respect among middle managers.

Continued on page 141

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

Refrigerator auto-run unit

This circuit was devised to allow the automatic time-out of an electro-magnetic clutch after a period of 15, 30, 45 or 60 minutes. The clutch drives a refrigeration compressor onboard a cruising yacht, and as the unit is driven from the main engine, the clutch was manually switched on and off. The problem was that if the compressor was left running, the beer became solid.

The digital timer uses a RC oscillator formed from gates IC1a and b, oscillating at 4.55Hz, to clock counter IC3 via the enabling AND gate IC2a. The counter divides the fundamental to a signal with a period of 120 minutes at output Q14, 60 minutes at Q13 and 30 minutes at Q12.

On start-up, the reset line is taken high and the counter's outputs are cleared. The output line is inverted to high, base current flows, transistor BC337 saturates and then energises the relay, and gate IC2a allows clock pulses through to the counter. When the selected line goes high, at the half period, the counter is disabled and the relay opens. The circuit remains in this state until reset.

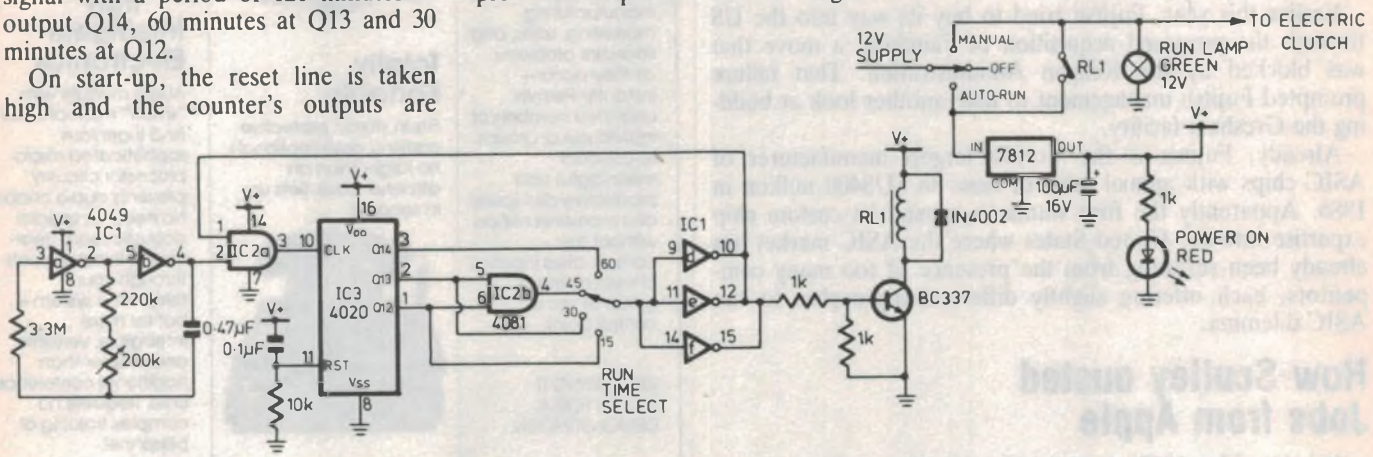
The 15 and 30 minute lines are ANDed to provide a 45-minute preset.

The SPDT centre-off switch is used as shown, so that manual operation is unaffected, and when in the Auto-Run position the relay is energised for the preset time period. A 12V regulator provides a stable supply to the oscillator, which is filtered with the 100uF electrolytic capacitor. A green bezel lamp indicates whenever the fridge is running, whilst the red LED indicates that power is applied to the circuit. Calibration of the unit was carried out by initially setting VR1 at mid-range and timing the run time of the unit. If the period is greater than that set, VR1 is reduced and vice-versa.

The circuit could be useful for a variety of situations where a device is to be turned on and then off some preset time later.

Richard Grant,
Mordialloc, Vic.

$20



Low-cost deep-cycle NiCad charger

This circuit is a simplification of the EA charger of March 1987. It is more flexible, but somewhat less convenient in use.

NiCad batteries have rather delicate health, but a soft life is likely to lead to reduced capacity. Deep discharge is necessary to avoid gross overcharge of the stronger cells in a battery, as their reduced capacity brethren are given a full charge. A voltage of 1.1 volts per cell is conventionally taken as the end point because very little capacity remains and there is otherwise the risk of polarity reversal as the strong cells reverse charge the weaker ones.

Discharging the cells individually is evidently desirable. An extra transistor has been added to the output of each comparator to drive the discharge transistors and light the LEDs. In use, the LEDs glow as the cells are discharged and go out one by one as the cells reach the end point. The cells may be removed for storage or recharge when the last light has gone out. If not, the LEDs will continue to flash sporadically as the unloaded cells recover.

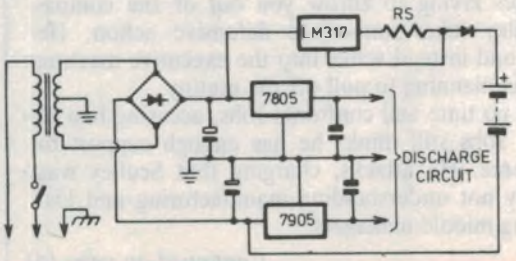
A number of other changes should be made to the discharge circuitry of the EA design. These are:

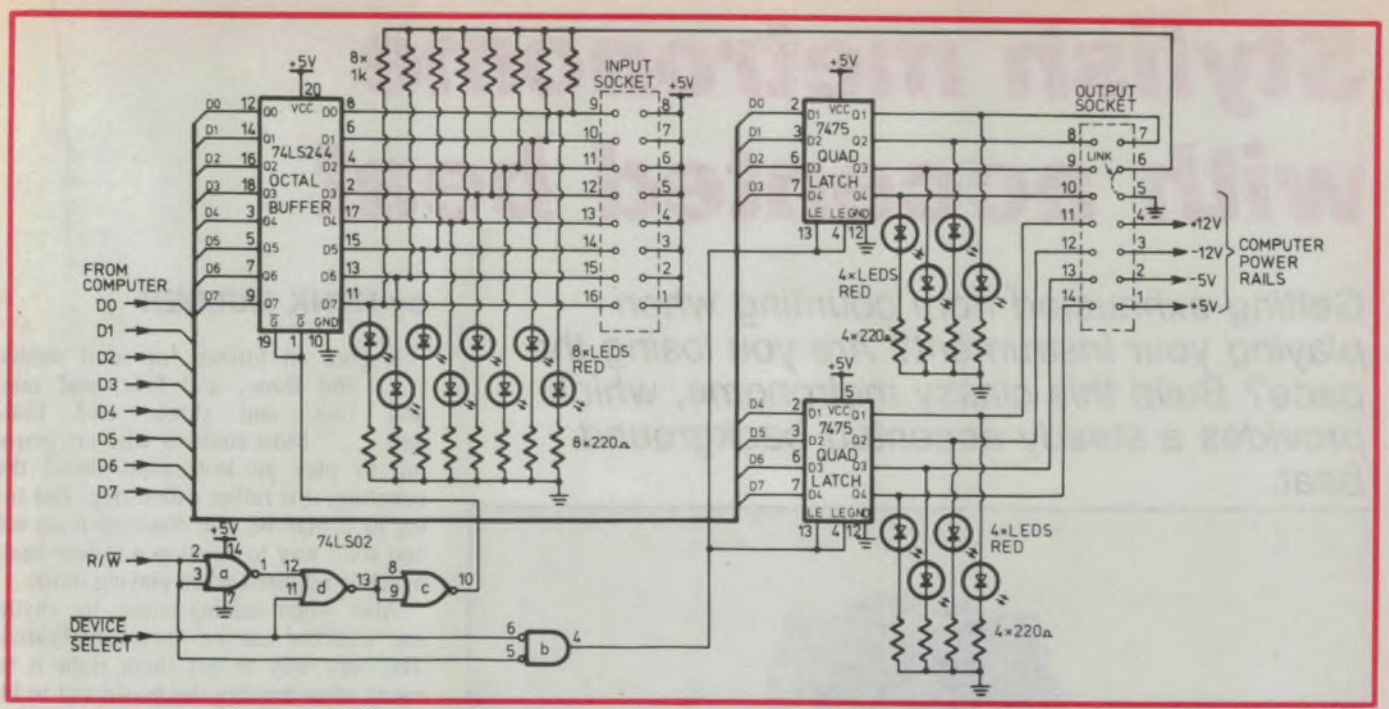
1. The trickle charge resistors (RT) should be omitted, or the LEDs will never go out and the cells never properly discharge.

2. A 1M pullup resistor on the inverting input of the negative comparators is necessary to prevent the inputs floating and keep the LEDs off when no cell is present.

3. The reference voltage divider has been beefed-up to prevent loading by the 2.2M feedback resistors, which otherwise leads to excessive hysteresis.

On the charging side, there is nothing wrong with charging cells in series. It has the great advantage that only one constant current source is required and





I/O expansion for Apple II+

This board allows 8 channels, both of input and output, for the Apple. Each input channel and each output channel is monitored by a LED, so the user always knows what is going on. Input is fed in through a 16-pin DIL socket. Another socket could be used if desired, but this system facilitates easy connection of other specialised boards, either for input or output or both, to the main board. The input socket can also hold an 8-way DIL switch, for testing or hardware switching purposes.

Output is fed through a 14-pin similar socket, which also has pins for the four power rails of the computer, the ground and one pin used to tie the input channels to ground if needed.

A 74LS244 octal tri-state buffer is used to take input, as little current driving capacity is necessary to drive the Apple bus. Eight 1k resistors tie the inputs to ground through a wire link inserted in the output socket if this function is desired, for example if pushbuttons or DIL switches are used. Using logic (from the 7402 quad NOR gate), the 74LS244 is enabled only when the R/W-bar is high (i.e., the computer is reading and the bus is free) and the DEVICE SELECT-bar is low (the computer is in fact reading from the appropriate I/O slot, and not a location in RAM or ROM).

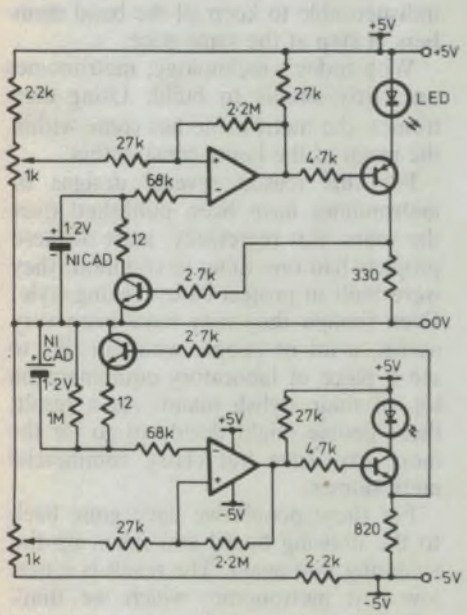
Two TTL 7475 quad latches are used for output, because of their TTL current driving capacity. The remaining 7402 gate is used to ensure that these are only accessed when DEVICE SELECT-bar is low and R/W-bar is low. Access at any other time could destroy the data in the latches.

It is suggested that the board be mounted outside the computer as the LEDs should be visible and space must be available for other boards to plug into it. A cable thus runs into the computer, leading to a small board used as a plug for the Apple's slots.

The location of the card in memory can be calculated by multiplying the slot number used by $10, and adding it to $C080. The card may be used in any slot (0-7). To output data, load from it in the same way.

The board has many uses. It can control a complete high-tech alarm system with up to eight sectors, and, if one has a modem, report a break-in as soon as it occurs. It can also be used to output data to a D-to-A converter to generate music, control instruments, or accept data via an A-to-D converter from a microphone, machinery or other equipment.

Ross Donelly,
Lindfield, NSW. **$20**



the current demand is halved. A suitable current source using the LM317 is illustrated.

The value of the series resistor Rs for a charge current Ic is found from the equation Rs = 1.23/Ic. For a charge rate of 50mA, 24 ohms (0.25W) is required.

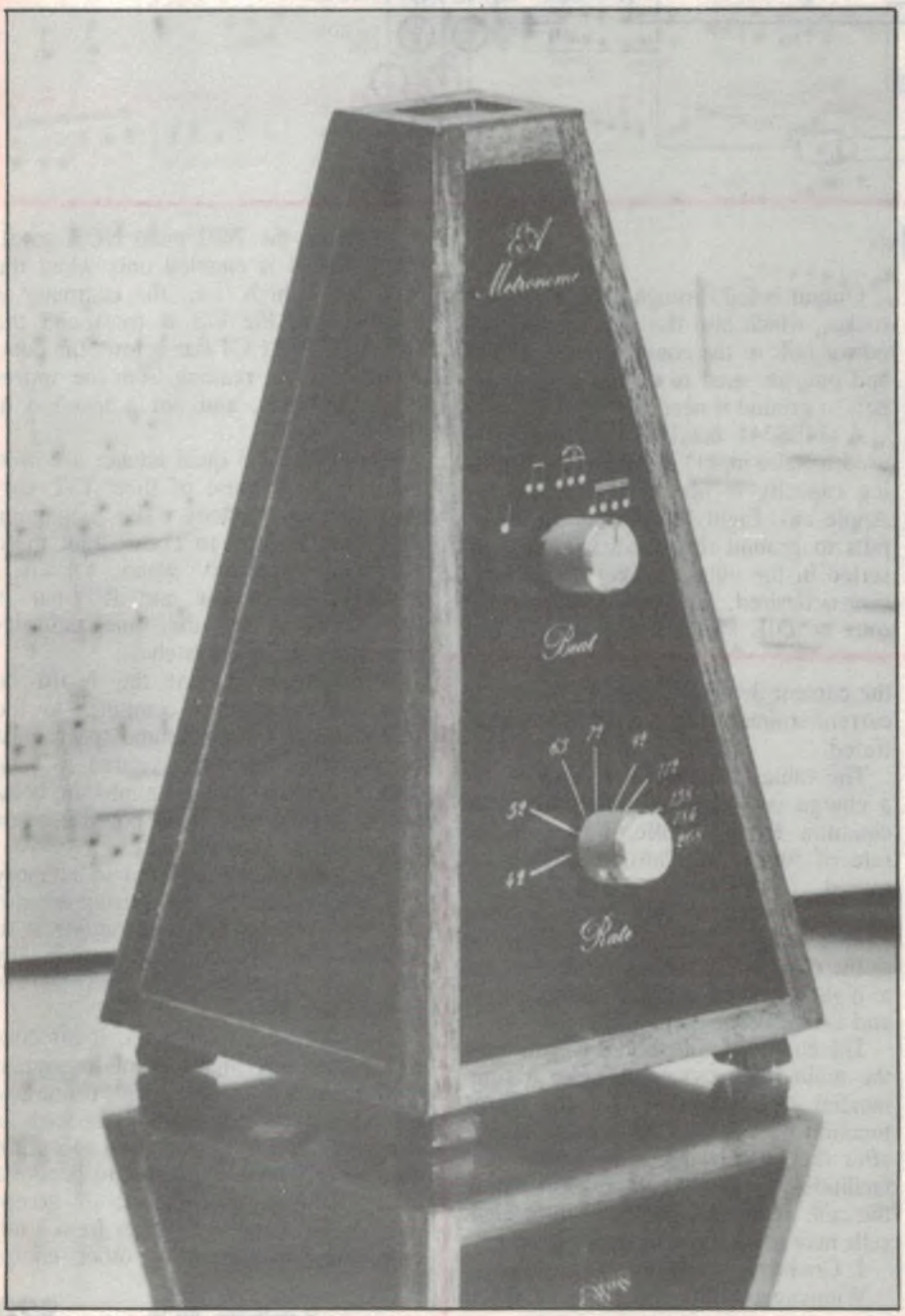
Alternatively, a 7805 could be used (50mA requires 100 ohms at 0.5W), but at the cost of less voltage headroom and a higher control resistor rating for C and D size cells.

The charge circuit should be run from the main filter capacitors using a commercial electronic timer for the timing function. A period of trickle charge after the main charge is beneficial as it facilitates oxygen recombination within the cell. Using the LM 317, up to eight cells may be charged in series at once.

J. Crichton,
Winmalee, NSW **$25**

Stylish metronome with accented beat

Getting exhausted from counting when playing your instrument? Are you losing the pace? Build this classy metronome, which provides a steady accented background beat.



EA's metronome: when looks count.

by HENK MULDER

It goes on forever, or so it seems: " . . . and three, and four, and one, and two, and three, and four, and . . . " Most students who are learning to play an instrument dread the counting; it is rather exhausting. But tiring as it may be, the counting is an old and solid way to develop a steady beat, which is required when playing music.

Also, when reading music, the rhythmic patterns can be very complicated. The only way to get them right is to count while reading the music and to hit the right key or press the required valve at a certain count.

Once the student has got the rhythm in his mind, the counting can be left out.

Music schools often have metronomes; little boxes which produce a sound similar to that of a ticking clock. The beat of the metronome is variable between, say, 42 and 208 beats per minute.

In certain cases, the metronome takes over the counting for the student; the steady beat provides enough reference to stick to the rhythm.

When a band without a rhythm section rehearses, the metronome can be indispensable to keep all the band members in step at the same pace.

With today's technology, metronomes are fairly simple to build. Using electronics, the metronome has come within the reach of the home constructors.

For this reason several designs of metronomes have been published over the years. But regretfully, most of these projects had one thing in common: they were built in project cases lacking style. Even though they may have been very useful, a lot of people wouldn't like to see a piece of laboratory equipment on top of their stylish piano. As a result, these people might decide to go for the more expensive but classy commercial metronomes.

For these people we have gone back to the drawing board and taken up the soldering iron again. The result is a new low cost metronome, which we think will change your mind.

The sound of this metronome is really

good but not very special; it just sounds like somebody tapping on a box.

Of course it features an accented beat, as every self respecting metronome nowadays does. Every second, third or fourth beat is accented. Or all of them, if you like.

When you look at the older metronome designs which featured an accented beat, you will notice that quite a few of them did not provide a beat rate scale. The reason for not providing a scale was in most cases technical: each accented beat setting required a different beat scale.

A beat rate scale however is most useful. Most music pieces specify the speed at which it has to be played. Often this speed is specified as the number of beats per minute.

We have designed this new classy metronome to have one single scale for all the different beat settings. And the scale provided is in beats per minute, as required.

To avoid confusion, when talking about beats per minute we mean accented beats per minute. The background beat is a counting aid and can be ignored when determining the beat rate.

Construction of this project involves two phases. The first is constructing the electronic "insides" of the metronome; the second is building a classy box.

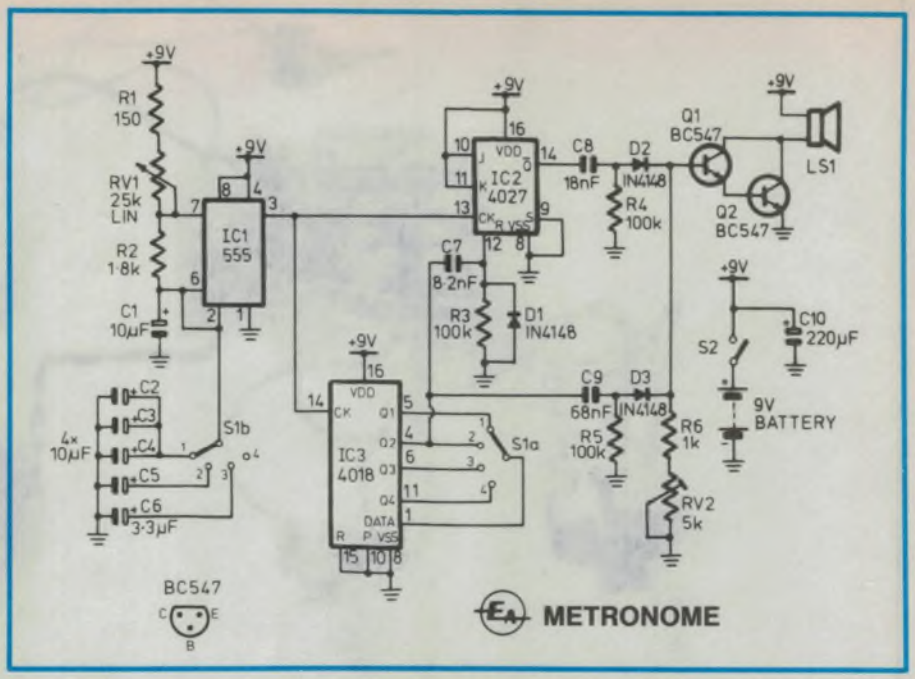
If you take your time with it then you will end up with a beautiful metronome, which has only one disadvantage. When you are showing off your musical abilities to friends with the metronome in the vicinity, then there is a slight risk that the applause may be for the metronome, and not your performance!

The circuit

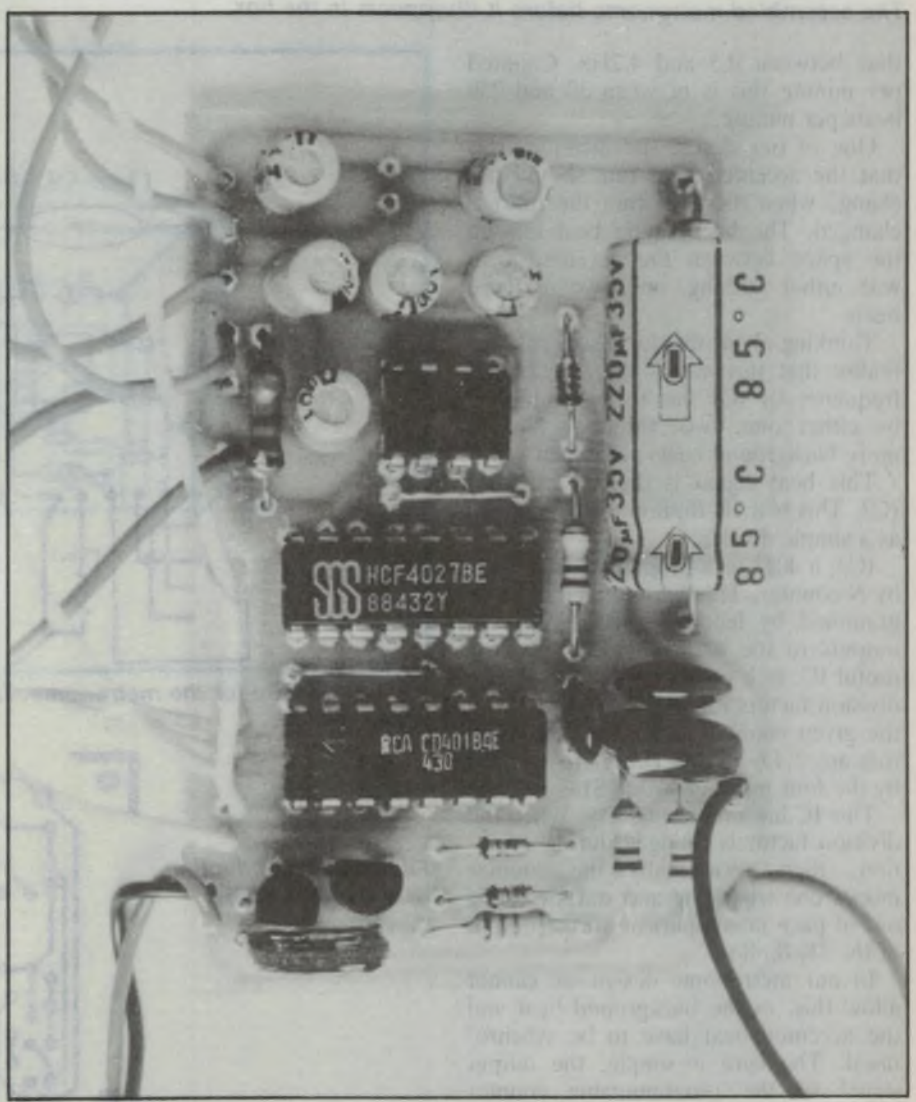
The circuit isn't very complicated at all, even though it might not be too obvious at first sight. Leaving out the tricky details, there is an adjustable oscillator (IC1) whose output signal is divided by 2 (IC2) and by either 2,4,6 or 8 (IC3). The output of IC2 is the source for the background beat, and the output of IC3 provides the accented beat. The rest of the circuitry converts the stiff square wave signals of the counters into a pleasant beat signal.

Let's get down to the details. IC1, the ubiquitous 555 timer, is wired as an astable multivibrator. When S1b is in position 1, then the total capacitance as seen by IC1 is 40uF. With pot RV1, the frequency can then be varied between 1 and 8.3Hz.

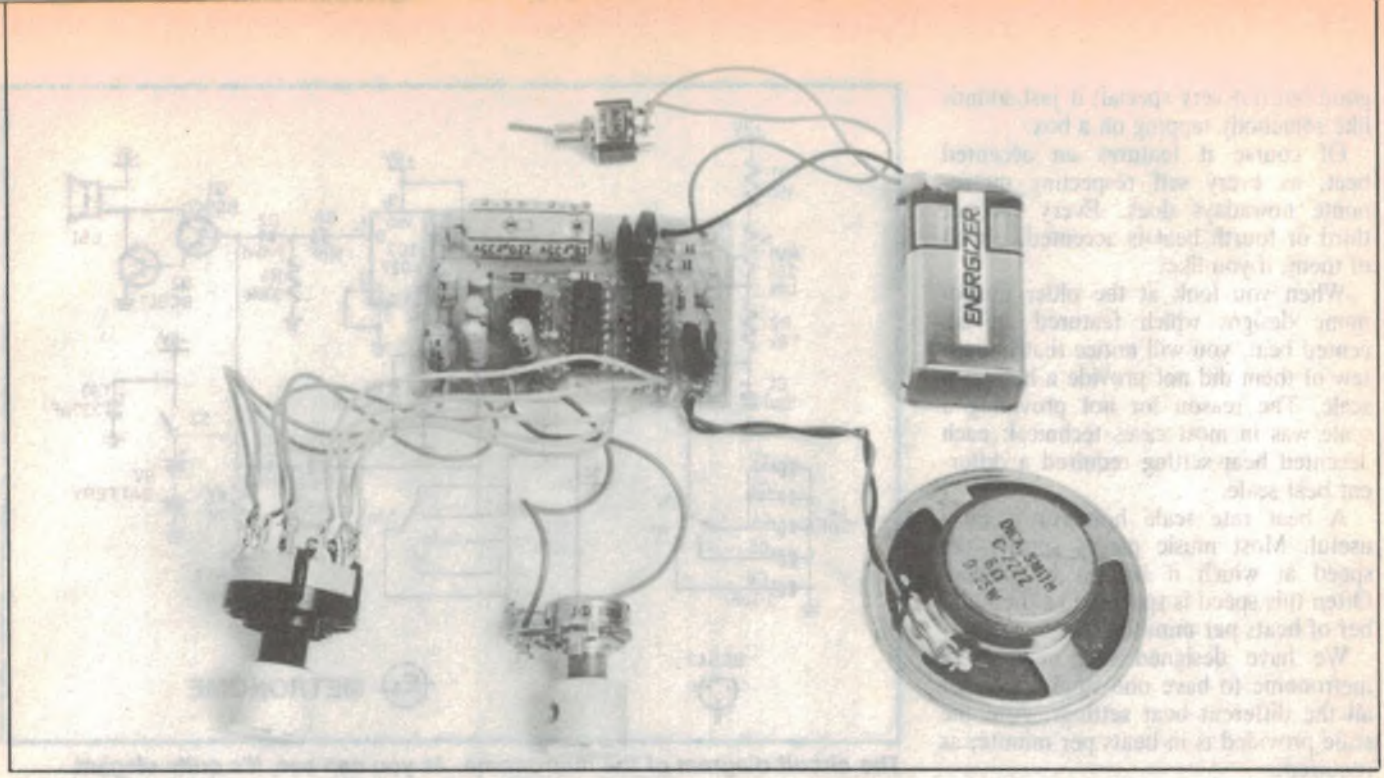
The output beat (S1 still in position 1) will be half the oscillator frequency,



The circuit diagram of the metronome. As you can see, it's quite elegant.



The assembled PCB. Note that the final version is slightly different.



The assembled metronome before it disappears in the box.

thus between 0.5 and 4.2Hz. Counted per minute this is between 30 and 250 beats per minute.

One of our design specifications was that the accented beat rate should not change when the beat (not the rate) is changed. The background beat fills up the space between the accented beat with either nothing, one, two or three beats.

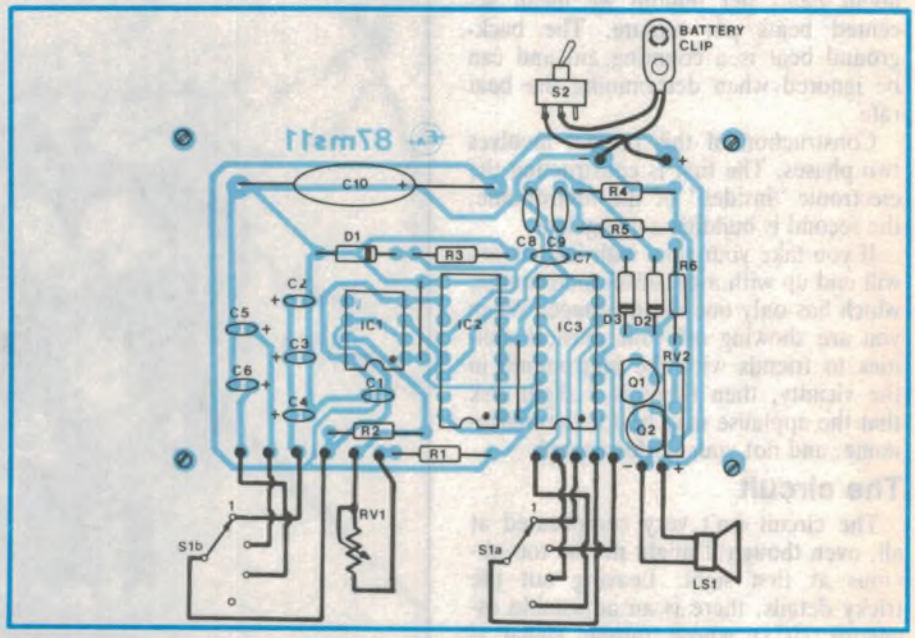
Thinking about this for a sec, you will realise that this means that the output frequency of IC1 has to be multiplied by either one, two, three or four as more background beats are added.

This beat signal is divided by 2 by IC2. This is a JK-flipflop which is wired as a simple divider.

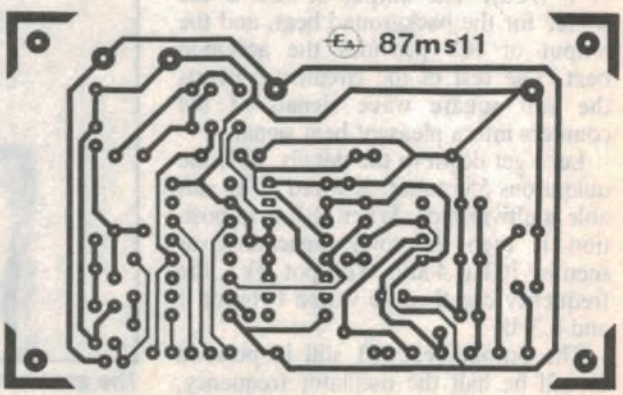
IC3, a 4018, is a programmable divide by N counter. The division factor is programmed by feeding back any of the outputs to the data input. It is a very useful IC, as it can be programmed with division factors ranging from 1 to 10. In the given configuration its division factors are 2,4,6 and 8. These are selected by the four position switch S1a.

This IC has one peculiarity. When the division factor is changed during operation, then occasionally the counter misses one triggering and starts running out of pace in comparison to the output of the JK-flipflop.

In our metronome design we cannot allow this, as the background beat and the accented beat have to be synchronised. The cure is simple; the output signal of the programmable counter resets the JK-flipflop via C7,R3 and D1.



Wiring diagram for the metronome. Take care not to invert the wires to the rotary switch.



Full scale reproduction of the PCB artwork.

so that both dividers start their cycle at the same moment.

The square output signals of the counters are differentiated by the capacitor/resistor combinations C8/R4 and C9/R5. What's left after this stage are positive and negative spikes, derived from the positive and negative edges of the square wave signals.

The amplitude of the spikes depends on the values of these capacitor/resistor "differentiating" networks. With the given values, the accented beat spikes are higher than the background beat spikes.

The spike signals of the beat generators are rectified and mixed together by D2 and D3.

The resulting voltage spikes are amplified by the two transistors. The output signal can be attenuated by pot RV2.

Capacitor C10 buffers the battery as the very short output current pulses in transistors Q1 and Q2 are in amplitude quite high. This current would upset the logic without such a buffer capacitor.

Construction

The construction of the metronome involves both crafting the box and the assembly of the PCB, as mentioned earlier. We'll start with the electronics.

The heart of this metronome consists of a printed circuit board (PCB) coded 87ms11. It measures 78 x 47mm.

The construction of the electronics is not very complicated. First mount the two wire links, then the resistors, diodes, the ICs, transistors, the capacitors and finally the trimpot.

The assembly does not involve any tricky soldering. Just take care with the orientation of the ICs, transistors, diodes and the electrolytic capacitors.

Before you connect the potentiometer, battery clip etc., you should work out how you are going to mount the metronome in the box.

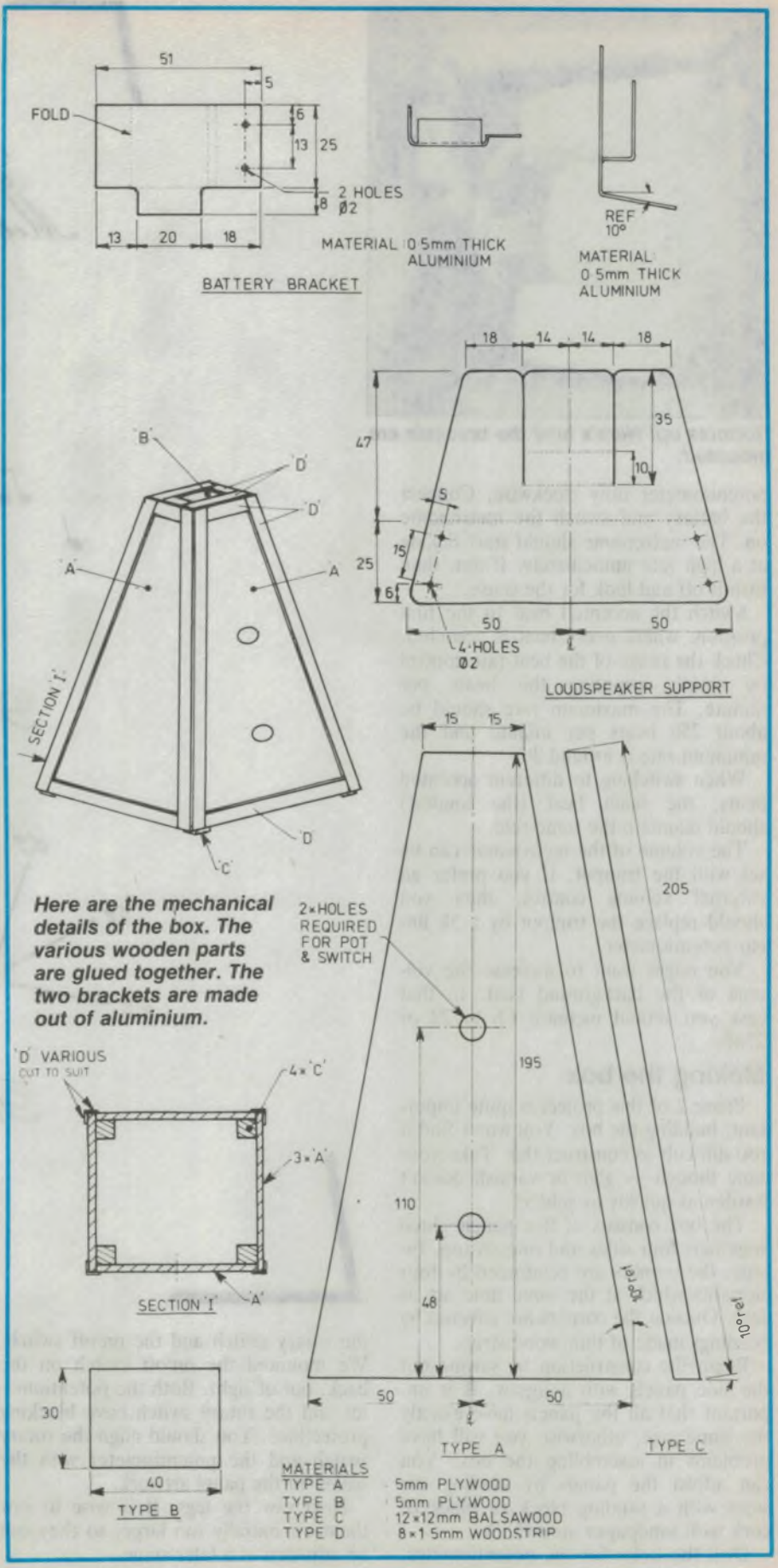
Once you've worked out the mechanical details, you'll be able to determine the length of the wires going to the switch etc.

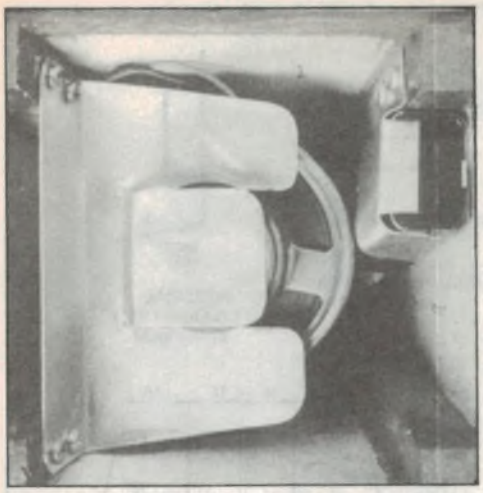
Connect the beat rate potentiometer, the battery clip, the On/Off switch and the accented beat switch. Take care when wiring up the latter, not to mix the wires up. The wiring diagram should provide all the information you need.

Testing your ticker

Before you stamp "Tested and Approved" on the first part of this project you should try out the metronome.

Before you connect the battery, turn the trimpot (volume) and the beat rate





Bottoms up! Here's how the brackets are mounted.

potentiometer fully clockwise. Connect the battery and switch the metronome on. The metronome should start ticking at a high rate immediately. If not, then turn it off and look for the cause.

Switch the accented beat to the first position, where every beat is accented. Check the range of the beat rate control by simply counting the beats per minute. The maximum rate should be about 250 beats per minute and the minimum rate is around 30.

When switching to different accented beats, the main beat (the loudest) should maintain the same rate.

The volume of the metronome can be set with the trimpot. If you prefer an external volume control, then you should replace the trimpot by a 5k linear potentiometer.

You might want to increase the volume of the background beat. In that case you should increase C8 to 22 or 27nF.

Making the box

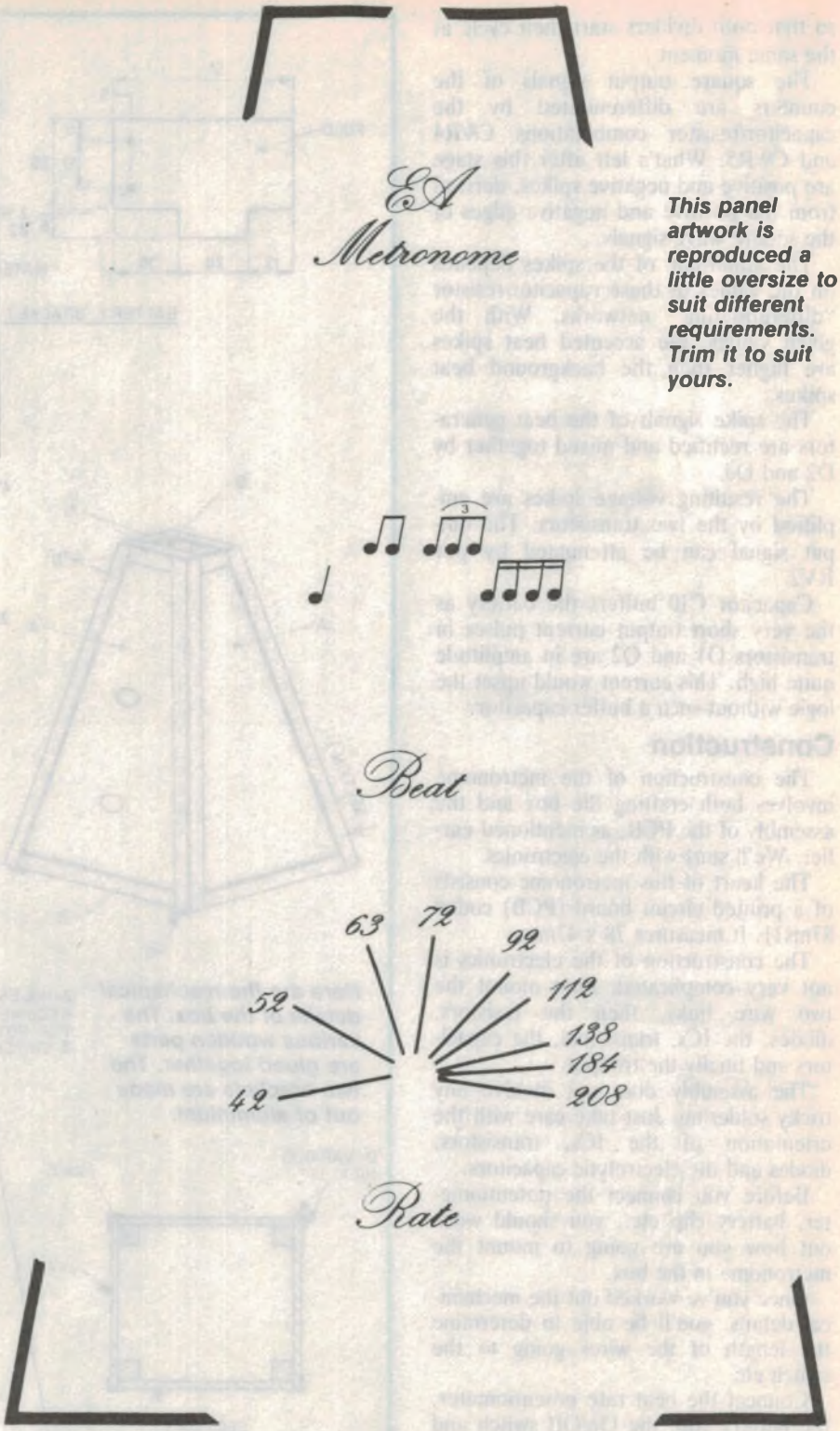
Phase 2 of this project is quite important; building the box. You won't find it too difficult to construct this. Take your time though — glue or varnish doesn't harden as quickly as solder!

The box consists of five panels glued together; four sides and one on top. Inside, the corners are reinforced by four uprights which at the same time act as legs. Outside the corners are covered by beadings made of thin wood strips.

Begin the construction by sawing out the side panels with a jigsaw. It is important that all the panels have exactly the same size, otherwise you will have problems in assembling the box. You can adjust the panels by sanding the sides with a sanding block (a block of cork with sandpaper around it).

Drill the holes for the potentiometer, the rotary switch and the on/off switch. We mounted the on/off switch on the back, out of sight. Both the potentiometer and the rotary switch have blocking projections. You should align the rotary switch and the potentiometer with the scales on the panel artwork.

Next saw the legs. It is wise to saw them off initially too large, so they can be adjusted at a later stage.



This panel artwork is reproduced a little oversize to suit different requirements. Trim it to suit yours.

Have a good look at the mechanical drawing before you assemble the box. In particularly look at section I. You'll see that the front and the back of the final box are larger than the sides.

The assembly of the bare box is done in two stages. Firstly glue the uprights to the front and the back panel. That makes two each. After the glue has dried, you can glue the side panels to

Parts list

1 PCB coded 87ms11, 78 x 47mm
1 small loudspeaker
1 6 position 2 pole rotary switch
1 SPST switch
1 9V battery clip
1 9V battery 216 or similar
2 knobs

Semiconductors

1 4018 programmable divide by N counter
1 4027 dual JK master-slave flipflop
1 555 timer
2 BC547 NPN transistors
3 1N4148, 1N914 diodes

Capacitors

1 8.2nF metallised polyester
1 18nF metallised polyester
1 68nF metallised polyester
5 10uF, 16VW PC electrolytic
1 3.3uF, 16VW PC electrolytic
1 220uF, 16VW axial electrolytic

Resistors (0.25W, 5%)

1 x 150, 1 x 1k, 1 x 1.8k, 1 x 10k, 3 x 100k
25k linear potentiometer
5k trimpot

Box

900 x 100 x 5mm plywood
1000 x 12 x 12mm balsawood
2.5 meter woodstrip 8 x 1.5mm
Glue, as used for wooden model aircrafts
Woodstain
Varnish
0.5mm sheet aluminium
All the parts for the box should be available in hobby shops specialising in model aircraft.

Miscellaneous

Solder, wire, screws etc.

the front and back panels. This is probably the most tricky part of the whole operation. You might have to hold the lot until the glue has dried, or perhaps use some wood clamps if you have some laying around. Even stout rubber bands can be used.

When the glue has fully hardened you can proceed by sanding down the top of the metronome until it's nice and flat. The top panel can now be glued to the box. The size of the top panel as given in the drawing is merely theoretical; check the actual requirements before sawing it out.

You can now adjust the length of the legs by sanding them down (up?), so that the whole thing stands upright. By now a naked metronome should be standing on your bench.

As we wanted the panels to have a different colour from the beadings, we used two coats of woodstain to colour the metronome before mounting the beadings.

The wood strip used for the beadings should be cut with a sharp hobby knife. The strips are glued to the metronome.

Finally the metronome box should be finished with varnish. Perhaps you should try out the varnish on a bit of scrap wood; this to work out which treatment gives the best result.

The metronome box should now be ready and you can start building all the electronic bits and pieces into it.

For the battery we made a bracket. It is made out of 0.5mm aluminium, cut and bent into shape. In the same way we made a bracket for the loudspeaker. The sound output of the loudspeaker is directed into the box. The shape of the box improves the sound of the metronome. Both brackets are screwed to the balsa uprights.

Mount all the electronic bits in the box and there you are, the metronome is ready!

WHY NOT GIVE A MULTIMETER THIS CHRISTMAS

• ECONOMY POCKET
- 2000Ω/volt
- size 90 x 50 x 30mm

Cat. QM-1001

$17.50

DIRT CHEAP!!

• LOW COST
- 10,000Ω/volt
- 19 ranges

Cat. QM-1015

$23.50 SAVE $6

• WITH CONTINUITY BUZZER
- 20,000Ω/volt
- 10A DC range

Cat. QM-1022

$39.95

• ELECTRONIC FET VOM
- Transistor tester
- Centre zero adjust
- Peak to peak & rms reading

Cat. QM-1050

$79.95

NEW

• 10 AMP DIGITAL
- Transistor tester
- Vinyl case

Cat. QM-1530

$89.95

• 10 AMP WITH CAPACITANCE METER
- Digital
- Transistor tester
- Vinyl case

Cat. QM-1540

$129.00

• 4 1/2 DIGIT - 10 AMP
- Transistor tester
- Diode tester
- Data hold

Cat. QM-1550

$179.00

• DIGITAL WITH FREQUENCY COUNTER
- Capacitance tester
- Transistor tester
- 20 amp current
- High impact case

Cat. QM-1555

$159.00 SAVE $10

"SPY IN THE SKY" SENSOR

The Pyroelectric infra-red sensor element is the 'eye' of a passive infra red detector. It measures 10mm high, 9mm wide and only 6.2mm deep. The IRA.F001-P comes complete with full technical data including performance graphs. Information on the operating principle and two typical application circuits!

Typical Applications:
- Burglar alarms
- Proximity detectors
- Automatic door/shutter switch
- Toys, robotics
- Accident prevention/machine guard
- Electronic appliances
- Automatic lighting (in toilet?)

Cat. ZR-9500

ONLY $19.95

DIRT CHEAP!!

50 & 100W MOSFET AMPLIFIER 'BRICK'

NOT A KIT - INSTANT POWER!

At last, a good value AUSTRALIAN MADE amplifier module that is rugged, has the heatsink built in and is cheap!

The 'JAYBRIK' as they are called are basically rugged Mosfet power amplifiers manufactured to high standards on fibreglass board with a special DIECAST heatsink. All board components are enclosed in a special conformed coating that ensures that the amp will operate in extreme environmental conditions. If in the unlikely event of a repair being necessary the coating can be picked away and the offending component replaced. The Jaybrik will drive either 4, 8 ohms or 100V line step-up transformers and has unconditional stability. They are virtually bullet proof. They are ideal for professionals who need slave P.A. in a hurry or any Hi Fi or sound reinforcement application. You simply connect filtered DC and a signal to them and they are guaranteed to go!

So check out the specs. You will find them stunning for a PROFESSIONAL amplifier module.

JAYBRIK

SPECS:

J-100 100W RMS min into 8Ω, with 45-0-45 3A transformer and 1 x 8000μF/75 filter cap each rail and 6A bridge rect. 45-0-45 is MAS permitted power supply voltage. (This will produce 30V across 8Ω which is 112.5W). Max off load volts! 125.
Distortion: <0.1% max any frequency typ 0.06%. 0.018 @ 1kHz.
Frequency Response: 20 - 20kHz ±0dB (-3dB @ 200kHz)
Sensitivity: 850mV p.p. for rated output
Impedance: 47kΩ
S/Noise: Over 100 dB W.R.T. 850mV
Stability: Unconditional
Cat. AA-0382

$125.00

J-50 50W RMS min into 8Ω, with 25-0-25 2A transformer, 1 x 4700μF/50V filter cap each side and 3A bridge rect.
All other specs the same or better than above.
(Filter capacitor values must be doubled for use on 4Ω loads)
Cat. AA-0380

No time for Pic. See next months ads

$99.00

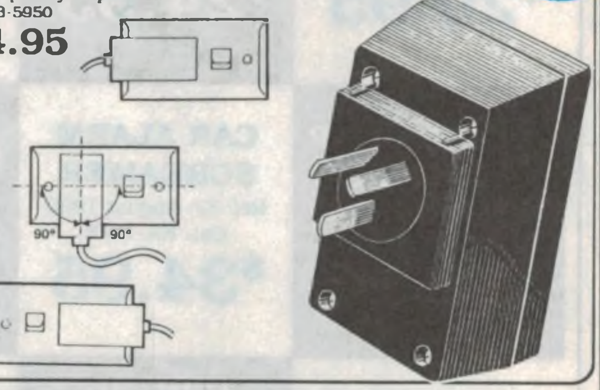
240V 3 PIN PLUG/ENCLOSURE

This enclosure which measures 78(L) x 50(W) x 40(usable depth)mm has a moulded 240V 3 pin plug insert which can be rotated thru 180° to allow the adaptor to mount in any of 3 positions (see fig #1).
There is a generous space inside the box to fit relays, electronics, etc for whatever reason you like.
We expect that many mains powered magazine projects will require this unique Jaycar product!

Cat. HB-5950

$14.95

NEW



SAVE ON POLYPROPYLENE WOOFERS

6" Woofer Cat. CW-2108
$29.95
SAVE $10

8" Woofer Cat. CW-2114
$39.95
SAVE $10

10" Woofer Cat. CW-2117
$57.50
SAVE $12

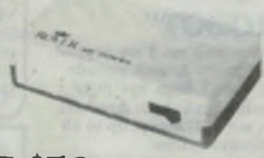
12" Woofer Cat. CW-2130
$64.50
SAVE $15

See our Cat for full specifications

MASSIVE SCOOP PURCHASE

ROVER NEGATIVE ION GENERATOR

Yes, we've made another scoop purchase. These ionisers are 240 volt operated, draw about 1/2 watt, deliver about 250 billion ions per second, and cover about 25 square metres. It's even supplied with a Tester PC board and spare needles. If you've ever wondered about negative ion generators, this MUST be the time to buy one. These were selling for about $80. Jaycar has a limited quantity available for:



Cat. YX-2905 **$29.95** **SAVE $50**

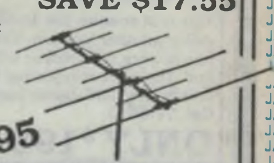
TV ANTENNA BARGAIN

NORMALLY $57.50

SAVE $17.55

We have just purchased a quantity of VHF TV antennas from a wholesaler who is no longer in the TV antenna business. The antennas are a 7 element type suitable for metropolitan areas. They have excellent gain and directivity for areas with moderate signal strength! For coax use use outdoor balun Cat. LT-3026 $3.75. Australian made. These will never be this cheap again.

Cat. LT-3166



ONLY $39.95

SQUEAKY CLEAN MAINS FILTERS

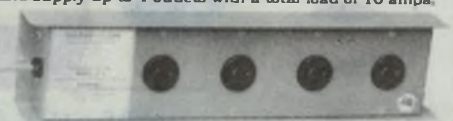
TWO BRAND NEW MODELS, BOTH FULLY APPROVED BY THE ELECTRICITY AUTHORITY

4 OUTLET

The MS-4020 will supply up to 4 appliances. Each 240V socket is independently filtered from the other, i.e. interference from disk drives is de-coupled from the CPU power supply, etc. The filter will suppress interference from RF sources, spikes, transients and lighting, and supply up to 4 outlets with a total load of 10 amps.

Cat. MS-4020

$269.00



2 OUTLET

The two outlet will handle up to 7.5 amps and will suppress interference from RF sources, spikes, transients and lighting. The two sockets are not independently filtered although.

Cat. MS-4025

$99.00

BEWARE! There are many mains filters on the market. One sample we evaluated had only one capacitor in it!

WORLD CLASS ADCOLA SOLDERING/ DESOLDERING SYSTEM BARGAIN

We have purchased a quantity of these quality soldering stations and accessories, and can offer them at never to be repeated prices. Adcola have put their prices up recently, so these special prices represent a saving of about 40% on what you can expect to pay in the near future. See our catalogue for full specs on this fabulous soldering system.

DEAL 1.

You get
- Base station Cat. TS-1470
- CT7 Iron Cat. TS-1480

• $169

Current price (before price increase) $192

DEAL 2.

You get
- Base station Cat. TS-1470
- CT7 Iron Cat. TS-1480
- Desolder tool Cat. TS-1476

• $224

Current price (before price increase) $261.95

Desolder tool on its own (if you already own the station) **$59.95**

SAVE $10

Cat. TS-1476

SAVE HEAPS

PORTABLE GAS SOLDERING IRON

- No cords, batteries or gas bottles
- Heavy duty, tip temperature up to 400°C
- Adjustable temperature, equivalent to 10-60 watts
- Hard working, up to 60 minutes continuous use
- Refills in seconds, uses standard Butane gas lighter fuel
- No leakage current to sensitive circuits
- Made in Ireland

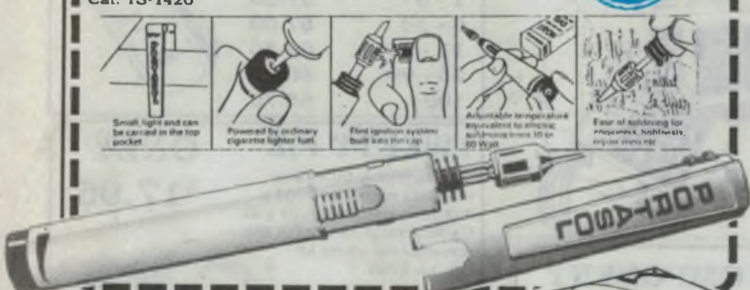
$39.95

NEW

WAS SELLING FOR $59.95

Jaycar introduces the product at a very realistic $39.95

Cat. TS-1420



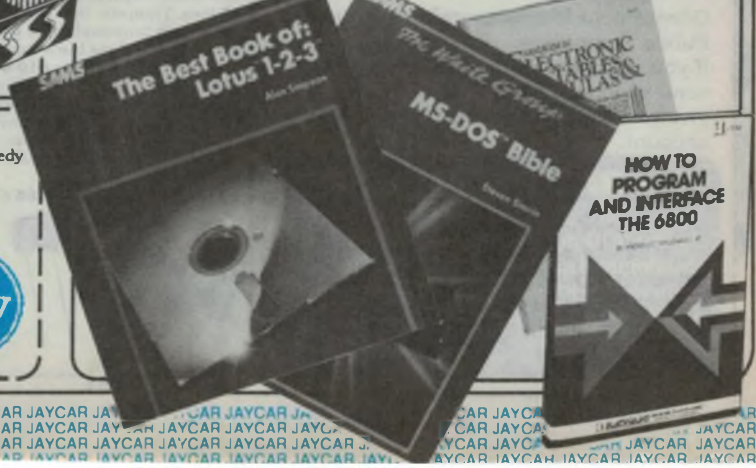
NEW BOOK SHIPMENT JUST ARRIVED

(See our catalogue for full details)

BS-0402	Video cameras, theory and servicing	$29.95
BS-0404	Introduction to automotive solid state	$19.95
BS-0406	Soul of CP/M	$39.95
BS-0408	Interfacing the IBM computer	$32.95
BS-0412	Printer connections bible	$29.95
BS-0416	Macintosh programming techniques	$44.50
BS-0422	Computer connections solved	$37.95
BS-0455	Understanding data communications	$27.95
BS-0456	Understanding microprocessors	$27.95
BS-0458	Understanding digital electronics	$27.95
BS-0518	CMOS cookbook	$23.95
BS-0522	555 Timer sourcebook	$12.95
BS-0534	Design of PLL's	$18.95
BS-0550	Handbook of electronic tables & formulas	$34.95
BS-0580	Programming and interfacing the 6502 with experiments	$28.95
BS-0582	How to program and interface the 6800	$25.95
BS-0594	Z80 microprocessor handbook	$21.95
BS-0596	Z80 microprocessor design projects	$25.95
BS-0614	Electronic telephone projects	$17.95
BS-0729	How to build speaker enclosures	$14.95
BS-0733	Data communications, network and systems	$75.00
BS-0736	MS-DOS bible	$39.95
BS-0739	Best book of Lotus 1-2-3 (2nd ed)	$26.50

TAKE 20% OFF THE FOLLOWING BOOKS

		Was	Now
BS-0420	C programming techniques for Macintosh	37.95	$30.36
BS-0703	Howard Sams crash course digital technology	$34.95	$27.96
BS-0720	Fibre optics experiments & projects	$26.95	$21.56
BS-0732	Complete guide car audio	$19.95	$15.96



GREY JIFFY BOXES

If you want some colour in your projects, try a grey Jiffy box.

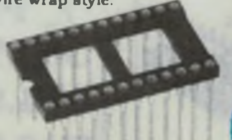
Available in 3 sizes, all with ABS plastic lids.

Cat. HB-6021	UBI (150x90x50)	$4.25	$4.00
Cat. HB-6023	UB3 (130x68x41)	$3.25	$3.00
Cat. HB-6025	UB5 (83x54x28)	$2.45	$2.25

WIRE WRAP MACHINED IC SOCKETS

We have found it impossible to purchase wire wrap IC sockets lately. To remedy this we have introduced machined wire wrap style.

	Cat	Price	10 up
8 pin	PI-6491	$1.75	$1.65
14 pin	PI-6492	$2.65	$2.50
16 pin	PI-6493	$3.25	$3.10
18 pin	PI-6494	$3.40	$3.20
20 pin	PI-6495	$3.50	$3.30
22 pin	PI-6496	$3.85	$3.60
24 pin	PI-6497	$4.40	$4.15
28 pin	PI-6498	$4.95	$4.65
40 pin	PI-6499	$6.50	$6.20



NEW

TELEPHONE CALL DIVERTER

This unit enables you to divert an incoming phone call to another location. The diverter will divert either line (2 lines required) or will divert only one incoming line. There are many other features which you will find in the 1987 Jaycar catalogue.

Cat. YT-6510

ONLY $199 **NOW AVAILABLE**

CORDLESS PHONE

The fabulous Portable Telephone that you can take anywhere around the house, garden or swimming pool. Microprocessor controlled with a range of up to 250 metres and absolute clarity.

Features:

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

Cat. YT-7065

SAVE $70 WAS $269

NOW ONLY $199

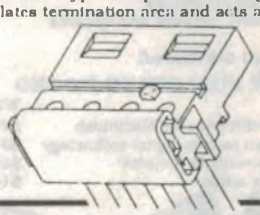
AT LAST!!
4 PIN DISK DRIVE PLUG

We must be asked so many times per day for this device and now we have finally found it. Top quality insulation Displacement type with positive locking cover which insulates termination area and acts as a strain relief.

Cat. PP-0920

$6.50

10 up
$6.00 each



Government Instrumentalities, Schools, Public Companies.

If you wish to purchase from us, simply send us your official order and we will give you a complimentary 30 day account.

FREE CATALOGUE

If you don't already own a copy of the Jaycar 116 page 1987 Engineering Catalogue drop into any one of our showrooms for a free copy. If you can't get in send a large SAE and we'll forward you one.

ROBOTS

ECONOMY "FRIENDLY LITTLE ROBOT"

Programmable via 8 key keypad on its "chest". Actions include music sound, flash 'eye' (light on head) turn in both direction, circle, etc. Will accept up to 18 consecutive entries.

Also features a tactile bumper switch and moveable arms which can grip small objects. Measures 150mm diameter and 210 high.

Batteries extra $4.75 - 4 x AA & 1 x 9V.

Cat. XR-1020

$49.95

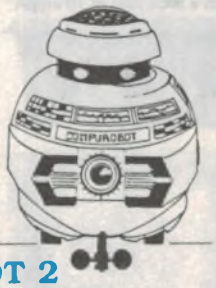
COMPUROBOT

Very sophisticated, microprocessor controlled via 25 key keypad on robots 'head'. Up to 48 separate routines can be entered. Multi speed gearbox, travels in 4 separate directions, as well as angles and curves. It has lights and can make sounds. Hundreds sold to primary schools.

Batteries extra $4.75 - 4 x AA and 1 x 9V

Cat. XR-1024

$69.95



COMPUROBOT 2

This highly sophisticated robot has it all. Programmable via a wireless infra red hand held controller with a 25 key keypad. 30 page instruction manual provided. Up to 64 program steps can be entered into its memory. Will go in any direction, as well as make different noises and flash lights. It has two motorised mechanical arms to carry a payload. The robot will draw with a crayon. It will carry the IR controller when not in use. Auto turn-off to save batteries. Size 230(H) x 210(W) x 175(D)mm. Rugged case, Japanese motors.

Batteries extra $6.33 - 4 x AA & 4 x C

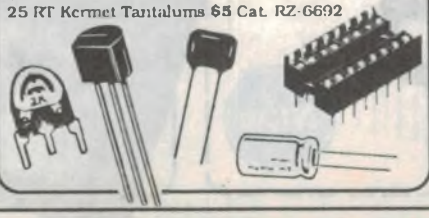
Cat. XR-1028

$129.95

DIRT CHEAP!!

BARGAIN COMPONENT PACKS

80 Electrolytics **$10** Cat. RE-6250
150 Mixed Capacitors **$10** Cat. RE-6260
35 Pots, Trimpots, Sliders **$10** Cat. RP-3902
100 mixed Semiconductors **$10** Cat. ZP-8990
100 mixed BC type transistors **$11.95** Cat. ZT-2170
100 3mm & 5mm LEDs **$10.50** Cat. ZD-1694
100 mixed IC sockets **$24.95** Cat. PI-6490
50 assorted Pots **$7.95** Cat. RP-3900
50 assorted Resistor Networks **$10** Cat. RR-3380
Assorted Pot Cores **$9.95** Cat. LF-1280
20 Precision 1% & 2% Capacitors **$12.50** Cat. RG-5198
25 RT Kermet Tantalums **$5** Cat. RZ-6692



STOP WATCH

Attractive all weather stop watch as well as a 5 function watch. (Day, date, etc) Complete with a generous length of knitted lanyard. Very easy to use. Quartz controlled for greater accuracy.

Cat. XW-0380

$16.95

QUARTZ CLOCK/COMPASS

ONLY $5.95

GREAT XMAS PRESENT FOR DAD

This great small product has many applications. It's a quartz digital clock and a compass in one small, handy size.

Cat. XW-0250

NEW

UNBELIEVABLE ELECTROLYTIC BUY

Through Jaycar's surplus stock buying scheme, we have purchased a substantial quantity of an electro that would normally be out of reach of the hobbyists pocket. This electro is made in Germany by ROEDERSTEIN!

6,800uF 63V LONG LIFE

ONLY $7.50!!

That's right ROEDERSTEIN brand long life, high ripple current etched electrodes, screw terminals - all class! And at a price below "Taiwanese". These are absolutely fantastic for power supplies for high power amps, etc.

Electrical to DIN 41332
Tolerance -10 +50%
Dimensions 50(D) x 80(H)
Terminal M5 screw

Cat. RN-6712
$7.50

QUANTITY DISCOUNTS

1 - 5	$7.50
6 - 10	$7.00
11 - 24	$6.50
25 - 99	$6.00
100+	$5.75

TWEETY PIE

ONLY $17.95

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

Cat. LA-5255

ULTRASONIC PEST & INSECT REPELLER

(Full details in the 1987 Jaycar catalogue)

Cat. YS-5510

1/2 PRICE

ONLY $24.95

WAS $55

INNER EAR MINI STEREO PHONES

Unique type headphones, so small they can be stored in a MATCHBOX. Very high sound quality and comfortable to use. Supplied with adaptor plug to 6.5mm and spare replacement ear pads.
Cat. AA-2014 **$8.95**

INFRA RED PHOTO ELECTRIC RELAY

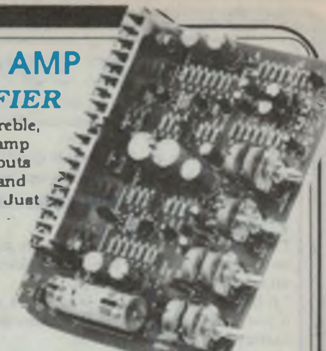
NEW

This is the device which makes all the noise when you walk into a shop. Mounts on one side of the door, and the reflector (which is supplied) on the other. It will sound when someone breaks the beam, or can be switched so it sounds for 5 seconds and then resets. 240 volt operating.
Will operate up to 15 metres. Built-in buzzer (extension buzzer can be added)
Size 90 x 143 x 190mm
Cat. LA-5120

$129.00

30 + 30 WATT STEREO AMP

INCLUDING PRE-AMPLIFIER



Fully built and tested with separate bass, treble, balance and volume controls. This superb amp has less than 0.1% distortion. There are inputs for microphone, phono and auxiliary (line) and all power supply components are on board. Just connect transformer, speakers and a signal - and away you go!
Cat. AA-0300

ONLY $59.95

Transformer to suit
Cat. MM-2010
$22.50

6 WATT 'MICRO' AMPLIFIER 1 CHANNEL

AMPLIFY YOUR WALKMAN!

This little amplifier will provide up to 6 watts into 4 ohms from a 15V power supply. Onboard volume control and high or low impedance inputs. 'Walkman' type 'low' and 'high' for standard line level signal sources such as tuners, VCR's, etc. (regard as AUX). Output is short circuit protected. A copper heatsink fin must be soldered to the top of the IC to achieve this.

SPECIFICATIONS

Power Out	6W (max) into 4 ohms
Input Sensitivity	100mV
T.H.D.	0.3%
Gain at 6V	38dB
Power supply	4 - 16V @ 1-2A

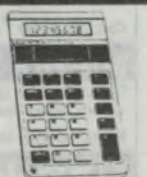
Cat. AA-0340
(Two required for stereo)

$15.95

See our catalogue for other prebuilt modules in this range - preamps, power amp, sound switch, light switch, IR remote control, speaker protector, LED level meter.

TEXAS INSTRUMENTS CALCULATORS

TI-1103

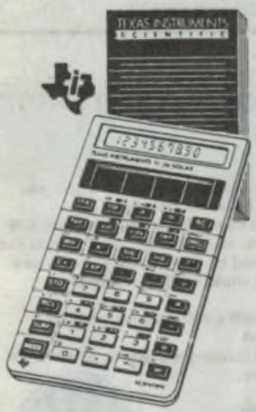


Handy everyday calculator in unique carry case! • Compact, economical eight digit, six function calculator with large keys • Full function • Automatic percent key, automatic constant, square root key • Automatic power down
Cat. QC-7172 **$15.95**

TI30 SLR

Solar powered slide rule calculator. If you can see it has enough light to work. • Contains the advanced algebraic and trigonometric functions • Most needed slide rule functions roots, reciprocals, logs • Angular conversion for degrees, radians and grads
Complete with vinyl wallet
Cat. QC-7164 **$29.95**

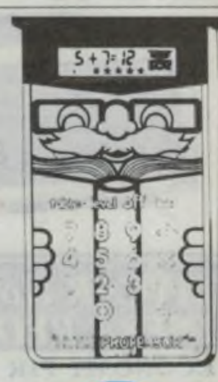
TI-36 SOLAR



Performs 89 scientific functions, magnificent helpful guide book included!
• Designed for high school and college students - scientific functions include logs, reciprocals, powers, roots, factorials, combinations, permutations, hyperbolics, complex numbers, polar/rectangular conversions and trig calculations including inverse in degrees, radians or grads • Statistical functions include mean and standard deviation, normal distribution • Enter numbers and perform calculations in binary, octal, decimal or hexadecimal number bases. Convert numbers. Perform mixed calculations.
• Floating decimal, scientific notation or engineering notation. • 10 digit/2 exponent display • Low light solar cells • Guidebook, vinyl wallet and quick reference guide.
Cat. QC-7170
$49.95

NEW

LITTLE PROFESSOR



A marvellous way to teach young children their maths tables plus addition, subtraction, multiplication and division!
• Tables mode gives practice in math tables
• Comes with Little Professor Activity Book
• Your child gets two chances to solve the problem before Little Professor gives the answer • Contains over 50,000 pre-programmed problems • Makes learning what it should be - FUN!
Cat. QC-7160
$34.95

TI56 PROGRAMMABLE

Ideal for Tech Students, at a bargain price - factorials, imperial to metric conversions (or visa versa), engineering and scientific notation, integration, statistics, polar/rectangular conversions, stores a constant (even when off), algebraic operating system. Operates in proper mathematical order.
8 digits and 2 exponents. Degrees, radians and grads.
Cat. QC-7174
$49.95

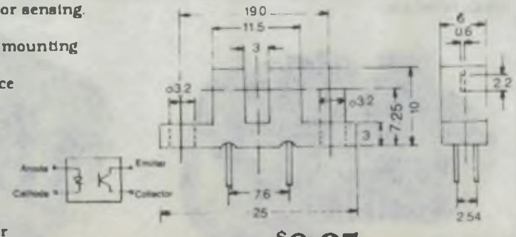
NEW

PHOTO INTERRUPTER

This device enables you to turn a circuit on and off optically.
It consists of a moulded plastic housing with an IR LED facing a phototransistor across a gap. Any object in the gap will interrupt the IR beam and consequently switch the phototransistor on and off. The device is very fast and ideal for counting, timing or sensing.

FEATURES:
- PCB or chassis mounting
- Low cost
- Rugged one piece construction
- Very fast

APPLICATION:
- Counter sensor
- Tachometer
- Opto ignition
- Edge sensor
- Tape end sensor



Full specs supplied with each unit. Cat. ZD-1901 **$8.95** 10+ $7.95

MORE VIATEL MADNESS!!

Yet another unbelievable deal.
Once again Jaycar has made a scoop purchase of - this time - Viatel ADAPTORS for your own TV set!
That's right, you connect them to your own TV via the antenna and to a telephone line as well. A nifty little infra-red wireless remote control is supplied so that you can operate Viatel from the comfort of your lounge chair!
We must emphasise that the goods offered are NOT BRAND NEW and are 'ex-rental'. They are in very good condition and fully operational when supplied. The adaptor will drive an RGB monitor as well as a telly. It also has parts for a tape recorder and printer and a socket for full QWERTY keyboard.
If you want to integrate VIATEL into your home entertainment system then this is definitely for you. Because of the compact size, this offer is available to Mail Order customers as well as our personal customers - but be quick!
Naturally, documentation is included.
Cat. XV-2210 inc remote control pad

ONLY $199

DIRT CHEAP!!

Cat. XV-2212 Full QWERTY keyboard $99

ULTRASONIC BURGLAR ALARM

The same wholesaler who sold us the antennas (see elsewhere these ads) is also no longer in the alarm business. We purchased a quantity of these and can offer them for less than 1/2 price.
The alarm is basically suitable for flats, units, one room, garages, etc., but it can also form the basis of a "build-up" system.

IDEAS FOR USING ALARM

SIMPLE ALARM

The most simplest way to use is to simply sit the unit on a shelf. It can be switched on/off from the unit* and can be plugged directly into 240 volts through an adaptor MP-3012 $18.95.
* It has a delay function, so it won't alarm before you switch it off.
If you wish, you can mount an external horn speaker, and it has facilities for battery back-up (5 x C size).

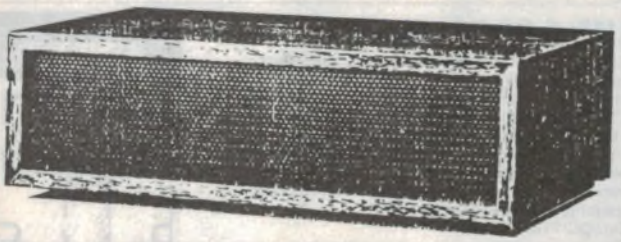
MORE INVOLVED SYSTEM

The alarm can be the basis of a comprehensive system.
The unit can be screwed into a shelf, and hard wired from behind. A keyswitch can be used and mounted on a plate either just inside the front door, or even outside.
There is an output for NC and NO circuits.
NC can be used for window and door reed switches and passivve infra red detectors. NO can be used for panic buttons, smoke detectors and PIRS.
The unit can be switched for instant alarm, so if an intruder walks in the room the alarm sounds instantly.
Rechargeable batteries can be used in case of power failures and are automatically charged by the unit. There is a built-in output relay which allows you to use any device which operates on 240V e.g. floodlights, diallers, etc.
We beleive this alarm at $49.95 is a bargain. That other big electronics retailer has the exact unit (with power supply) in their catalogue for $139.00.
If you can't afford a full system with panel and PIRS everywhere then this is the unit for you.
Power supply to suit Cat. MP-3012 $18.95
Cat. LA-5140

ONLY $49.95

DIRT CHEAP!!

SAVE $89

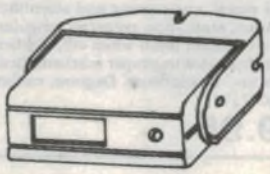


JAYCAR No1 FOR PASSIVE INFRA RED DETECTORS

ECONOMY PIR

- Coverage 12m x 12m
- 14 twin beam detectors
- NO or NC contacts
- Tamper protected and walk test

Cat. LA-5017



SAVE $10.00

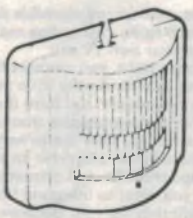
$99.00

WITH PULSE COUNT

A new addition to our range. After the tremendous acceptance of our LA-5019 Pulse count, we have found a lower cost unit with Pulse Count.

- 30 beams 2 (dual sensor elements)
- Wide angle multi layer coverage
- 12 metre coverage
- Tamper protected and walk test
- Pulse count triggering

Cat. LA-5018



NEW

$119

LA5019 PULSE COUNT

The absolute latest technology is used in this PIR.
FEATURES:

- Dual element pyroelectric sensor
- Pulse count triggering circuitry
- Fresnel lens array large coverage
- 24 dual element detection zones for long, mid and short range protection
- Surface or corner mounting without extra accessories

Cat. LA-5019

$139

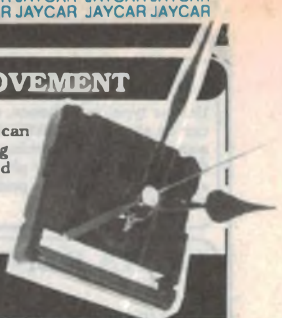
DIRT CHEAP!!

QUARTZ CRYSTAL CLOCK MOVEMENT

SUPPLIED WITH 3 SETS OF HANDS

Very compact unit (56mm square x 15mm deep) that can be used in your own design of clock face. Self starting one second stepping motor has strong torque. Powered by 1 x 1.5V AA battery that lasts around 1 year.

Accuracy is ±15 secs/month. Cat. XC-0100



ONLY $12.50

NEW CLOCK MOVEMENTS!

PENDULUM DRIVER

This small module measuring 130(L) x 60(W) x 35(D)mm uses 1 x AA cell. It causes a suspended arm within the module to swing back and forth. A suitable pendulum can be attached to the bottom of the arm. (Note: pendulum driver is NOT a clock). Battery (alkaline) will last over a year. Cat. XC-0110 **$14.95**

QUARTZ MOVEMENT WITH SWITCH CONTACTS

This is virtually identical to our XC-0100 standard movement except that it has a set of switch contacts that close every hour. These contacts can be used to trigger the "melody modules" (see elsewhere these ads).

Supplied with hands. Cat. XC-0105 **$16.95**

MD-01 MELODY MODULE - 12 SONGS

This module consists of 2" speaker with electronics mounted on the speaker frame. A single AA battery holder is attached. When the switch wires are shorted the module plays one tune from its repertoire of 12. It cycles through the 12 until it comes back to the first. (Typical tunes are nursery rhymes). Cat. XC-0115

$12.95

MD-02 WESTMINSTER CHIME

This module (similar in appearance to the MD-01) reproduces a 'Westminster chime' when activated. It is also supplied with a neat little "test button" switch.

Cat. XC-0120 **$14.95**

MD-202 12 SONGS PLUS CHIME

If you hear 10, give me a home where the Buffaloes roam. . . ' you know its 3 o'clock! After each tune a sombre chime rings out once for each hour of the day.

Supplied with test switch. Really nifty! Cat. XC-0122 **$14.95**

"TWINKLE, TWINKLE LITTLE STAR" MODULE

This tiny module measuring 45(L) x 30(W) x 4mm (thin!) is the module that you find in those crazy musical Xmas cards. When tiny spring switch contacts are closed it plays "Twinkle, Twinkle Little Star". Absolutely useless and eventually annoying. Great fun to build into anything ghastly! Cat. XC-1030 **$3.95**

NEW

2 MELBOURNE LOCATIONS
45 A'BECKETT STREET CITY
887 SPRINGVALE ROAD MULGRAVE

SCOOP PURCHASE!!

MICROPROCESSOR CONTROLLED/SOLENOID OPERATED HI FI CASSETTE DECK MECHANISM

You guessed it, another Jaycar buy far, far below manufacturers cost where you buy at a normally silly price because other people have lost heavily.
This time its a VERY HIGH QUALITY cassette deck mechanism that cost over $35 US in 1000 lots! This JAPANESE MADE mechanism is deck only - i.e. a door is not fitted nor are there buttons. The deck is not operated by mechanical buttons and all control is by electric signals, therefore the deck could easily be software controlled.
The deck also features an air damper cylinder for soft eject, massive capstan flywheel, Hi Fi head and excellent specs. (see below).
This deck is ideal as either a fast high capacity PC memory storage or as a retrofit to an existing cassette deck to improve performance.
Worth at least $80, grab one for ONLY

$24.95

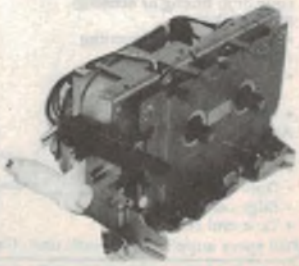
DIRT CHEAP!!

NEW

Cat. AC-1590

SPECS:

- 4 track, 2 channel Philips compact cassette deck
- Tape speed 4.75cm/sec
- Wow and flutter <0.12% RMS
- Winding time 110 sec FF & REW C-60
- Working volts 9 - 15V
- Supplied with 12 page comprehensive manual including circuit diagram, truth table, etc.



A Universal Voice Operated Relay

Are you an amateur or CB radio operator, who is sick of having to push a button on your microphone every time you want to transmit? Well, this simple device will take the drudgery out of talking for less than the cost of a new desk microphone!

by MARK CHEESEMAN

One of the most convenient features of many modern amateur transceivers is a voice-operated switch or VOX. The use of such a device allows virtually hands-free operation of the radio, but unfortunately many amateur rigs and most CB units do not have this facility.

A voice operated relay is a rather simple device, which samples the sound from a microphone and switches a relay when the level of the sound from the microphone exceeds a preset level. The relay is held on as long as the sound level stays above that threshold. When the output level from the microphone drops below the critical level, the relay drops out again, after a delay period which ensures that the relay does not drop out between words or sentences.

However, when a voice operated relay is used with a transceiver, a further problem is introduced which can cause false triggering if not accounted for. When the radio is receiving a signal, this signal will be amplified and passed to the speaker so that you can hear it. Unfortunately, the microphone also picks up the sound from the speaker, but the unit normally can't distinguish between this signal and your voice.

To compensate for this effect, the speaker signal is also fed directly to the unit, and the level of this is compared with that of the microphone. The speaker signal then has the effect of raising the threshold at which the unit triggers. Thus, when the levels are properly set, the speaker signal will not trigger the unit, yet it is still possible to trigger it by speaking into the microphone even in the presence of a received signal. Because the speaker signal works against the VOX action, it is termed ANTI-VOX.

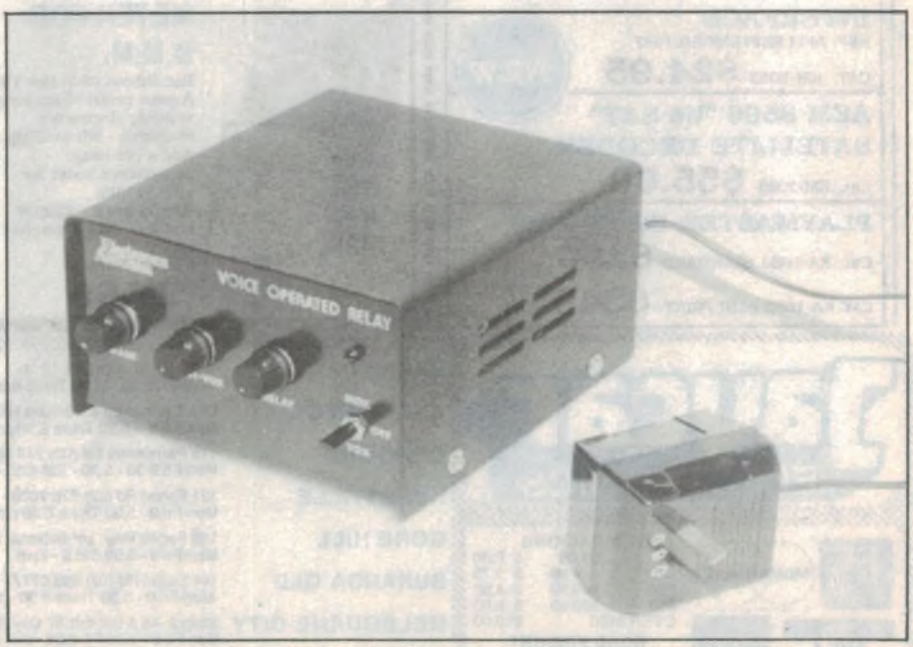
The easy to build voice operated relay presented here incorporates anti-vox circuitry, and features adjustable gain on the microphone and speaker inputs. The delay period before the relay drops out is also adjustable, to allow for varying gaps between words and syllables.It can also operate from a wide range of supply voltages, allowing the unit to be powered from the rig to which it is connected if this is convenient.

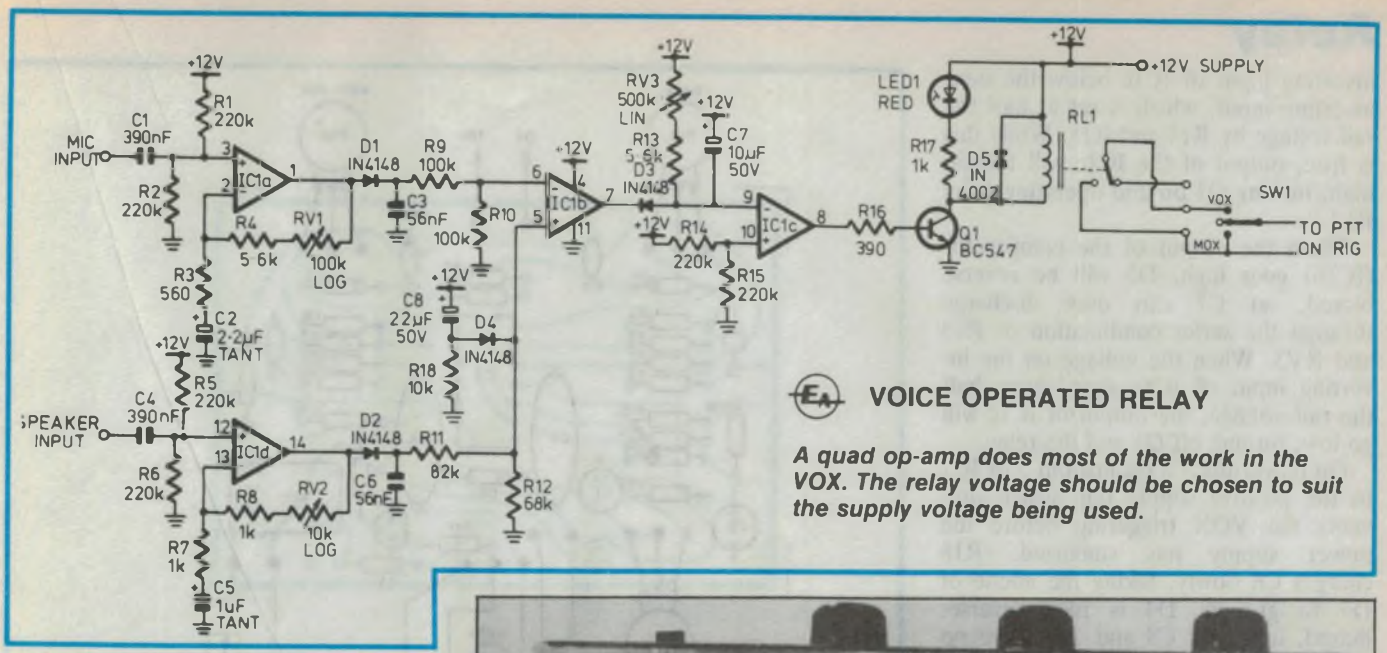
A switch on the front panel allows the VOX unit to be disabled if desired. If this switch is switched to the MOX (manually operated switch) position, the transmitter is keyed manually as if the push-to-talk button on the microphone had been pressed. You may wish to use a switch with a spring return on the MOX side, to prevent the transmitter being inadvertently left on.

While the most common application of a voice operated relay is probably hands-free transmit/receive switching for a transceiver, the device is in fact operated by virtually any sound. It could therefore form the basis of an intrusion detection system, an automatic advance unit for a slide show, or possibly even a sound-activated flash trigger for photography.

Circuitry

The microphone signal is AC-coupled to a non-inverting op-amp stage (IC1a) which has an adjustable gain of between 10 and 200, determined by the adjustable feedback resistor RV1. The non-inverting input of the op-amp biased at half rail voltage, as the circuit runs from a single supply rail. The output from the op-amp is rectified and filtered by D1 and C3, to provide a DC signal which varies in proportion to the level of the incoming audio. The DC gain of the input amplifier is set to unity by C2. This means that the voltage appearing





VOICE OPERATED RELAY

A quad op-amp does most of the work in the VOX. The relay voltage should be chosen to suit the supply voltage being used.

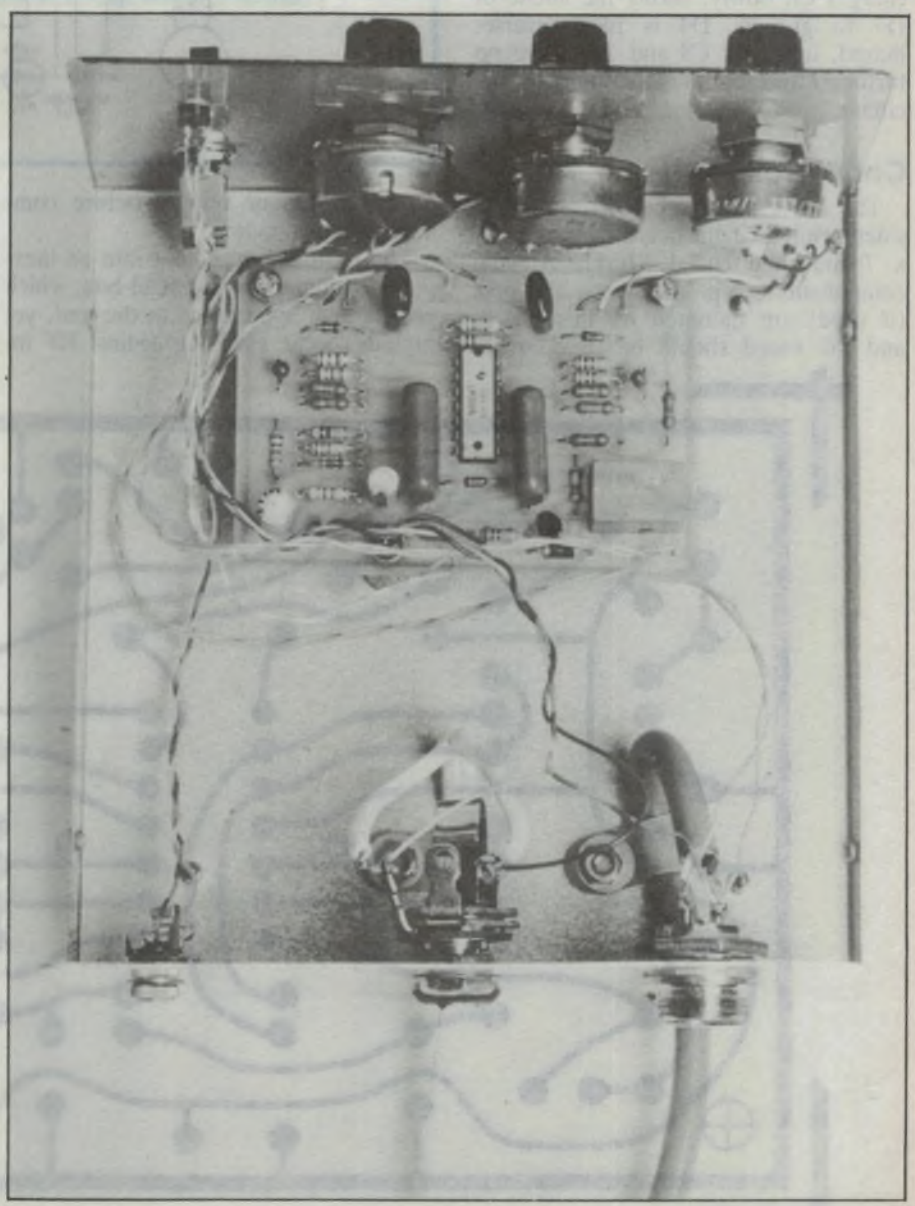
across C3 is half of the rail voltage plus the amplitude of any amplified microphone signal.

Similarly, the speaker signal from the receiver is AC-coupled by C4 before being amplified by IC1d. Note that the maximum gain of this stage is 10, as the speaker signal has a much higher level than the microphone. The output of this op-amp is then rectified by D2 and C6, giving a varying DC signal similar to the one derived from the microphone.

These two voltages are each fed to voltage dividers, set up so that with no signal applied to either input, the inverting input of IC1b is at a higher voltage than the non-inverting input. This voltage difference is the voltage rise which must occur on C3 in order to trip the VOX. Any increase in voltage on C6 results in this threshold being increased, and thus a larger signal is needed from the microphone to trigger the VOX.

In operation, the unit is set up so that any signal from the speaker produces the same change in voltage at the input of the comparator as the signal which the microphone picks up from the speaker. The time constants of the two filter circuits (C3, C6 and associated components) are set up so that the microphone voltage drops faster than the one from the speaker, in order to prevent false triggering.

When the voltage on the inverting input of IC1b exceeds that on the non-inverting input, the output of the op-amp will swing low, charging C7 via D3. As long as the microphone signal exceeds the pre-set threshold, C7 will be kept charged by IC1b. This keeps the

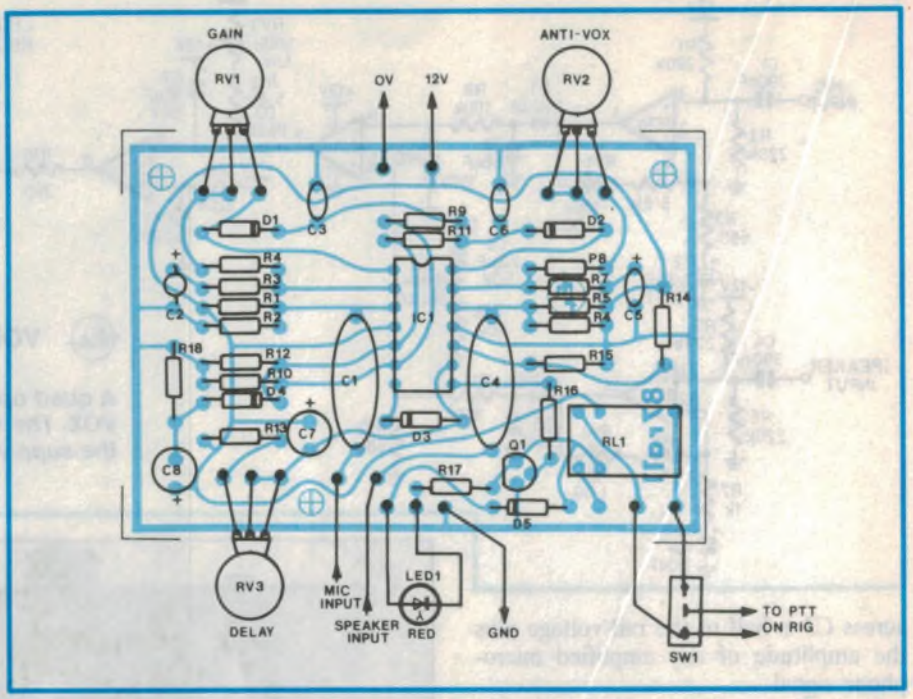


The PCB is mounted in the front half of the box, supported by three plastic standoffs.

inverting input of IC1c below the non-inverting input, which is set at half the rail voltage by R14 and R15. While this is true, output of the IC1c will remain high, turning Q1 on and operating relay RL1.

When the output of the comparator (IC1b) goes high, D3 will be reverse biased, so C7 can only discharge through the series combination of R13 and RV3. When the voltage on the inverting input of IC1c rises above half the rail voltage, the output of IC1c will go low, turning off Q1 and the relay.

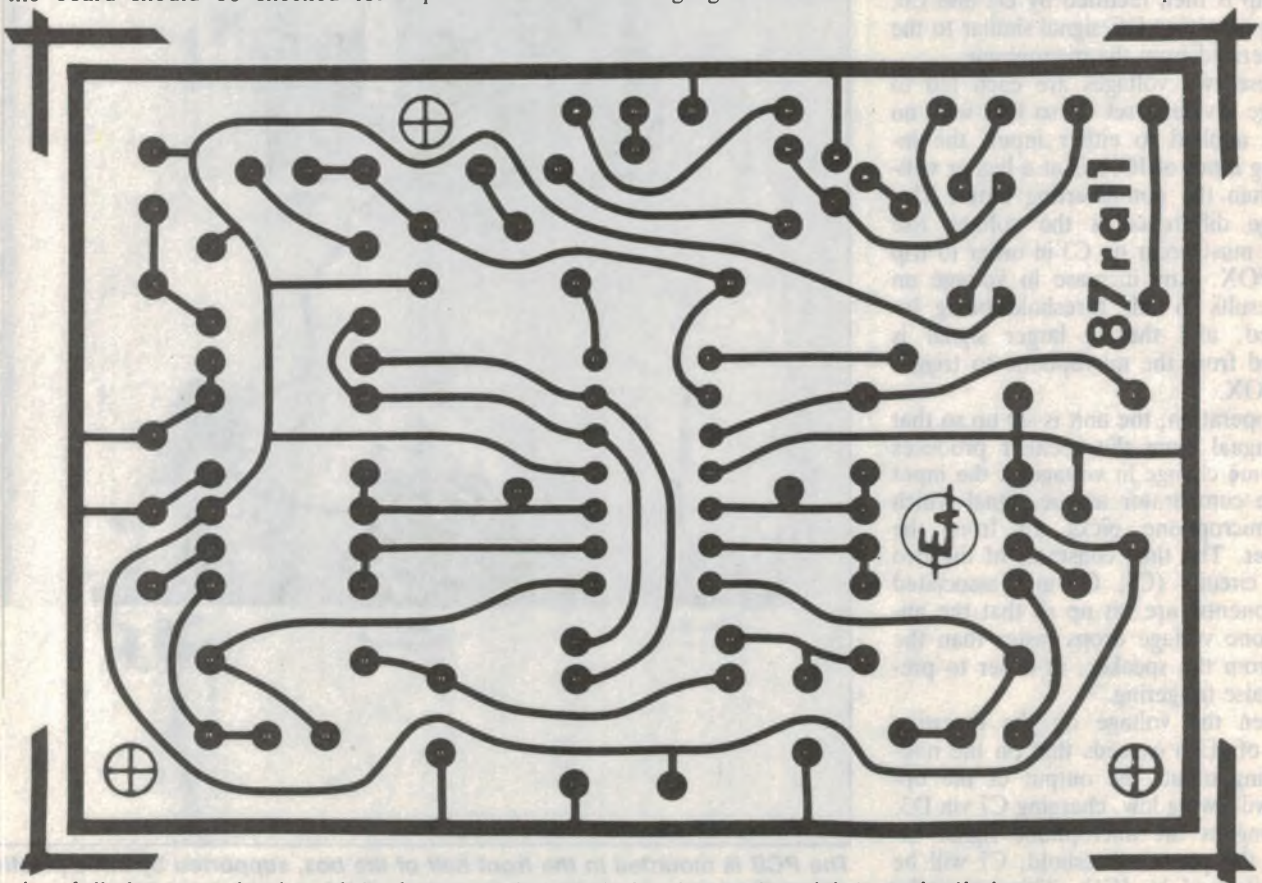
On power-up, C8 clamps pin 5 of IC1 to the positive supply rail, which prevents the VOX triggering before the power supply has stabilized. R18 charges C8 slowly, taking the anode of D4 to ground. D4 is then reverse-biased, and thus C8 and R18 have no further effect on the operation of the circuit.



Construction

The VOX is constructed on a single sided printed circuit board measuring 54 x 78mm, and coded 87ra11. All the components except the switch and pots (if used) are mounted on this board, and the board should be checked for broken tracks or bridges before commencing construction.

The prototype was built into an inexpensive aluminium and steel box, which gives a neat appearance to the unit, yet provides some shielding against RF interference. However some people may wish to build it into an existing piece of equipment (such as a transceiver or alarm unit). For this reason, the PCB layout is designed so that trimpots may be used in lieu of the panel mounted



Here is a full-size reproduction of the front-panel artwork, for those who wish to make their own.

variety if desired. Although the internal size of the box is larger than necessary, the front panel is the required size, and there is room inside for further boards to be mounted here in the future.

Start with the lower profile components such as resistors and diodes, being careful to insert the diodes the correct way around. Also insert the tantalum and electrolytic capacitors, being careful with polarity here also. While it is normal to insert ICs last, it may be difficult in this case because of the rather large capacitors mounted close to the IC. Therefore, it is best to put the IC in at this point, making sure it is orientated as shown in the overlay.

Now insert the remaining capacitors and the transistor according to the overlay. If you are going to use trimpots they may be inserted at this point, as can the relay. If the VOX is only required to switch a low voltage to ground and less than 80mA is involved, the relay could possibly be omitted and the transistor used to switch the rig directly.

Using short pieces of hookup wire, connect the potentiometers to the PCB, allowing enough wire to reach the pots when they are mounted on the front panel. Also wire up the VOX/MOX switch and the input and output sockets. The choice of input and output sockets is left up to the individual constructor, as there is a wide variety used and it would probably be desirable to use ones which match those on the microphone and rig.

All of the pins on the microphone socket are wired directly to the corresponding pins on the plug, to carry the microphone signal to the rig, and to allow the push-to-talk switch on the microphone to operate normally. The same is true for the speaker plug and socket, as inserting a plug into the extention speaker socket of most receivers will disable the built-in speaker. Be sure also to use shielded cable for the microphone cable, to avoid hum and noise pickup.

Using the front panel as a template (or preferably a photocopy of it), mark out the front panel. Position the PCB in the bottom of the box and mark out the positions of the mounting holes, and also decide where to mount the sockets on the rear panel. Carefully drill and de-burr the holes, and affix the Scotchcal front panel, cutting the mounting holes in the Scotchcal panel with a scalpel.

The PCB may now be mounted in the bottom of the box, using short standoffs. It is suggested that you mount the board as close as possible to the front panel, both to minimize the length of the connecting wires to the controls on the front panel, and to leave room for another board which you may wish to install at a later date. The pots and switch can be mounted in their respective holes on the front panel, and the sockets on the rear. The unit should now be ready for use.

The circuit will operate happily from any supply voltage from about 5 to 15 volts (in fact the prototype operated happily down to 3V!). If you are using a different voltage to that specified on the circuit diagram, make sure the relay used has a suitable coil voltage. The relay used on the prototype is also available with a 5V coil if needed.

Adjustment and Operation

To use the VOX with a transceiver, connect the unit to the microphone and the rig, but leave the VOX switch on the centre (off) position. This disconnects the transceiver so that unnecessary transmissions are not made, but the LED remains operational for adjusting the unit. Speak into the microphone as you would during a normal contact, adjusting the gain control so that reliable triggering occurs.

Next, tune in to a transmission with the volume control of the receiver set to normal listening volume. Hold the microphone a little closer to the speaker than you normally would, and adjust the anti-vox control so that no triggering occurs. Finally, set the delay control so that the VOX will not 'drop out' between words or sentences.

Parts list

1 PCB coded 87ra11
1 Aluminium case with steel lid, 134 x 150 x 76mm
1 Scotchcal front panel, 134 x 70mm
1 SPDT center-off toggle switch
1 12V SPDT PCB mounting relay
1 6.5mm Plug
1 6.5mm Socket
1 Microphone plug to suit rig
1 Microphone socket to suit microphone

Semiconductors

1 LM324 Quad Bipolar op-amp
1 BC547 NPN transitor
4 1N4148 diodes
1 1N4002 diode
1 Red LED

Capacitors

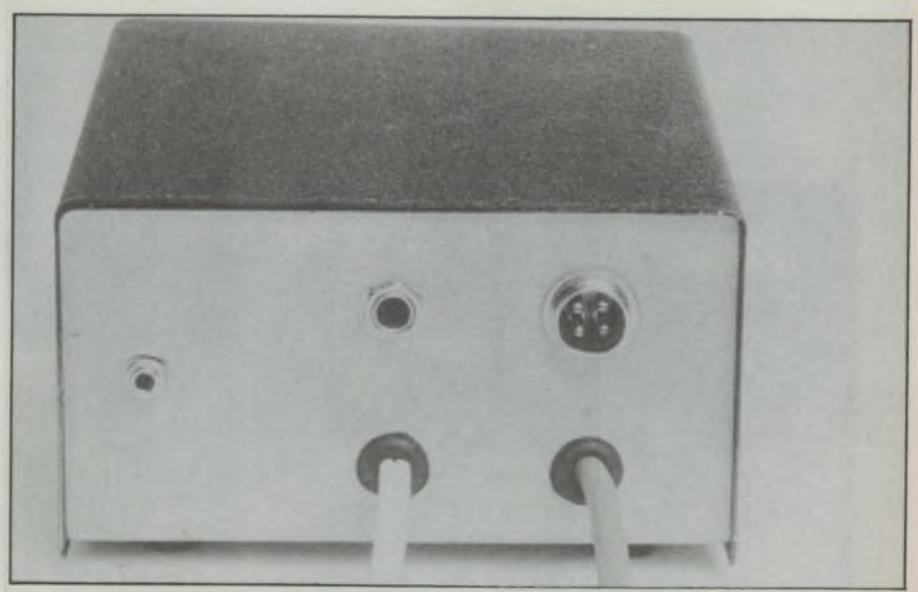
2 390nF greencaps
2 56nF greencaps
1 1uF tantalum
1 2.2uF tantalum
1 10uF 50VW electrolytic
1 22uF 50VW electrolytic

Resistors (all 1/4W 5%)

6 x 220k, 1 x 560 Ω, 2 x 5.6k, 3 x 1k, 1 , 82k, 1 x 68k, 2 x 100k, 1 x 390 Ω.
1 500k linear pot
1 100k log pot
1 10k log pot

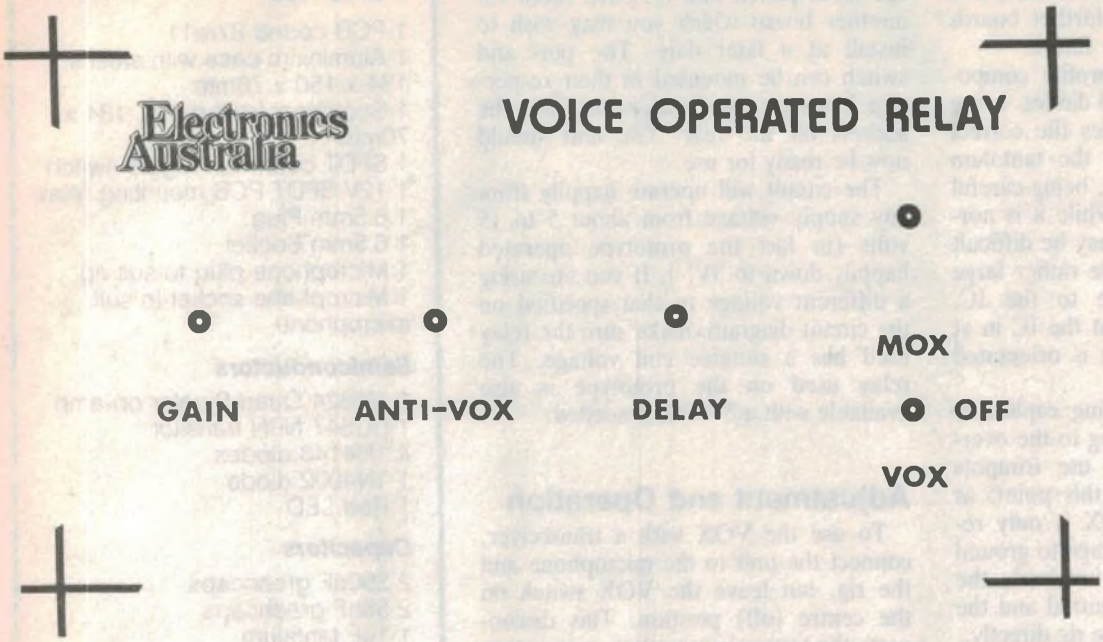
Miscellaneous

Cable clamps, Rubber grommets, PCB standoffs, hookup wire.



The business end. The cable on the right connects to the mic socket on the rig, and the one in the centre goes to the speaker socket. The mini jack on the left is for the power supply.

Voice Operated Relay



Here is a full-size reproduction of the front-panel artwork, for those who wish to make their own.

The switch may now be set to the VOX position and the rig will be keyed whenever you speak into the microphone. The MOX position of the switch is useful if the microphone you are using does not have a PTT switch and you wish to key the transmitter manually. If you wish to leave the transmitter unattended but switched on, make sure you leave the VOX switch in the off position to prevent background noises (such as the 'harmonics') from triggering the unit.

If you wish to use the unit for a security related application, the anti-vox (speaker) input would probably not be required, unless the alarm sounder is located in close proximity to the microphone used to pick up the sounds. If this is the case, the anti-vox facility would be set up as above to prevent the alarm from triggering itself.

Note that a sound activated switch should not be used to trigger a very loud alarm (such as a home burglar alarm) as there is too much possibility of false triggering (say, from cars, low-flying aircraft or earthquakes). It is more suited to applications such as a sound activated light or doorbell, which are less likely to make enemies of the neighbours.

In this application, a longer delay period would probably be required than that which is attainable with the component values specified. The delay time is determined by C7 and the total series resistance of R13 and RV3. Therefore, to increase the delay period, it is necessary to increase the value of C7 and/or R13. If a larger capacitor is used it will probably need to be placed on the back of the board as there is not much room on top.

The VOX may also be used to control a slide projector advance mechanism by connecting the relay contacts in parallel with the slide advance switch in the remote control unit. Because the VOX is capable of being triggered by any sound and not just a single tone, it is necessary to use a separate channel on the tape recorder to prevent the unit from being triggered by the program material on the tape.

This involves using a stereo tape deck, with the narration on one channel and the slide-advance information on the other. The advantage of this is that the advance information is not heard by the audience (which is rather annoying, to say the least), and also virtually any sound can be recorded on the other track as the frequency is not critical.

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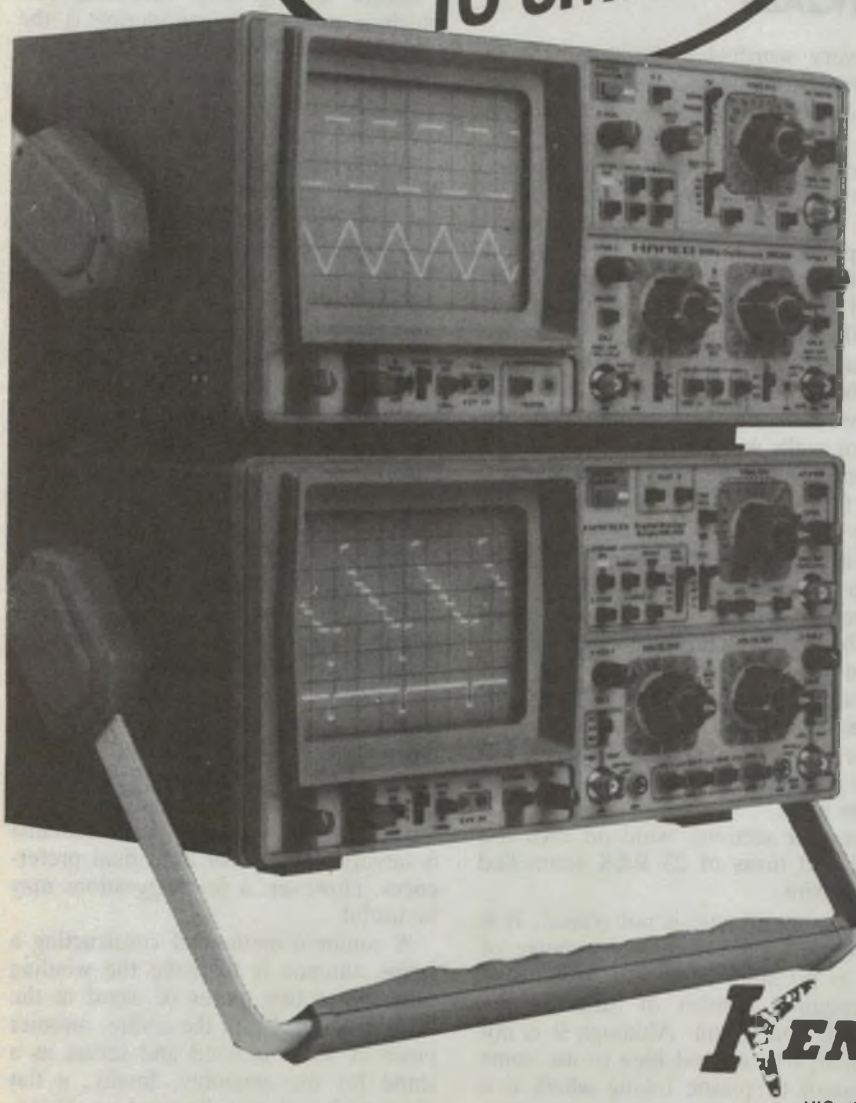

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Antennas for VLF reception

With the current interest in VLF standard transmissions as references for frequency and time, the need for suitable antennas has also arisen. The writer has experimented with VLF antennas for a number of years and here are some suggestions which may be of use to interested readers.

by IAN POGSON VK2AZN

Since I described the Omega Derived Frequency Standard in May 1987, the question of suitable antennas has come to the fore, with one enquiry coming from as far away as Singapore.

The ferrite rod antenna described in the above article was presented as a minimum, and could be used satisfactorily at least in all Eastern Australian States and possibly beyond. Having said that, it is recognised that there would be many locations where such a simple antenna would not be satisfactory. With this in mind and having spent considerable time in experimenting with and researching antennas for VLF (very low frequencies) the following are some of the results of those endeavours.

Although in this instance we are specifically interested in Omega signals on 13kHz, the comments are relevant for a frequency range of say, 10-30kHz. This covers all the Omega frequencies (10-14kHz) and many communications transmissions, including GBR (Rugby, England) on 16kHz and NWC (North West Cape) on 22.3kHz.

Let's start with the antenna described in May 1987. This type of antenna can be improved to a very worthwhile extent by increasing the physical size. As a first step, instead of using a rod 9mm diameter and 203mm long, we can use a rod with a diameter of 12mm but still 203mm long. This will give just a marginal improvement. So, as a starting point to improve the performance of the ferrite rod antenna, we should use 12mm rods in preference to the thinner ones.

A very worthwhile improvement in the amount of signal received is to use two rods butted together, thereby doubling the length of the unit to say, 406mm. A further improvement may be had by adding a third rod. Each additional rod results in an increase in signal pickup. However, we are faced with a condition of diminishing returns. Each added rod contributed less added gain than the one before it.

I have found that a maximum of four rods butted end to end are about as far as one can go. Any further additions are not really worthwhile.

Summarising, here are some suggestions for progressively larger ferrite rod loops:

1. With a single rod, either 9mm or 12mm diameter, 500 turns of 30 B&S enamelled copper wire. Terminate the ends by taping securely.
2. For two sections, wind the two rods separately, each with about 325 turns of 23 B&S enamelled copper wire.
3. For three sections, wind on each rod about 270 turns of 23 B&S enamelled copper wire.
4. For four sections, wind on each rod about 250 turns of 23 B&S enamelled copper wire.

The gauge of wire is not critical. It is preferable to use as heavy a gauge of wire as possible, consistent with fitting the required number of turns on the available rod length. Although it is not essential, it is a good idea to use some cardboard or plastic tubing which is a slide fit over the rods and put the winding on the tubing instead of winding it directly on the rods.

After the rods have been wound they should be butted together, taped at the joins and firmly taped to a strip of wood about 30m wide and 10mm or so thick and a little longer than the combined length of the rods. When connecting the windings in series, it is most important that they add inductively. This will work out correctly provided that all windings have been wound in the same direction.

Before leaving loop antennas, one which is well worth considering is the open loop or frame antenna, provided the extra space required is available. I have used such a loop for a number of years and it has greater signal pickup than the 4-section ferrite rod loop just described. Compared with the ferrite rod loop, the open loop has a lower Q and consequently it has a wider bandwidth.

The physical size of the frame antenna may be varied over a fairly wide range. As a rule of thumb, a turns-area figure of 100 square metres should be sufficient. This means that if you have a frame with all four sides one metre long, then 100 turns will meet this criterion. Variations each side of this figure could be expected to influence the amount of signal pickup accordingly.

My frame antenna has sides each 1.67 metres long and the winding has 48 turns. This comes out to a turns-area figure of 133. Incidentally, the frame does not have to be in the form of a square; a rectangle with a convenient ratio of say, 4:5 or 3:4 should be alright. Another option is to make the antenna in the form of a circle.

The construction of a frame antenna is largely a matter of individual preferences. However, a few suggestions may be useful.

A common method of constructing a frame antenna is to make the winding supports of two pieces of wood in the form of an X. From the centre, another piece of wood is fixed and serves as a stand for the assembly, finally, a flat piece of board may be used as a base. The base should be sufficiently large to

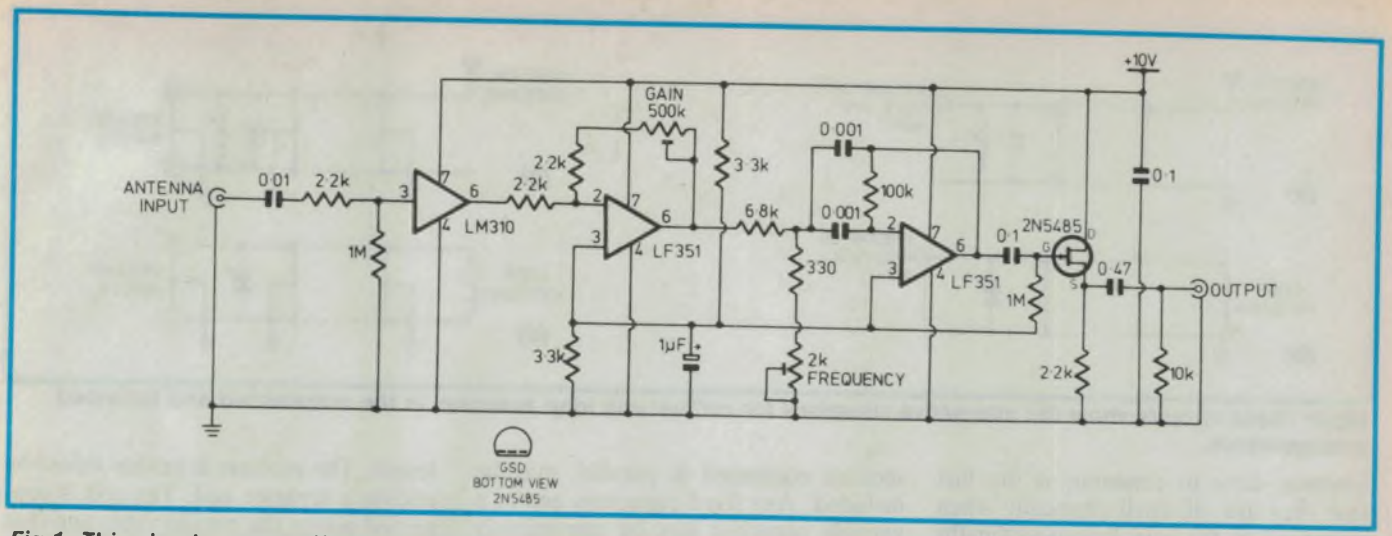

Fig.1: This simple preamplifier circuit should be adequate for most situations. The gain is controlled with the 500k potentiometer and the tuning is done with the 2k potentiometer.

provide a stable support for the antenna.

With this arrangement, the winding is fixed around the outside of the X, with recesses provided to ensure that the turns of the winding remain firmly in place. The gauge of wire is not critical. As mentioned earlier for the ferrite rod windings, I have used 23 B&S enamelled wire as it was available at the time. The two ends of the winding may be terminated on a suitable terminal block fixed to the vertical timber of the assembly. Alternatively, a coaxial socket may be used if this is required.

Another type of antenna suitable for VLF reception is the vertical, in its various forms. It can vary between a modest whip about three metres long, up to large structures in the form of a top loaded vertical either a T or an inverted L.

A vertical whip only three metres long is not very effective, in that the amount of signal pickup is quite modest. As such, it would only be a proposition close to the transmitter and where the signal strength is fairly high. However, as the length is increased to six or even 10 metres, the amount of pickup increases markedly.

Without doubt, the most effective antenna for our purpose is the large T, possibly held aloft between two masts or convenient trees. The taller the vertical component, the better. Also the greater length which can be used for the flat top, which gives effective capacitive loading to the vertical section, the more effective will be signal pickup on the vertical component. Vertical heights of 12 to 16 metres can be very effective, with a flat top of a similar order.

The inverted L, also referred earlier, may also be used to advantage and much the same comments apply as for the T version.

My own efforts at erecting a top loaded vertical have been hampered by restrictions of the space available, trees, etc. I have a mast 15.25 metres high, and the antenna which I erected has its apex at the top of the mast. Perhaps the shape of the antenna may be described as a "sloping inverted V".

The feed end comes down to ground level and so the vertical component is 15.25 metres. The other end is terminated on a fence about 1.5 metres above ground. The latter half may be considered as the "flat top". Despite the rather odd shape, it performs remarkably well.

So much for the various types of antenna which may be used. The next question is, what are the characteristics of each type and how are they coupled into the receiver?

One characteristic which all of these

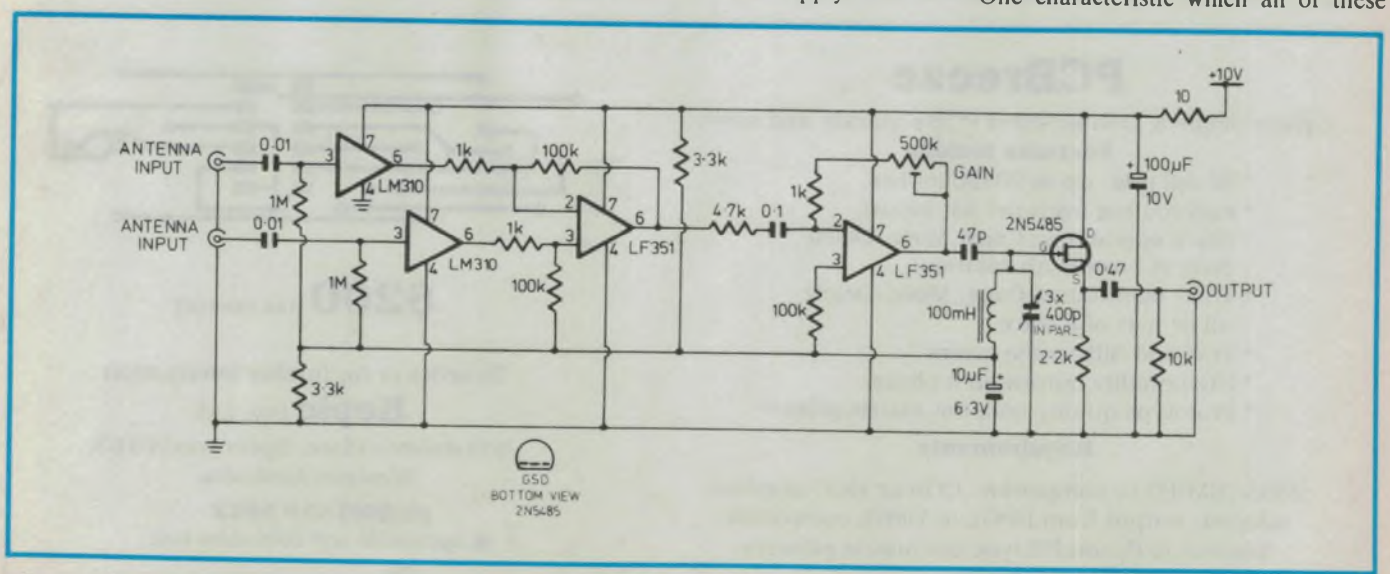

Fig.2: This preamplifier has a balanced input and offers greater gain and selectivity than the simpler version.

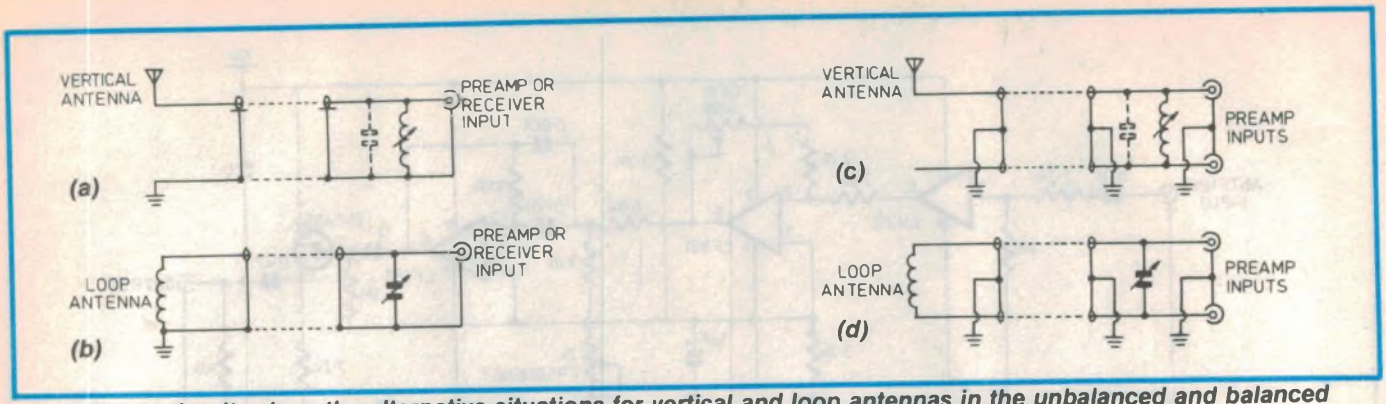

Fig.3: These circuits show the alternative situations for vertical and loop antennas in the unbalanced and balanced arrangements.

antennas have in common, is the fact that they are all small physically when compared to the very long wavelengths of the signals to be received. In order to make the antenna an effective signal gatherer, it must be tuned to the frequency of the wanted signal.

Ferrite rods, loops and the larger frame loops lend themselves quite readily to tuning, simply by adding the required amount of capacitance across the coil inductance to resonate at the frequency of interest. As is the case with the Omega Derived Frequency Standard, it is assumed that these antennas will be feeding into a high impedance, i.e., 1MΩ or more.

As the antenna will normally be placed at a distance from the receiver and very preferably outdoors, a length of coaxial cable will be required between it and the receiver. The actual capacitance of the cable will be at least part of the needed capacitance, with the rest made up of good quality fixed capacitors. To make tuning that much easier a variable tuning gang, with the sections connected in parallel, may be included. Any fixed capacitors and/or a variable capacitor may be conveniently connected across the cable at the receiver end.

Because of their small size, it is sometimes convenient to place a ferrite rod loop indoors. This may be quite satisfactory provided that the amount of signal pickup is sufficient and just as important, provided that the amount of electrical noise picked up from internal building wiring is not excessive.

Ferrite rod loops have a bidirectional pattern like a figure 8, with maximum response broadside to the rod's length, and minimum response off the ends. The frame antenna has a similar pattern, with maximum response in line with the plane of the antenna and minimum response from the sides.

Considering the situation for vertical antennas, quite obviously they do not have any significant inductance which may be tuned. Indeed, they are a very high impedance device as the length is very much less than a quarter wavelength. The problem is readily solved by adding a separate coil. The coil is connected across the coaxial cable and it is tuned with capacitance in the same way as described for loops. The vertical antenna has its lower end connected to the top end of the coil which connects to the centre conductor of the coax.

There is an important point which must be observed with the coil used for this purpose. As well as having a high Q, the inductance must be as high as possible. Having determined the amount of capacitance provided by the coaxial cable, only a minimum amount extra should be added so as to make tuning convenient. This may be a variable gang as mentioned earlier. Again, the coil and capacitance may be added to the receiver end of the cable.

A suitable coil may be wound fairly easily. You will need a cardboard former 75mm long and large enough so that it will slide over a piece of 12mm diameter ferrite rod. Wind on the former 500 turns of 30 B&S enamelled wire, five layers each of 100 turns. Insu-

late between layers with paper. You will also need a piece of ferrite rod about the same length as the coil former.

With the coil and rod just described, the antenna may be tuned to resonance by sliding the rod inside the coil former. Using this approach the variable capacitor will not be required. Make sure that the ferrite rod used to tune the coil cannot pick up interference from mains wiring, etc.

Vertical whip antennas are omnidirectional and so pick up signals equally well from all directions. This also applies to the much larger top loaded T. There is one exception, the inverted L antenna has some directional properties. This applies particularly if the top portion is longer than the vertical part. The antenna then responds most strongly to signals coming from the direction opposite to the top section.

Once you have installed the best antenna which can be conveniently arranged and if the received signal is still not satisfactory, then it may be possible to remedy the situation by adding a preamplifier. Two circuits which I have used are shown, one fairly simple and another somewhat more ambitious.

The first circuit (Fig.1) consists of three ICs and a junction FET, together with some components sprinkled around them. This circuit should be of sufficient help in most cases. An LM310 voltage follower IC provides a high input impedance with unity gain. This is followed by an LF351 op amp with variable gain. Following is another LF351 connected as an active filter, which performs the duty of a variable tuned circuit with low gain. Finally, the output is fed via a 2N5485 JFET as a source follower.

The second circuit (Fig.2) has a balanced input. This allows for a balanced coaxial antenna feedline to be used and so helps to reduce noise pickup on the feedline itself. The balanced input stage consists of two LM310s, and these are fed into the two inputs of an LF351 connected as a fixed gain amplifier. This is followed by another LF351 connected as a variable gain amplifier, followed in turn by a variable parallel tuned circuit. The output circuit is again a 2N5485 JFET connected as a source follower.

The tuned circuit just referred to consists of a 100mH inductance tuned by a 3-gang variable capacitor, with each of its 400pF sections connected in parallel. The inductor which I used as a potcore type and which was originally intended for use as a 9 or 10kHz whistle filter in wideband AM broadcast receivers.

The balanced coaxial cable required for the preamp of Fig.2 consists of two identical lengths of cable, with the outer braids connected together and grounded. The inner conductors are the balanced line. In the case of a loop or rod antenna, the loop coil is simply connected between the inner conductors as shown in Fig.3(d). For a vertical, the antenna itself is connected to one inner conductor, while the other is simply left unconnected at the antenna end (Fig.3c).

The preamplifiers may be built up on a piece of Veroboard with a layout approximating that of the circuit diagram. The assembly may then be fitted into a small diecast metal box. Power from the main receiver could be used for the preamplifier.

An alternate scheme would be to design a PC board but at this stage I haven't had the opportunity to do this.

Much more could be written on the subject of VLF antennas. However the foregoing should give some useful pointers as the best way to provide antennas to suit individual readers' needs. Suitable ferrite rods may be obtained from Geoff Wood Electronics, 229 Burns Bay Road, Lane Cove West NSW. EA

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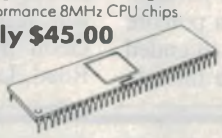

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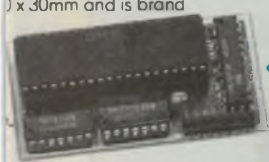

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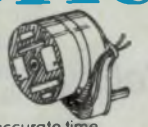

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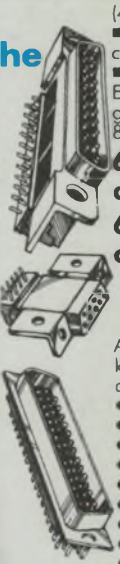

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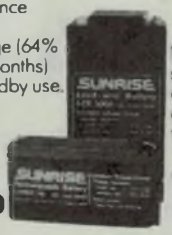

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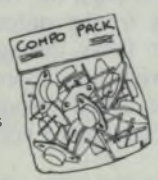

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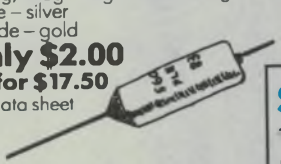

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DC Electronic Fuse

Have you ever experienced trying to service existing equipment or get a new project operational, only to keep blowing fuses? Well, this low cost project is the answer.

by PETER HARRIS

It is simple to build, easy to use, and should become a very useful piece of test equipment for the professional's workbench or the hobbyist's "shack".

It features fast and slow blow settings, manual reset button, LED "fuse tripped" indicator, two current ranges 0-1A and 0-10A fully adjustable via a pot and calibrated scale, and operates off a single 9V battery.

By the way, the Electronic Fuse has been designed by Altronics Distributors, of Perth WA, and this firm is able to supply complete kits for the project.

How it works

The circuit can be broken up into four sections. These are:

1. Current Sense
2. Comparator
3. Trip and relay driver
4. Power Supply and Inverter

These will now be described in turn.

The current sense section comprises the low value resistors, and the current range switch SW4. With the switch in the 10A position, the input current will flow in through the relay contacts, through the switch and through the two 0.1 ohm resistors, back to the output terminal. When current flows through these resistors, a small volt drop is produced across them. The actual voltage will be Iin x 0.05 which equals 0.5 volts at 10 amps.

This small voltage appears across the 100 ohm trimpot RV1 which can be adjusted to calibrate the unit. With the switch in the 1A position the current flows through the two 1 ohm resistors. This means that to produce the same voltage drop, the current is reduced by a power of ten i.e., one tenth of the value of the 10A range or 1A. Note that the in-circuit resistance is now 0.5 ohms, not 0.05 ohms.

The comparator section comprises IC1, RV2 and associated components. The comparator works by comparing the two voltages at the inverting and the non-inverting inputs. When the voltage on the non-inverting input exceeds that of the inverting input, the comparator switches its output high. The opposite input action will cause the output to go low again.

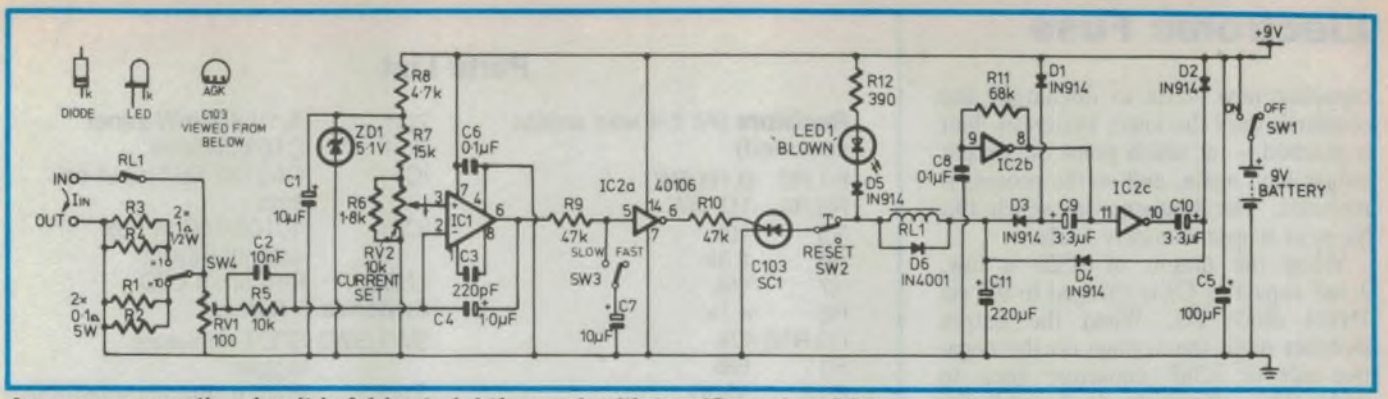
The reference voltage is fed into the non-inverting input (pin 3), and the current sense voltage is fed into the inverting input (pin 2). When the current sense voltage exceeds the preset level from RV2, the output of IC1 switches low.

The reference voltage is derived from the 5.1V zener diode ZD1, which feeds a voltage divider comprised of a 15k resistor and RV2 in a parallel with a 1.8k resistor. The maximum voltage available to the comparator is 0.47 volts. This means that the voltage at pin 2 must exceed 0.47V before the IC turns off. The 100 ohm trimpot RV1 is used to set the current sense voltage to exactly the same as the reference voltage. This sets the full scale current trip to 10A (or 1A in the case of the 1 ohm resistors).

The purpose of the 1.0uF capacitor (C4) between pin 6 and pin 2 is to provide high frequency feedback, to keep the system stable and to provide some noise immunity.

The trip and relay driver section is that associated with IC2a and SC1. When the output of the comparator switches low, the output of the inverter

The completed unit, housed in a compact Jiffy box.



As you can see, the circuit is fairly straightforward, with two ICs and an SCR.

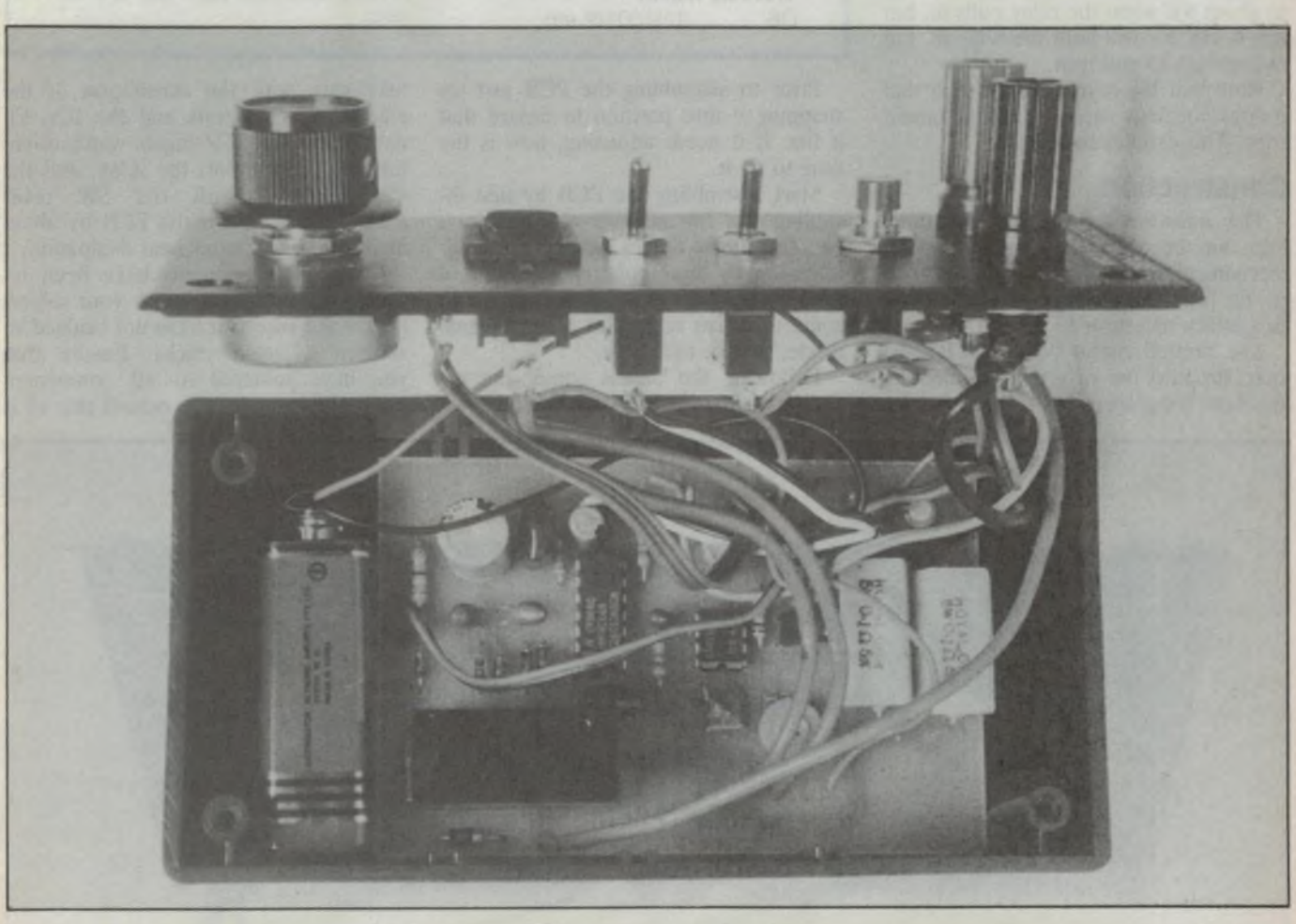
switches high (IC2a), which switches the SCR on. The only way to reset the SCR (i.e., turn it off) is to remove the voltage on the anode. This is done with a push to break switch. The SCR provides the earth for the "blown" or trip indicator LED and the relay.

The "slow blow" feature of the circuit uses the time constant formed by the 47k resistor R9 and the 10uF capacitor C7. Initially the capacitor is charged (output of IC1 high). When the comparator switches low, the capacitor begins to discharge via the 47k resistor. When the voltage drops to 1/3, the inverter changes state and thus trips the SCR. The time can be adjusted by changing the value of the capacitor: the larger C7, the longer the delay before the fuse will trip.

The final section is the power supply and charge pump. The power for the circuit is derived from a 9V battery, and is decoupled by the 100uF (C5) and the 0.1uF (C6) capacitors.

Because the circuit runs on 9V, a standard 12 volt relay will not work. As a 6V/10A relay is both expensive and hard to obtain, a small charge pump converter has been used to bring the 9V up to about 15V. The charge pump is formed from IC2b and IC2c, and associated components.

The pump works as follows. IC2b is configured as a CMOS square wave oscillator. The 68k resistor R11 charges the 0.1uF capacitor C8 until the upper hysteresis limit is reached, at which point the output goes low. The 0.1uF



Inside the case, with most of the parts visible.

capacitor now starts to discharge, and continues until the lower hysteresis limit is reached — at which point the output swings high again, and so the process is repeated. The frequency at which this happens is approximately 68Hz.

When the output of IC2b is low, 3.3uF capacitor C9 is charged to 9V via 1N914 diode D1. When the output switches high, the voltage on the negative side of 3.3uF capacitor goes to +9V. This effectively "jacks up" the positive side to +18V (duc to losses this voltage is about 15V). IC2c does exactly the same thing, but its output is 180 degrees apart, i.e., while one capacitor is charging, the other is supplying the load.

Both sides of the pump feed the 220uF capacitor C11, so that this develops enough charge to activate the relay (the charge pump does not have enough current capacity to drive the relay directly). Because the charge pump cannot supply much current, the voltage on the 220uF capacitor will drop to about 9V when the relay pulls in, but this is OK 9V will hold the relay in, but not enough to pull it in.

Note that the relay is wired such that it does not draw current until the circuit trips. This extends battery life.

Construction

The construction of the Electronic Fuse has been greatly simplified by its mechanical design. It has been designed to fit into the Altronic H 0203 Jiffy Box,which measures 67 x 130 x 42mm.

The printed circuit board (PCB) just snap fits into the jiffy box, eliminating the need for spacers etc.

Parts List

Resistors (All 1/4 watt unless specified)

R1,R2	0.1Ω 5W
R3,R4	1Ω .5W
R5	10k
R6	1.8k
R7	15k
R8	4.7k
R9,R10	47k
R11	68k
R12	390Ω
RV1	100Ω horizontal mount trimpot
RV2	10k linear

Capacitors

C1,C7	10uF/16V RB electrolytic
C2	.01uF green cap
C3	220pF ceramic
C4	1.0uF tantalum
C5	100uF/16V RB
C6,C8	0.1uF green cap
C9,C10	3.3uF/35V tantalum
C11	220uF/25V RB electrolytic

Semiconductors

D1,D2,D3,D4,D5	1N4148/1N914
D6	1N4001/2 etc.
ZD1	5.1V 400mW zener
SC1	C103/2N5064
IC1	CA3130 FET input op amp
IC2	40106/74C14 hex schmitt trigger
LED1,	Red 5mm LED

Switches & Relays

SW1,SW3	SPDT miniature toggle
SW2	Push to break momentary push button
SW4	SPDT 10A Rocker
RL1	SPDT 10A

Hardware

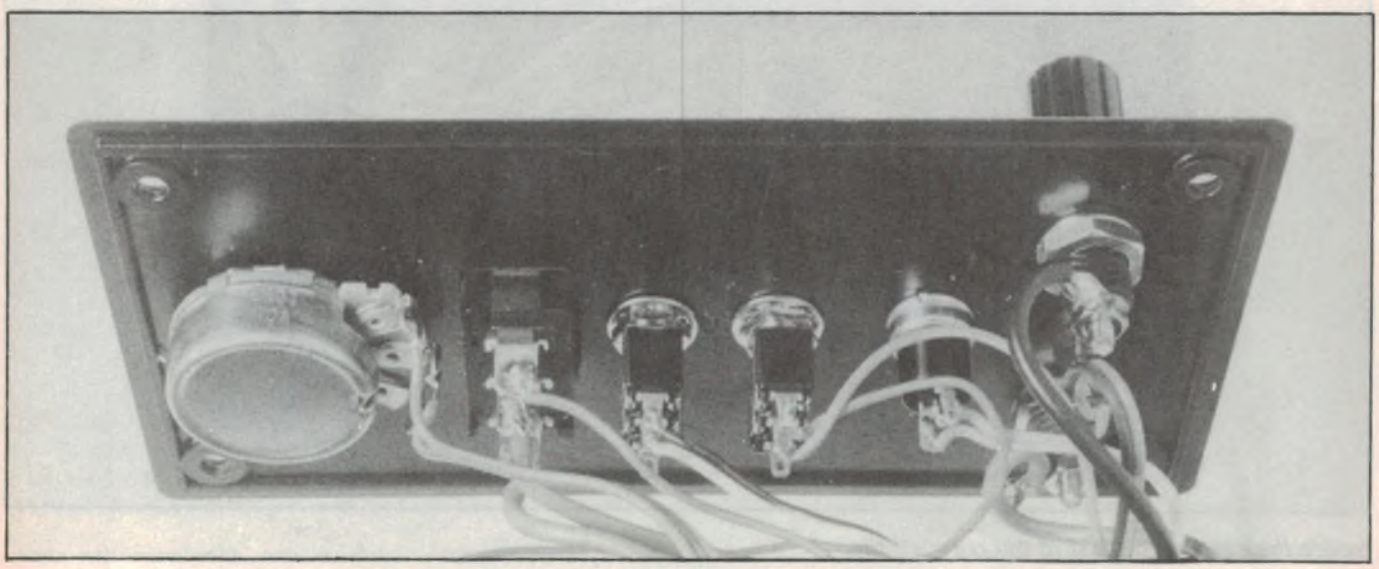
1 x Red binding post
1 x Black binding post
1 x Knob
1 x Battery snap
2 x Solder plugs
1 x PCB coded K-2535
1 x LED mounting bezel
1 x H-0203 jiffy box, punched and silk screened
Rainbow cable;
heavy duty hookup wire; solder, etc.

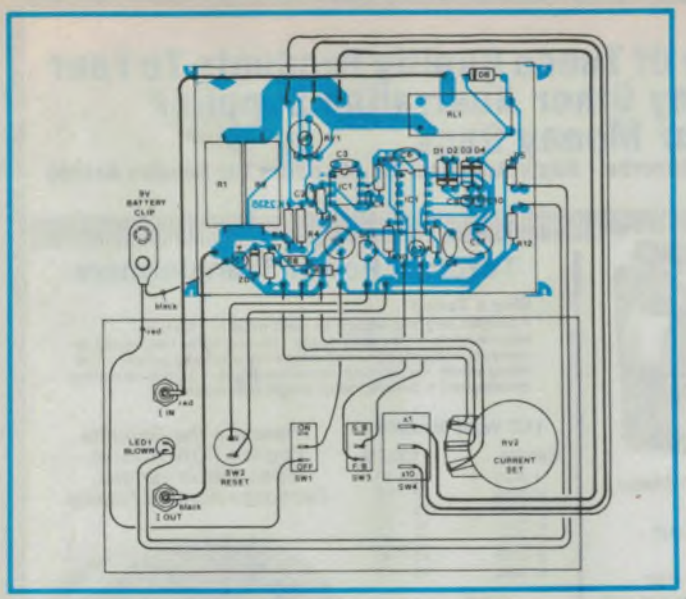
Prior to assembling the PCB just try snapping it into position to ensure that it fits. If it needs adjusting, now is the time to do it.

Start assembling the PCB by first installing the 1/4 and 1/2 watt resistors. Next insert the diodes, paying particular attention to their polarity. A point to note is that the 5.1V zener diode in some instances resembles a small signal diode, so take care here.

Following the diodes come the capacitors and the two ICs. Once again take care with the orientation of the electrolytic capacitors and the ICs. Finally insert the SCR (again watch orientation), the trimpot, the relay, and the 5W resistor. With the 5W resistors, space them off the PCB by about 3mm or so, for better heat dissipation.

Once all components have been installed and soldered, check your soldering. Make sure you have not bridged or shorted adjacent tracks. Ensure that you have soldered to all component pads. Having satisfied yourself that all is





Specifications

Current Rating	0-1A DC 0-10A DC fully variable
Max Voltage Rating	24V DC at 10A
Supply Voltage	9V alkaline cell
Trip Time	Fast Blow at 200% of rated current approx .75 seconds Slow Blow at 200% of rated current approx 2.5 seconds
Reset Time	Approx. 1 second — depends on battery condition
Accuracy	At half scale depends on calibration At full scale, 10% of indication
Terminals	Binding post/banana sockets

OK, place the PCB aside for the time being.

Next comes the front panel. This is simplified with the Altronics kit, as all holes are pre-punched and it is just a matter of positioning the parts as shown on the wiring diagram. Note: We used the Red terminal for the IN and the Black terminal for the OUT.

When mounting the binding posts, cut the non threaded section off with a pair of cutting pliers so that they will clear the PCB and power resistors. Do not use your side cutters, as they may break.

The rest of the front panel is straight forward and should not present any problems.

Finally comes the wiring. Following the wiring diagram carefully, wire the unit, using the appropriate size insulated hookup wire. Use heavy gauge wire for all the high current circuitry. This is indicated on the drawing. All the rest of the circuitry uses rainbow cable.

It is important not to make the connecting wires too long. Otherwise it will be difficult to fit everything into the box once it is all completed.

IMPORTANT NOTE!

Please note that the project described in this article is designed to protect equipment and experimental circuits connected to a low voltage DC power supply. It is NOT intended to replace a fuse or circuit breaker in AC circuits operating at any voltage level.

It should not, in any circumstances, be connected directly to the 240V power mains.

With the wiring completed snap the PCB into the box towards one end. This leaves room at the other end for the battery which can be secured in a number of ways. In our prototype we used Blue Tac. Sponge rubber is also ideal, or it can be left as is and the pot will stop it travelling too far.

All that remains now is the set up and test procedure.

To use the electronic fuse, simply remove the equipment or circuit's existing fuse from its holder and clip the electronic fuse across it, connecting the IN terminal to the unfused side, and the OUT to the fused side of the circuitry. This can be determined by removing the fuse and switching the unit on. Then, by using your multimeter, measure the voltage on both sides of the fuse holder. The side that registers a higher reading is the IN side of the fuse.

Having connected the electronic fuse into the circuit, select the maximum current desired, switch the electronic fuse on and hit the reset button. With this done, switch the suspect unit on. If the suspect unit endeavours to draw more current than selected, the electronic fuse will trip.

NOTE: It is important that you connect the input to the fuse the correct way around, otherwise damage may result.

It should be noted that the electronic fuse is not a precision instrument, in the sense that if you dial up 500mA, it may in actual fact be 450 — 550mA. But its tolerance rating will be superior to that of a normal glass fuse.

To calibrate the completed unit you can either use a current limited power supply or a standard power supply with a current meter.

Turn the fuse on and rotate the current control fully anti-clockwise. Set the trimpot for the mid position and the fast/slow blow switch to "slow".

If you are using a current limited supply, set its current limit to 0.5A.

Set the fuse to the 1A range and rotate the current control fully clockwise. Then connect the positive lead to the input terminal and the negative lead to the output terminal.

The relay should not trip. Now rotate the current control back until the relay clicks in; this proves that the unit works. Rotate the current control to the 1A position and reset the fuse, by pressing the reset button for a second. (Note that it takes about a second to charge the 220uF capacitor).

Continued on page 141

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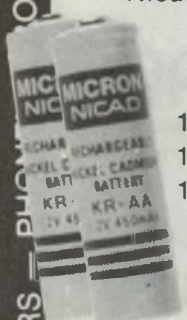

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30 Watt RMS-50 Watts Max

C 3055 **$24.50**

Frequency Response fo—3000Hz **Resonant Frequency** 36Hz **Sensitivity** (1M/1Watt) 87db (+ or -2db **Voice Coil** 25mm **Nett Weight** 900gm **Electromagnetic Q** .48 **Magnet** 280 gm.

8" Woofer
60 Watt RMS 100W Max

C 3060 **$49.50**

Frequency Response Fo—3000Hz **Resonant Frequency** 33Hz **Sensitivity**(M/1Watt) 90db (+ or -2db) **Voice Coil** 38mm **Nett Weight** 2200 gm. **Electromagnetic Q** .4 **Magnet** 836 gm.

10" Woofer
60 Watt RMS 100W Max.

C 3065 **$65.00**

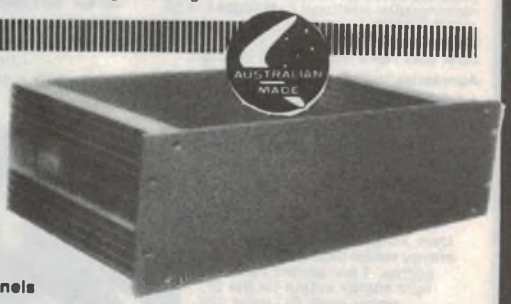
Frequency Response fo—3000Hz **Resonant Frequency** 30Hz **Sensitivity (1M/1Watt) 92db** (+ or -2db) **Voice Coil** 38mm **Nett Weight** 2650 gm **Electromagnetic Q** .23 **Magnet** 836 gm.

12" Woofer
100 Watt RMS 150W Max

C 3070 **$99.00**

Frequency Response fo—2000Hz **Resonant Frequency** 23Hz **Sensitivity** (1M/1Watt) 93db (+ or -2db) **Voice Coil** 38mm **Nett Weight** 3620 gm **Electromagnet Q** .22 **Magnet** 1410 gm.

High Energy Rack Case



The use of Super Heavy Duty Heatsinks as Rack Case sides now allows a myriad of Amplifiers, Power Supplies, Battery Chargers etc. to be built in an "Off the Shelf" rack case.

Fantastic for Stereo Amplifiers—Each Heatsink will accommodate an audio output stage of approximately 120W with normal efficiency and dissipation.

A Great Chassis for Heavy Duty Power Supplies and Battery Chargers. We suggest the mounting of Rectifier Bridge or diodes on one Heatsink and the Regulator devices on the other.

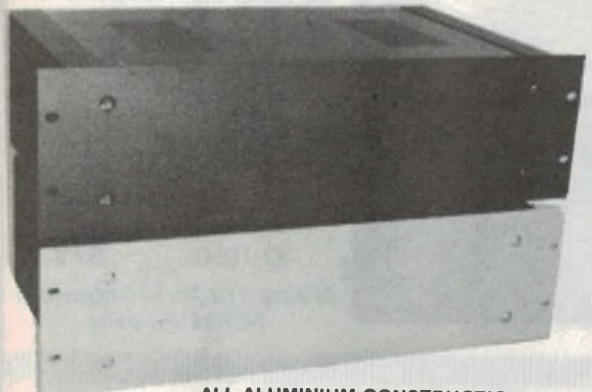
Order With Either Black Or Natural Anodised Front Panels

H 0417 Natural Anodised Front Panel **$89.00** H 0418 Black Anodised Front Panel **$89.00**

Specifications:
Heatsinks Altronics H 0590 **Front Panel** 3 unit Rack size 480mm x 132mm x 3mm **Base** 1.0mm steel, ventilation slots provided **Top Cover** 1.0mm steel, ventilation slots provided **Internal Dimensions** 125 x 370 x 250mm **External Dimensions** 130 x 440 x 252mm plus standard front panel **Finish** Black anodised aluminium plus powder coat black top/base.

PROFESSIONAL SERIES RACK CABINETS

Now your preamps, Amps, Control Modules Monitor Panels etc. can look every bit as good as Technics Nakamichi and other top manufacturers.



ALL ALUMINIUM CONSTRUCTION

FEATURES: These beautifully crafted rack cabinet boxes will give your equipment a real 1st class appearance with removable top and bottom cover panels • All dimensioning conforms to the International Standard • Natural or Black finish • Ventilated lid • Deluxe finish front panel • Individually cartoned • Supplied in Flat Pack Form - Easily assembled in minutes - **Side Elevations:**- D=254mm C (Internal Chassis Height) • B (mounting Bolt Centres).

SIX NATURAL AND BLACK FINISH MODELS — The Black or Natural finish cabinets are each available in 44mm, 88mm or 132mm high models. Mounting hole centres conform exactly to International Racking Specifications both vertically and horizontally.

Cat. No.	Finish	A	B	C	Were	Now
H 0401	Natural	44	34	38	$59.95	$50
H 0402	Natural	88	57	82	$69.95	$62
H 0403	Natural	132	89	126	$85.00	$79
H 0411	Black	44	34	38	$59.95	$52
H 0412	Black	88	57	82	$79.95	$70
H 0413	Black	132	89	126	$89.95	$80

Nifty Little Chassis Maker and Pan Brake Bender

Make Your own Chassis and Cases and Save a Fortune

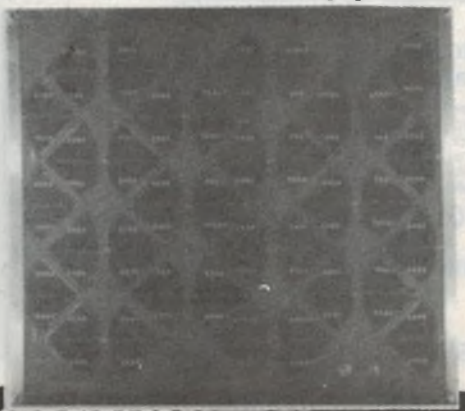
Please Note: This product is a genuine Pan Brake Bender allowing you to make quite complex chassis boxes, lids, trays etc. - It is made from solid steel and is not to be confused with inferior Non Pan Brake simple benders currently sold by our competitors.

Value Plus

T 2400 ..... **$99.95**

Brilliant Solar Panel Array 18V @ 400mA

Fantastic for Trickle Charging 12V Battery Systems



18V at up to 600mA under ideal sunlight conditions. Intended for charging 12 volt systems such as Car, Caravan and Boat batteries etc.
Cat. A 0220

Was $119
Now $99

Superb Eleco Wireless Microphone System uses Dual Diversity Receivers for Long Range, Noise Free Pure Fidelity Reproduction.

Now Available In Australia For Less Than $1,000

Altronics proudly release the Eleco System - Used Worldwide by Entertainers i.e. Rolling Stones, Dire Straites, Tina Turner and 1000's more!

Superb Microphone Reproduction Compares with Shure, Beyer and AKG

Unique Microphone design completely Eliminates "Dangling" Antenna

Breathtaking performance without signal drop-out or noise interference. The Eleco Wireless Microphone System is virtually the ultimate in an Entertainers Microphone system (or for any roving microphone application for that matter!)
All the annoying wireless microphone characteristics such as "drop out", static and noise are completely eliminated by use of **auto switching dual diversity receivers.** The output of each receiver is continually monitored, with the strongest and clearest signal always selected. **Dynamic Range exceeding 100 db** is obtained by employment of a Patented special Parabola level compressor and Dynamic expander.

The operating range is a minimum of 50 metres (often this can be extended to 200 metres and more in normal circumstances).

Several Frequencies are available to alleviate cross interference when two or more systems are used in proximity.

Brief Specifications Frequency 202.1, 202.9, 203.7 MHz (Please specify if you have a preference)
Mic Carrier Power 50mW (Max) **Mic Antenna** built-in **Dynamic Range** over 100db **S/N Ratio** better than 90db **Frequency Response** 20Hz to 16KHz + or - 3db **Mic Battery** 4 x AA cells **Battery Life** over 24 hours continuous operation. **Receiver Sensitivity** 12db/micro volt for 60db S/N ratio **Pre emphasis/De emphasis** 50us. **Receiver output** unbalanced 6.3mm phone jack and balanced 3 pin cannon type. **Output Level** (adjustable) Unbalanced 0-2.5V Balanced O to + or - .3V into 600 ohms. **Receiver Power Supply** 200 - 260VAC.

Prices
(A) Dual Diversity Receiver **$729.00**
(B) Entertainment Microphone (hand held type) **$349.00**
(C) Lavalier Type Microphone **$349.00**

Bonus Offer SAVE $78 **Choose Receiver and Either Microphone For Just $999**

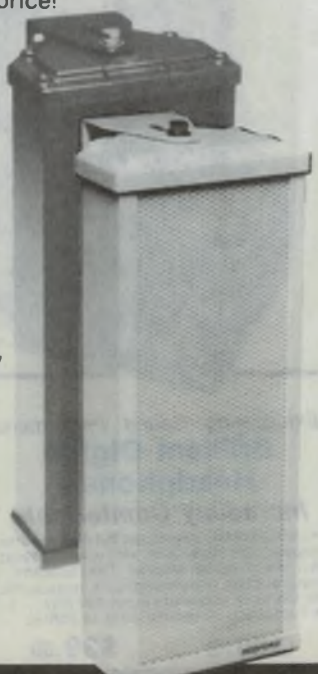
Please Note 3 different operating frequencies are available (you will need to specifically nominate desired frequency only if the equipment is being used in proximity with other Eleco Systems on the 200MHz band

Frequencies

C 0111	Dual Diversity Receiver	202.1MHz	$729
C 0113	Dual Diversity Receiver	202.9MHz	$729
C 0115	Dual Diversity Receiver	203.7MHz	$729
C 0121	Entertainment Microphone	202.1MHz	$349
C 0123	Entertainment Microphone	202.9MHz	$349
C 0125	Entertainment Microphone	203.7MHz	$349
C 0131	Lavalier Microphone	202.1MHz	$349
C 0133	Lavalier Microphone	202.9MHz	$349
C 0135	Lavalier Microphone	203.7MHz	$349

AT LAST Design Quality Weather Proof Speakers And Sound Columns By *Redford*

• Rugged extruded aluminium construction • Superb powdercoat industrial paint finish • Engineered in Australia • Excellent reproduction • Superior to imports — Yet just a fraction of the price!



Altronics proudly announce the release of the superb ***Redford*** Weatherproof Speaker and Sound Column Range. Imagine a wide range speaker system which is highly directional and with efficiency approaching that of reflex horns!

Redford is the solution for high quality sound reproduction outdoors. The Five Models to choose from "Fill the Bill" from applications on boats to high grade paging and music entertainment installations.

RUGGED EXTRUDED CONSTRUCTION

These vibration free enclosures are constructed from die extruded heavy gauge aluminium and finished with incredibly durable industrial powdercoat enamel. The speaker ends are sealed via gaskets and tough moulded "LURAN S" UV resistant end caps. The end result is "Good Looks" together with assured rugged durability for the Australian environment.

EXCELLENT REPORDUCTION

The drivers have been chosen for wide range, low distortion, mid range "presence" (essential for high grade vocal work) and high efficiency in general. **Power Capacity** for short term use, the drivers will safely handle 150% of rated power. Acoustic wadding is used to dampen Bass resonance. **Weather Proof Construction and use of "Doped Cones"** Foam plastic and cloth is sandwiched between Baffle and Front Grill to prevent water ingress. A first for ***Redford*** is the use of a patented cone moisture repellant process for all models.

Wide Range Weatherproof Extension Speakers For Your Stereo System

Great For The Back Patio, Swimming Pool, Games Room, Den, Pool Room Etc.

Dimensions 260mm wide x 170mm high x 150mm D. (Mounting brackets are included)

10 Watt 16 Ohm (Max 15 Watt)
Single dual doped cone driver 16 ohm impedance is employed to give a generally correct volume balance with main speakers - an added bonus is your amplifier load is kept to respectable limits!! Great for back patio, Den, Boat Deck etc.

C 0938	White	$99ea	$190 per Pair
C 0940	Black	$99ea	$190 per Pair

20 Watt 8 Ohm (Max 30 Watt)
Use 2 special dual doped cone drivers for those wanting a bit more umph!

C 0943	Black	$139ea	$260 per pair
C 0944	White	$139ea	$260 per pair

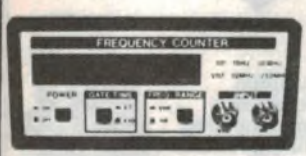
100 Volt Line Models For Use With Professional PA And Music Systems
Using a "Doped" wide range drivers and fitted with grain oriented steel line transformer. Output cable allows connection to 10W/5W/2.5W with 10 watt models, 20W/10W/5W with 20 watt models and 40W/20W/10W with the 40 watt versions.

C 0941	10W/100V line Black	$119ea	$220 per pair
C 0942	10W/100V line White	$119ea	$220 per pair
C 0945	20W/100V line Black	$169ea	$299 per pair
C 0946	20W/100V line White	$169ea	$299 per pair
C 0950	40W/100V line Black	$225ea	$399 per pair
C 0955	40W/100V line White	$225ea	$399 per pair

Great Test Gear At Bargain Prices

150MHz Frequency Counter

A frequency counter is invaluable for the accurate alignment and testing of many modern electronic circuits.



SPECIFICATIONS:-

Frequency Range	10Hz - 150MHz
Gate Time	1 sec, 6 sec.
Accuracy	+/- 1 count
Max. Input	20V P-P
Sensitivity:-	
• 10Hz - 30 MHz	25mV - 100mV
• 10MHz - 150MHz	100mV - 300mV
• Power requirement	9V DC at 100mA

Use Our 9V Plug Pack **M 9004**

Q 1520 ..... **$199.00**

Audio Frequency Generator

Often in testing audio circuitry it is necessary to have an accurate and adjustable audio signal source available. This little generator even allows you to test 455KHz IF stages!

SPECIFICATIONS:-

Frequency Range	10Hz - 1MHz
Accuracy	+/- 3% + 2Hz
Output Waveforms	Sine/Square
Output Level	Sine : 8V RMS Square : 10V P-P
Output Attenuator	0,-20 db,-40 db and fine adjust.

Q 1540 ..... **$249.00**

RF Signal Generator

An RF signal generator is an absolute must when it comes to radio servicing. With provision for both internal and external modulation this generator is a winner.

SPECIFICATIONS:-

Frequency Range	100KHz - 150MHz In 6 Ranges
RF Output Level	100mV RMS
Accuracy	+/- 3%
Modulation:-	
• Internal (30% Depth)	1KHz
• External	50Hz - 20KHz
• Crystal Locked Oscillator	

Q 1550 ..... **$199.00**

Brilliant Auto Ranging Digital Multimeter

Autoranging with Memory Function for Relative Measurements

Q 1075 **Only $99.95**

Free Select either a carry Case or Holster this Month with your Q 1075 at no charge

Specifications

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

Holster

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

Q 1077 **$9.50**

Carry Case

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

Q 1076 **$9.50**

EA's Greatest Amp Project In 10 Years

'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**

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.**

"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.*

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

Build These Fantastic New Playmaster HiFi Loudspeakers

See Electronics Australia Sept '86

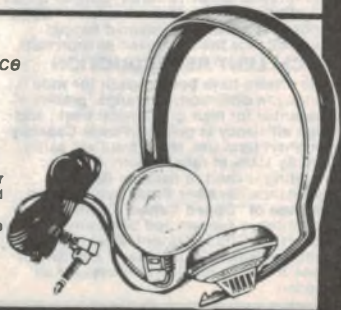
$449 full kit K 5090

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

Exhilarating Sound Performance

Brilliant Digital Headphones

Incredibly Comfortable



• Utilizes newly developed flat disk vibrator copper clad aluminium wire voice coil and Somarium cobalt Magnet. The resultant reproduction is outstanding • Impedance 45 Ohms. • Maximum input 400 mW • Frequency Response 20Hz to 20KHz.

C 9010 .. .. **$39.50**

LOOK
Great Projects To Build

Fantastic New Kit From EA

Super Large LED Display Module

(Display 150 x 60)

Need to produce an LED display that can be seen from a long way off? This single digit 153mm high seven segment LED display module is just what you need. It can be used as a replacement for both common anode and common cathode LED displays, can be either multiplexed or DC driven, and can be provided with a decimal point on either the right or left.

External DC Supply Required 20 - 24V at 150mA

K 1225 **$49.95**

This Natty Single Button Security Lock Is Just The Shot For Your Garage, Workshop, Wine Cellar Or Front Door

4—Digit Combination Lock

This electronic combination lock has a four digit security code which is entered using a single pushbutton switch. For added security, each number of the code must be entered within certain time restraints. Once the correct code has been entered, the circuit triggers a solenoid operated door catch to unlock the door.

Altronic Kit Housed in sturdy Jiffy Box.

K 1925 ..... **$35.00**

Excludes Solenoid Door Catch (Available from your local Security Store)

TRANSISTOR ASSISTED IGNITION WITH DWELL EXTENSION

Dead easy to build and (even better) there are only 3 electrical connections required to the car wiring system.

K 4010 ..... **$39.50**

The Power House Arrives

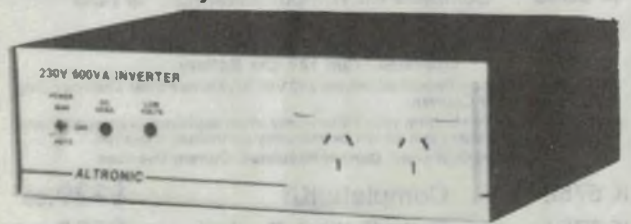
Massive 600 Watt Inverter

Operates from 12 or 24 Volt systems via internal wiring connections

Big brother to our 300W Model this brilliant design can be internally connected for either 12 or 24V operation. Full 600 watt output — and that will power a fantastic array of appliances e.g. Lighting, Electric Motors, Electric drills, Hi Fi, TV Sets, Computer.

An absolute must for House Power or for the Truck, Tractor etc.

K 6770	Complete Kit	**$399.00**
K 6775	Fully Built & Tested	**$499.00**



With Soldering Stations Costing $150 and More, This Represents Excellent Value

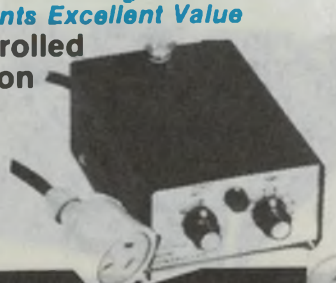
Temperature Controlled Soldering Station

(EA Sept.'86)

Controls the temperature of your standard soldering iron. Suitable for irons rated from 20W—75W - Standard soldering iron plugs straight in, no need for modification.

The Altronics Kit comes complete — Pre-punched and silk screened **K 6400**

$35.00



Zener Tester

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

$12.50

Save A Bundle On Those Dangerous Pesticides

Build EA's Great Ultrasonic Pest Repeller

EA's "Pest Off" generates frequencies between 23KHz and 64KHz claimed to be the best for driving off most vermin and beasties. **K 1600**

$39.95

Blowing Fuses Blowing Your Cool? You Need

The Electronic Fuse

K 2535 **$32.50**

All you do is clip the unit across the DC fuse holder (fuse removed), dial up the required current (max. 10A) and if the circuit draws more than this then the circuit "trips" or opens. Thus power is removed from the device.

Features: Fast blow - slow blow setting • Manual reset button • LED fuse tripped indicator • Operates off 1 single 9V battery (not supplied) • Two current ranges 0-1A & 0-10A • Any current setting available up to 10A • Current Settings easily adjustable via a pot and calibrated scale • Housed in a rugged Jiffy Box.

A Must for prototyping and service work. No Electronic workshop should be without one.

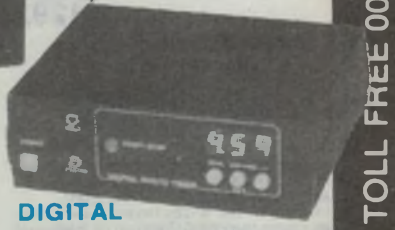
Mosfet Power Amp Module 150 Watt

Here is a high power, general purpose power Amplifier module suitable for HiFi, guitar and PA applications employing sturdy, reliable **MOSFET's** in the output stage.

K 5120 **$75**

SPECIFICATIONS:

Power Output
150W RMS into 4 Ohms
100W RMS into 8 Ohms
(At onset of clipping)
Frequency Response
20Hz to 20KHz +0 -0.5db
10Hz to 60KHz +0 -3db
(Measured at 1 W and 100W Levels)
Input Sensitivity
1 Volt RMS for full output
Hum
98db below full output
Noise
114db below full output
Total Harmonic Distortion
0.006% @ 1KHz 12W
0.03% @ 10KHz 12W
Stability
Exceptional (tested to full output driving 3.3uF into short circuit at 10KHz).



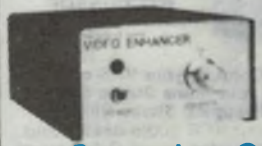
DIGITAL PHOTO TIMER $79.50

This classy digital timer 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 interrupts timing and focus switch which bypasses the timer settings. **K 1850**

Video Enhancer

Sharpens up your picture when Copying Video to Video



Here's a simple but effective video enhancer that is super easy to build at a fraction of the cost of commercial models. Unit sharpens picture detail, and can actually improve the quality of a copy by amplyfying the top end of the video signal **K 5825**

$42.50

Screecher Car Burglar Alarm

This alarm drives off wouldbe thieves with an ear splitting modulated tone. Once activated it is near impossible to stay within the confines of the car.

Features: Entry Delay • Exit Delay • Alarm Timer • Lamp Flasher • Three second soft alarm reminder. Piezo siren produces modulated tone of 110db at 1 metre. Simple to build and install. **Two Sensor Inputs**

K 4360

$39.95

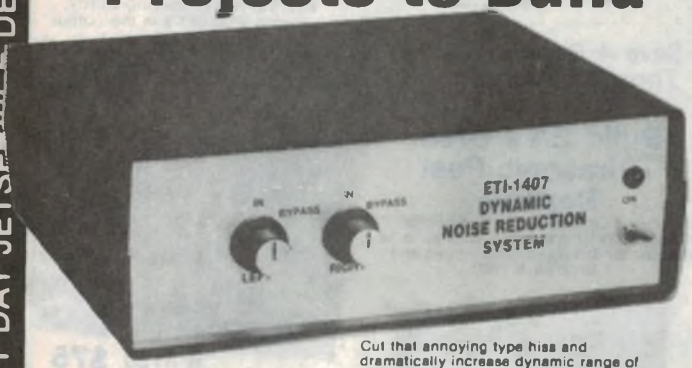
Ultrasonic Movement Detector

This Ultrasonic Movement Detector provides added protection against illegal entry via an open window etc. Connects directly to an alarm with a normally open input. Detects any movement up to 3 metres within an angle of 30 degrees. Will operate directly off 12V i.e. Car Battery etc.

K 4400

$29.50

Excellent Kit Projects to Build



Stunning Design Makes Your Tape Machine Sound Like A CD Player

Dynamic Noise Reduction System

(See ETI Dec.'86)

Cut that annoying type hiss and dramatically increase dynamic range of your cassette recordings with this Dynamic Noise Reduction System It.
This fantastic system improves signal to noise of your tape deck by up to an incredible 18dB without treble attenuation It also expands dynamic range, allowing greatly improved recordings from compact disc players.

K 5575 ..... **$99.00**

EA Dual Tracking Power Supply

The Ideal Power Supply For The Audiophile Experimenting with Linear Op Amp Designs

• Floating Ground• Meter Switchable V to A • Voltage adjustable to within 10mV • Output + or - 1.3V to + or -22V at 2 Amps +5V @ 1.0 Amps **K 3320**

$129.95

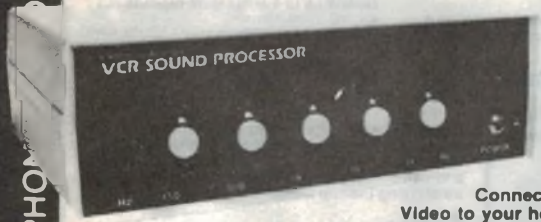
Check Appliances And Electrical Wiring

Build This 1000V Megohm Meter

(1985 Successor to the "Megger")

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

Just $55



VCR Sound Processor

Connect your VHS or Beta Video to your home Stereo System via. this superb Stereo Simulator

Now a quite phenomenal enhancement to your VCR audio quality and impact realism can be achieved by feeding the Video sound O/P through your home HiFi system via. ***EA's simply brilliant VCR Sound Procesor.*** Not only does it give simulated stereo but the inbuilt 5 stage graphic equaliser provides tonal depth for added realism and listening enjoyment.

K 5820 ..... **$59.95**

12/240V Inverter for Small Appliances

Low Power Design also Works as a Battery Charger

$79.50

The inverter is ideally suited to powering low wattage mains appliances from the car battery while camping. This considerably improves the comfort level of the civilised camper. Similarly, it has uses in boating. Typically, it can be used to power an electric shaver, electric blanket, electric can opener or a 40W light bulb. Alternatively, back in the home (or still on the camp site). Frequency sensitive items such as belt or idler driven turntables can be powered at a very precise crystal controlled frequency for accurate sound reproduction. If speed variation over a small range is required, then a switch is provided to change from the crystal based 50Hz signal to a variable oscillator. **K 6705**

K 3300

$165.00

Laboratory Power Supply

3-5 Volts at up to 5 Amps

Designed by Electronics Australia, this supply has been one of our most popular kits. Our version incorporates refinements and is now housed in an attractive, tough "ABS" instrument case. This all new compact version has been made possible by the use of a highefficiency Toroid Power Transformer. So you win four ways - less heat, less weight - Greatly enhanced appearance and easier to build - **Remember the Altronics Kit is fully drilled and punched.**

Beat Triggered Strobe

Add Some Life To Your Next Party

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

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

Two Tube Option For Increased Power

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

FANTASTIC HI TECH - HI SPEC

Audio Oscillator and Function Generator

This Ultra low distortion oscillator is comparable with the very best laboratory standard sine wave oscillators. As well as having very low distortion it has excellent envelope stability, square wave output and output metering

2 Models to choose from (metered and unmetered)

• Frequency range 10Hz - 100KHz in 4 ranges • Output level 3V RMS max adjustable • Attenuator Odb, -10db, -20db, -30db, -40db, -50db plus fine adjustment • Output impedance — 600 ohms unbalanced • Output waveforms — sine and square.

All components mount on one single PCB making it a breeze to Construct

Save $200 and More by Building this Fine Kit Project

K 2540 Complete Kit with Front Panel Metering **$155**

K 2545 Complete Kit Without Metering **$139**

300 Watt Inverter With Auto Start

Operates From 12V Car Battery

Just think how handy it 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

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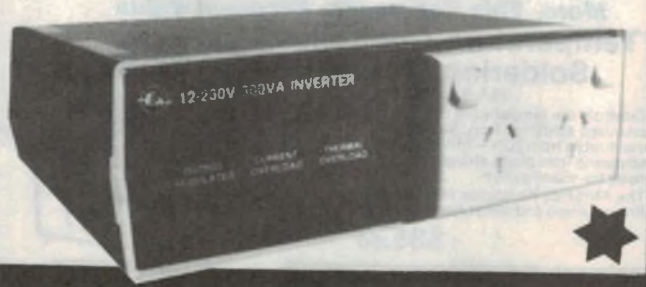

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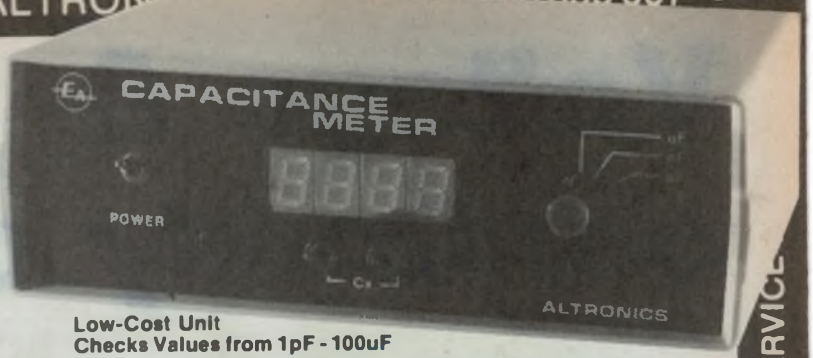

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Voltage & continuity checker

This handy voltage and continuity checker probably belongs in every toolbox. It tests AC and DC voltages and also continuity in wires and cables.

by HENK MULDER

Those amongst us who have ever tried to find their way into the electrical system of their car, motorbike or boat know the problem: is this point or wire at 12V or at earth? The better equipped technician gets his voltmeter out, and crawls under the dashboard with the test leads. But while you're concentrating on keeping the test probes at the right spot, you'll find it very difficult to read the voltmeter at your side.

This is just one of the problems you can encounter when working on electrical installations. Often the only important thing when working in cars or boats etc. is to know whether a certain point is "active" or not. Also the polarity can be of importance. When doing measurements in such environments, precision is generally not required.

When working on 3-phase AC power systems, one would like to make the distinction between inter-phase (415V), line (240V) and neutral or earth, but measuring actual changes in the mains voltage is generally not relevant, and often in fact can only be distracting.

Another important thing in electrical installations is the measurement of continuity of wires. After a modification or installation of wiring has been completed, it is vital to test the new installation in order to find out whether there is an inversion of wires, or perhaps wires missing.

If you have ever worked in an installation environment, then you will know that this environment does not exactly resemble an electronic test laboratory where you can take off your jacket before you put the probes of a four-digit voltmeter on a car battery to test the polarity.

In real-life installation work one could be on top of some wobbly worn-out steps, or within a few centimetres of a growling engine. Often there is not much time for reading scales, if at all.

So it is that today's electricians are often equipped with commercial voltage checkers which only read out the general voltages like 12V, 240V, 415V etc. The great advantage of these checkers is that they only take a glance at the display to read the voltage. Some of the better testers are also equipped for continuity testing.

The major problem with these commercial voltage & continuity checkers is the price, around $75. For lot of people this is just a bit too much.

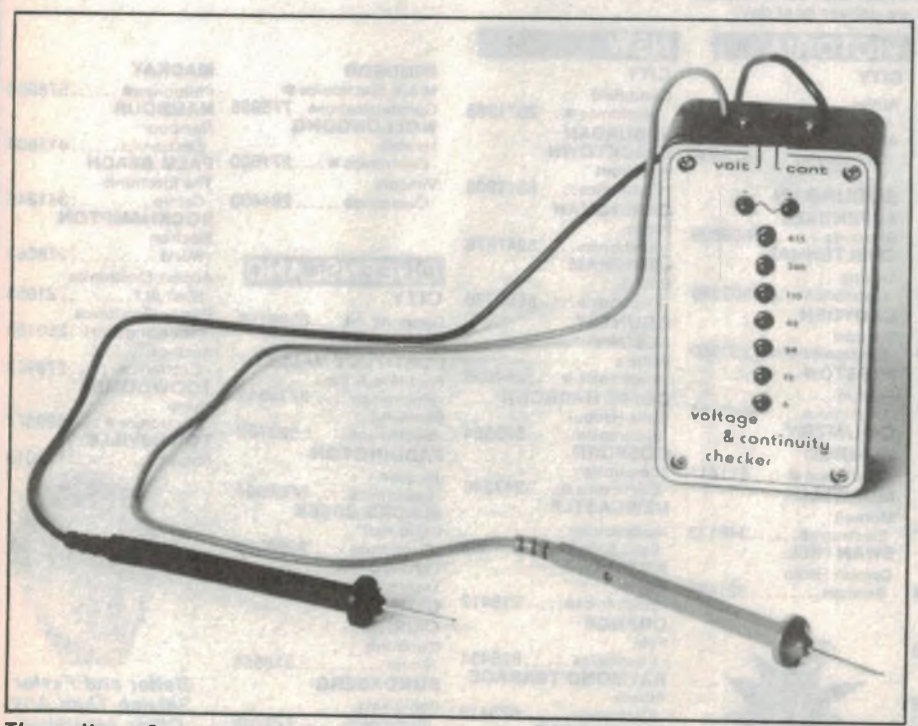
As these voltage & continuity testers really are very handy, we decided to cut down the price by designing our own.

The voltage & continuity checker described here measures AC & DC voltages in the ranges: 6V, 12V, 24V, 48V, 110V, 240V and 415V. There is also a polarity indication, and in case of AC, both polarity LEDs will light up.

Whenever a voltage is measured, there is also a "beep" tone.

The continuity tester is selected by a switch. The continuity of a wire is indicated by an audiovisual signal: both a beep and a glowing LED.

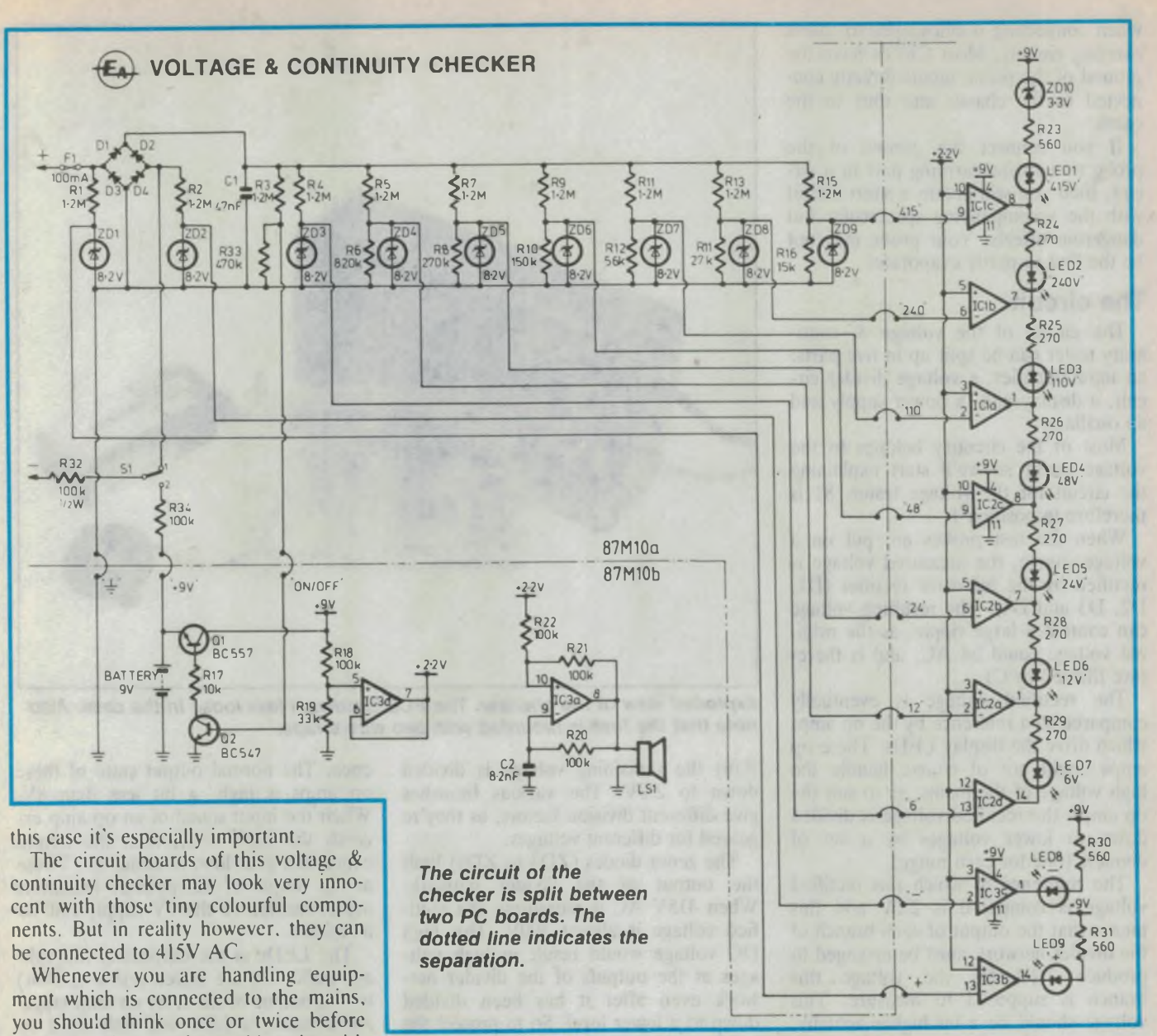
As said before, we have tried to cut the commercial price of these voltage & continuity checkers. We succeeded in doing so, for you'll be able to build our checker for less than thirty bucks. That even includes the battery for a change!



The voltage & continuity checker: a useful tool for installation and servicing work.

Danger: HIGH VOLTAGE!

Similar warnings should be stuck on any project involving mains, of course. In



The circuit of the checker is split between two PC boards. The dotted line indicates the separation.

this case it's especially important.

The circuit boards of this voltage & continuity checker may look very innocent with those tiny colourful components. But in reality however, they can be connected to 415V AC.

Whenever you are handling equipment which is connected to the mains, you should think once or twice before you touch them or do anything else with them.

You should realise that high voltage (and that includes 110V) is a possible killer. Every year there are still several people killed through electrocution. Even very experienced technicians get killed. It might be ignorance, negligence or just plain bad luck, but the result is still the same: curtains!

It is strongly recommended not to use the voltage tester for AC measurement when the lid is not firmly screwed to the case. If there is a problem with the tester, then you should try to work it out at lower voltages like 12V.

Smoke signals from the EA lab . . .

While working on the prototype of the voltage & continuity tester we made a mistake that was fatal — though luckily only for the prototype itself. As the mistake was not too obvious, we would like to explain what happened. It might save you, your tester and other expensive equipment from the consequences of making a similar mistake.

The prototype was built on a breadboard and was ready to be tested. As a supply we used a benchtop power supply rather than a 9V battery. Everything worked fine for the lower voltages. When we got to the stage of testing AC 240V we heard an explosion and saw smoke escaping from a carbonised breadboard . . .

After the crowds had disappeared, we had a closer look at the prototype and the test set-up and tried to figure out what had happened.

The source of the problem was the power supply we had used, our own 5A/50V switch-mode power supply. When connecting the power supply to the prototype, we assumed wrongly that the output of the supply was floating.

Having looked at the circuit diagram of the power supply, we learned that the output was connected to earth via two 100uF capacitors.

The diagram of the test set-up (Fig.1) will illustrate what happened to our prototype when testing the mains. The mains was shorted to earth via a diode of the rectifier bridge and the 100uF capacitor of the power supply. It was this that resulted in the explosion which welded the test leads to the breadboard . . .

Needless to say the power supply also did not like this treatment, and needed some new components.

Similarly you should take much care

when connecting oscilloscopes to mains carrying circuits. Most CRO's have the ground of the probe inputs directly connected to the chassis and thus to the earth.

If you connect the ground of the probe to a mains carrying part in a circuit, then you will create a short circuit with the accompanying spectacular but dangerous effects. Your probe may not be the first to partly evaporate!

The circuit

The circuit of the voltage & continuity tester can be split up in five parts: an input rectifier, a voltage divider circuit, a display unit, a power supply and an oscillator.

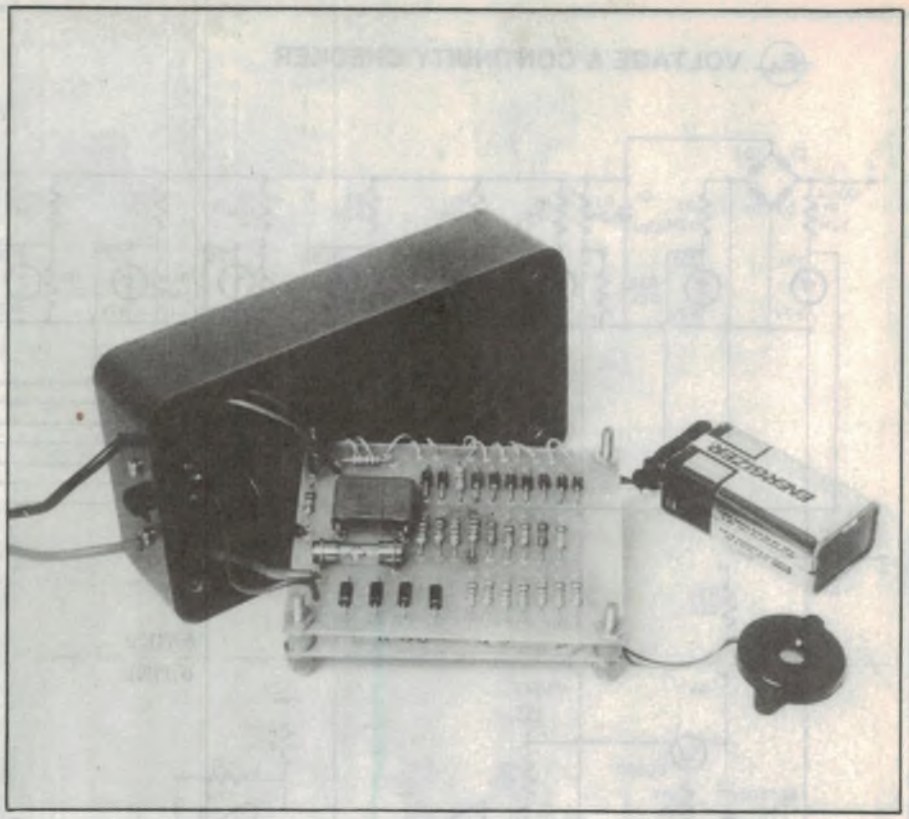
Most of the circuitry belongs to the voltage tester so we'll start explaining the circuit for the voltage tester. S1 is therefore in position 1.

When the test probes are put on a voltage source, the measured voltage is rectified by the full-wave rectifier (D1, D2, D3 and D4). The resulting voltage can contain a large ripple, as the original voltage could be AC, and is therefore filtered by C1.

The rectified voltage is eventually compared to a reference by the op amps which drive the display LEDs. These op amps could not of course handle the high voltage of the mains, so to suit the op amps, the rectified voltage is divided down to lower voltages by a set of dividers (one for each range).

The reference to which this rectified voltage is compared is 2.2V and this means that the output of each branch of the divider network must be arranged to produce 2.2V for the voltage this branch is supposed to measure. This voltage should be a bit higher actually, to prevent the voltage tester being too critical. The actual output voltage of each branch is about 2.6V for its corresponding voltage.

The divider network works in two steps. First the input voltage is roughly halved by R32, the 100k resistor at the negative input. In the next stage (R4 to R16) the remaining voltage is divided down to 2.6V. The various branches give different division factors, as they're geared for different voltages.



Exploded view of the checker. The PCB sandwich lays loose in the case. Also note that the fuse is mounted with two wire straps.

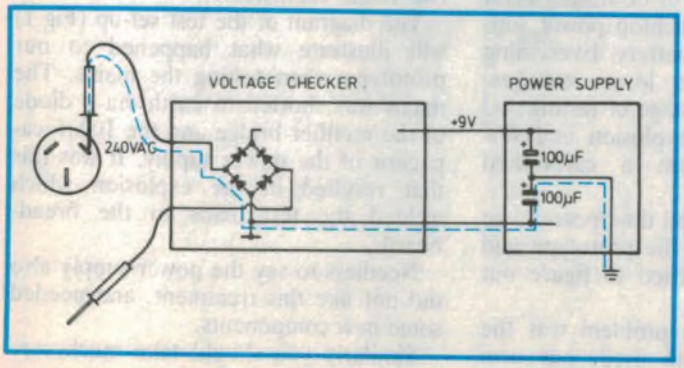
The zener diodes (ZD3 to ZD9) limit the output of the divider network. When 415V AC is measured, the rectified voltage is almost 300V. This high DC voltage would result in high voltages at the outputs of the divider network even after it has been divided down to a lower level. So to protect the op amps, these zener diodes have been added to the network.

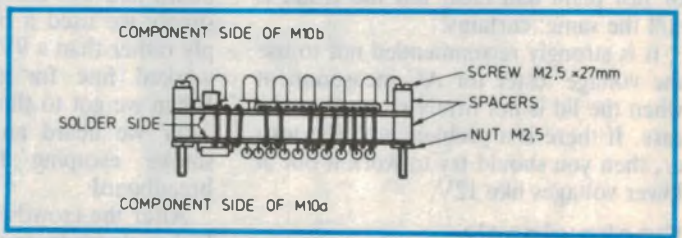
The resistor/zener diode combinations R1/ZD1 and R2/ZD2 give a polarity signal to the display unit.

The op amps of the display unit compare all the input signals from the divider network against a 2.2V reference. The normal output state of these op amps is high, a bit less than 8V. When the input signal of an op amp exceeds the 2.2V level, then the output concerned goes low, to about 1V. Those at the output of the polarity indicators are connected to the 9V supply rail via a resistor.

The LEDs at the outputs of the voltage indicators are linked (via a resistor) to the output of the next op amp stage. As a result, a LED will only light up when the output of the next stage is still high. This means that only the LED corresponding to the highest measured voltage will light up.

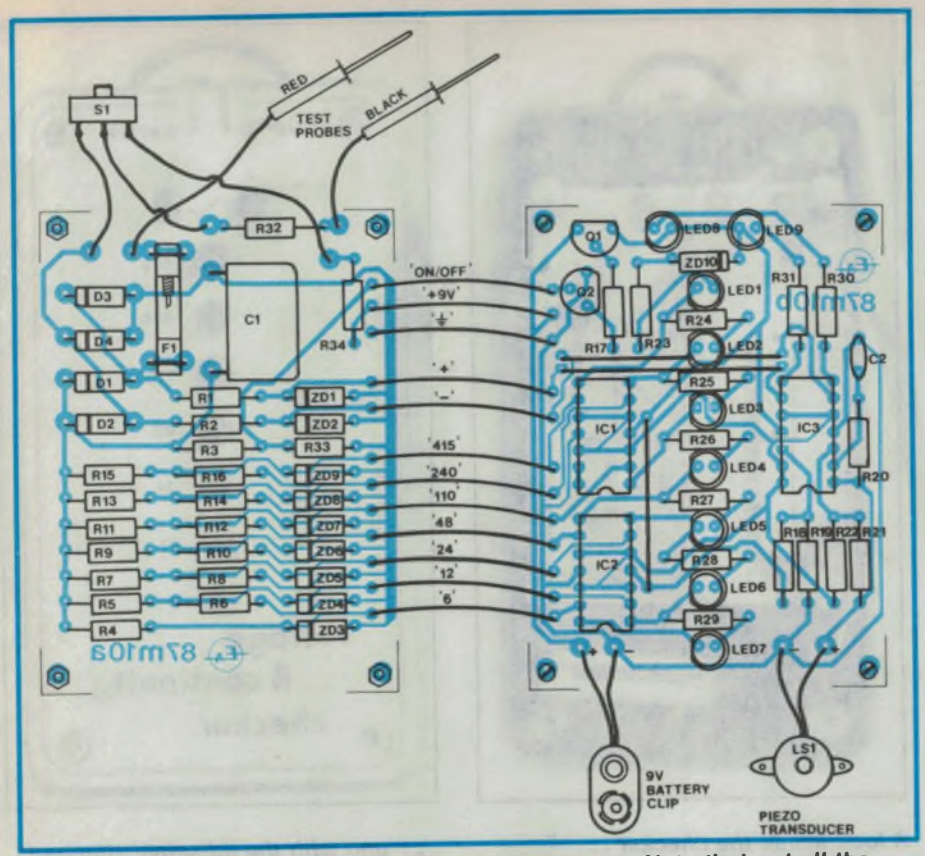
Transistors Q1 and Q2 function as an electronic ON/OFF switch. When a voltage is measured, the base of Q2 is driven via R3. Q2 in turn drives the





The PCB assembly consists of the PCBs, eight spacers and four screws and nuts.

Fig.1: (left) This set up was disastrous for our prototype. The coloured line indicates the current path (refer text).



Assemble the tester according to this wiring diagram. Note that not all the LEDs have the same orientation.

base of Q1, which becomes conductive. The voltage drop over Q1 is very low, only about 100mV. The 2.2V reference is derived from the 9V supply and is buffered by op amp IC3d.

Op amp IC3a is wired as a Schmitt-trigger oscillator and generates a 2.5kHz signal to drive the loudspeaker, actually a piezo transducer. As this beep-generator is directly wired to the 9V supply rail, a tone will sound as long as there is power on the supply rail. This will be whenever a voltage is being measured.

So far we have been talking about the voltage tester. Let's put the switch in position 2 and look at the continuity tester. In this position, the 9V of the battery is fed to one of the probes. When a connection is made between the probes, the base of Q2 is driven by this 9V through R34, R32, D1 and R3. This switches Q1 on and the beeper indicates the continuity measurement.

When measuring continuity, the voltage at the divider network is about 4.5V. As a result, also the 6V LED and the "+" LED will light up. Incidentally the "-" will also light up for one second.

Construction

To keep the voltage & continuity tester as small as possible, we have used all the space inside a small jiffy case. As a result the tester consists of two printed circuit boards (PCBs), stacked on top of one another. The PCBs are coded 87m10a and 87m10b and each measure 53 x 72 mm.

The display LEDs are directly mounted on the top PCB and the two PCBs form a "sandwich". The two layers are held together by four screws and are separated by spacers.

This "sandwich" lays loose in the jiffy case. The length of the four screws has to be adjusted so that the PCB assembly fits tightly in the case when the lid is screwed on. We have not used screws which penetrate the walls of the case, for safety reasons.

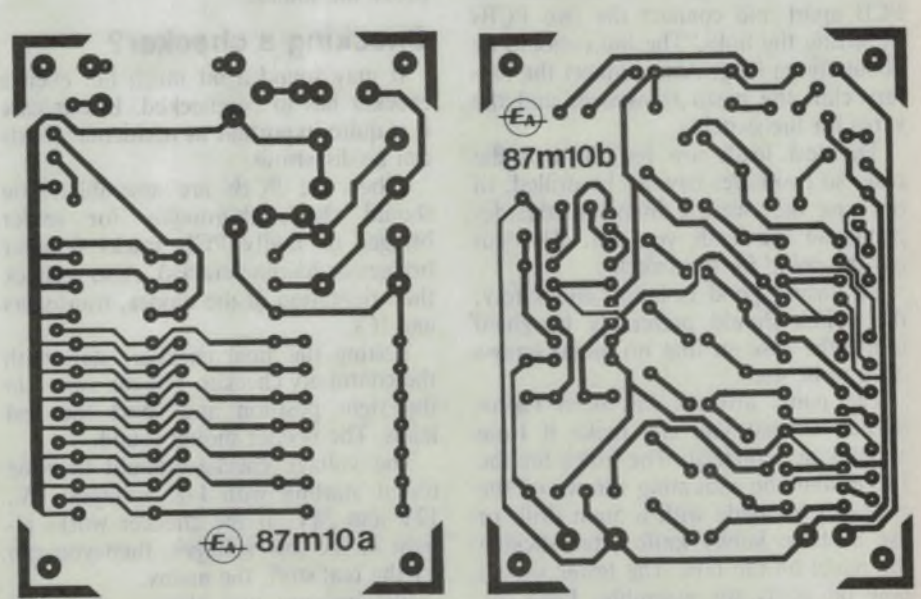
The construction of the PCBs is quite uncomplicated. Starting with 87m10a, the divider network, you first mount the resistors, the diodes, the capacitor and finally the fuse.

The fuse should in principle never blow. The only time that things can go wrong is when there is an accidental solder or copper bridge where it should not be. As this won't happen in most cases, a fuse holder is redundant. Accordingly, we soldered the fuse directly to the board with two wire straps.

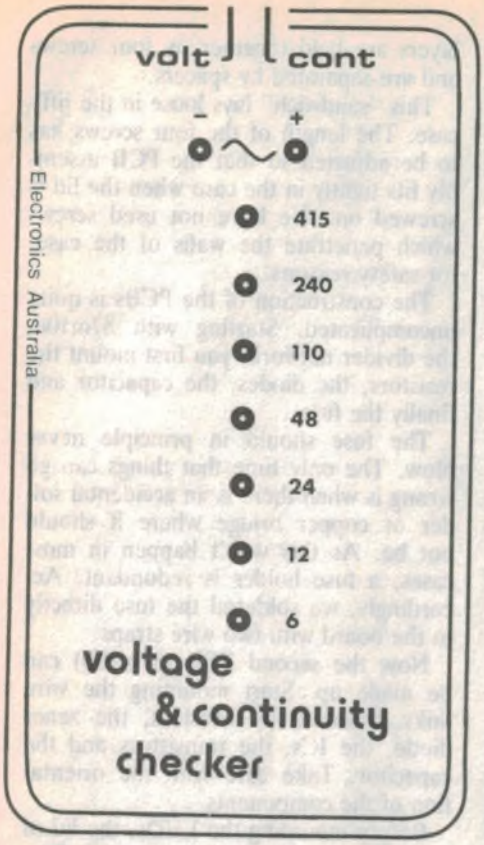
Now the second PCB (87m10b) can be made up. Start mounting the wire links, followed by resistors, the zener diode, the ICs, the transistors and the capacitor. Take care with the orientation of the components.

Before mounting the LEDs, the lid of the jiffy case has to be prepared. Several holes have to be drilled. The easiest way to get the holes in the right place is to make a photocopy of the panel artwork and to stick that to the lid with sticky tape. Having done so you can easily drill the holes for the LEDs with a 5mm drill.

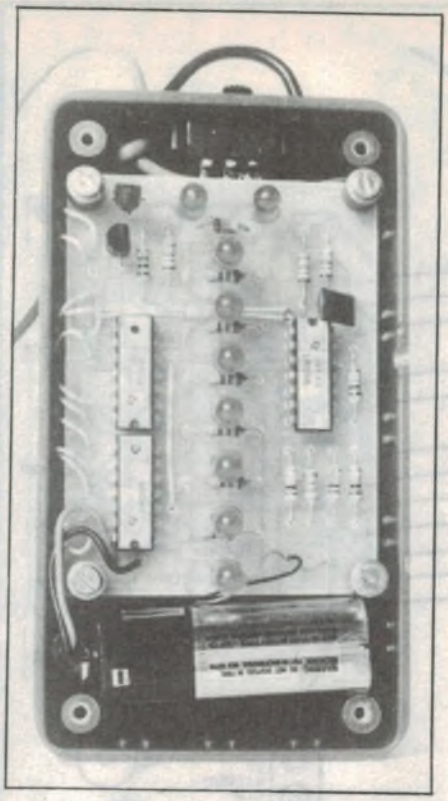
To mount all of the LEDs at the same height you should put the LEDs into place without soldering and assem-



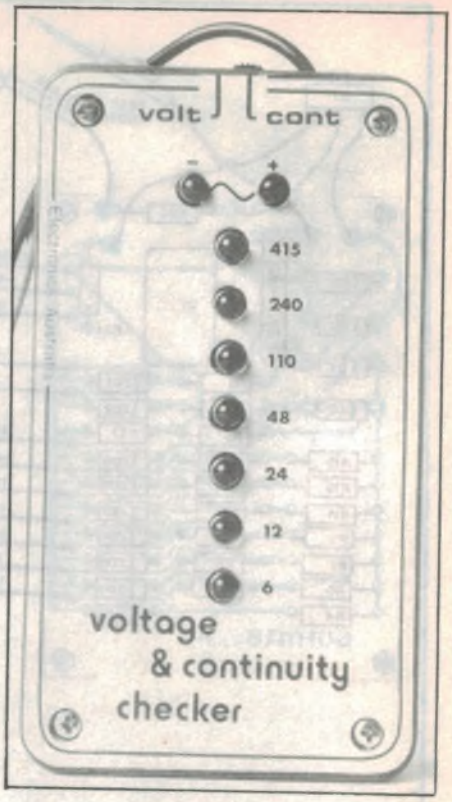
An actual size reproduction of the PCB artwork.



The actual size panel artwork.



A look inside the checker . . .



. . . and with the lid safely attached.

ble the display PCB with the lid, using the proper spacers. Note that the lid is laying loose on the four screws. Place the lid on a flat working surface with two bits of PCB (or something similar) under the sides of the lid. Now push the LEDs down to the working surface which projects them about 2mm out of the lid and solder them.

You can now take the lid and the PCB apart and connect the two PCBs by wiring the links. The links should be about 20mm long. Also connect the battery clip, the piezo transducer and the wires for the switch.

The test leads are fed through the case, so two holes have to be drilled. In our case they were 2.5mm, but this depends on the leads you use. Also cut out the space for the switch.

To ensure good isolation and safety, the switch should preferably be glued inside the case so that no metal screws need to be used.

The panel artwork has been reproduced, so that you can make it from aluminium Scotchcal. The holes for the LEDs and the mounting screws of the case can be made with a 5mm drill, or use a sharp hobby knife after sticking the panel on the box. The tester should now be ready for assembly. Feed the test leads through the holes, make a knot in them at 50mm from the ends and solder them to the divider network PCB. Fold the two PCBs together with the copper sides inside, and assemble the boards.

The last step is to solder the wires to the switch, connect the battery and screw the lid on the case. The piezo transducer is placed on the bottom of the case. Put a bit of foam between the transducer and the PCB; this will improve the sound.

Checking a checker?

It may sound a bit much but even a checker has to be checked. In our case it is quite important as accidental shorts can be disastrous.

When the PCBs are assembled you should check thoroughly for solder bridges or faulty PCB tracks (copper bridges or hairline cracks). Also recheck the orientation of the diodes, transistors and ICs.

Testing the final checker, start with the continuity checker. Put the switch in the right position and short the test leads. The beeper should sound.

The voltage checker should then be tested starting with low voltages: 6V, 12V and 24V. If the checker works alright at the low voltages, then you can try the real stuff, the mains.

Just be sure you observe the usual precautions when making checks on mains wiring. We don't want to lose a single reader!

Parts list

1 PCB coded 87m10a, 53 x 72mm
1 PCB coded 87m10b, 53 x 72mm
1 plastic utility case 30 x 60 x 110mm (Tandy)
1 piezo transducer, should be less than 5mm high
1 switch SPDT
1 fuse, 100mA
1 pair of test leads
1 9V battery snap
1 9V battery, 216 or similar

Semiconductors

3 LM324 quad op amp
1 BC557 PNP transistor
1 BC547 NPN transistor
9 8.2V zener diodes
1 3.3V zener diode
4 1N4007 diodes (1000V)
9 LEDs, 5mm red

Capacitors

1 47nF/630V capacitor, metalised polyester
1 8.2nF capacitor, greencap or similar

Resistors (5%,0.25W unless noted)

1 x 100k, 0.5W, 5%
6 x 270, 3 x 560, 1 x 10k, 1 x 15k, 1 x 27k, 1 x 33k, 1 x 56k, 5 x 100k, 1x 150k, 1 x 270k, 1 x 470k, 1 x 820k, 10 x 1.2M

Miscellaneous

screws, nuts, spacers, hookup wire, solder etc.

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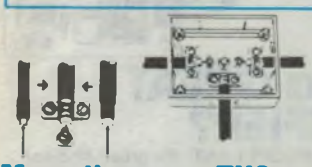


More than one TV?

Don't just connect them together: it doesn't work! Use a splitter for optimum performance — sets won't interfere with each other. Cat L-4472

$5.45

Two Antennas?

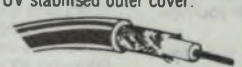
UHF & VHF Antennas don't need two lead-ins. Save money by using a diplexer — one lead in is much more convenient (saves madly swapping leads!) Cat L-4470

$4.95

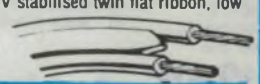
Cable:

DSE stocks top quality TV cable in both 75 ohm coax and 300 ohm twin lead.

75 Ohm — Air dielectric, low loss cable for external/internal installations. Dual shielded (foil/braid) with UV stabilised outer cover. Cat W-2082

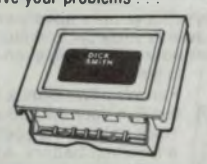


300 Ohm — UV stabilised twin flat ribbon, low loss. Cat W-2070



Need more Signal?

We have two amplifiers which might solve your problems . . .



Masthead Amp

Especially for long range viewing, a masthead amp often works wonders. Amplifies signal right at the antenna — away from the noise —for best possible results. Complete with mains supply. Cat L-4200

$75

In-line Amp

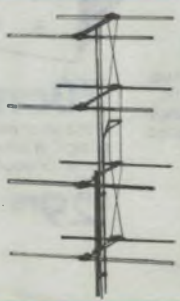
Especially suitable for multi-set use, great for VCR signal amplification. Simply plugs into output of VCR, splitter, etc, and lead to TV plugs into it. Mains power adaptor required. Cat L-4202

$29.95

Need that extra range on VHF?

For country viewing (deep fringe area) or where signal levels are very low (shielded, etc) you'll probably need one of the "big guns": the phased array. High gain, high performance on all high VHF channels. Suitable for horizontal or vertical mounting. Cat L-4025

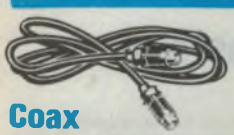
$99



How About FM Radio?

For best results an outside FM antenna is essential. Ours is specially designed for the FM band, can be erected in either polarity. 300 ohm type. Cat L-4064

$34.95



Coax Extension Lead

Perfect for wall socket to TV, VCR to TV, etc. 1.2m coax lead with male plugs both ends. Cat L-4506

$4.50

Wall Sockets for Coax Cable

Two different types to choose from for that really professional installation:
Skirting board type — Small and unobtrusive Cat L-4504

$4.95

Wall Plate type — fits over standard wall box, can also be used as 75 ohm splitter for second or third TV. Cat P-2042

$4.35

DICK SMITH ELECTRONICS PTY LTD

Build (or give!) a Kit this Kitmas...

Kits make great gifts: beats a pair of sox anytime!

Dick Smith's own Fun Way Into Electronics

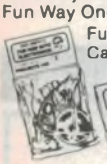
Here's great value: the Fun Way One gift box. All the components needed to build any of the projects in Fun Way One . . . and the book is included too! All this for under $25! Cat K-2605

Projects to build include:
Dog & Cat Communicator
Beer Powered Radio
Morse Code Practice Set
Crystal Sets
Mini Amplifiers And much, much more

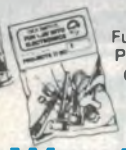
$24.50

Fun Way One Project Packs

Two project packs to allow you to build any of the kits. Project Pack One allows you to build any of the first ten kits in Fun Way One. Project Pack Two gives you the additional components required to build any of the 20 kits (needs Pack one too!) Note - Fun Way One book is NOT included with these kits.



Fun Way One: Project Pack One
Cat K-2600 $8.95



Fun Way One: Project Pack Two
Cat K-2610 $9.95

Fun Way TWO

Ready for something more advanced? Fun Way Two has another twenty projects to build - all on modern printed circuit boards. And we even teach you how to solder!

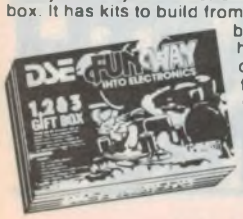
Fun Way Two Bonus Pack includes the Fun Way Two book, a quality soldering iron, a pack of solder, a nine volt battery, AND the most popular kit in Fun Way Two: the Wireless Microphone. Cat K-2620 $26.95

Fun Way THREE

The real professionals! Build the Fun Way Three kits and you'll be ready to tackle most projects. The Fun Way Three Bonus Pack includes the Fun Way Three book and not one, but TWO popular Fun Way Three kits: the Cricket and the Mini Amplifier. Great value!
Cat K-2670 $29.95

One, Two and Three Gift Box

If they're really into electronics, they'll LOVE the gift box. It has kits to build from all three Fun Way books: nearly one hundred dollars value for only $59.95! Build a flashing brooch, a wireless microphone, cricket, mini amplifier and more Cat K-2680 $59.95

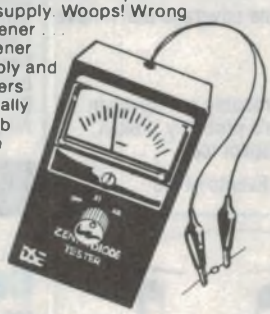


And the really big one . . . Get the Jumbo Gift Box!

Over thirty great projects to build from all three Fun Way books. And the books are included! Over $120 worth of goodies crammed into this value-packed box. Any kid from 6 to 60 would think it was Christmas. (Now that sounds like a good idea!).
Cat K-2690 $99.95

How do you test a Zener?

Let's see. Out with the power supply. Work out the series resistor. Get the voltmeter and put it across the zener. Turn on the supply. Woops! Wrong resistor. One cooked Zener . . .
Or you can build the Zener Diode Tester. Very simply and accurately checks Zeners without danger. Expecially handy in the service lab when the markings are worn off! Cat K-3051 $29.95

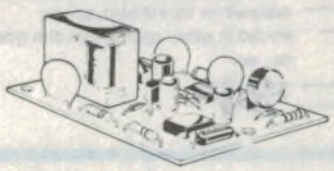


Look Mum. No Bike!

Bikes (the vroom vroom variety) are, unfortunately, very vulnerable. Don't become the victim of a very vulnerable vroom vroom. Fit a bike alarm to your bike and it'll scream its head off if some light fingered larrikin tries to lift it. Easy to build, easy to fit - suits most bikes. Cat K-3249 $39.95

And one for the Car, Too!

Police statistics are staggering: and your car could be next. Build this simple alarm and the odds are back on your side. It's very easy to make, operates on "voltage drop" principle so no holes are needed for key switches, etc. It works! Cat K-3250 $16.95

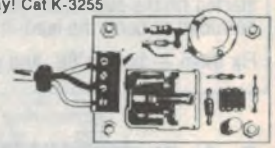


Or the Deluxe Job

The ultimate in protection! One of the best alarms around - better than most commercial units. Includes its own siren output (doesn't rely on car horn), has provision for back-up battery . . . and it's about the best investment you could make for your car. Cat K-3252 $79.95

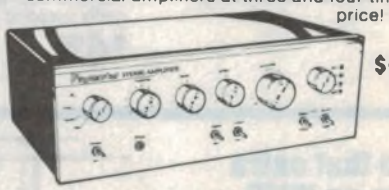
Add an Ignition Killer for 100% Protection

Nothing's worse than a car that misbehaves. Especially if you're trying to knock it off. Imagine. It starts, but very soon splutters and stops. Bill Sykes thinks the car's crook and goes off searching for another! You return to your car, reset the ignition killer - and drive away! Cat K-3255 $22.95



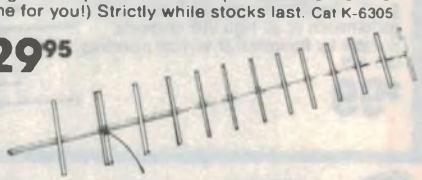
Want a GREAT AMPLIFIER?

Build yourself a MOSFET AMP. It's great! And our value-packed kit makes it even greater! 42 watts per channel into 8 ohms - with professional specs and features. Comprehensive step-by-step manual included to make it easy on you. Compare it to commercial amplifiers at three and four times the price! Cat K-3515 $219



70cm YAGI KIT

Build your own Yagi for UHF. This 13 element design is simple to construct (all the hard work is done for you!) Strictly while stocks last. Cat K-6305 $29.95



70cm Phasing Harness

Want to stack a couple of Yagis for more gain? Use this ready-made Phasing Harness. At UHF every uB (microBel - as distinct from dB) is a help - so help yourself! Cat K-6299 $10.95

While stocks last!

DICK SMITH ELECTRONICS PTY LTD

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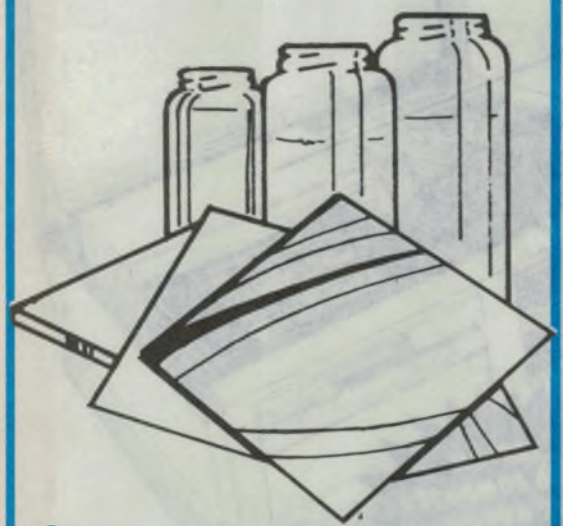
For 24 hour despatch

Do it Yourself!

The poor old hobbyist or engineer wanting one-off pcb's: prototype boards from the manufacturers have been horrendously expensive, making your own always lacked that professional quality!

DATAK

Until now! Dick Smith Electronics is proud to introduce you to the "Datak" range of US-made pcb materials. Top quality, easy to use, make a professional product . . . yet extremely good value. What more could you want?



Complete Photo Tech PCB Kit

It's so simple! This kit contains everything the hobbyist or workshop could want to make pro-quality PCB's: 125 x 150mm stell printing frame, pos-neg film, film processing pack, yellow filter, 100g negative acting etch resist, resist developer, blank pcb's, dry concentrated etchant, 1:1 resist patterns and tapes and, best of all, COMPLETE INSTRUCTIONS.

Cat N-5700 **$104.95**

Individual Components to Build Up or Replenish your Packs.

Photofilm Sheet

Makes film positives from magazine art, 1:1 patterns on film, etc. Two sizes available: 125 x 150mm (6 sheets) Cat N-5705 **$18.85**

200 x 275mm (2 sheets) Cat N-5709 **$18.85**

Film Processing Chemical Pack

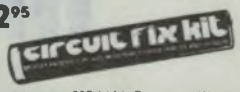
Processes either of above photofilm sheets. Cat N-5909 **$11**

Tin your PCB pattern

Avoid oxidation & contamination of patterns: tin them without mess or elecricity. Soluble powder puts bright tin plate over copper of pcb, ready for soldering. Cat N-5730 **$12.55**

Circuit Fix-It

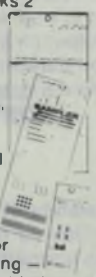
Damaged PCB? Fix it easily and simply with this one. Pure copper pads, sheets on self-adhesive carrier to allow virtually any repair. Cat N-5900 **$62.95**



Dry Transfers for Panels, projects

Choice of three types for that real "factory made" appearance.

(1) Switches and Marks 2 sheets each of black and white. Cat N-5750 **$11.95**



(2) PCB pads, fingers, etc. DIL, surface mount and component donuts all in one handy pack. Cat N-5766 **$19.95**

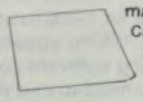
(3) Targets. A must for accuracy in pcb making — especially on double sided boards! Cat N-5820 **$7.95**

Contact Printing Frame **$35.65**

Pro quality frame makes negs or pos up to 225 x 300mm, from film pattern or even direct from printed magazine pages. Contains spring loaded steel exposing frame with glass, backboard, yellow filter & instructions. Cat N-5710

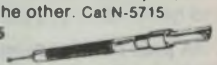
Yellow Filter

215 x 295mm yellow filter for exposing Datak light-sensitive products to pcb patterns. Full instructions included with master kit. Cat N-5711 **$10.45**

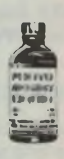


Burnishing Tool

Sure beats using the old ball-point pen! Professional quality results demand a professional approach. Aluminium ball one end, flat pastic the other. Cat N-5715 **$10.45**

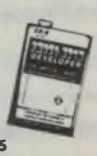


Photoresist Made Easy



Spray pump of negative photo resist (118ml) ready for coating blank pcb's. Easy to use, no tight tolerances required for heating, etc. Cat N-5907 **$18.95**

Resist Developer



Suitable for above resist. 473ml tin. Cat N-5905 **$11.95**

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IT HAD TO HAPPEN!

BUILD-IT-YOURSELF 'AT' COMPUTER!

At last! The perfect opportunity for the hobbyist to build the perfect computer. . . Perfect because it has in it what YOU want! All the features of the "AT" – blinding speed, high expandability, and so on - but you put it together yourself – and $ave!

There's more: each board or module comes with a full 12 month warranty PLUS individual, professionally prepared manuals – no Jinglish to decipher!

And best of all, you don't have to buy it in one hit: add what you want, when you want it (and when the pocket allows it!)

Look at the features:

SUPERB QUALITY HINGED CASE

"Baby AT" case in heavy gauge steel, heavily covered in damage-resistant bone crinkle finish. The lid is hinged and locks up for instant internal access - no more undoing screws! Large enough for expansion - but features a footprint of just 430mm square! Cat X-1005

ONLY $175

200W POWER SUPPLY

Completely pre-assembled - even to the on/off switch and input sockets! Simply slots into place in cutouts provided in case. Heavily plated steel case for minimum RFI with integral whisper-quiet fan. 200W capacity is ready for . . . anything! Cat X-1010

ONLY $275

"BABY AT" MOTHERBOARD

Again, completely pre-assembled. No risk of dry joints – you just connect appropriate cables (as described in detailed manual included). On-board capacity for 1Mb RAM and 8 slots for expansion in true"AT" format. Offers 6, 8, 10 & 12MHz speed (switch & software selectable) giving outstanding software compatability PLUS blinding speed when you need it, and time & date memory with battery back-up. Cat X-1000 **JUST $995**

PLUG-IN CARDS

Cards for the various graphic standards, printer ports, serial ports, etc etc. Choose the one that suits your requirements – and remember, you can always upgrade later!

CGA plus Parallel Printer Card Cat X-2010 **$129**
MGA plus Parallel Printer Card Cat X-8141 **$149**
EGA Card with Hercules compatability Cat X-2013 **$399**
Serial/Parallel/Game Card Cat X-2012 **$139**

DISK CONTROLLERS

Your choice of hard/floppy or floppy disk controller card: choose the one that suits your needs best. Both plug in to motherboard.

Floppy Controller (2 disk drives 1.2Mb or 360Kb) Cat X-2014 **$129**

Hard/Floppy Controller (2 of each) Cat X-2008 **$399**

DISK DRIVES

Also include appropriate cables.

1.2Mb Floppy Disk Drive Cat X-2200 **$269**

20Mb Hard Disk Drive Cat X-2203 **$795**

(Other higher capacity Hard Disks available if required)

KEYBOARDS

Two types available:
84 Keys with top quality "Alps" keyswitches Cat X-3820 **$129.00**
101 Keys - with numeric keypad Cat X-3821 **$149.00**

WHERE ELSE BUT

DICK SMITH ELECTRONICS

PTY LTD

DSEB450/RT1087

Bargraph Multimeter

Finally, an LCD Multimeter which accurately shows analog-type readings! All those essential dynamics that are often lost on a DMM . . . often it's not so much a reading you're after as the change in readings!

But there's more: the information is displayed in "bar graph" format for instant recognition and ease of reading. And if you need to expand the scale, it's a simple one-button operation to go to a 10x magnification!

Plus a data hold function (last reading retained), a maximum hold function (highest reading retained & marked, but readings continue), diode check & continuity, etc, etc: it's one of the best general purpose multimeters available today — simply because it does everything better!

- **105 step LCD bargraph display giving 1% resolution on any scale (eg 10 volts on 1000V range with mag pressed).**
- **Fast 10/second sampling rate for virtually instantaneous display (much faster than most digitals).**
- **Automatic positive or negative indication**
- **DATA Hold key freezes reading immediately previous to pressing. This can then be magnified (by up to 10:1) for a more accurate and precise reading.**
- **6 DC ranges (down to 100mV with virtual 1mV sensitivity), 4 AC ranges, 5 resistance, 3 DC plus diode check and continuity ranges.**
- **Single input terminals mean no swapping of leads when you change to different scales. Fully shrouded test leads supplied, with full instructions.**

Cat Q-1777

$149

Specifications:

DCV: 100mV, 2.5V, 10V, 50V, 250V, 1000V, 5Mohm impedance

ACV: 10V, 50V, 250V, 750V (minimum 5k/V, 25k/V on 10V)

DC: 2.5mA, 25mA, 250mA

Res: 250 ohms, 2.5k, 25k, 250k, 2.5M

Cont: 250 ohms max, continuity beeper approx <100 ohms

Diode: Test current approx 0.5mA, reads Vf on display

Measuring Method: dual integration mode

Sampling: 10 times per second

Power:1.5V (AA) x 2

Battery Life: Approx 800 hours or more.

Size: 145 x 86 x 34mm (w x h x d)

Weight: Approx 250g (inc batteries).

Available exclusively from Dick Smith Electronics

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For 24 hour despatch

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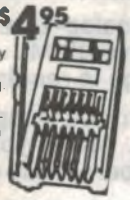
Just for the Kiwis!

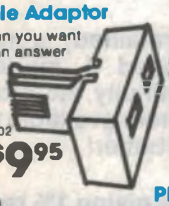
Super Special Phone Accessories!

Phone Plug $4.95
High quality modular phone plug. Accepts standard 4-wire phone cable.
Cat F-9001

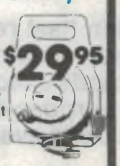


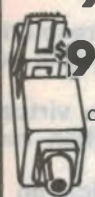
Move the Phone $12.95
18 foot Extension Cord with plug and socket!
Cat F-9008

Double Adaptor
For when you want to run an answer service or a spare phone.
Cat F-9002
$9.95



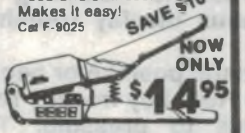
50' Cord Caddy $29.95
Take the phone into any room with this 50' extension cord. Caddy keeps it neat and out of harms way!
Cat F-9020





Retro Phone Plug $9.95
Clips onto cable to give you an additional phone plug!
Cat F-9003

Phone Connecting Tool
If you're working with phone cable for installation, repair... whatever — you need one of these! Makes it easy!
Cat F-9025



Wall Outlet
Standard line jack similar to those used by NZPO.
Cat F-9005
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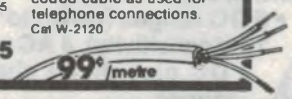

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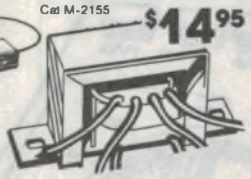

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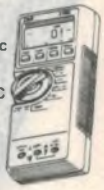

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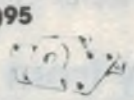

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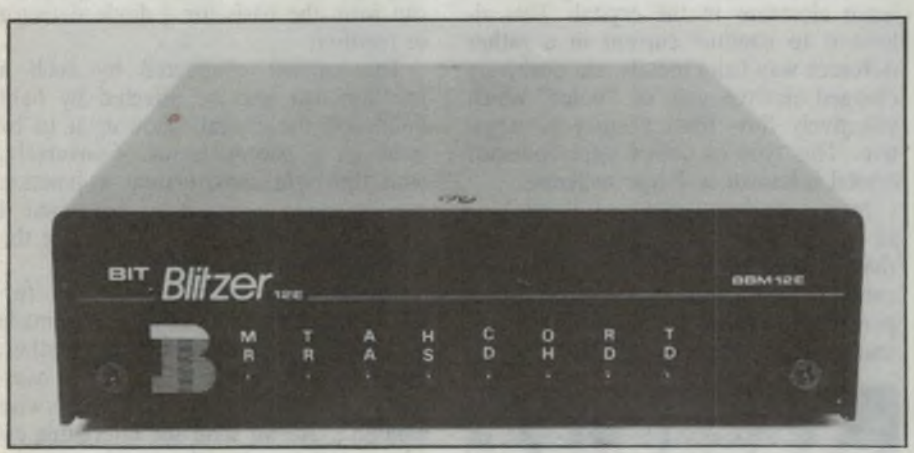
PRODUCT REVIEW:

The Bit Blitzer 12E automatic modem

Always hankered for one of those fancy auto-dialling, auto answering modems to go with your personal computer, but found the price too daunting? Your wait might well be over . . .



How much would you expect to pay for a Hayes-compatible automatic modem with the facility to operate in full duplex mode at both 1200bps (V.22) and 300bps (V.21)? Until very recently, you wouldn't get much change out of $800.

That's why our ears immediately pricked up when the marketing people at Dick Smith Electronics asked if we'd like to check out a new modem they've just added to their range — offering these features for only $399! Needless to say we got them to send one over straight away.

It goes under the somewhat fanciful name of "Bit Blitzer", and as you can see from the picture it comes in a neat but solid little black anodised aluminium box measuring only 190 x 133 x 40mm. This is just big enough for a standard Telecom Colorfone to sit on top, if you're really short of desk space. The Blitzer is made in Hong Kong, we discovered, by a firm calling itself Banksia Information Technology (BIT).

To emphasise that it's fully automatic, there are essentially no manual controls at all. On the front panel, there's simply a row of LEDs to indicate operating modes and the status of various signal and control lines. At the back there's a socket for the 12V DC power input, a DB-25 connector for the RS-232C serial cable from your computer, and a couple of the compact "modular" telephone sockets — one for the line cable from the Telecom phone socket, and the other for an optional phone. A matching 12V plug pack is supplied, plus a cable to connect the modem to the Telecom line socket.

There's also a very easy to follow driving manual, without a trace of the half-expected Chinglish.

Actually it's not quite right to say that there aren't *any* manual controls. If you turn the Bit Blitzer upside down, you find a little window in the case providing access to a 10-pole DIP switch used to configure the various operating modes and parameters. Alongside there's also a convenient data panel, explaining each switch's function and its action in each position.

Basically the 10 switches control the operation of RS-232C handshaking lines like DTR, DSR and CD; whether the modem is to operate to CCITT or Bell (US) standards; whether the internal speaker is to have high or low volume; and various aspects of its operation in automatic mode.

We took a peek inside the case, and discovered a very neatly made PCB which occupies virtually the entire area. Literally everything is mounted on the board, too; there's no conventional wiring at all. The board isn't all that crowded, either. Fairly obviously all of the built-in "brains" is housed in a pair of fancy LSI chips; apart from these there's only a few "glue" chips plus the usual passive parts, line coupling transformer and dialling relay. All very neat and tidy.

Using the manual as a guide, we had no problem in configuring the Blitzer and hooking it up to an IBM PC. In fact it turned out to be somewhat easier than some of the simpler manual modems we've tried.

We gave it a try with the prize-winning Australian data communications program Supercom2, designed to work with Hayes-compatible automatic modems. It worked with the Blitzer exactly as expected, and the Blitzer itself seemed to perform just as it should, responding without a murmur to the Hayes AT command set. In short, we couldn't fault it.

No doubt about it, an automatic modem is certainly a lot more convenient than the old manual clunker we ourselves have been using. There's no fiddly switching, no looking up the numbers and manual dialling — just the pleasure of pressing a few keys, and waiting while the Blitzer does it all for you!

So if you're looking for an automatic modem that does just about all the right things but won't break your personal bank, the Bit Blitzer is well worth considering. It seems to us excellent value at the quoted price of $399.

About the only thing the model 12E won't do is operate at the split 1200/75 baud rate (CCITT V.23) used by Telecom's Viatel and other videotex services — and I'm told there's another model coming shortly that will do this as well. Needless to say, though, it'll be a mite more expensive. (J.R.)

PRIMER ON
Semiconductor Devices

by JIM ROWE

1 — Introduction

This is the first of a series of short articles designed to provide an easy to read introduction to the various kinds of semiconductor device and their basic principles of operation.

We won't be going into a lot of solid state theory or maths. The idea is to give you just the essential concepts, which are generally all that are needed for both the hobby enthusiast and the working technician. They're also a good starting place if you do want to go into things more deeply. Those who do want to go a little deeper into solid state theory might like to refer to my book *Fundamentals of Solid State*, copies of which are still available via our Reader Services department.

I thought we'd start the ball rolling this month with a few general points about semiconductors, and introduce some of the jargon.

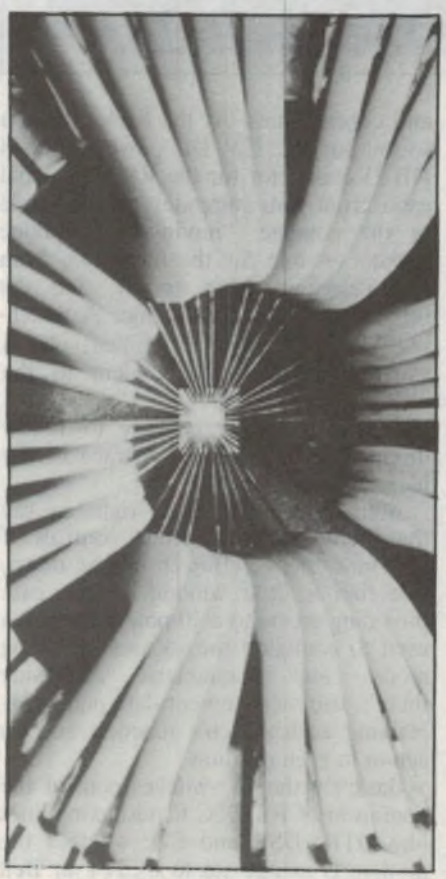
Basically all semiconductor devices depend on the peculiar electrical behaviour of *crystals* formed from a group of chemical elements and compounds known as — you guessed it — *semiconductors*. As the name itself suggests, these are different from normal metallic conductors like copper, silver or gold. In fact pure semiconductors like silicon or germanium often have more in common with insulators such as the ceramics, than they do with normal conductors.

Actually most semiconductor devices are based not on pure or *intrinsic* semiconductor crystals, but on crystals into which have been introduced tiny amounts of other elements, known as dopants. The effect of these is to modify the electrical behaviour of the crystal dramatically, making it a much better conductor — but in two different and almost "opposite" ways.

One kind of dopant element, called a *donor*, creates an excess of conduction electrons in the crystal, allowing it to conduct a current in much the same way as do metals — with electrons going from negative to positive. The resulting semiconductor crystal is known as *N-type material*.

But the other kind of dopant, called an *acceptor*, creates a shortage of valence electrons in the crystal. This allows it to conduct current in a rather different way from metals, via positively charged electron gaps or "holes" which effectively flow from positive to negative. This type of doped semiconductor crystal is known as *P-type material*.

Now a uniform chunk of either kind of doped semiconductor crystal isn't all that exciting by itself. The really interesting things generally only start to happen when we create different N-type and P-type regions alongside each other, in the same crystal.



Probing a newly-made experimental chip, to check its performance. (Courtesy IBM)

What happens when we do this is that the *junctions* formed between the adjacent regions turn out to have all sorts of interesting electrical properties. They generally conduct current much better in one direction than the other, for example, so that a simple P-N junction can form the basis for a diode detector or rectifier.

The current conducted by such a junction can also be affected by light falling on the crystal, allowing it to be used as a photodetector. Conversely, with the right construction, a junction can be made to *produce* light when it conducts a current - making possible the LED and the semiconductor laser.

The current conducted by one forward-biased junction can also be made to influence the behaviour of another, reverse biased junction nearby — causing it to conduct, when it otherwise wouldn't. As we shall see later, this effect makes possible the bipolar transistor.

A reverse-biased junction can also be made to control the current conduction of a narrow uniform region nearby, to produce the basic effect used in the junction FET or field-effect transistor.

There are a lot of other semiconductor devices that you'll come across nowadays, and we'll try to cover most of the main ones in this series. The main thing to bear in mind is that just about all of them are based on the behaviour of an interaction between N-type and P-type regions formed inside crystals of semiconductor material. And in most modern devices the basic semiconductor material is either the element *silicon*, or (much less frequently) the compound *Gallium Arsenide*.

Early devices were made from the element *germanium*, but this proved to be not nearly as satisfactory as silicon.

How are the various N-type and P-type regions formed in a crystal of silicon? In a variety of ways. Traditionally, one of the most common is to expose slices or *wafers* of the crystal to a hot vapour containing molecules of the dopant element, for some hours. This causes dopant atoms to penetrate into the crystal a short distance, a process

known as *diffusion*. Another way is to bombard the surface of the crystal with molecules of the dopant element, by turning them into electrically charged ions and accelerating them using an electric field. This much faster and more modern technique is known as *ion implantation*.

In both diffusion and ion implantation, the area of the crystal surface to be doped is defined by masking, using patterns which are photo-etched into a protective layer of silicon dioxide (quartz) or silicon nitride previously grown on the surface.

By performing a number of different masking and diffusion or ion implanation steps, using both donor and acceptor dopants, it is possible to produce quite a number of adjacent N-type and P- type regions in the crystal, as desired. This is how a great many semiconductor devices, both discrete and integrated, are made.

By the way, the active part of most semiconductor devices must be made from quite lightly doped N-type or P-type material, to allow it to be turned into the various regions required. But because lightly doped semiconductor material is a relatively poor conductor, heavily doped (and therefore low resistance) material is used to make up the bulk of the crystal. The lightly doped layer used to form the active regions is generally grown on the surface of the heavily-doped wafers of crystal, in a way which ensures that it continues the same crystal structure. This is known as *epitaxial* growth, and the lightly doped layer is quite often called the epitaxial layer.

A single wafer of silicon is used to make hundreds, sometimes thousands, of individual devices. After the sequence of masking, diffusion and ion implanation steps has been used to create the regions forming each device (all made at the same time), the wafer is sliced into individual chips or *dice* using a very thin diamond saw. The dice are then packaged into the final devices — diodes, transistors, integrated circuits (ICs) or whatever.

If you open up a typical device, you'll find that the actual die that forms its active "works" is generally quite tiny — often only a millimetre or two square. Even the largest microprocessor and memory ICs are rarely more than about 10mm square. The rest of most devices is protective package, plus pins to connect it with the outside world.

Next month, we'll look at the simplest semiconductor device: the junction diode.

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There's a massive pack of literature including a databook 40mm thick, a 20mm thick instruction set reference manual, a TDS user guide, a programming reference guide, application notes on UNIX, 32 bit architecture and even a PASCAL listing to aid development of 32000 code using a PC. To top it all off there's an article print from the US on a UNIX co-processor for under $US400!!

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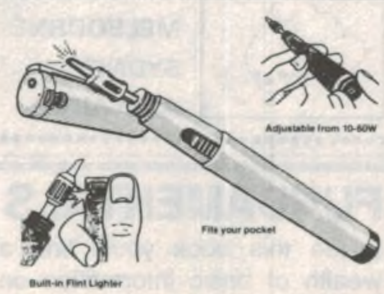

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One of our most popular lines is data books and we can never get enough of them, but this time National have had the Logic Book reprinted in Australia so we'll risk advertising them in the hope there will be enough still here when the advert appears. Contains 54HC, 74HC, 54HCT, 74HCT, High speed MicroCMOS, CD4000, MM54C/74C,CMOS LSI/VLSI. It's a massive publication some 70mm thick. Every digital designer needs one and it's only **$25.00** (P&P $6.00 local or $15 airmail - it's that big!)

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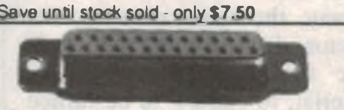

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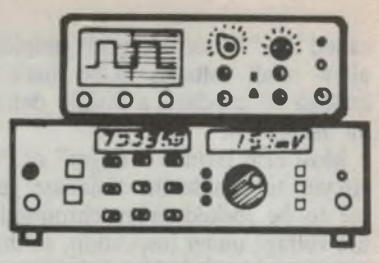


1 — The Oscilloscope

The oscilloscope is one of the most useful and versatile instruments in modern electronics. It is essential to almost any practical work in electronics and it is therefore important to have a clear idea of how it works.

by PAUL GRAD

The oscilloscope provides a means of "looking" at what is happening to the voltages and currents in a circuit. Also called *cathode ray oscilloscope, CRO* or simply *scope*, it displays, on a fluorescent screen, a clear, "frozen" image of a voltage waveform between any two points of a circuit.

The image is displayed as a graph of voltage plotted against time. This can be any of the many types of waveform which appear in modern electronics, such as sinusoidal, square, or sawtooth waves. Besides being able to see the waveform, the user can read off the display much useful information, including voltage levels, the changes that may take place in them and the time rate of these changes.

Fig.1 shows the basic idea: the voltage is plotted in the vertical or "Y" direction, while the horizontal or "X" direction is a plot of time in either seconds, milliseconds, microseconds or even nanoseconds or picoseconds.

The basic principle of operation of an oscilloscope is fairly simple. An electron gun produces a fine stream of electrons aimed at a fluorescent screen. The gun has a heated cathode which is the source of the electrons, and which is similar to the cathode in a normal thermionic valve. The cathode, heated by a current passing through it, emits electrons into the space around it. These are attracted toward a positively charged anode, passing through a hole into the rest of the gun assembly. The gun also has a system of cylindrical and disc electrodes to control and guide the electrons into a narrow beam.

A pair of parallel, flat and horizontal plates, just ahead of the gun, are effectively connected to the the two points of the circuit under test. The voltage variation between the two points in the circuit to be examined is therefore replicated between these plates, which causes the electrons to be deflected vertically, either up or down from their path, before hitting the screen.

Because of their effect on the electrons, these plates are called vertical deflection plates.

Another pair of parallel, flat but vertical plates, is connected to a timebase generator which applies a sawtooth sweeping voltage horizontally across the path of the electrons. This voltage increases linearly to a certain maximum value, then drops abruptly back to its initial value and starts another cycle. Its effect is to spread the up and down motion of the electron beam, produced by the circuit voltage. This sweeping frequency is adjustable over a wide range, by controls in the timebase generator circuit.

These plates are called the horizontal deflection plates. In older scopes they used to be placed ahead, but in modern scopes they are placed after the vertical deflection plates, to give the electron stream maximum susceptibility to the Y deflection.

Without the action of the deflecting plates the electron beam from the gun would strike the centre of the screen and cause only a small bright dot to be visible there.

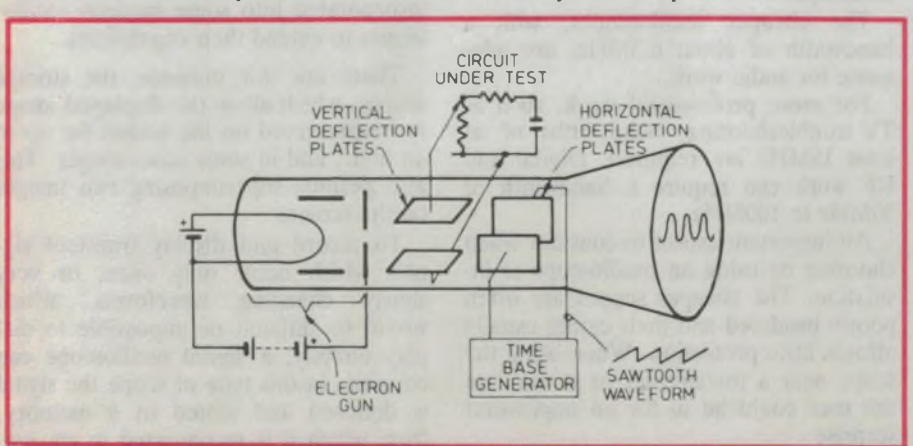
If only the vertical deflection plates were in action the electrons would produce only a vertical line on the screen, which could be steady or intermittent, depending on the frequency of the circuit voltage under test.

Conversely, if only the horizontal deflection plates were active only a continuous horizontal line would appear on the screen.

Naturally, if the circuit voltage under test is too high the electrons will be deflected right into the glass neck of the tube and nothing will be visible on the screen.

The height of the wave pattern on the screen allows the user to measure the amount by which a voltage under test is changing. The time it takes for a change to take place can similarly be determined from a knowledge of the time period of the sweeping timebase waveform.

Most oscilloscopes have an amplifier



The diagram shows the main elements of a typical oscilloscope.

called the "Y" or "vertical" amplifier to allow small voltages to be made large enough to produce a visible deflection on the screen.

Most also include "trigger" or "sync" circuits to enable the timebase generator to be locked or synchronised with the voltage under inspection, so that the screen pattern is held steady.

As a measuring instrument the oscilloscope distinguishes itself mainly in that it is necessary to adjust and balance various controls to enable an accurate representation of the voltage waveform to be examined.

For example, the voltage under test produces a signal in the oscilloscope which has to be adjusted through two completely separate channels, one the amplifier for the Y plane and the other the triggering and timebase for the X plane.

Modern oscilloscopes are often extremely versatile and may indeed be too sophisticated for their intended use, for which a simpler and cheaper instrument may suffice.

It would be a good idea to read carefully the instruction manual of an oscilloscope before buying or using it.

One of the scope's crucial parameters is its bandwidth, which is the frequency range of voltages to be tested over which the scope can respond with accuracy and clarity.

Both the amplifier for the test voltage in the Y direction and the triggering mechanism of the time base generator in the X direction, must be fast enough to cope with the frequencies of the voltages to be measured.

Besides, for each scope type there is a minimum value of the amplitude of test voltage for which accurate displays can be obtained.

The test voltage goes through a circuit including an amplifier to ensure that the deflection of the electron beam on the screen is large enough for easy and accurate reading of the display.

The actual value of the test voltage amplitude can be deduced from the position to which it was necessary to turn the adjusting attenuator knob to obtain the desired deflection.

A scope is designed so that maximum deflection of the display — allowing best reading accuracy — occurs for a range of test frequencies, provided the test voltage amplitude is large enough.

As the test frequency increases, there comes a point beyond which no adjustment succeeds in achieving maximum deflection of the electron beam on the display screen. It is, of course, possible to continue using the scope for higher frequencies, at less than maximum deflection and therefore less than the maximum reading accuracy achievable with it, but up to a point.

For any given test voltage amplitude the limit of a scope's usefulness is reached, by definition, at the frequency for which the amplitude of the displayed signal has fallen to 0.707 of the value of the maximum deflection on the screen (a 3dB reduction). That frequency is, by definition, the oscilloscope's bandwidth.

The bandwidth is also the main parameter determining the price of an oscilloscope.

The cheaper oscilloscopes, with a bandwidth of about 6.5MHz, are adequate for audio work.

For more professional work, such as TV troubleshooting, bandwidths of at least 15MHz are required. Digital and RF work can require a bandwidth of 50MHz to 100MHz.

An important aspect to consider when choosing or using an oscilloscope is insulation. The cheaper scopes are often poorly insulated and their casing usually affords little protection. When using the scope near a transformer or power line the user could be in for an unpleasant surprise.

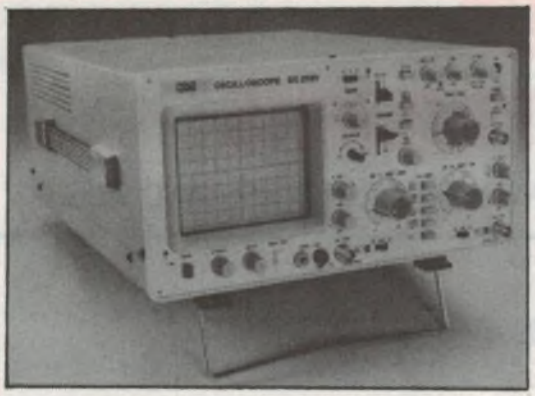
Modern-day scopes originated from the cruder but similar devices used by a number of researchers at the turn of the century to study the discharge of electricity through gases. It was with such a device that J.J.Thompson in England first obtained an accurate value for the ratio between the charge and the mass of an electron.

Modern TV tubes work on similar principles to those of an oscilloscope but use magnetic deflection, instead of the electrostatic deflection used in oscilloscopes, which would not suit the much larger voltages needed for a TV tube.

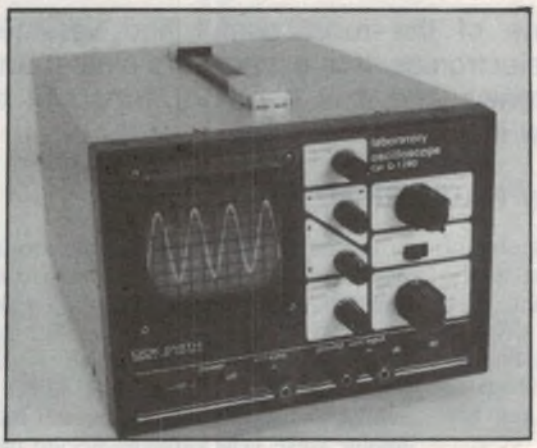
A number of refinements have been incorporated into some modern oscilloscopes to extend their capabilities.

There are, for instance, the storage scopes, which allow the displayed image to be preserved on the screen for up to an hour, and in some cases longer. This also permits superimposing two images on the screen.

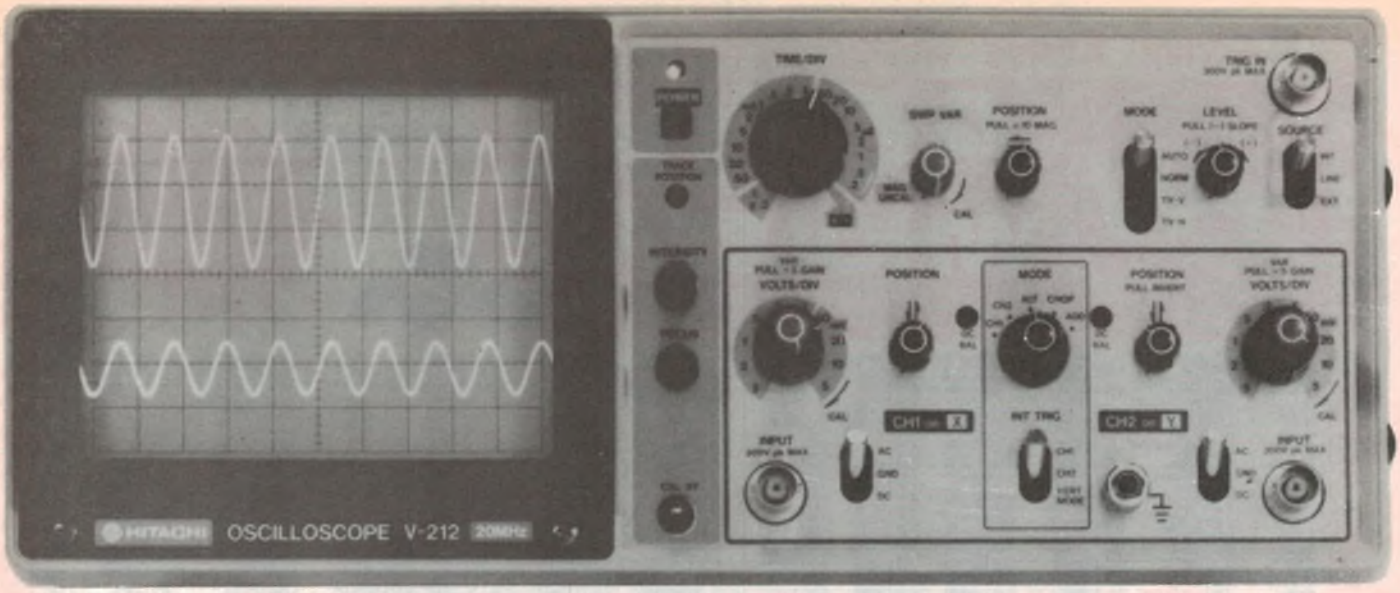
To record and display transient signals which occur only once, or very slowly changing waveforms, which would be difficult or impossible to display directly, a digital oscilloscope can be used. In this type of scope the signal is digitised and stored in a memory, from which it is reconverted to an analog signal and displayed on the screen.



This is a 20MHz oscilloscope, suitable for professional work such as TV troubleshooting. (Courtesy of Dick Smith Electronics)



This 6.5MHz scope is of the cheaper kind. It is suitable for audio work. (Courtesy of Dick Smith Electronics).



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Accelerating Potential	2 kV.
External Intensity Modulation	Voltage: 5V or more. Effective bandwidth: DC to 2 MHz. Max. input voltage: 30V (DC + AC peak)
Vertical Deflection	
Sensitivity	5mV/div to 5V/div in 10 calibrated steps ±3%. 1mV/div, 2mV/div ±5% when using x5 magnifier. Uncalibrated continuous control between steps 1 : < 2.5.
Bandwidth	DC to 20 MHz (−3 dB). DC to 7 MHz (−3 dB) when using x5 magnifier.
Rise Time	17.5 ns. 50 ns when using x5 magnifier.
MAX. Input Voltage	300V (DC + AC peak) or 500Vp-p AC at 1 kHz.
Input Coupling	AC, GND, DC.
Input Impedance	1MΩ approx. 25 pF.
Display Mode	CH1, CH2 (normal or invert), ALT, CHOP, ADD
CH1 Vertical Signal Output	Voltage: approx. 20mV/div into 50Ω Bandwidth: 50 Hz to 5 MHz (−3 dB) into 50Ω.
X-Y Operation	CH1: X-axis, CH2: Y axis.
Sensitivity	5mV/div to 5V/div. 1mV/div, 2mV/div when using x5 magnifier.
Bandwidth	DC to 500 kHz (−3 dB).
Phase Difference	3° or less from DC to 50 kHz.
Horizontal Deflection	
Sweep Time Range	0.2 µs/div to 0.2s/div in 19 calibrated steps ±3%. 100 ns ±5% when using x10 magnifier. (20 ns and 50 ns uncalibrated). Uncalibrated continuous control between steps 1 : < 2.5.
Trigger	
Trigger Mode	Automatic (sweep runs in absence of a triggering signal and for signal below 30 Hz), Normal (sweep runs when triggered), TV-V, TV-H
Trigger Source	CH1, CH2, V-MODE, External, Line.
Trigger Sensitivity	<table><tr><th></th><th>20Hz to 2MHz</th><th>2MHz to 20MHz</th></tr><tr><td>CH1 and CH2</td><td>0.5 div</td><td>1.5 div</td></tr><tr><td>External</td><td>20mV</td><td>800mV</td></tr></table>
Trigger Coupling	AC.
Trigger Slope	+ or −
Calibrator	Square wave. Voltage: 0.5V ±3% Frequency: Approx. 1kHz
Power Supply	Voltage 100/120/220/240 V ±10%. Frequency 50/60/400 Hz Power consumption approx. 30 W.
Ambient Temperature	Rated range of use: +10 to 35°C. Limits of operation: 0 to 50°C. Storage and transport: −20 to 70°C.
Dimensions	310(W) x 130(H) x 370(D) mm. 12.2 x 5.1 x 14.6 in.
Weight	Approx. 6 kg/13.2 lb.
MTBF	20,000 hours for target value.
Accessories Supplied	Two AT-10AJ1.5 probes, Fuse, Power cable, Operation manual.

The TELE-LINK Direct Connect Modem Pt.2

Here is the conclusion to our modem project. Some hints are presented on operation of the modem, in addition to the all-important PCB and front-panel artwork.

by MARK CHEESEMAN

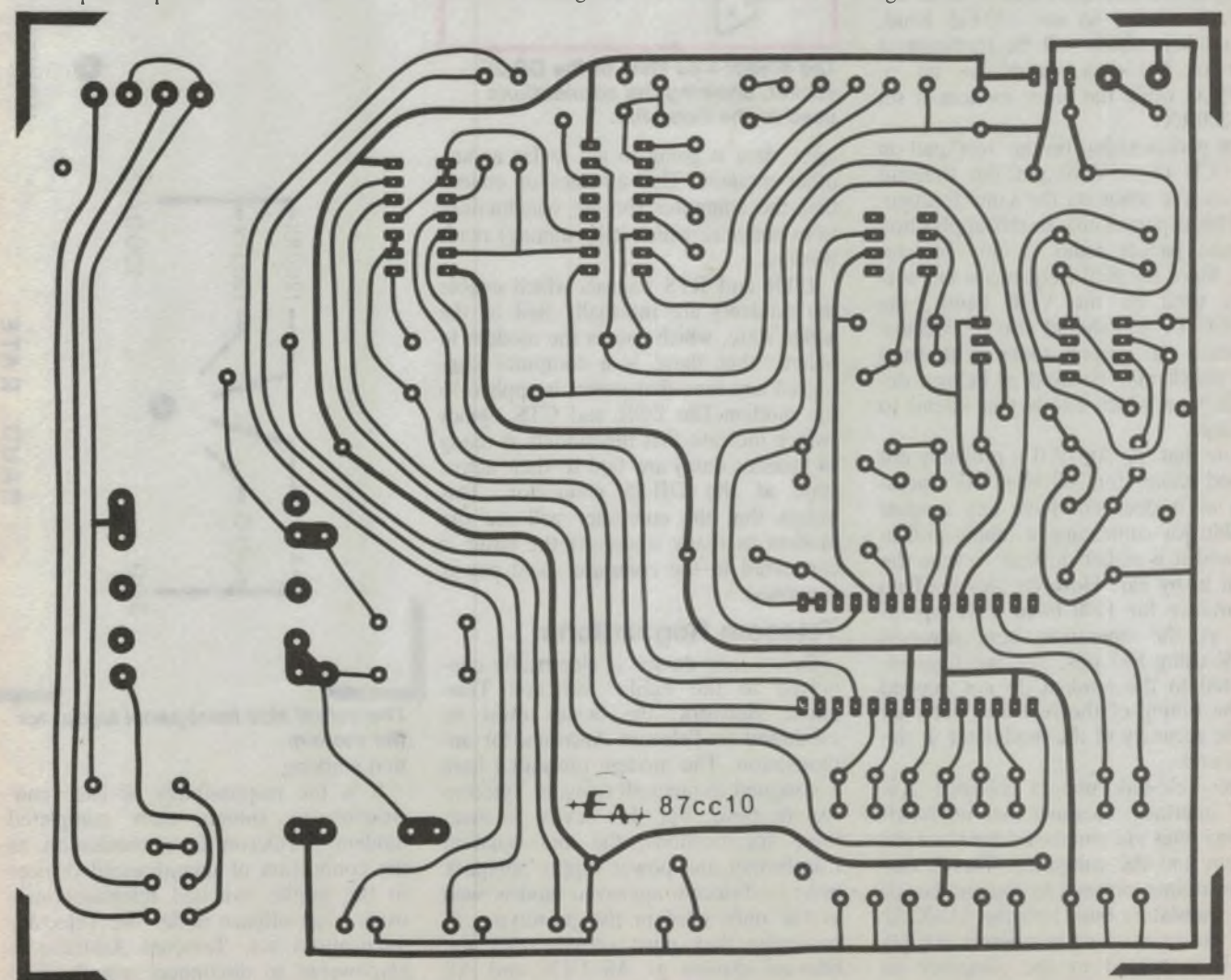
Using the Tele-Link

To use the modem the first thing to do is to disconnect the telephone from the wall socket, and plug the phone into the socket on the rear panel of the modem. Then plug the modem into the wall socket, making sure the line switch is in the 'phone' position.

Now select the baud rate which you wish to use. If you are dialling up a bulletin board, you would normally select the "originate" position of the baud rate switch. If the bulletin board uses 1200/75 baud (for example Viatel), then select the '1200RX' position.

After dialling the desired number, wait until you hear the carrier of the remote modem — this sounds like a single audio tone. When you hear this, flip the phone/modem switch to modem and hang up the handset of the telephone. Wait for the 'carrier detect' LED to light before attempting to communicate. This should occur within a second or two of switching the modem on line.

If the LED doesn't come on soon after that, you should check that the baud rate switch is in the correct position. Note that if the modem at the other end is capable of selecting from many baud rates automatically (auto-bauding) then it will probably take longer than this unless the baud rate



Here is a full size reproduction of the PCB layout.

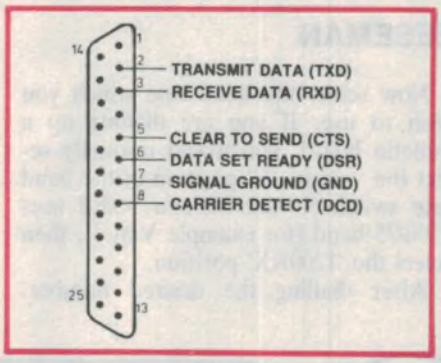
which you are using is the first one which the other modem tries. When the DCD LED finally lights, press the return key a few times until something intelligent (such as the 'login' message of the remote computer) appears on the screen.

If you are using the modem to communicate with a friend, then set up the two modems so that one is on the originate position and the other is set to answer. Similarly, to use 1200/75 baud, the modem which will be transmitting most of the data should be set to '1200TX' while the other modem is set to '1200RX'.

For packet radio, tie the 'test' pad on the PCB to +5V to put the transmit and receive tones on the same frequency. This is permissible in this application because packet radio is only half-duplex. Since the Bell frequencies are normally used on the VHF bands, the Bell/CCITT pad should also be tied low to select the correct tones. The baud rate switch may be used as before, depending on which bands you intend to operate.

Note that the Am7910 is probably not a good choice for 300 baud HF operation, as it does not have any outputs suitable for connecting a tuning indicator, and it is rather difficult to tune the signal in by ear. However this is of no importance for 1200 baud VHF operation as the operation here involves AFSK using FM rigs, and the frequencies fed to the modem do not depend on the tuning of the receiver, but only on the accuracy of the modulator at the other end.

The Tele-link uses a minimal RS-232C interface, meaning that no handshaking lines are connected between the modem and the computer. This is due to constraints imposed by the number of level translators built into the MAX232 chip. However, a carrier detect (DCD) line is presented to the computer to allow it to determine that, at the very least, data is going to get as far as another modem. This assumes of course that the computer (or the communications software which it is running) reads this line.

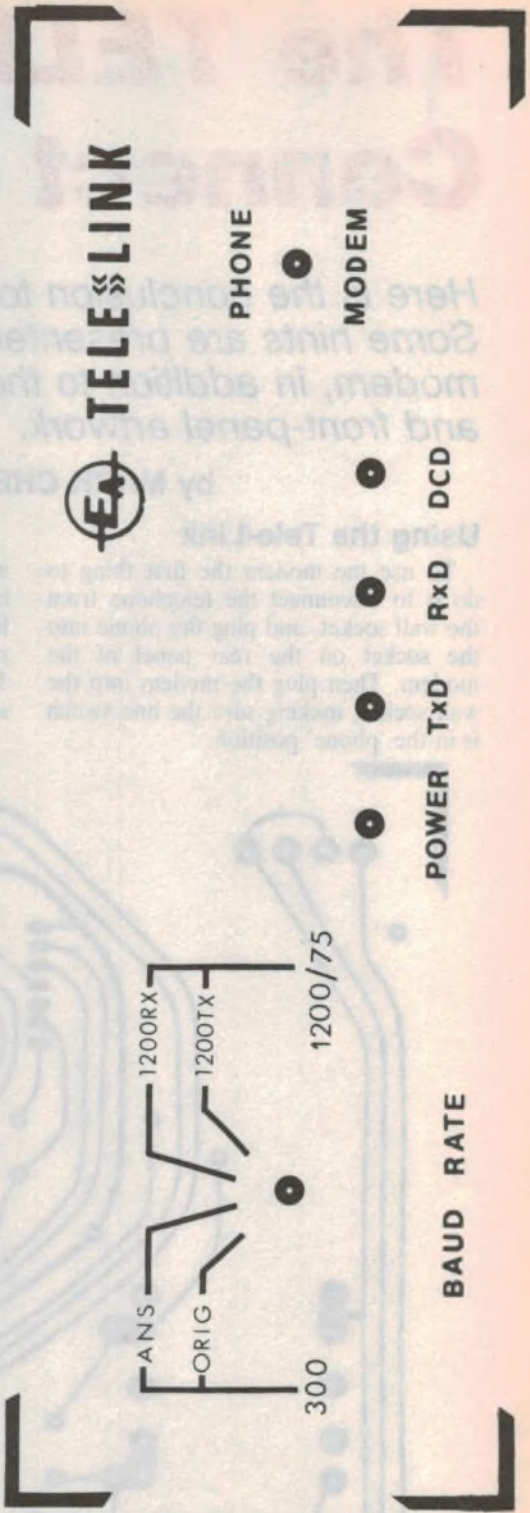


The solder-side view of the DB-25 socket, showing the connections used in the Tele-Link.

DTR and RTS (signals which enable the modem) are internally tied to the active state, which causes the modem to believe that there is a computer connected any time that power is applied to the modem.The DSR and CTS signals (which indicate that the modem is ready to transfer data) are tied to their active state at the DB-25 connector. This means that the computer will see the modem as ready whenever the latter is connected to the computer, and power is applied.

Telecom Regulations

Before any device is electrically connected to the Public Switched Telephone Network, the device must be submitted to Telecom Australia for authorisation. The modem presented here is designed to meet all relevant Telecom specifications. For this device to meet these specifications, the line isolation transformer and power supply plugpack must be Telecom approved models such as the ones used in the prototype. In particular they must comply with the relevant clauses of AS C126 and AS C100, and carry a Telecom authorisation marking.



The actual size front-panel layout for the modem.

It is the responsibility of each constructor to submit their completed modem to Telecom for authorisation, as the connection of unauthorized devices to the public switched telephone network is an offence under the Telecommunications act. Telecom Australia is empowered to disconnect unauthorised devices from the phone system.

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4510	38cm	Straight surround	8 or 15 Ohms	45	40-6000	100	$150.00 or	$294.00
4350	38cm	HI-FI	8 or 15 Ohms	30	30-4000	120	$127.00 or	$251.00

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8 POL	8"	35	40-5000	50	$36.95	$68.95

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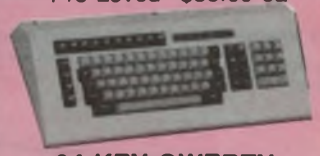

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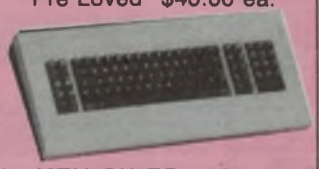

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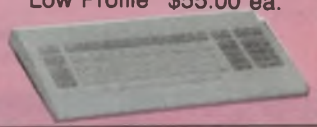

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Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2 ohms
Moving Mass: 0.2 grams
Weight: 0.28kg
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Resonance Frequency: 39Hz
Sensitivity 1W at 1m: 90dB
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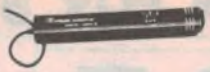
Cat. K44801 ..... **$34.80**
(Heatsink optional extra)



OMNI-DIRECTIONAL WIRELESS MICROPHONE

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

2¼" MINI SPEAKERS (57mm)

Cat.No.	1-9	10+
C10610	$1.95	$1.75

SUPER HORN

- Wide dispersion tweeter, handles up to 100W
- Sensitivity: 105dB/0.5m
- Frequency Response: 3kHz-30kHz
- Impedance: 8 OHMS
- Size: 145x54mm

Cat. C12103 ..... **Normally $12.95**
SPECIAL, ONLY $9.95

SUPER HORN TWEETER

- Requires no crossover and handles up to 100W!
- Sensitivity: 100dB/0.5m
- Frequency Response: 3kHz-30kHz
- Impedance: 8 OHMS
- Size 96mm diameter

Cat. C12102 ..... **Normally $12.95**
SPECIAL, ONLY $9.95

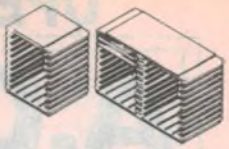
PHILIPS SPEAKERS

"Unfortunately we cannot always guarantee Philips speakers to be in stock due to availability problems, nor can we guarantee the exact models listed. However, Philips equivalent or better will be supplied." -Rod.

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

PIEZO DIRECT RADIATING TWEETER

Requires no crossover, handles up to 100 watts.
Sensitivity: 98dB
Maximum Input: 24 volts
Freq. Response: 3.2 - 30kHz
Dimensions: 95mm diameter
Cat. C12104 ..... **$11.95**



COMPACT DISC STORAGE UNITS

- Holds 10/20 compact discs in their cases
- Interlocking modular design allows vertical and horizontal interlocking
- Discs slide into place horizontally making titles easy to read
- Wall mount or free standing

A10031 (10 discs) **$12.95**
A10032 (20 discs) **$19.95**

ROTATING LIGHT

Motor driven rotating reflecting mirror with a flash rate of about 150 per minute. Large lens fit right to base, making unit weatherproof. Spare globe included.

SPECIFICATIONS:
- Available in Blue or Orange
- 150 Revolutions per minute (approximately)
- Shock absorbing rubber mounting legs
- Connecting wire fitted through base
- 12V DC 750mA
- Base diameter: 102mm
- Height: 140mm

A15042 Blue **$42.95**
A15043 Orange ... **$42.95**

CRYSTAL LOCKED WIRELESS MICROPHONE AND RECIEVER

MICROPHONE SPECIFICATIONS:
Transmitting Frequency: 37.1MHz
Transmitting System: crystal oscillation
Microphone: Electret condenser
Power Supply: 9V battery
Range: 300 feet in open field
Dimensions: 185 x 27 x 38mm
Weight: 160 grams

RECIEVER SPECIFICATIONS:
Recieving Freq: 37.1MHz
Output Level: 30mV (maximum)
Recieving System: Super heterodyne crystal oscillation
Power Supply: 9V Battery or 9V DC power adapter
Volume control
Tuning LED
Dimensions: 115 x 32 x 44mm
Weight: 220 grams

Cat. A10452 ..... **R.R.P. $113**
Our price, $99

WIRELESS MICROPHONE RECEIVER WA100

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

Cat. A10520 ..... **R.R.P. $199**
Our price, only $189

Marine Electronics Feature:

Electronics Afloat in

Each year at about this time, EA takes a special look at the benefits electronics can offer for the small and medium boat owner. This year's feature has been prepared with expert guidance and assistance by Jeff Mellefont, associate editor of "Modern Boating" magazine.

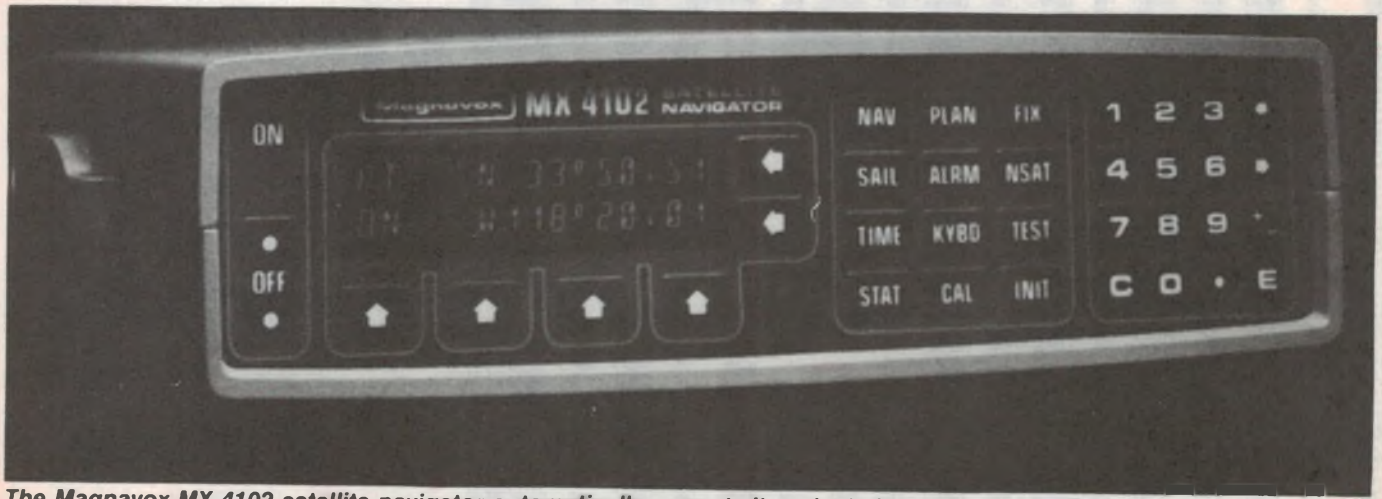
There was a time — and it wasn't all that long ago — when marine electronics gear of any sort of sophistication wasn't really on the agenda for the average boat owner. Several things put them in the too hard — and too expensive — category.

The more modest devices which some of us had contact with, like wind instruments, logs and simple echosounders, weren't always dazzling in their reliability, while the majority of modern electronics we regarded as the domain of commercial mariners and the owners of very large, very expensive yachts. Radars, single sideband radios, satellite navigators and the like were too bulky, too expensive and too power-hungry to really be considered.

It's the microchip that has changed all that, and it really has been a revolution. It has been responsible for the development of far more compact equipment and it requires very modest electrical supplies. It has made equipment smarter, and at the same time its enormous programme capacity has challenged designers to think up more tasks for equipment to perform. A classic example of this is the development of sailing computers, by linking together once relatively straightforward wind and boat speed instrumentation.

Part of the picture, too, has been development in display technology, with colour video screens and liquid crystal screens being adapted to displays which incorporate more and more data. Microcircuitry has allowed for simple, touch pad operation.

Along with this has been an increasingly systems approach to electronics,



The Magnavox MX 4102 satellite navigator automatically corrects its calculation for your location each time a satellite passes overhead, and will interface to your gyrocompass and speed log. (Courtesy Coursemaster Autopilots)

with separate function modules becoming linked together, or interfaced, in increasingly powerful combinations. Small remote repeater displays allow the main equipment to gather in dry, protected nerve centres on board, sending their data up to the deck for working helmsmen and navigators. At the same time, there do seem to have been advances in weatherproofing modern electronics.

On the following pages we look at the major navigation electronics — radar, satnav, weatherfax, radio direction finding and echosounders. We also examine marine communications — SSB, VHF and the new cellular phones, — as well as electronic instrumentation, autopilots and, on a lighter note, marine hifi systems.

In each section we look at how the equipment has developed over recent years, what it can accomplish and the sort of user features that can be expected. We're not doing comparison testing — there's just too much gear around these days to more than scratch the surface — but we certainly make reference to some of the leading brand name equipment by way of illustration.

As you can see we've also prepared a table showing the main suppliers of the various kinds of marine electronics gear, to serve as a guide to readers who want to get further information.

SUPPLIER	RADAR	WEATHER FAX	RDF	SAT NAV	DEPTH SOUNDERS	TWO-WAY RADIO	EMERGENCY BEACONS	AUTO PILOTS	MARINE HI-FI	INSTRUMENTS	CELLULAR TELEPHONES
ACL Special Instruments 27 Rosella St., East Doncaster Vic. 3109. (03) 842 8822			●	●							
Ansett Technologies 27 Parer Rd., Airport West 3042 (03) 668 1122	●										
AWA Marine 67 Lords Rd., Leichhardt, NSW 2040 (02) 560 8644	●	●	●	●	●	●		●	●	●	
Codan Pty. Ltd. 8 Help St., Chatswood 2067 (02) 419 2397						●					
Coursemaster Autopilots 7 Smith St., Chatswood, NSW 2067. (02) 417 7097				●				●			
GME 6 Frank St., Gladesville, NSW 2067. (02) 816 2933	●				●	●	●		●		
Peter Green Ship Chandlers 12 Polo Av., Mona Vale, NSW 2103. (02) 417 7097			●	●	●					●	
Honeywell Marine Services 4/10 Pitt Myaree, WA 6154. (09) 330 7559	●	●	●	●	●	●		●			
Icom 7 Duke St., Windsor, Vic 3181. (03) 51 2284						●					
Imark 167 Roden St., West Melbourne, Vic 3003 (03) 329 5433					●	●					
Macson Trading Co. 44 Alexander Parade, Clifton Hill 3068 (03) 419 2397					●						
Magna-Tech Marine 7-9 George Pl., Artarmon, NSW 2064. (02) 427 0666					●						
Marine Navaid Systems 100 Elliott St., Balmain, NSW. (02) 810 7711							●				
Mayfair Wholesale 170 Logan Rd., Buranda, Qld. 4102 (07) 52 8016					●						
Mee Too Industries 1 Thew Pde., Dee Why, NSW 2099. (02) 997 5411		●									
Meridian Survey Services PO Box 1264, Booragoon, WA 6154. (09) 330-2402										●	
Mitsubishi Electric 73 Epping Rd., North Ryde, NSW 2113 (02) 888 5777											●
Mobilectronics Holdings 4 Collins St., Wahroonga, NSW 2067 (02) 487 2684											●
Nautilec 45 Rocky Pt Rd., Kogarah, NSW 2217 (02) 587 7288	●										
NEC 99 Nicholson St., St. Leonards 2065 (02) 438-4033											●
Novatel (Air Internat. Gp) 437 Williamstown Road, Port Melbourne 3207											●
Olbis Industries 1717 Ipswich Rd., Rocklea, Qld 4106. (07) 379 1087					●	●					
Plastimo 160 Epping Rd., Lane Cove, NSW 2066 (02) 428 9111								●		●	
Quin's of Port Adelaide Box 384 GPO Pt Adelaide, SA 5015. (08) 47 1277	●	●			●	●		●		●	
Racal Marine 115B Ferras St., Sth Melbourne, Vic. (03) 699 2133						●					●
C.H. Smith Marine 16 Langridge St., Collingwood, Vic 3066 (03) 417 1077	●	●		●	●						
Dick Smith Electronics PO Box 321, North Ryde, NSW 2113. (02) 888 3200						●					
Solo Marine 11 Green St., Revesby, NSW 2212. (02) 774 5255								●			
Tandy Electronics 91 Kurrajong Ave., Mt. Druitt 2770 (02) 675 1222						●					
Taylor Marine PO Box 192, Fremantle, WA 6160. (09) 335 3291	●	●		●	●			●			
Tickles Discount Marine 125 Wellington St., Brisbane, Qld 4169 (07) 391 5788						●					
Trymax Marine 280 Tingal Rd., Wynumm, Qld 4178. (07) 396-7245	●										
VDO Instruments PO Box 51, Heidelberg, Vic 3081. (03) 450 3209										●	
Wagner Industries 483 Princes Hwy, Sydenham, NSW 2044 (02) 519-6387						●					

Marine Electronics Feature:

Navigation, radar, weather fax & sounders

Whether you're using a boat for business or pleasure, it's very important to be able to work out exactly where you are, what else is there with you and what the weather is doing. Here's where modern electronics has a great deal to offer, even for the small boat owner.

by JEFF MELLEFONT

First of all, let's have a look at the low-cost approach to navigation equipment — radio direction finders or "RDFs".

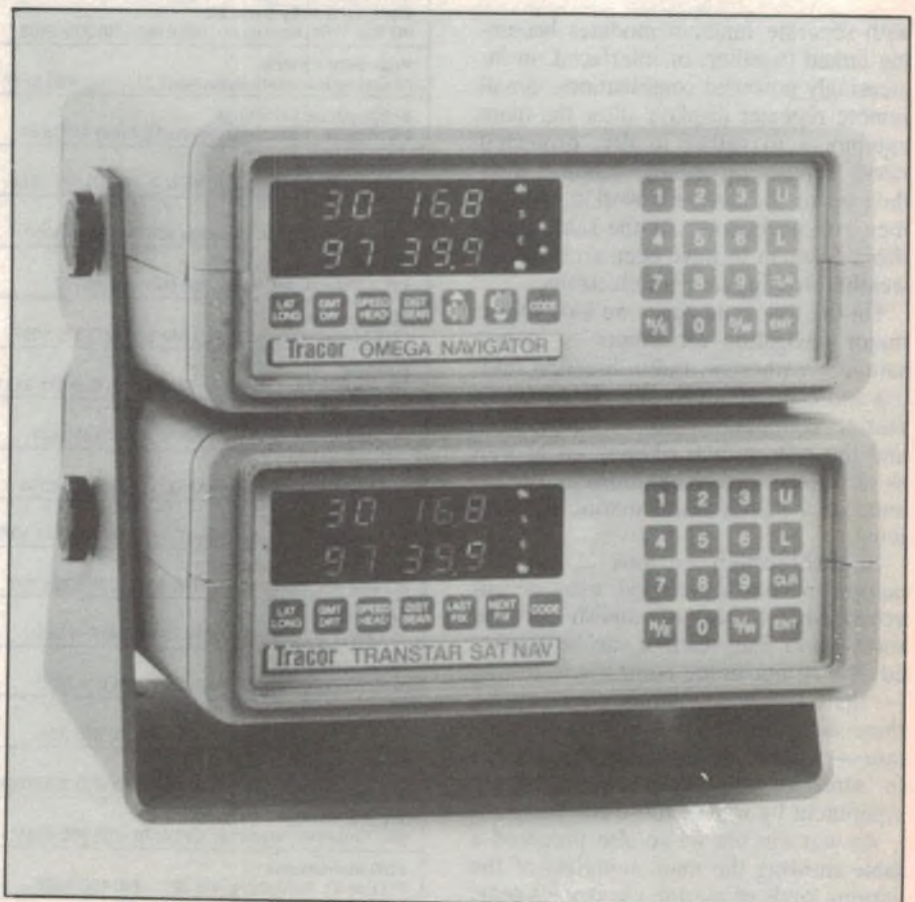
Costing less than a quarter the price of an average satnav, a radio direction finder is the frequently overlooked, low-tech electronic navigation device. There are reasons for their relative unpopularity along our coasts, not the least of which is the scarcity of marine beacons. However, RDF is by no means limited to use with special marine beacons; the aerobeacons at any commercial airstrip close to the coast may be used, as indeed can coastal AM commercial radio station signals.

Unlike satnav, which provides a precise fix, RDF gives only a line of position (LOP) by determining the bearing of a radio source. This is done by rotating a directional antenna. RDF can be subject to inaccuracies due to distance from the signal, on-board interference or geographical deviations of the signal — an intervening landmass can distort the result. As the accuracy of the bearing tends to increase as the source is approached RDF can be an excellent means of homing in on a beacon — like the one on Lord Howe island — providing there are no intervening hazards like reefs. If two suitably placed beacons are within range, a fix can be obtained from the intersection of the two LOPs.

RDFs range from simple handheld units with built in bearing compass and earphones, to listen for the "null" in the signal which indicates the unit is pointing at the signal source — like the popular British Seafix 2000 which covers beacons in the 200 to 420kHz range. At the other end of the scale are larger digital units like Fujion's AD8000E which covers beacons, AM broadcasting in the 535 to 1604kHz band, 1600 to 3900kHz marine band and FM from 88 to 108MHz, with manual and automatic DF.

Brookes and Gatehouse has a handheld compass and earphone equipped DF aerial attachment which turns its Homer V radio receiver unit into an RDF. The Heron DF aerial can then be used to source any of the appropriate coastal radio stations.

A new twist on the RDF game is Raytheon offshoot Apelco's AXL 1500 ADF which is dedicated to direction finding VHF transmission, including Class C EPIRBs (Emergency Position Indicating Radio Beacons). Previously VHF and HF direction finding required expensive equipment and was limited to



Tracor's Global Navigation System combines satellite navigation with Omega, to provide the benefits of both. (Courtesy ACL Special Instruments)

search and rescue organisations.

Attached to the VHF set on board, the AXL 1500's LCD and azimuth dials give relative and true bearings in analog and digital formats. This opens up DF navigation, with every VHF-carrying vessel a potential radio beacon for you to track — provided they are sure of their own position!

Satnav and Omega

More accurate than RDF, but also more expensive are satellite navigation systems, or "Satnavs". The use of satellites for navigation was pioneered by the military, and for quite a while satnav gear was only of interest to navies and commercial shipping lines because of its high cost, bulk, power consumption and complexity. However in the last few years this has all changed, thanks to developments in solid state and digital electronics. Now you can buy an easy to use satnav receiver for less than $3000, bringing the technology well within the budget of many small boat owners.

The original satnav system, called Transit, is based on a set of nine satellites which circle the earth every 107 minutes in orbits which pass over the poles. Each satellite continuously transmits information regarding its position and orbit, at an internationally reserved frequency of 400MHz in the UHF band. By tracking the signals using a special antenna and receiver — computer combination, it is possible to fix your position typically to within 1/3rd of a nautical mile, and often much more accurately again. However this can only be done during each satellite "pass", so at worst this can be at intervals of 107 minutes or so.

Virtually all of the satnav equipment currently available for small and medium boats uses the Transit system, but a newer and more accurate system again is scheduled to replace Transit by by around the mid 1990s. Known as the Global Positioning System, or GPS, this is currently very much more expensive than Transit and only of interest to large shipping lines and the military. GPS offers the ability to fix your position to within less than a metre, and every 6.5 seconds.

The latest satnav receivers are virtually fully automatic, thanks to their built-in microcomputers. In use you simply key in your speed and heading at any time, and the satnav will indicate your position in latitude and longitude. Each time a satellite passes overhead, the satnav automatically updates its calculations; in between passes it updates by dead reckoning using your speed and heading inputs, or those fed to it by your gyrocompass and speed log.

For example the Magnavox MX 4102 satnav from Coursemaster Autopilots has inputs for connection to compass and speed log, and also an NMEA 0183 interface which allows it to connect to a wide variety of other electronics including Loran C, autopilots, a GPS receiver and a personal computer.

The satnav can also guide you in following a planned route. Many modern units allow you to key in waypoint information for the planned route, and will then automatically provide heading indication on route to take you from one waypoint to the next.

If you have an autopilot, the satnav can be hooked up to this, to automatically maintain the desired course/route.

Another feature of modern satnavs is the ability to automatically power down into a low-drain standby mode after each satellite pass, and only "wake up" just before the next pass in order to carry out a reading. This can conserve battery power on long cruises. Needless to say they will also wake up when you wish to fix your current position; the information from the last satellite pass and your compass/log are automatically retained in memory even in the standby mode.

Tracor's Transtar satnav unit, available from ACL Special Instruments, draws only 3 watts when operating in its "sleep" mode. The same unit will accept storage of route information for up to 15 waypoints.

Tracor is now also able to provide low cost receivers for the worldwide Omega VLF (very low frequency) navigation system, as used by large shipping lines and submarines. Two receivers are available, the Omega navigator and the Automatic Omega II. Both again feature an inbuilt microcomputer, and automatically process signals from the three nearest Omega stations to display directly in latitude and longitude. No charts, tables or calculations are required, and the readings are updated every every minute. Positional accuracy is between 1 and 2 nautical miles during the day, and 2-4 nautical miles at night. The simpler Omega Navigator unit sells for around $6000, and the more powerful and flexible Automatic Omega II for $25,000.

The latest thing is to combine a satnav with an Omega navigation receiver, so the Omega system can be used to boost the accuracy of the satnav between satellite passes. This gives a system with the absolute accuracy of satnav, coupled with the short-term stability and frequent updating of Omega — the best of both worlds! Tracor offers the Global Navigation System, which combines its Bridgestar satnav and Omega Navigator, and costs around $12,000. Further details are available from ACL Special Instruments.

Radars

A number of major changes in radar technology in the last few years has resulted in more compact sets capable of being installed on quite small pleasure craft. Radars need no longer be considered solely the domain of large luxury yachts, with base prices of the simpler units not much more than an ordinary satnav, and in some cases less.

At the same time, some of the more advanced small craft radar are offering a wealth of navigational data owing to changes in screen technology and the ability to interface with other on-board navigation electronics, making the radar screen a true working navigation station.

The traditional PPI — plan position indicator — cathode ray tube screen, with the revolving scan line illuminatng targets which when faded between sweeps, required a hood for daylight viewing. Daylight viewing was more a possibility when colour displays were developed, digitally superimposing colours on the screen according to different levels of target reflectivity.

The new raster scan display has improved screen resolution and reduced power drain, as well as offering direct daylight viewing. The raster scan, like TV, develops its picture in horizontal lines and provides a constant image of targets.

At the same time, the "front end" or scanner has developed, largely through the use of microcircuitry, and become more compact. No longer are the radio waves generated in a box on board and sent by conduit to the transmitter; now it all happens in the radome unit itself. Sensitivity has increased, allowing greater range without increasing power demands. Five years ago 3kW got you about 15 miles range; today the same power can reach out to 30 miles.

Increasingly featured on the compact sets, like Raytheon's 16-mile 1603 model from Honeywell Marine are variable range marker (VRM) rings which with electronic bearing lines (EBL) allow accurate range and relative bearing readouts of selected targets.

In sets capable of interface with a fluxgate compass target bearings can be read out as true. Such bearings are

Advantages of the GME-Goldstar GS-951 turbo marine radar include 24nm range (5kW) and daylight viewing display. (Courtesy Greenwich Marine)

amongst the increasing amount of data which now appear as on-screen graphics and alpha-numeric displays. By manipulating the VRM and EBL functions, alarm zones of various widths can be created, either in a continuous band around the vessel or covering partial sectors.

GME — Goldstar has recently released a family of radars with models offering ranges of 16, 24 and 32 nautical miles, and prices from $3600 for the 3kW/16nm model GS930. All models feature a raster scan display, while the more powerful models offer VRMs and EBLs.

Colour is again on the agenda with the latest bright screen radar units, allowing the operator to apply different colours to the various range marker rings, heading lines, bearing lines and alarm zones. Some sets, like Koden's MDC 400 (Quins of Port Adelaide) have a plot function which preserves targets' previous positions, giving a graphic target track.

The adoption by some companies of liquid crystal screen displays, as on JRC's JMA-2010 (C.H. Smith Marine) and Apelco's LDR 9900 (Honeywell Marine) has further shrunk the below-decks hardware to a size which could be accommodated by virtually any navigation station.

These 8-mile sets can be hard to read in direct sunlight, for example on a flybridge, because of the nature of liquid crystal displays, and their resolution is fairly rudimentary. For example, a buoy and a large fishing boat could appear on the screen as equally sized dots. However, the modest amperage they demand is definitely a plus for power-conscious small craft operators. The JMSA-2010, for example, with its peak power output of only 1kW, consumes a meagre 24W at 12V, or 2 Amps. Mea-only 240 x 182 x 111mm, these mini marvels offer the safety of radar's seeing eye to the smallest boats.

With the arrival of marine electronics standards like the NMEA 0183 specifying a format and protocol for digital information, the potential for linking

The JRC colour radar JMA-2040, which offers 48nm range with two bearing lines and range markers. (Courtesy C.H. Smith Marine)

radar with other on-board navigation electronics opens up all sorts of avenues. Radar screens with their real time, real world display of the craft's environment are an ideal place to display other navigational data.

Weather fax

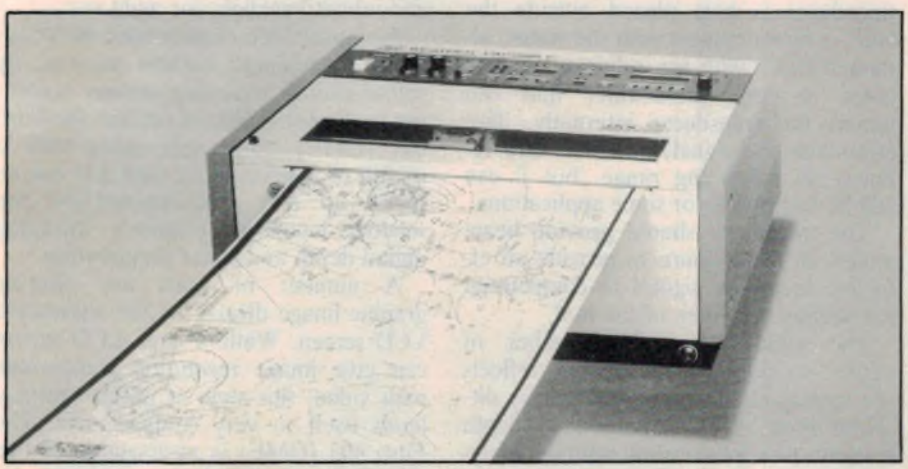
One piece of gear carried by almost all the competitors in the recent BOC singlehanded race around the world was the weather facsimile printer, or weatherfax. The detailed synopsis and forecast charts which the weatherfax receives and prints out were an essential navigation tool for strategic planning of routes, to dodge the light-air highs and head for the strong winds of the lows.

A worldwide network of some 60 land-based radio facsimile transmitters regularly broadcasts weather charts and other information, including analysis of ocean currents and waves, weather fronts, highs and lows with speed and direction of movement, sea conditions with wave heights, crest time and direction, polar ice conditions and satellite weather pictures.

In addition, more NAVTEX stations are coming on line, which broadcast notices to mariners, and many modern weatherfax machines can receive these. Australia has two stations on line, transmitting weather information — AXM in Canberra and AXI in Darwin.

While some weatherfax set-ups consist solely of a printer and the signal decoding circuitry required to turn the incoming radio signals into lines of image on the page, relying upon a hookup with an existing on-board radio receiver, most modern systems incorporate a dedicated receiver with facility to store a number of weatherfax frequencies in memory, for rapid access. The frequencies of the transmitting stations are in the ranges 2 to 25MHz and 80 to 160kHz.

The facsimile pictures are built up of horizontally scanned lines which are drawn on electro-sensitive paper as it is fed past the shuttling recording head. Rate of scanning is often variable, be-



Rapidly becoming popular are weather faxes, like the JAX-2 from Japan Radio Company. It includes a synthesised receiver. (Courtesy C.H. Smith Marine)

tween 60 and 120 lines per minute. It can take some minutes to produce the thousands of lines needed to make up a chart. Two types of paper can be used depending on the machine, one a silvery, aluminised paper which sometimes produces a carbon dust residue, the other a white, heat sensitive paper more familiar to users of office fax machines.

One compact weatherfax suited to smaller craft because of its use of 8 inch printouts (10 inch is common) is the Furuno Model FAX-208A (Taylor Marine). This yields four print tone levels on white thermal paper. Its inbuilt receiver handles all known facsimile frequencies.

AWA's JMC FX-240 MK2 is a slightly larger unit, using 10 inch dry metallic recording paper. Its synthesised general coverage receiver covers 100kHz to 30MHz continuously, on AM, FAX, SSB and CW.

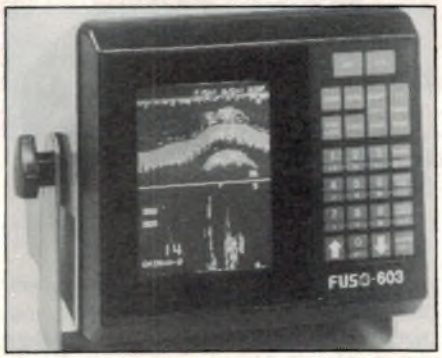
While most weatherfax equipment is imported, Flexible Systems in Hobart is producing the Navimate. This is a Brother printer, modified to convert the incoming fax signals. It needs to be linked to an existing radio receiver. The company successfully applied for protection, resulting in an import duty being applied to the other sets on the market, including those with a built-in receiver. This duty is currently at 28 per cent. In a demonstration the print resolution from the Navimate did not appear to be sufficient to resolve adequately the finer transmitted data, however.

Depth Sounders

They say it started with a scientist kneeling in the bilges of an iron ship, pounding on the hull with a thumping big hammer and timing the return of the echo with a stopwatch. There are a few flaws in this story, but suffice to say it has been established that soundwaves travel at a nearly constant velocity through water, at 1500m/sec, or about five times faster than they do through air.

To apply this, a depth sounder transducer sends down a pulse of ultrasonic energy somewhere between 25kHz and 200kHz, which is reflected back when it encounters anything of sufficient density such as fish or solid bottom. Oddly enough, a pocket of air will reflect the pulse, which is why turbulent water gives a bad reading. The time taken by the pulse to return is measured and distance calculated.

The lower frequencies suffer less attenuation as they travel through water, and 25 to 50kHz is used where depths of over 1000 metres are to be measured. The high frequencies produce a narrower beam for a given size of transducer and are used when the best resolution of depth changes or quality of reflection is required. For example, a very soft muddy bottom or weeds cause a fading, weak signal. Depending on the type of display, however, the variablity of the returning signal can be recorded as a means of interpreting the nature of the bottom, or the size and density of a school of fish.



The Fuso 603 fishfinder uses a colour CRT display and provides digital display of depth and water temperature. (Greenwich Marine)

All fishfinders are also, of course, echosounders, but not all echosounders are fishfinders. The simplest type of sounder with a digital readout can have the annoying (and sometimes alarming) habit of bouncing back and forth between the bottom and intervening fish, if it doesn't have the circuitry to filter out the unwanted echoes. But at the other end of the scale, a modern colour video unit will graphically show bottom contours and density, and everything from single fish to schools that may be swimming below.

In order to be efficient in transmitting and receiving the pulse, the acoustic window covering the crystal of the transducer is best placed outside the hull, in direct contact with the water, although those who are reluctant to drill holes in their underwater hull can mount the transducer internally. This attenuates the signal, however, and reduces the operating range, but it can still be acceptable for some applications.

The transducer should provide beam angles of 22° or more to provide an effective spread of signals to compensate for heeling or rolling of the hull.

The quite remarkable number of depth sounders on the market reflects the variety of functions required by different boat users, from a plain depth readout to sophisticated bottom analysis, recording and fishfinding. It also reflects the number of different types of displays now available.

One of the oldest types of display utilises a neon lamp or light-emitting diode (LED) mounting on a rapidly rotating arm, behind a clear circular screen. The transducer transmit pulse lights up the LED as the arm is at the top of the dial, and the returning echo lights it up again as the arm passes the appropriate depth marked around the circumference of the dial. This direct display is still popular and a number of sounder models on the market use it, like the British Seafarer 700 (AWA Marine) which has been around in various models for some time. If depth alarms are fitted, as they are on the Seafarer, they are visually displayed by a different coloured LED lighting up at the programmed guard depths.

Depth alarms are virtually universal, even on the simpler sets, and frequently take the form of a dual alarm allowing the operator to set a "safe" range of depth when anchored, for example. If the vessel drifts into shallower or deeper water, an audible alarm will be triggered.

Digital readout via a liquid crystal display (LCD) offers the most basic "two-dimensional" depth data display, which is nonetheless more than adequate for the purposes of many small craft operators; the compact Fuso Model 30-A (GME) is one such. A simple LCD readout is an economical way to obtain a repeater function, in the cockpit for example, from a more elaborate set which might be among the electronics in a navigation station. Digital need not mean basic, however, models such as the SMR SD6100 (Imark) offer discriminating circuitry to prevent false readings due to surface clutter or other interference, readout in metric or fathoms, depth alarms and signal gain control, readout sunshade and inbuilt backlight for night use.

A colour video display adds the possibility of enhanced bottom analysis, by colour-coding returning signals according to their strength. A set like the Fuso 603 (GME) offers this along with a wealth of alphanumeric data that can be called up and superimposed on the readout image as required, including digital depth and water temperature.

A number of units are offering graphic image display by the alternative LCD screen. While a large LCD screen can give image resolution comparable with video, this style of graphic display lends itself to very compact sets. The Fuso 403 (GME) is an example of this type, offering a resolution of 20,480 pixels.

Marine Electronics Feature:

Communicating over the water

Even when you're out on the water to get away from it all, it's still quite important to be able to make contact when you need to. Thanks to modern electronics, marine communications are getting easier and more reliable all the time.

by JEFF MELLEFONT

GME's GX-286 marine handheld transceiver provides 6 channels on 27MHz. (Courtesy Greenwich Marine)

Probably the most important development in marine communications in Australia during the last year has been the launching of Telecom's cellular telephone service. This started in Sydney in February and has now begun in Melbourne as well.

Basically cellular phones are portable or mobile radiotelephones which use frequencies in the UHF (ultra-high frequency) band. They're a bit like a combination of a modern push-button electronic phone and a "walkie-talkie" two way radio; you can be called just like a normal phone, and you can dial local, STD and even ISD calls.

The main difference between the new cellular phones and earlier radiotelephones is that instead of communicating with a single, centrally located "base station", the new phones are designed to work with a complete network of smaller stations. These are distributed in a grid pattern, with each station servicing its own local area or "cell". The idea is that as the mobile or portable phone moves around, it moves from cell to cell, but always stays in reliable contact with the rest of the telephone system. Switching between the fixed cell stations is done automatically by the equipment.

Telecom's main reason for bringing in the cellular system has been to provide a more efficient and reliable service for cars, but the system has also brought big benefits for boat owners who spend most of their time in the harbour or nearby coastal waters. In Sydney, it has provided reliable telephone operation over an area extending from Barrenjoey down to Cronulla, and about 30km out to sea.

Many different cellular phone models are now available, from both Telecom itself and suppliers such as Mobiletronics, Novatel, Mitsubishi, Racal and NEC. The models range from tiny hand-held units to much larger fully featured sets intended for building into a car, truck or boat. The fancier models include all of the frills found on "executive" office phones — memories for storing frequently-called numbers, op-

The GME GX-552 VHF transceiver provides 25W output on 55 channels. (Courtesy Greenwich Marine)

tional hands-free operation, inbuilt clock/calendar and so on.

Prices vary from about $3000 up to around $5500, but there's also an annual "access fee" of $600. Both incoming and outgoing calls are charged at the STD prime rate of 40c per minute.

VHF marine radio

What if you go further afield, beyond the reach of cellular radio phones? Well, one relatively low cost solution is VHF (very high frequency) marine two-way radio.

Marine VHF radio operates in the 156-162MHz range, which covers a standardised international range of marine channels, with various bands to reserved for ship-to-ship, ship-to-shore, pilotage and other specialised functions. In Australia channel 87A is reserved as the yachting frequency on which pleasure craft can communicate without competing with commercial users of the airwaves.

VHF sets operate on a maximum output of 25W, with a 1W range available for close-to transmission, for example within a harbour. Reception is essentially line of sight, except on occasions when atmospheric anomalies make the radio waves skip out further. (Very rarely, a station within a normal range will be unobtainable, while a station hundreds of miles away might respond to your call). Normally, with a good antenna mounted as high as possible (on the masthead in the case of a yacht) ranges of 25 to 50 nautical miles can be expected, and sometimes more where a shore station has its transmitting antenna on high ground.

The most important channel on VHF is the international distress channel 16, which is monitored 24 hours a day by coastal stations and by all commerical shipping. Any craft fitted with VHF, even a small pleasure craft, should monitor channel 16 whenever it is operating, both to join in the safety net that mariners provide each other by listening out for distress calls, and to take advantage of weather and other safety messages which are notified from time to time on this channel (usually with a message to switch to an appropriate channel, channel 67 in Australia, to receive the broadcast). Contact between stations is usually established briefly on 16 before switching to an agreed channel, leaving 16 free for its most important role of safety monitoring.

The Overseas Telecommunications Commission (OTC) operates a growing number of coastal stations around our shores, providing regular weather reports and other information on VHF channel 67, as well as 24 hour monitoring for distress calls. The stations have direct links with Seasafety, the Federal search and rescue co-ordinator in Canberra.

Uniden's MC-724 VHF transceiver provides 90-channel programmable scanning, 25W output. (Courtesy Dick Smith Electronics)

In addition, OTC operates its Seaphone service through these coastal marine stations, enabling vessels to be linked quickly with the national and international telephone services. The primary Seaphone channels, on which contact with the shore station may be made directly, are 26 and 27, depending on the location (e.g., Sydney 26, Newcastle 27), with channel 23 as the secondary channel. All are duplex channels, allocated for radio telephone calls. VHF's use of FM (frequency modulation) ensures high quality, distortion-free reception which makes it suitable for voice transmission and link-up with the telephone system.

Sydney's Seaphone coverage is complicated by the geography of the Pittwater and Hawkesbury region, where reception of VHF in popular boating areas like Refuge Bay was blocked out by the hilly terrain. Now, using a remotely operated installation near Cowan, OTC has extended Seaphone into the Hawkesbury River System. By the use of further stations near Port Stephens and Nowra, continuous coverage of the NSW coast is possible between Tuncurry and Narooma. All other capital cities have an OTC Seaphone station, as well as Townsville, and it is planned to extend continuous coastal coverage from Cairns to Adelaide.

Provided your boat is within range of a coastal station, VHF Seaphone provides a superior radiotelephone service — speed of connection and clarity of reception — than MF or HF, and at a lower cost (now reduced to $1.30 for a one minute call anywhere in Australia; previously $3.90 minimum of three minutes; overseas calls at $1.30 per minute plus operator connected rate to destination).

Now OTC is moving to provide fully automatic, computerised calling services at the Sydney coast station, on a trial basis. The on-board operator will be able to direct dial an onshore telephone number, using a special handset which will plug into the microphone jack. With each call, the calling station will identify itself by a code automatically transmitted, and the shore computer will verify this, place the call, record the tie and charges and bill the operator's account. The modification to existing VHF sets, it is believed, will cost less than $500. If the system proves viable after trials in Sydney, it will extend to the other OTC shore stations. Its much smaller setting-up costs for a boat owner must certainly make this system a strong competitor to cellular phones, despite Seaphones's greater per-minute costs.

A Seaphone operator must hold the Restricted Radio Operator's Certificate of Proficiency from the Department of Communications, while the transceiver has to conform in the department's specification RB274B or RB275B. At the moment there are some 25 companies (all imports) that have DoC approval for their VHF transceivers.

The features offered by VHF sets are pretty well standardised, with simple squelch controls, volume and broadcast power selection. A common and useful facility on many sets is the "dual watch" which, when selected, automatically cycles the set from whichever channel it

is on back to emergency channel 16 every few seconds. If a signal is detected, channel 16 will be held so the message can be heard.

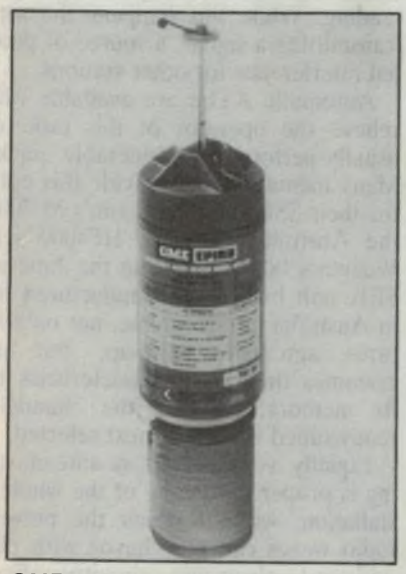
GME's familiar Electrophone GX552, released last year, provides a standard 55 international marine VHF channels, with pushbutton electronic channel selection (via an inbuilt synthesiser) and instant one-touch selection of channel 16 and AYF channel 87A. The unit has a reversible front panel that allows it to be mounted on a console or from an overhead surface.

VHF transceivers are becoming more compact as a general trend. Icom's little IC-M55 measures only 140mm (5.25 inches) x 50.5mm (1.75 inches) at the display panel, and 163mm (6 inches) deep. It weighs 1.3kg and can be mounted almost anywhere. Despite its small size, it covers 78 international VHF marine channels, with 10 programmable instant access channels for quick selection of your most frequently used ones. The fully synthesised unit can scan for signals on all of these programmed channels, as well as perform the normal channel 16 dual watch.

Now available are VHF handheld sets for mobile ship stations like tenders, or very small craft without a DC power supply. The SMR Sea Lab 9000, imported by Imark, has a full 78 channels and power of 3 watts and operates from rechargeable nicad batteries with a claimed life of 6-8 hours.

A VHF installation will cost at least twice that of the familiar 27MHz (citizens' band) sets that have been the mainstay of small recreational craft here, but it offers better range, less interference, full 24-hour emergency monitoring and easy access to the tele-

Emergency radio beacons: exciting new developments



GME's new upgraded MT248 EPIRB (emergency position indicating radio beacon)

In the event of a marine emergency, an emergency position indicating radio beacon or "EPIRB" can greatly improve the chances of help arriving. EPIRBs are small self-contained and waterproof transmitters, which transmit a warbling distress signal continuously for a few days, on the 121.5MHz and 243MHz aviation distress frequencies in the VHF band.

Local manufacturer Greenwich Marine Electronics has just released an upgraded EPIRB, the MT248 (shown), which uses lithium batteries and provides a minimum continuous transmissions of at least 5 days (after an "shelf life" of up to 10 years). The unit has an inbuilt self-test facility, and measures only 3260mm long by 80mm in diameter.

The only shortcoming of this type of conventional EPIRB is that if you are well away from popular air routes, the signals may not be picked up or tracked down before the EPIRB's batteries are exhausted. To obviate this problem, French firm SA Informatique Electronique Securite Maritime has announced a new type of EPIRB which transmits on 406MHz as well as 121.5MHz. The higher of these frequencies can be received by a global network of four polar-orbit satellites called SARSAT-COSPAS, which has been set up as a co-operative effort by Canada, France, the USA and the USSR.

The satellites orbit every 100 minutes, and cover virtually everywhere on the earth's surface. So with one of the new EPIRBs, you can be assured that wherever you are, a distress message will be received by the relevant search and rescue authorities within about 3 hours — in the worst case. The satellites use a doppler measurement technique which allows them to place the EPIRB's position on within one square nautical mile. The new EPIRB also generates a digitally coded ID signal, allowing the authorities to fully identify the vessel in distress. Initial price of the new "satellite EPIRB" is around $2000.

phone system. Consequently, VHF seems destined to become the standard small boat communications system for boaters around the Australian coastline.

MF/HF SSB radio

Beyond coastal waters, the 25 to 50 miles within which line-of-sight VHF radio signals keep us in contact with the land, the requirements of ship-to-ship and ship-to-shore communications are met by MF/HF SSB radio. This utilises the medium/high frequency band encompassing two megahertz (MHz) to 24MHz - although basic communication needs on waters around Australia can be met by quite basic sets operating between the 2 to 8MHz bands.

Single side band (SSB) refers to a modulation technique used in propagating radio waves. Transmitting power for SSB marine sets varies from about 90 watts peak for the smaller sets up to the maximum authorised 400 watts peak for top-of-the-line sets.

SSB radio channels occur in a number of configurations which need to be understood. Simplex channels are those on which transmission and receiving occurs on the same frequency. If you try to talk over the other station, the signals interfere and no-one hears anything. Hence the old "blah, blah, over," routine, signalling that one station will remain silent while the other speaks.

A duplex channel employs separate frequencies for transmit and receive, and simultaneous transmission is possible — you can interrupt, contradict, and shout down your caller to your heart's content.

Twin frequency simplex (or semi duplex) channels use duplex frequencies on simplex fittings, with the operator transmitting and receiving on different frequencies. It doesn't allow for simultaneous transmission by both operators but gives a measure of privacy as an eavesdropper can listen to only half of a two-way conversation.

SSB radiotelephone services worldwide have operators at coast stations who will switch a calling ship station into the local or world telephone system. This is known as Radphone. With good radio equipment, and a knowledge of the working frequencies of the various Radphone coast stations like Portishead in England and the High Seas networks on either coast of the USA or Australia's OTC stations in the capital cities, a vessel can make contact from anywhere in the world.

Other ship-to-shore communications facilities exist besides radiotelephone. Seagram is a telegram service for morse code or voice transmission to or from coast stations over permanent working frequencies, or frequencies that operate the service at designated hours.

A new service called Seatex, introduced last year, is a fully automatic direct dial system for telex transmission to other vessels or any telex subscriber in the world. It requires an onboard communications centre (some systems can utilise a personal computer keyboard and VDU) to compose and edit text, and a special radio transceiver for error-free transmission. This is important to overcome the problems inherent in transmitting digital data over the inter-

Uniden's MC-610 VHF transceiver provides 25W/1W output and PLL synthesis for 55 channel operation. (Courtesy Dick Smith Electronics)

ference-prone SSB bands. The data are transmitted in blocks, with the transmitting station waiting between each block to receive confirmation from the receiving station that the preceding block was received correctly . . . all made possible by the advanced computing capabilities of modern microchip circuitry in the hardware. This type of equipment goes well over $10,000 and is available in Australia from several companies including AWA and Honeywell.

The Radphone frequencies likely to be of more interest to the average yacht SSB station are assigned to designated duplex channels which vary from one coastal station to another, and which are spread across the bands from 2 to 22MHz. SSB radio sets were until fairly recently limited in the numbers of channels they could access. There are 160 approved marine HF voice channels worldwide.

Previously each frequency was generated by a discrete quartz crystal, which was separately installed with its own circuitry and was rather expensive and time consuming to have replaced. The introduction of fully synthesised frequency selection on some modern SSB sets, like Wagner's 1829-S or the Skanti TRP 8250 S — both fully up-to-date, touchpad control sets — allows for almost unlimited choice of frequencies from a single high accuracy quartz crystal, from which a microprocesssor chip can select the required frequencies. This gives literally unlimited access to receive frequencies, while transmitting is only allowed on approved frequencies, by means of electronic gating.

Absolutely essential to efficient HF communications is a properly installed antenna system, with proper grounding. Even making a long section of yacht backstay between two insulators serve as the antenna, it is rarely possible to have it equal the desired length of a quarter-wave at the lowest HF frequencies. A separate antenna tuning unit (ATU) is required to compensate for this, to provide inductive loading to the antenna for low frequencies and capacitive loading for high frequencies.

A manual ATU usually consists of a control on the radio set and a dial; when the station is selected the operator twists the tuner looking for the highest reading. While this happens the set is transmitting a signal, a source of potential interference for other stations.

Automatic ATUs are available which relieve the operator of this task, and usually perform it considerably quicker. Many manufacturers provide this option for their SSB sets, like Icom's M-700 or the Australian Codan's HF4000 series Wagner's 1829S, based on the American SEA unit but to be manufactured here in Australia in due course, not only features automatic tune-up, but programmes the tuned characteristics into its memory, so that the channel is ready-tuned when it is next selected.

Equally as important as antenna tuning is proper grounding of the whole installation, without which the powerful radio waves can play havoc with other on-board electronic circuitry. Fortunately for boat owners, the water itself provides the best earth available, and it should be relatively easy to connect the radio installation, including antenna, ATU and transceiver, with it. This can be done in several ways: via an external metal grounding plate throughbolted to the hull; by connecting up with through-hull fittings, metal tanks, engine blocks and so on. In the case of GRP or wooden vessels, the ground does not need to be in direct contact with the water. For example, a copper mesh laminated into a portion of the hull would make an excellent ground. The various components should be linked up by copper foil, rather than normal round cable, which is a poor conductor at radio frequencies.

Marine Electronics Feature:

Less drudgery, more enjoyment

Thanks to modern electronics, you can now spends a lot less of your time on board doing dreary things like keeping on course and more time relaxing. Listening to music, for example . . .

by JEFF MELLEFONT

An autopilot is the one item of boating equipment that I can think of which very often ends up with a personalised name. There must be hundreds of boats on which the autopilot is affectionately known as "George". This speaks volumes about the usefulness — indeed, the indispensability — of a good autopilot, although it says little about the imagination of all those George-christeners.

Indeed, for all its dullness, its repetitiveness, for the constant effort to correct the course as a boat's bow is endlessly knocked off line in a seaway, no other task on board is as dreary as the steering watch. To be freed from this drudgery is a great benefit for all except offshore racing helmsmen, who specialise in steering the fastest course through any particular sea.

For everyone else a reliable autopilot means more time to attend to other onboard tasks or simply to relax and enjoy life on the water. And, because its attention never lapses and it never gets tired, it actually steers a better course in many conditions than a human helmsman, which means quicker passages, greater fuel economy and more accurate position reckoning.

As with all marine electronics, the microprocessor revolution has spelled smarter, more power-efficient and frequently more compact units, making possible, for example, the entirely self contained tiller steering units that have extended the joys of having your own "George" right down to trailer sailers and outboard runabout fishing boats. A good modern autopilot can be programmed to sense the different conditions and adjust itself to them, increasingly cutting out many of the adjustments that used to be necessary for the operator to make.

These include the dead band, or the zone in which the bow is allowed to wander before a course correction is made. This must increase naturally with heavier seas or the autopilot would be working overtime and wasting power. Another important function, the rate of turn, varies greatly with different crafts' differing steering characteristics as well as boatspeed — at faster speeds, less rudder is required to effect a course change.

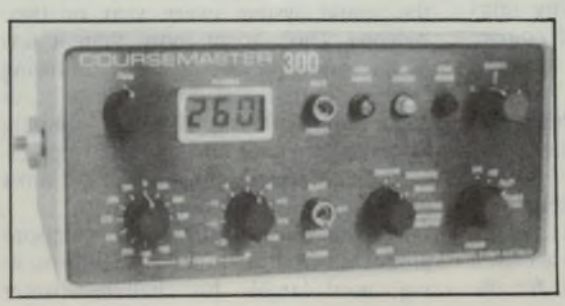
A good counter rudder function is what makes a good autopilot really excellent. This is its ability to anticipate the point, before the desired course is reached, where the helm is gradually moved back to neutral so that the vessel stabilises on the correct course without overshooting and having to be steered back to it.

Among the new generation of autopilots, with microcircuitry to take care of much of these adjustments, is the Norwegian Robertson AP200 series (Quins of Port Adelaide) which includes in its programming the ability to pick up any rudder bias required to maintain straight line steering, like the weather helm of a properly trimmed sailing craft. The rudder angle is synthesised so that the steering unit knows which position the rudder is in at any time. Functions such as rudder and counter rudder are chosen with one switch, and the rate of turn is controlled automatically. The series includes a navigational interface to calculate and order course to selected waypoints, while the large microprocessor capacity allows a number of expansion possibilities such as remote control, rudder angle indicator, and alarms.

The British Autohelm series (Solo Marine) has long been popular on cruising yachts, and the company has specialised in cockpit units where all the components including fluxgate compass, circuitry, controls and rudder drive are cockpit located. These have included the 800 and 1000 self-contained tiller drive units, and the more powerful modular 2000 linear drive and 3000 rubber belt connected wheel drive. The Autohelm 5000 and 6000 come closer to commercial type units in offering the main rudder drive options of rotary (i.e., electric motor, clutch and gearbox to drive either wheel or rudder stock), linear (suited to tiller type connections) or hydraulic where the rams are linked usually to the rudder quadrant. With the fitting of an optional windvane for course keeping to a relative wind angle, the microprocessor is smart enough to ignore short term changes of wind direction, using averages to look for significant shifts.

Autopilots were put to the supreme test during the recent BOC single-handed race around the world — and failures were legion. This is hardly surprising; few average users would expect theirs to handle wild down-wind running through mountainous seas during South Ocean gales.

Some BOC entrants accepted that their auto units would burn out from abuse, carried multiple backups and tossed the dead ones overboard as they went along. The best manufacturers,



The Australian-made Coursemaster 300 autopilot, which offers automatic "lock-on" course setting. (Courtesy Coursemaster Autopilots)

GME's GR-934 marine stereo features AM and FM stereo, electronic tuning, auto-reverse cassette deck and 16W/channel output. (Courtesy Greenwich Marine)

providing keen backup and servicing in each stopover port, will probably learn from the failures and improve their models, and some competitors, like American Dave White aimed to take back their own experience and build a better autopilot.

One of the success stories in this area was that of the Australian manufactured Coursemaster 300 which did the trip around on Ian Kiernan's Triple M/Spirit of Sydney. At the end of the 27,000 mile event, Kiernan had nothing but praise for his Coursemaster.

"It was bloody excellent," he enthused. "I'm positive I had the best in the fleet". The unit, which had to steer Spirit at 20 knots in extreme conditions, maintained a low power drain of seven to eight amps, rising to not much over nine in the hardest running. Kiernan gave some credit for the unit's economy and reliability to using an electric motor powering a hydraulic pump and ram. Much of the reported BOC gear failure included the burnout of direct electric rotary drives, lacking the "buffer" of hydraulics.

Coursemaster's 300 is their top-of-the-line model, featuring both advance course setting by dial as well as the now popular "lock-on" course setting where the unit picks up the course being steered by the helmsman at the moment it is engaged. The company also offers the 250, a more modern unit in styling with its touch pad controls including finger-touch dodge.

Marine hifi

What do you do while the autopilot is looking after the drudgery? Why relax by listening to marine hifi, of course! But there are a few things to consider before you go out and buy one.

Like any of the other sophisticated electronics that go on board your boat a hifi is inherently susceptible to the humid, salty marine environment. It's made worse by the fact that a cassette player must have a hole in it to accept a cassette — a ready made portal for the entry of whatever moisture and salt the cassette or the air may carry.

Clearly, then, for durability and reliability a hifi going onto a boat should be just as well marinised and moisture-proofed as your satnav or radio transceiver.

Now any consumer walking into a car stereo specialist outlet these days is confronted by an enviable array of system and combinations of system. He's become accustomed to mixing and matching when he's choosing a sound system for his car or van — selecting radio, cassette and even compact disc combinations to suit his requirements, adding or subtracting amplifiers and graphic equalisers and playing around with speakers to his heart's content.

Until now, however, the economics of producing marinised hifi in much smaller volume for a specialised market have prohibited this kind of flexibility in installation choice. And as one importer of one of the few fully marinised sets on the market reports, buyer resistance has been considerable. People would want to use their own speakers, or might require the cassette deck but not the AM/FM radio. These, however, could not be split up given the economics of importing such small numbers of units.

The first decision the buyer will have to make, then, is whether to go for a basic marinised unit out of the box, or take a chance with the sea air survival rate of an auto system customised to his own requirements. The owner of a hard-sailed yacht anything smaller than 15-odd metres in length should go for a marine unit unless prepared to replace the sound system every year or two. Anyone who's spent more than a few hours sailing before a fresh following breeze, or battened down into a headwind blow with the offwatch tramping below in dripping oilskins, will appreciate how thoroughly soggy even the most watertight yacht interior becomes.

On the other hand, given a reasonable sized craft with good weather sealing, used largely for sheltered water recreation chiefly in fair weather, there's probably not much wrong with an automotive installation if care is taken to site the "front end" - deck and controls — and ancillary equipment like booster amps in a dry, protected part of the interior. In or near the navigation centre, along with the other electronics, is a popular spot for locating hifi hardware, but an increasingly favoured installation is to create an entertainment centre in its own cabinet in the saloon. The opportunity then exists to make a real attempt at climate control by enclosing the lot within a hermetic space behind well designed doors of some sort.

It's important when considering installation to ensure that loudspeakers, which have strong external magnetic fields, are kept well away from steering compasses and fluxgate sensors.

Greenwich Marine Electronics (GME) has a range of Australian-designed marine stereo systems which are produced in a joint venture with a major Japanese car radio manufacturer, and distributed worldwide. Their model GR926, which retails for $289, is a manually tuned AM/FM radio cassette with a weather band facility that allows selection of airport weather information broadcasts. More sophisticated is GME's GR934 featuring FM stereo, full electronic tuning and auto-reverse cassette player with Dolby noise reduction. Retail price is $425.

GME also produces marinised stereo speakers to suit these systems, utilising polypropylene water resistant speaker cones which can be mounted in external areas like cockpits or flybridges.

AWA Marine has been importing and selling about 200 units a year of the Polaris MS 5000 marine stereo ($870). This 50W set complete with its own three-way speaker system in rugged stainless steel boxes has a computer memory, quartz synthesised AM/FM tuner and auto-reverse cassette player with Dolby noise reduction and 5-band graphic equaliser. Moisture protection comes from polypropylene speaker cones, and a specially cased and gasketed front end with sealed moving switches along with coated circuit boards. In addition a flip-up perspex cover protects the face of the installation from splashes.

Due, however, to the abovementioned difficulties of the market for specially marinised hifi equipment AWA is finding it an uneconomical field and is currently running down stocks of this model.

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349.95

Realistic TRC-621. Our best marine CB provides 10 AM and 10 SSB channels for freedom of communication no matter where you are on the water! Ideal for speedy checks of weather reports, for letting people know where you are, or for those slow days when you need to know where the fish are biting. With digital display, squelch and RF gain. 12V DC. With mounting/microphone hardware. 21-9621 D.O.C. Approval #244023

2. Marine Transceiver

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3. Marine Walkie Talkie

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Realistic TRC-211M. Your link with land! This full-featured portable unit is ideal to take on any sized boat, from an out-board to a cruiser. 5 watts with emergency channel 88 crystals (6 channel operation with 5 more optional crystals), built-in mike and speaker. Combines a noise limiter, ceramic filter, auto-modulation and auto-gain for optimum reception. Req. 8 x "AA" Alk. or 10 x "AA" Ni-cad batteries. 21-9652 D.O.C. Approval #244024

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EA test drives and reports on

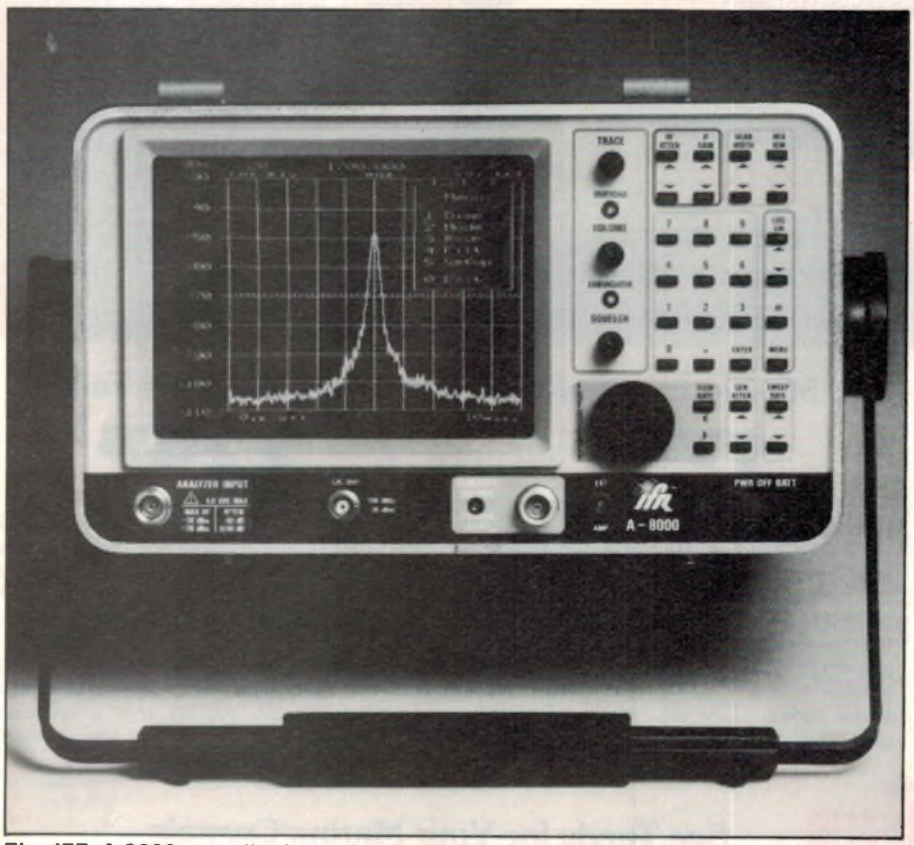
The IFR A-8000 Spectrum Analyser

Spectrum analysers have come a long, long way since they first appeared on the electronics scene. The latest models offer digital frequency synthesis and almost mind-boggling measurement capabilities, like IFR's new top of the line A-8000. Here's what we discovered when we took one for a "test drive"...

by JIM ROWE

I can still remember when I first came across a spectrum analyser. It was back in the late 1950s, when I was in about the second year of my electronics course.

There was this whopping great box in the corner of one of the labs, with a small cathode-ray tube screen up in one corner and what seemed like about 30 control knobs. It looked a little like one of the you-beaut but terribly expensive early laboratory oscilloscopes made by one of those American firms like Tektronix or Hewlett-Packard (the ones we drooled over in the US magazine advertisements), but it wasn't.



The IFR A-8000 can display any part of the spectrum from 10kHz to 2.6GHz, in a single sweep if necessary. Based on a synthesiser, it is fully calibrated in terms of both frequency and amplitude.

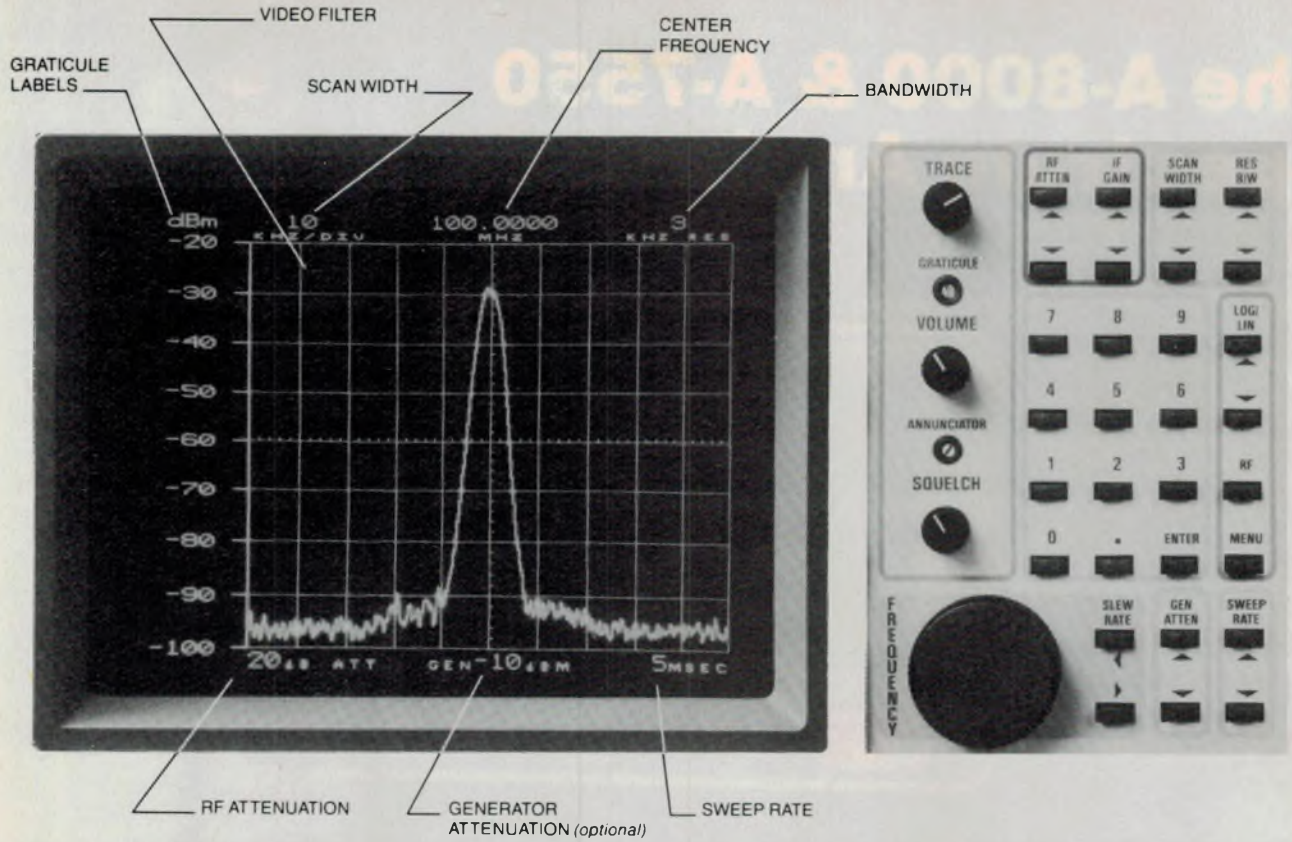
As I recall it wasn't even a complete analyser, but rather an analyser *adapter* which was designed to plug into a matching communications receiver, and make use of the receiver's front end circuitry. In fact I think it had been made by Hallicrafters, or one of the other US receiver manufacturers, for use by that country's armed forces during the second world war.

The basic idea was that by hooking up the analyser to one of the maker's receivers, you could use it to sweep over any desired part of the frequency spectrum, and look at the radio signals that were present. Each signal showed up as a vertical "blip" or peak on the horizontal trace, with the frequency the receiver was actually tuned to corresponding to the centre of the screen. From memory you could display about 500kHz of the spectrum either side of the receiver's tuning point.

It was a bit like a modern scanner, in that it let you monitor what was happening in the frequency range of interest. If a new signal popped up, you would see a blip on the screen, and could quickly tune into it to eavesdrop. Hopefully it would be a transmission by the enemy, and you'd discover things to your advantage. An early example of "bugging" or electronic surveillance, in effect . . .

From memory it was the only spectrum analyser possessed by the uni's school of elec engineering at the time, and they had picked it up for the proverbial "song" at an ex-services disposals auction with various other gear. I seem to recall that there was only one of the matching receivers around, too, and this was in almost constant use elsewhere. So most of the time the analyser adaptor just sat there, something of a white elephant.

Mind you, even when you hooked it up to the receiver and got the combination going the results were pretty disappointing. Like the early scopes the analyser was capable of little more than



All major parameters are displayed on screen, including centre frequency, scan bandwidth and amplitude calibration. Entry of all parameters is easy, using the keyboard and a series of on-screen menus.

letting you "look" at the spectrum in a rough kind of way. The frequency sweeping was fairly non-linear, the vertical amplifier and gain system provided no way to accurately measure the amplitude of any of the signals (even the one you were tuned to!), and the whole setup drifted all over the spectrum until it had been operating for hours and the temperature had reached some kind of vaguely stable equilibrium.

In short, it wasn't really much of a measuring tool, in any sense of the word. But it was tantalising, to be able to see all those signals dancing up and down on the screen. I can remember thinking that wouldn't it be great when — one day — we'd be able to use such a spectrum analyser as a real measuring tool!

Well folks, I can testify that the day has well and truly arrived. Thanks to the good people at Vicom Australia, I've just been able to test drive one of the very latest all-singing all dancing, top of the line A-8000 digital spectrum analysers from IFR Systems Inc., of Wichita, in Kansas. And it's been a real eye-opener.

The A-8000 is so far ahead of that old WWII analyser that comparisons are mind boggling. For a start, it's a complete instrument in its own right, and fully self contained. In fact with a small optional detector module fitted, it offers virtually all of the features of a modern synthesiser-driven communications receiver thrown in, as well as spectrum analysis. Plus a lot more, as I'll explain shortly.

Instead of the 1MHz — 30MHz frequency range offered by the old timer, the A-8000 can make measurements over a staggering 10kHz — 2600MHz. That's from audio right up to microwaves! And instead of the 1MHz or so maximum sweep width of the old timer, it offers virtually anything you want from +/-5kHz up to a mind-blowing "full sweep" mode, where it sweeps the full spectrum up to 2500MHz. Wow!

The sweep ranges are actually calibrated in terms of frequency change per horizontal screen division, rather like the timebase calibration of a good scope. And the screen is basically 10 major divisions wide, five either side of the centre frequency line. So the 17 sweep ranges go from 1kHz/division to 200MHz/div, in the usual 1-2-5 sequence. There's also an eighteenth range of 250MHz/div, which comes into operation in the "full sweep" mode, and a zero sweep mode for using the instrument as a straight receiver.

Of course it's all based on a digital frequency synthesiser, so you can key in virtually any centre frequency you want to look at: anywhere between 10kHz and 2600MHz, in increments of (wait for it) only 100Hz. The basic timebase accuracy is 0.5 parts per million.

As well as being able to key in any centre frequency directly via the keyboard, you can also move along the spectrum continuously by turning a large rotary knob in either direction — just like tuning a conventional receiver. The knob basically "slews" you along in finite frequency increments, and the increments concerned can be set for any desired "dial slewing rate", from very fine to quite coarse.

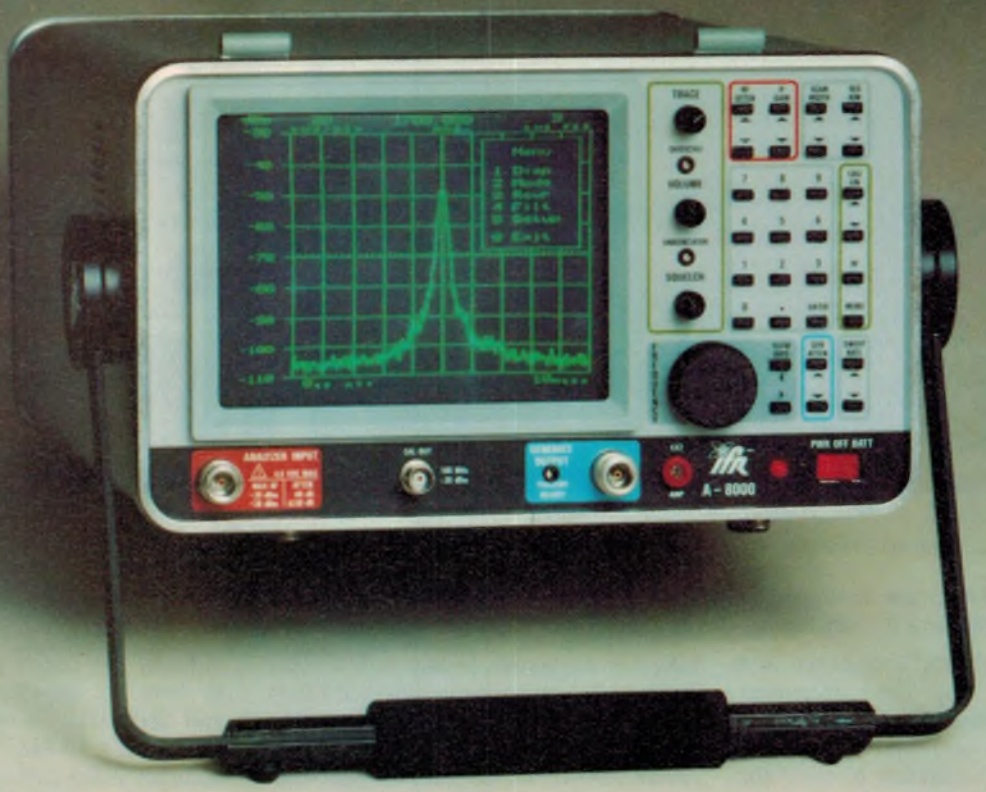
The centre frequency itself is always indicated at the top centre of the screen, above the centre axis line.

The actual frequency resolution of the analyser is set independently of the centre frequency and sweep width. There are five ranges in this case, from 300Hz to 3MHz in decade steps. Both the sweep width and resolution are displayed at the top of the screen, either side of the centre frequency.

You can also set the rate at which the A-8000 actually sweeps the segment of the spectrum you're looking at, from a fairly fast 5ms/div to a very slow 10s/div.

If you're wondering how easy it is to adjust all of those parameters for accu-

The A-8000 & A-7550 Spectrum Analyzers



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rate results, don't worry. The A-8000 also contains a built-in microprocessor, which basically adjusts most of the controls automatically to give the right results. Whenever you vary one of the controls yourself, it automatically makes any changes to the others to compensate. It's called "automatic optimisation".

That doesn't mean you can't adjust them yourself if you want to; you certainly can. All that happens is that if you try setting one to a range that will conflict with the others, it will indicate this on the screen with an "UNCAL" message. What more could you ask!

On the amplitude side, the A-8000 is calibrated from –120dBm to +30dBm and has a 70dB dynamic range. It can measure in either logarithmic or linear fashion. There are actually two log scales, one with 10dB steps per major vertical screen division and the other with 2dB steps. The absolute scale calibrations are automatically displayed up the left-hand side of the screen.

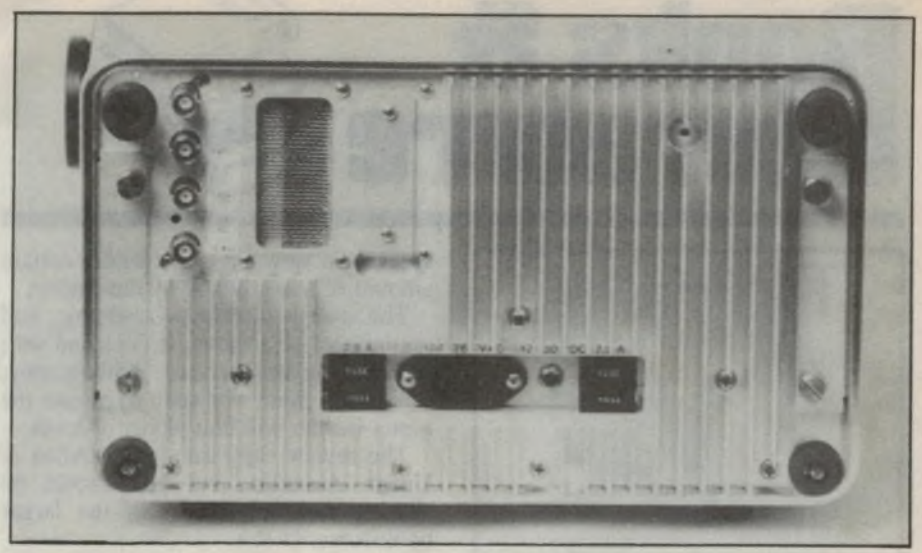
A built-in programmable RF input attenuator provides up to 60dB of attenuation in 10dB steps. This is adjusted by two RF GAIN buttons on the front panel. Again the attenuator setting is displayed on the bottom of the screen, along with the sweeping rate.

Are you impressed yet? Not to worry, because there's still more to come. For example if you've got the communications receiver option fitted, you can simply press a MENU key and call up a menu of demodulation modes on the screen. There's narrow and wide band FM, SSB and wide and narrow band AM. Also a special "time share" mode, where the A-8000 can be arranged to alternate between sweeping the spectrum and letting you listen to a signal at the centre frequency you've set it for . . .

Another menu can be called up to set the kind of screen display you want for the spectrum analysis. As well as the usual "line" display, you can select bar graph, average or peak hold. You can also have the A-8000 store a spectrum display in its memory, and then bring it back for comparison with a second sample.

Yet another menu lets you select video low-pass filters, if desired. There's a choice of none, 30kHz, 300Hz or an optional quasi-peak mode.

The A-8000 also has an option to fit a GPIB interface, and if this is fitted it can output displays to an X-Y plotter. It can also be remotely programmed from a computer or ATE controller, using the same GPIB interface or a similarly optional RS-232C serial interface.



Rear view of the A-8000, showing the additional connectors. These include drive for an X-Y plotter.

But in some ways, the most impressive option you can fit into the A-8000 is a "Tracking Generator" module. This provides a sweep frequency output which exactly matches the sweeping of the spectrum analyser itself, with an output level adjustable (and programmable) from 0dBm down to –70dBm in 1dB steps.

The output impedance of the tracking generator is normally 50 ohms, like the input impedance of the A-8000's analyser section. However either or both can be changed to 75 ohms if required, with an optional adaptor.

No doubt you've realised some time back that with all of these gee-whizz features, the A-8000 must obviously be intended for a lot more than just eavesdropping over the spectrum, as a kind of super scanner. You're quite right, of course.

One very important use for this kind of analyser is testing the output of virtually any kind of equipment designed to produce an RF signal, to measure the signal bandwidth and the presence or amplitude of any spurious signals that may be produced along with the main/intended signal. So designers, manufacturers and service people working on exciters and transmitters need to use one, to check for correct operation. Needless to say it can very easily show the presence of any spurious outputs, and let you measure their frequency and amplitude.

Another use is for testing other equipment that generates a strong RF signal as part of its own internal operation, but isn't supposed to radiate any of it when it's working correctly. The spectrum analyser can again let you track down any energy that does leak out, and measure it. It is therefore an extremely important tool for the control of electromagnetic interference (EMI).

Of course with the tracking generator option fitted, the A-8000 also becomes a complete sweep-frequency analyser, which can be used to measure the performance of amplifiers, filters, resonators, attenuators, antenna systems, diplexers or what have you — anywhere over its audio-to-microwaves frequency range. This makes it a particularly valuable tool for the RF design lab.

How did I find it? Well, the sample A-8000 loaned to us by Vicom had both the communications receiver and tracking generator options fitted, and frankly taking it for a "test drive" was magic. It's just so easy to look at any part of that whopping 10kHz-2.6GHz chunk of spectrum, from the whole thing right down to a tiny 10kHz-wide sliver. Just key in the parameters, and there it is! All with the accuracy and stability of a top-notch modern digital frequency synthesiser, and the convenience of a built-in microprocessor.

Now for the sobering part. Needless to say an instrument with the capabilities of the A-8000 doesn't come cheap. The basic analyser costs a cool $25,800, while if you want to add those beaut receiver and tracking generator options, these jack the price up to a tidy $34,000. I guess that means that most of us will still only be able to dream about one, or at the most rent one for a day or two when we really need it.

If you're one of the lucky ones who can consider buying one, talk to the people at Vicom Australia. They're in Sydney, Melbourne, Brisbane and Wellington. The phone number in Sydney is (02) 957 2766.

Books & Literature

Appliance history

ELECTRICAL APPLIANCES, by Penny Sparke. Published by Unwin Hyman, 1987. Soft covers, 209 x 196mm, 112 pages. ISBN 0 7135 2737 4. Recommended retail price $24.95.

An interesting book which traces the history of familiar household electrical appliances like the iron, vacuum cleaner, refrigerator, cooking range and toaster. But not from the technical function point of view, rather from their aesthetic design and sociological significance. The author is a senior tutor in the history of design, at the Royal College of Art in London, and apparently broadcasts in the UK regularly on both TV and radio, on the broad subject of design.

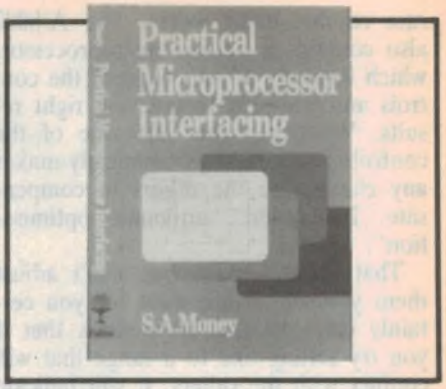
Despite the fairly heavy emphasis on aesthetics and sociology, there's still quite a lot to interest the technical reader. It's intriguing to see the first crude models of each kind of appliance, the story behind their development and the various permutations and combinations that have evolved over the years. Even the way that changing design fashions have altered their external appearance can be quite interesting.

It was only in places where the author seemed to be seeking to draw deep philosophical and sociological conclusions from these things that I found it heavy going. While it's fairly obvious that the form and function of home appliances will not be unrelated to the status of domestic activities, and thus historically with the status of women, somehow Ms Sparke seems to be trying to read a lot more into this.

So be aware that it's a history of electrical appliances, but from a slightly specialised viewpoint, and with a certain amount of axe-grinding by the author.

The style is also fairly academic, and reminiscent of a thesis. It does end with a fairly comprehensive bibliography, though, so those who wish to pursue the topics further will find plenty of leads.

The review copy came from Allen & Unwin Australia, but you should be able to find it at most of the larger bookstores. (J.R.)



Interfacing micros

PRACTICAL MICROPROCESSOR INTERFACING, by S.A. Money. Published by Collins Professional Books, 1987. Hard covers, 242 x 160mm, 247 pages. ISBN 0 00 383329 1. Recommended retail price $68.00.

A practical and fairly up to date, though relatively basic book on interfacing microprocessors to external devices. It is intended for the engineer or design technician as yet unfamiliar with microprocessors, or perhaps the senior student in a digital electronics course.

It begins with a couple of chapters on basic microprocessor and computer/controller system operation, then moves on to introduce the basic concepts of parallel I/O interfacing. This is followed by a chapter on practical parallel interfaces and their applications, including the GPIB/IEEE488 bus.

Following this in turn is a chapter on serial data principles, leading to a discussion of the various serial I/O interfaces — including RS232C, RS442 and RS423. Then there are sections on counting and timing systems, analog input and output interfaces, and interrupt operation.

The treatment throughout is down-to-earth, with many circuit examples using real-world logic devices and other components. There is also frequent discussion of timing, deglitching and other practical considerations, plus plenty of material on basic machine/assembly language programming of the interfaces described.

It does assume quite a good grasp of basic microprocessor operation and programming, though. In fact despite the introductory material up front, I believe the reader without this background will find it quite heavy going in places — particularly with respect to programming.

But for those with this background, it's a book which should be found very useful as a practical design guide and reference.

The review copy came from Blackwell Scientific Publications. (J.R.)

Waveguide design data

A HANDBOOK FOR THE MECHANICAL TOLERANCING OF WAVEGUIDE COMPONENTS, by W.B.W. Alison. Published by Artech House, 1987. Hard covers, 237 x 160mm, 470 pages. ISBN 0 89006 256 0.

This is actually a reprint of a reference book that was originally published in the UK in 1972, and has since become something of a classic in microwave design circles. It has apparently been out of print for some years, and Artech has republished it to meet the continuing demand.

The book is essentially a collection of data amassed by the author and coworkers at Telecommunication Instruments Limited in Great Yarmouth, Norfolk, working under Ministry of Defence contracts designed to discover ways to improve the performance of passive microwave components.

There's design information on basic waveguide components, twists, bends and corners, irises, posts, tuned windows and quarter-wave transformers, tapers, directional couplers, hybrid couplers, terminations, duplexers and waveguide/coaxial line transitions. It's virtually a complete reference to practical microwave "plumbing", chock-full of design formulae, reference tables and graphs.

A little too esoteric for the general reader, perhaps, but invaluable for the working microwave design engineer.

The review copy came direct from the publisher, but the larger technical bookstores will no doubt be able to order it on request.(J.R.)

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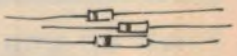

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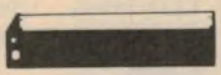

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R16300	0.1uF 35V	$0.13	$0.12
R16302	0.15uF 35V	$0.13	$0.12
R16304	0.22uF 35V	$0.15	$0.12
R16306	0.33uF 35V	$0.15	$0.14
R16308	0.47uF 35V	$0.15	$0.14
R16310	0.68uF 35V	$0.16	$0.15
R16311	0.82uF 35V	$0.18	$0.15
R16312	1uF 35V	$0.15	$0.12
R16314	1.5uF 35V	$0.24	$0.20
R16316	2.2uF 35V	$0.24	$0.23
R16318	3.3uF 35V	$0.29	$0.27
R16320	4.7uF 35V	$0.35	$0.33

30% Sales tax where applicable

RITRON II MONITORS

Swivel base monitor in stylish case

Desc/Cat No.	1-9	10+	50+
Green Cat X14506	$145	$135	$130
Amber Cat X14508	$145	$135	$130

Plus 20% tax where applicable

GREY FLAT RIBBON CABLE IN 100 FOOT ROLLS

Cat No.	Desc.	1-3	4-9	10-99	100+
W12614	14 Way	19.50	18.50	18.00	14.00
W12616	16 Way	21.50	19.50	19.00	16.00
W12620	20 Way	29.50	28.00	26.50	20.00
W12625	25 Way	32.50	29.00	28.50	25.00
W12626	26 Way	34.00	32.00	29.00	26.00
W12634	34 Way	44.00	42.00	39.00	34.00
W12636	36 Way	49.00	47.00	42.50	36.00
W12640	40 Way	55.00	52.50	49.50	40.00
W12650	50 Way	62.00	59.50	58.50	50.00

LARGER QUANTITIES NEGOTIABLE!
Plus 20% tax where applicable

75 OHM COAX CABLE IN 100M ROLLS

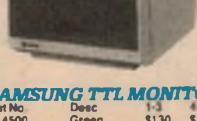
Cat No.	Descript.	1-4	5+	10+
W11222	3C2V	25.00	24.00	23.00
W11224	5C2V	30.00	29.00	28.00

(5C2V WHITE OR BLACK)
LINE LOSS PER 100 FEET (33M 200MHz)
W11222 3C2V 6.2dB (Approx.)
W11224 5C2V 3.9dB (Approx.)
Plus 20% tax where applicable

FANS

Cat No.	Descript	1-9	10+	100+
T12461	240V 4½"	11.00	10.00	9.00
T12465	240V 3½"	11.00	10.00	9.50
T12463	115V 4½"	11.00	10.00	9.00
T12467	115V 3½"	11.00	10.00	9.50

(Fan guards to suit also available)
Plus 20% tax where applicable



SAMSUNG TTL MONITORS

Cat No.	Desc	1-3	4+
X14500	Green	$130	$125
X14502	Amber	$135	$130

Plus 20% tax where applicable

TELEPHONE CABLE (200 METRE ROLLS)

Cat No.	Description	1-9	10+
W11302	2 Pair	$24.00	$22.00
W11303	3 Pair	$29.00	$27.00
W11310	10 Pair	$120.00	$115.00

Per 200m Roll
20% Sales tax where applicable

NICADS

Cat No.	Description	1-99	100+	250+
S15020	AA .5AH	$2.20	$2.00	$1.95
S15021	C 1.2AH	$6.75	$6.50	$6.20
S15022	D 1.2AH	$7.55	$7.25	$6.90

Plus 20% tax where applicable

HORN SPEAKERS

Cat No.		1-9	10+
C12010	5" Plastic 10W Max	6.00	5.80
C12015	5" Metal 10W Max	6.00	5.80
C12012	12V Siren	9.90	9.50

Plus 20% tax where applicable

LEDS 5mm STANDARD

Desc.	10+	100+	1000+	10,000+
Red	$0.10	$0.09	$0.08	$0.07
Green	$0.15	$0.10	$0.09	$0.08
Yellow	$0.15	$0.10	$0.09	$0.08

Plus 20% tax where applicable

SUPER DISCOUNT 5¼" FLOPPY DISKS IN BULK PACKS!

Attention schools, clubs, software houses etc! These are 100% certified, prime spec D/S D/D disks with a 5 year warranty and made by a leading manufacturer, only without labels or brand names! But have a look at the price! Sensational value to say the least!

Descript	10+	100+	1,000+	10,000+
D/S D/D	$1.00	$0.90	$0.80	$0.75

Plus 20% tax where applicable

FREE sample disk available on request!
(Please send $2 to cover postage)

FREE 58 PAGE WHOLESALE PRICE LIST!
Simply supply a Business Card!

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Power op-amp with VMOS output

The 1463 is third in a series of high speed, FET input, VMOS output power op amps. It operates from ±15V to ±40V supplies and has a guaranteed output of ±28V at 1A with ±36V supplies. The complementary VMOS output stage eliminates the safe operating area (SOA) restrictions and secondary breakdown problems that plague virtually all other presently available power op amps.

Internally compensated for unity gain stability, the 1463 still achieves an outstanding 80V/us slew rate (under full load condition), 7.5MHz gain-bandwidth (GBW) product, and 250ns settling time to 0.1% (10V step). Input bias current and offset voltage are guaranteed less than ±200pA and ±5mV respectively.

Further information is available from Reserve Electronics, . PO Box 197, Wembley 6014.

New Aluminium Gallium Arsenide LEDs, displays

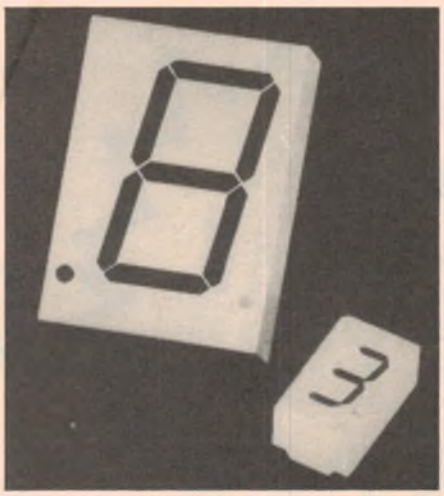
Hewlett-Packard has announced a new family of LED indicators and displays based on aluminum gallium arsenide (AlGaAs) technology. The new offering, which includes 12 LED lamps and four seven-segment displays, is ideal for applications ranging from low-current or battery-powered equipment to systems that must be viewable in sunlight.

The new parts use double-heterojunction aluminum galium arsenide (DH-AlGaAs), which yields efficient and bright products that can operate at lower currents than existing high-efficiency red materials.

The LED lamps fall into three categories: low current, high brightness and very high brightness. The high-brightness lamps include two T-1 3/4 LEDs (HLMP-D101/D105), two T-1 LEDs (HLMP-K101/K105) and one subminiature LED (HLMP-Q101). These products typically provide from 185 to 700% more light output than existing HP high-efficiency red LEDs at 20mA.

Low-current lamps also include two each of the T-1 3/4 (HLMP-D150/-D155), the T-1 (HLMP-K150/-K155) and one subminiature lamp (HLMP-Q150). These lamps are specified at 1mA. Typical intensities are between 2 and 10 millicandelas (mcd), depending on package style and part number. These LEDs are 2.5 to 12 times brighter than low-current LEDs presently offered by HP.

Two T-1 3/4 LEDs are being introduced in the very brightness category. The package shape and narrow viewing angle of approximately 8° maximise on-



axis intensity to 750mcd (HLMP-4100 at 20mA) and 1000mcd (HLMP-4101 at 20mA).

The seven-segment displays are available in four sizes: 0.3-inches/7.6mm (HDSP-A101 series), 0.43-inches/10.9mm (HDSP-E100 series), 0.56-inches/14.2mm (HDSP-H101 series) and 0.8-inches/20mm (HDSP-N100 series). These displays are specified as low-current devices (1mA per segment drive current). However, they are not limited to low-current applications.

All of the new LED lamps have an operating temperature range of –20 to +100 degrees C whilst the display products operate over the temperature range of –20 to +85 degrees C. AlGaAs products are available only in red.

For further details contact VSI Electronics, 16 Dickson Avenue, Artarmon 2064.

68020 successor

Motorola's Microprocessor Products Group has announced that its latest 32-bit microprocessor, the MC68030, is now in the evaluation stage. The new superchip, to be delivered by the end of this year, achieved first silicon on April 16, 1987. Motorola also announced first silicon for the MC68882 Enhanced Floating Point Coprocessor (EFPC).

Nicknamed the 030 (oh-thirty), the MC68030 is the latest generation in Motorola's M68000 family of fully compatible microprocessors, currently used in more than 7 million computer systems. The 030's immediate predecessor, the MC68020 (020), is used by the vast majority of 32-bit system manufacturers, including Apple Computer in its Macintosh II.

According to Motorola, the 030 will set the highest performance standards ever for 32-bit general purpose microprocessors. The 030 provides up to twice the performance of the 020, which Motorola claims to already outpace the Intel 80386. At the same time, the 030 maintains 100% upward compatibility with the entire family of M6800 microprocessors, as well as a $2 billion base of proven 32-bit software.

The new chip's performance is due in part to its high degree of parallelism. The 030 is the first microprocessor to use a Harvard-style architecture, which provides dual internal data and address buses.

New 030 features include an on-chip instruction cache and an on-chip data cache with burst fillable mode, an improved bus interface, and an on-chip paged memory management unit (MMU) with built-in translation cache.

CMOS remote control encoder/decoder chip

Motorola has introduced the MC145030, a new second generation single chip CMOS remote control encoder/decoder that enables customers to significantly reduce component count and PCB area. The MC145030 features wide (2.0 to 6.0V) supply voltage operation, 512 9-bit user selectable address codes, on-chip input amplifier, and separate I/O pins for the encoder/decoder. Manchester encoding and decoding is provided on chip.

The encoder serially transmits the data information upon receipt of a

Transmit Enable. Upon receiving the 9-bit serial data, the decoder compares it with the address setting. The decoder output toggles if the received code matches with the address setting. Decoder reset is provided for initial state setting.

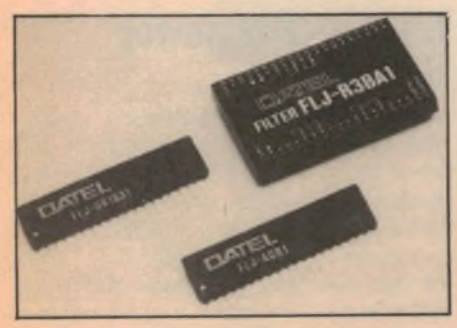
The MC145030 operates in a low supply range of +2V to +6V by employing the same process technology as high-speed CMOS. This enables the device to be used in applications where only two batteries are employed.

The MC145030 interfaces with RF, ultrasonic, or infrared modulators and demodulators. Applications for this single-chip device include cordless phones, paging systems, garage door openers, fire alarm systems, car security systems, and any other applications requiring security coding.

Active filters, resistor networks and oscillators

Datel has announced the availability of a complete family of resistor and voltage tuneable filters, digital programmable filters, logic controlled networks, resistor tuneable oscillators and oscillator adapters. The 37 new items provide front-end filtering and peripheral conditioning for data acquisition systems.

The FLJ-ACR1 and ACR2 are logic controlled resistor network products designed for use with resistor tuneable filters (such as the Datel FLJ-UR series). They offer four resistor networks, with each network comprising four resistors (R_r R/2, R/4 and R/8). The R value in the FLJ-ACR1 is 1.59 ohms, while that in the FLJ-ACR2 is 159k ohms.



The FLJ-UR series of Single In-Line hybrid resistor tuneable filters offer two cut off frequency ranges (low range from 40Hz — 1.6Hz and high range from 400Hz — 20kHz) and are available in 1-, 2- or 4-pole configurations for lowpass, highpass and bandpass output functions. The FLJ-UR series feature a 135dB or 100dB/octave value with a 1/3 octave bandwidth (Q = 4.32) bandpass filter.

The FLJ-D1, -D2, -DC are digital programmable filters for high accuracy and high stability applications, and can set the cutoff and centre frequency with 3 digit BCD signals. The resonant frequency program range is from 1Hz — 159.9kHz (or determined by external capacitors) and is accurate to 0.1%. Two-pole lowpass, highpass and bandpass output functions are available simultaneously from three different outputs.

The FLJ-D5, -D6 filters are high order, lowpass types and provide 5-pole, 60dB or 6-pole, 80dB/octave filtering specifications. They are Chebyshev types and the cutoff frequency is programmed with 3-bit, TTL-compatible digital logic with a maximum of 8 levels of settings.

The FLJ-AC01 is an oscillator adapter for the FLJ-D series of digital programmable filters and has a frequency range of 100Hz — 100kHz , with a low 0.1% distortion at 10kHz. The output voltage is trimmed internally to provide a 2.5V rms 0.5% output.

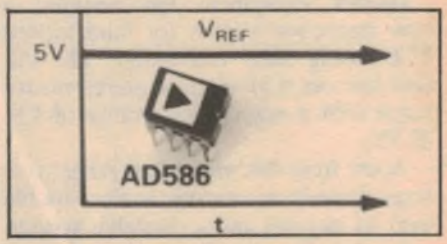
The ROJ-20, -1K series provides highly stable, resistor tuneable oscillators with low distortion (0.0018% at 1kHz). Oscillating frequency is set by two external resistors. Output frequency of the ROJ-20 is 20H-20kHz, while the FOJ-1K is 1kHz — 100kHz. Sine and cosine waves for both units are generated from two output terminals, and an input terminal is provided to tune the relationship of the two outputs.

For further information contact Elmeasco, which has offices in Sydney, Melbourne, Brisbane, Adelaide and Perth.

Precise +5V reference

Analog Devices has released a precise +5V reference featuring low initial offset error, low drift, and low cost in an 8-pin hermetic CERDIP. The AD586 provides offset and drift as low as 2.5mV and 5ppm, respectively, and is suitable for operation as a system reference with 16-bit DACs, power supply controllers, and autocalibration systems.

A proprietary noise reduction feature lets the user reduce the already low wideband noise by adding a single capacitor. A proprietary buried zener diode and production laser trimming provide low error, low noise, and high stability over time and temperature. Typical long term stability is 15 ppm/1000 hours. The output noise of the AD586 achieves a low 4uV peak-to-peak (p-p) value in the 0.1 to 10Hz band, and is only 200uV p-p to 1MHz. An external 1uF capacitor connected to the Noise Reduction pin on the IC reduces this wideband noise to 160uV p-p. The reference value can also be "fine-trimmed" with a single external potentiometer to provide exactly +5.000V, or to provide an output voltage that differs from nominal, such as +5.12V for binary applications. A total trim range of +300mV, -100mV is available.



The load regulation of the AD586 — 100uV/ma — provides output stability as the amount of load current changes, such as when a DAC or ADC switches internally or when varying loads occur on the reference output. Up to 10mA of current can be supplied by the AD586, which requires a +10.8V to +36V power supply.

Further details from Parameters, 25-27 Paul Street Nth., North Ryde 2113.

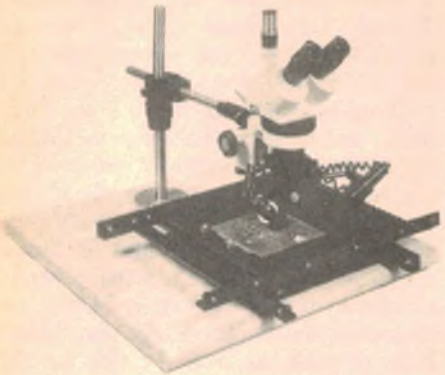
1500V PIN diode chip

A new high voltage PIN chip, Model CSB3779, has just been released by Alpha Industries. The device features 1500V minimum Vb at 10uA, low RF resistance, low thermal impedance, and hermeticity at the chip level.

Capable of meeting screening up to JANS, the chips are ideally suited for applications including high power phase shifting and radiation detection. Device specifications include a maximum power dissipation of 35W, junction capacitance (Cj) of 2.5pF max at 100V, series resistance (Rs) of 0.5 ohms typical at 100mA and carrier lifetime (Tl) of 6us typical for If = 10mA, Ir = 6mA.

For further information contact Benmar International, GPO Box 4098, Sydney 2001.

New Products



SMD inspection station

Hunter Equipment has released a new inspection station for miniaturised PCBs using SMD technology. The station features a Meiji zoom stereo microscope with a magnification range of 4 to 22.5X.

Apart from the wide zoom range, features include a viewing angle variable over 45 degrees and a rotatable systematic indexing stage. The workpiece stage moves freely through the X axis, with 10mm and 20mm indexing pitches along the Y axis; it also rotates about a centre point to allow maximum vision on even the most densely populated boards. Lighting is provided by two lamps which can be adjusted for both intensity and spread of light.

These features are claimed to make the station the most versatile SMD inspection equipment currently available. Both binocular and trinocular versions are available.

Further information is available from Westinghouse Systems, 80-86 Douglas Parade, Williamstown 3016.

Analog-digital converter card for VME bus

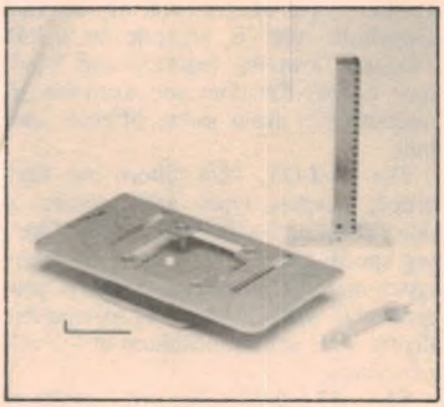
PEP Modular Computers has introduced a new low cost versatile VME-bus module which will accept up to 16 single-ended analog channel inputs or 8 differential mode analog inputs. Designated VADI, it is intended for process automation, data acquisition, monitoring and control systems. It is designed to interface to sensor or analog signals, and to convert those inputs into standard digital data commonly used in computer systems.

The VADI is pin compatible to Analog Devices signal conditioning modules series 3 Bxx and 5 Bxx.

Conversion time is 8us minimum, Throughput rate is 90kHz max. in 5 programmable steps. Gain can be programmed in 4 steps, x1, x10, x100, x500. Channel sequences are programmable from 1 to 16.

The VADI module is accommodated on a single height standard Eurocard.

For further information contact Dindima Group, PO Box 106, Vermont 3133.



IDC conversion kit

Scope Laboratories has released the 506 Retrofit Kit, which converts a standard Scope 501 or Precision 502 Panapress into a 505 insulation displacement connector (IDC) bench assembly press.

The Kit includes the assembly base, standard plate, modified ram guide arm and allen key.

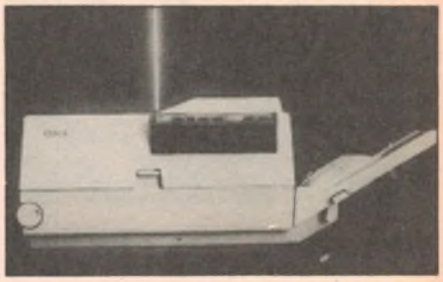
For further information contact Scope Laboratories, 3 Walton Street, Airport West 3042.

850Mb "electronic disk"

Featuring an "unformatted" storage capacity of 850 Mbyte on a solid state dynamic RAM, the Philips CC-95/2 Electronic Disk offers 200us average access time through an SCSI interface.

The CC-95/2 may be equipped with an optical disc back-up and is protected against loss of mains power by a UPS. At present the unit can be extended to 1 gigabyte, using full SCSI possibilities in one 19" rack housing. The data transfer rate is up to 730Kbyte/sec.

For further information contact Philips Scientific & Industrial, 25-27 Paul Street North, North Ryde 2113.



Lowest cost laser printer?

The OKI Laserline 6 laser printer is a very compact desktop page printer with features previously only found on laser printers costing much more. Costing only $2995, the OKI provides crisp 300dpi printing of text and graphics, in 15 resident and 27 optional cartridge based fonts.

The printer is fully industry standard, with Hewlett Packard LaserJet emulation. Serial and parallel ports are built-in. All the normal laser printer facilities are available, including graphics, vertical (portrait) and horizontal (landscape) format printing.

You can feed most things into the Laserline too, including A4, B5 and A5 paper, envelopes, gummed labels, and overhead transparencies. There's even a "face down" output stacker for proper collating, something not available on many laser printers three times the price. The standard 150 page paper tray can be upgraded to 550 pages if you have massive documents to print out.

Software compatibility covers virtually all IBM PC wordprocessors and desktop publishing programs, including Microsoft Word, WPS-PC, Wordperfect, Ventura Publisher and Aldus Pagemaker.

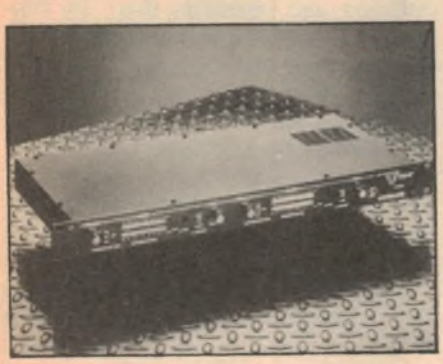
For further information contact Logo Computer Centre, Suite 303 Henry Lawson Business Centre, Birkenhead Point, Drummoyne 2047.

8 — 18GHz power dividers

The Norsa model EZD8324 (8-way) and EZD8325 (16-way) power dividers cover the 8 — 18GHz frequency range. Both models have isolation of 20dB minimum and output VSWR of 1.5:1 maximum. The units exhibit low values of insertion loss, amplitude and phase unbalance.

Model EZD8324 measures 4.44" x 1.44" x 0.22" and weighs 70 grams. Model EZD8325 is 8.69" x 1.75" x 0.22" and weighs 155 grams. Removable sm female connectors are standard, and hermetically sealed units are available.

For further information contact Scalar Distributors, 20 Shelley Avenue, Kilsyth 3137.



Audio signal processor

Using state-of-the-art components and a linear integration detection technique, The Leveller is claimed to yield unprecedented level control over audio signals, but with a warm, natural, "sonically correct" sound (i.e., the way the human ear would hear the signal).

The Leveller offers two independent channels that can be coupled for processing stereo information. The balanced, differential input section of each channel is capable of accepting –10dB, 0dB, or +4dB levels, making the device ideal for use by recording engineers, broadcasters, musicians and sound contractors.

Its most useful applications would be in controlling maximum audio levels, limiting vocals and preventing tape saturation.

The Leveller is available as a 2 channel 400 series unit or as a single channel 800 series module for use in PR-24 and PR-10.

For further information contact Amber Technology, Cnr Skyline Pl & Frenchs Forest Rd, Frenchs Forest 2086.

32-channel logic analyser

Hewlett-Packard has introduced the HP 1651A logic analyser, with 32 channels of state-and-timing analysis, a simplified pop-up-menu-driven user interface and an Australian list price of $7,470 before tax.

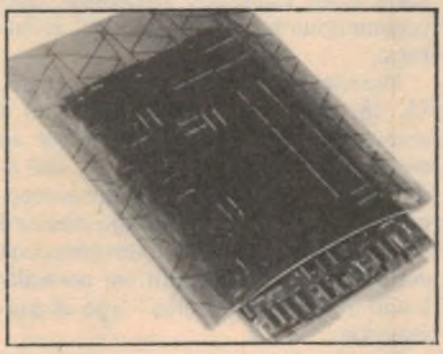
The new instrument brings general-purpose logic-analysis performance to the low-priced market. It is designed for engineers involved in the designed and test of 8-bit microprocessor-based systems.

The HP 1651A provides 100MHz transitional timing and 25MHz state analysis on all of its 32 channels. By providing all features on all channels, HP believes this makes the HP 1651A the best value available in the low-priced analyser market.

A simplified, intuitive user interface provides control of the instrument via a front-panel keypad and knob. The number of menu levels is minimised to substanially reduce moving from one menu to another. Front-panel selections are made from pop-up menus that are superimposed on the current display and show the user only valid choices for that field.

A built-in 3 1/2" disk drive provides convenient storage fast recall of instrument setups and measurement results, and a single keystroke can dump the current display to a RS-232C printer for report-quality documentation.

Further information from Hewlett-Packard Australia, PO Box 221, Blackburn 3130.



Static shielding bags

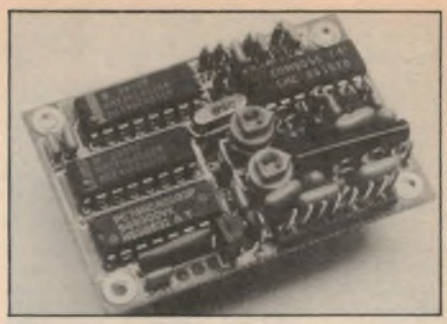
A range of metallized static-shielding bags released by Rheem Protective Packaging Products is claimed to provide complete protection against electrostatic discharge.

Rheem claims products shipped in Gridstat 9900 bags can be used immediately, without fear of static-induced damage. The bags contain a high performance, conductive grid and a metallized layer sandwiched between sheets of durable, anti-static plastic.

The bags can also be reused. A simple visual inspection is all that is needed to confirm their electrical integrity.

Gridstat 9900 bags are available in 17 different sizes to suit most applications.

For further information contact Rheem Protective Packaging Products, 3 Burrows Road, Alexandria 2015.



Low cost duplex scrambler

Measuring just 55mm by 38mm, GSA Technology's new Australian made Mini Scrambler offers speech security at a moderate cost.

Designated model GSA1000, the scrambler has been designed to offer commercial radio users affordable security by providing 8 programmable codes that dictate an audio spectrum "knee-over-point". This gives high recovered audio quality and low cost to the user. The scrambler is also claimed to be very simple to install in a radio or line communications system.

The GSA1000 will be priced under the $200 point for the end user. This should make it attractive to UHF CB band business users.

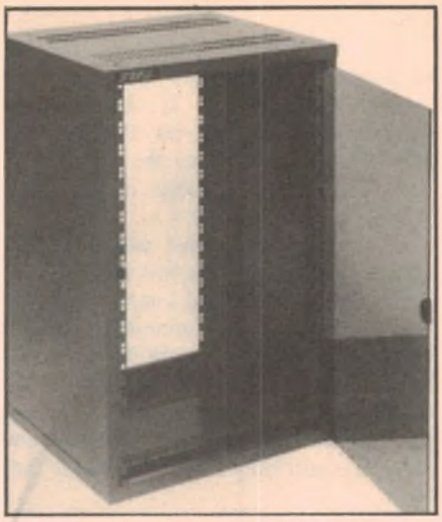
Serial mouse

Developed and made in Japan, the Neos serial mouse combines state-of-the-art technology with Japanese reliability. This is claimed to provide the user with a mouse that is not only easy to use, but highly accurate.

Features include full compatibility with the Microsoft serial mouse, optical encoding to provide superior movement sensing, the use of a silicone coated ball and Teflon feet to provide silent, smooth mouse movements.

For further information contact Alfatron, 1761 Ferntree Gully Road, Ferntree Gully 3156.

New Products



Australian made 19" racking system

CICB (Australia) has released a new Australian designed and manufactured "Studirac" 19" racking system, claimed to offer considerable advantages to users in the computer, electronics, telecommunications and broadcast industries.

The standard rack is available in 6, 8, 12, 18, 26 and 46 unit heights and a unique connector strip is available to enable expansion to virtually any size as the system requires. Only four components are used to build up the standard rack and the superior interconnection design provides a strength not normally found in the "square tube" type of construction.

The simplicity of the structure also lends itself to the incorporation of such options as CRT monitors, desk tops, etc., and being Australian made, an "ex-stock" situation normally exists.

Additional advantages claimed for "Studirac" include portability and a price level that for the first time, gives professional design strength with real economy.

For further information contact CICB at 58 Bath Road, Kirrawee 2232.

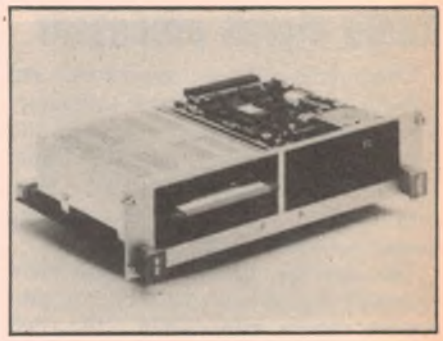
High speed arc welding robot

Lincoln Electric has announced a new model Hitachi compact 5-axis high speed arc welding robot.

The new model M5030 is a low cost compact and lightweight machine with a wide operating space and easy maintenance. It features controls and software optimised for arc welding, including a genuine operator guidance system for teaching. This means that an operator, with no knowledge about this robot, can operate the robot by simply following the instructions displayed on the teaching box, without the need to resort to complicated manuals.

The M5030 is designed to make installation and operation easy. Its construction is of a non-interference link-type structure and it is able to weld at the level of its own base, thus making it possible to mount the robot (weighing only 100kg) on the same table as the component jigs to which it is to weld. This feature, combined with its separate small controller, make installation almost anywhere.

For further information contact Lincoln Electric, 35 Bryant St, Padstow 2211.



3.5" drives on VME board

The Compcontrol CC-93 module has the standard VMEbus double Eurocard format and occupies three slots in a VMEbus card cage. It has a built-in 3.5" 1Mb floppy disk drive and a 3.5" 20Mb Winchester disk drive, with controller.

Both drives are fully SCSI compatible, and have their own ID number on the SCSI bus. Both logical units support the disconnect and reselect commands, for optimal SCSI bus usage and high performance. The SCSI lines are connected to the P2 connector, while the power supply pins of the P1 connector are the only lines used from the VMEbus.

Available modules include the following combinations:

- 1Mb floppy drive and 20Mb hard disk
- 1Mb floppy drive and 40Mb hard disk
- Two 1Mb floppy drives
- 40Mb tape drive and 40Mb hard disk

For further information contact Philips Scientific & Industrial, 25-27 Paul Street North, North Ryde 2113.

CCD camera with fibre-optic window

E G & G Reticon announces the introduction of a fibre-optic window version of its MC9128 camera. When the object to be viewed is not accessible using standard imaging optics, a flexible fibreoptic cable coupled to the camera's window can bring in the image sensing data from great distances, tight areas where a camera can't fit, or from areas too large for the image sensor itself.

The light coming into the image sensor can also be intensified by means of a microchannel plate, for low light level operation.

The fibreoptic window has been mounted directly onto the image sensor. The sensor in the MC9128 has a square format of 128 x 128 square elements on 60 micron centres. The fibres measure 6 — 8 microns in diameter and are packed together in a bundle that is larger than the sensitive area of the array.

The MC9128 modular camera is a compact, solid state camera with valuable features: high speed (up to 8MHz); asynchronous operation, accessibility to specific video lines, and a 1:1 aspect ratio.

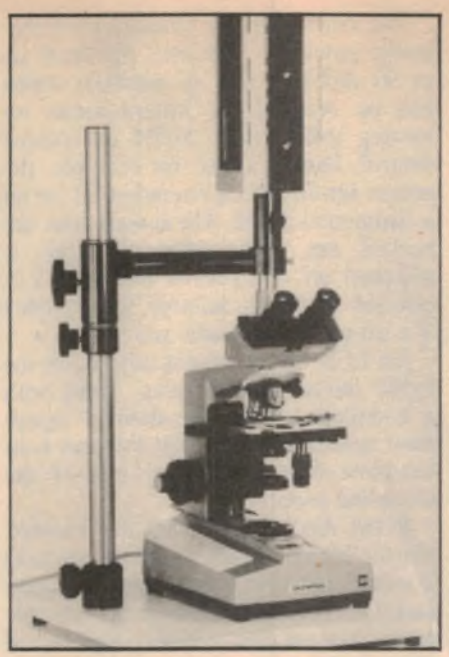
For further information contact Total Electronics, 9 Harker Street, Burwood 3125.

TV — microscope coupler

The series 2500-500 TV-microscope couplers connect any black and white or colour closed circuit TV camera to almost any microscope.

The couplers contain well corrected, coated optics and an adjustment knob to bring the TV monitor into focus at the same time the eyepieces are in focus. This "parfocality" control is of great help with a stereo zoom microscope, eliminating the need for drastic re-focusing when the microscope is zoomed to a different magnification.

Having a magnification of 1x, the



series 2500 coupler is best suited for general microscope usage, covering a large part of the field of view as seen through the eyepieces. The series 5000 has a magnification of 2x and is used when higher magnification is needed to achieve the maximum resolving power of the microscope.

A "C" mount thread that fits most TV cameras is supplied as standard equipment. Other mounts are available on special order.

Further information is available from Warsash, PO Box 217, Double Bay 2028.

Temperature recorder

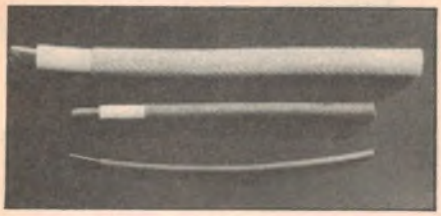
The Rustrak Digilog-55 is a new temperature recorder incorporating a liquid crystal display, which provides digital readout as well as hard copy recording. The LCD display eliminates the need for a separate digital indicator and enables the recorded value to be seen at a glance. It is self contained and the large display is readable from 10 feet away minimum.

The recorder is available in five common temperature ranges (0 — 250°F, 0 — 500°F, 0 — 1000°F, 0 — 100°C, 0 — 300°C) and is small, compact and lightweight.

Additional features include inkless, dry writing on pressure sensitive paper and interchangeable gear trains allowing 25 different chart speeds from 1/8"/h (252 days) to 30"/h (25.2h) on a single roll of paper.

For further details contact Technico Electronics, 11 Waltham Street, Artarmon 2064.

New Products



Silicone insulated cables

A new range of highly specialised silicone insulated cables has been developed in Australia by Elastomer Technologies.

The silicone insulated cables are specifically designed for use in areas of high operating temperatures and have been approved by the Victorian SEC and other electrical authorities for use in 150°, 200° and 220° applications. They are claimed to be the first Australian-manufactured silicone insulated wire cables complying with Australian Standards 3178 and 3171.

An important application area for the cables in medium sizes is by manufacturers of domestic ovens and appliances. However, the company also produces very small, highly flexible cables capable of carrying micro amperages for highly sensitive appliances such as hospital diathermy equipment. Larger cables, from 100 to 350 amps, are also available.

Further information from Elastomer Technologies, 1666 Centre Road, Springvale 3171.

Midi controlled audio matrix

The Tanktek Master Matrix M4000 series of MIDI controllable audio signal patchers uses electronic switching. The M4100 will route 12 audio signal sources into 16 destinations, while the M4200 expander increases this capability to 24 into 32.

The master matrix boasts a programmable patchbay. The user can store up to 99 different sets of patches, which can be recalled for instantaneous re-routing using either MIDI or manual control. During a mix, for example, the effects set-up can be reconfigured for an instrumental break. These memories are backed up, even when the unit is switched off and packed away, so it is claimed to be as suitable for complex live set-ups as for studio use.

An LCD screen graphically shows the entire interconnection plan, along with a complete set of user-defined equipment names, ensuring that the user is in complete control at every step of the recording process.

Rebel Audio claims that the Tanktek Master Matrix makes real-time patching possible, and brings audio signal routing under real control so that it can now become part of the creative process of music making.

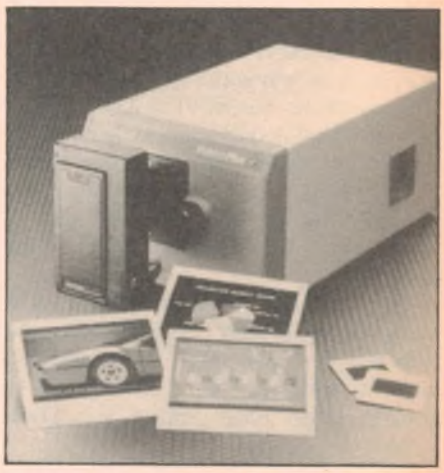
Further information from Rebel Audio, 104 Hampden Road, Five Dock 2046.

Loss angle bridge

CSD has produced a portable loss angle tangent/capacitance bridge designed to enable site staff to make capacitance and loss tangent measurement of substation components as a routine check on insulation integrity. The bridge is self contained, portable, and has a high level of immunity to electrical interference.

Based around a ratio-arm transformer, the bridge has a working voltage of 600V RMS. The frequency of operation is 80Hz, close to the power frequency, but allowing the phase sensitive bridge balance detector to be made insensitive to 50Hz interference. The bridge gives the sign of imbalance in capacitance and loss tangent separately, making it quick and easy to use. Particular care has been taken over the design of the filter circuits which drive the meters, to provide a fast response to large out-of-balance signals and a narrow bandwidth to reduce the effects of interference and noise during fine balancing of the bridge.

For more information contact Macey's Electrical Accessories, PO Box 276, Newport 2106.



EGA version of Paletteplus

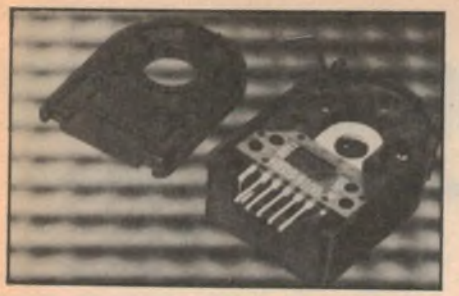
Polaroid has introduced a computer image recorder which delivers at-the-desk, high resolution colour prints, slides or overheads, from IBM-compatible personal computers using Enhanced Graphics Adapter (EGA) boards.

The new PalettePlus system, connected to a computer with a EGA or EGA emulating board (21.85kHz sweep) and graphics software with a PalettePlus driver, can produce 640 x 700 pixel hardcopy.

The system also can be used with Colour Graphics Adapter (CGA) or CGA-emulating board-equipped computers.

While the new PalettePlus is capable of producing images with resolutions as high as 920 x 700 pixels, output resolution is dependent on the actual hardware and application software combination used. For example, if the graphics application software used does not have built-in drivers for PalettePlus, image resolution with an EGA-equipped computer will be 640 x 350 pixels.

Further information from Polaroid Australia, Eden Park Estate, 31 Waterloo Road, North Ryde 2113.



"Quick-assembly" optical encoder

Hewlett-Packard has expanded its motion-control family of products by introducing a new "quick-assembly" optical incremental encoder developed for the high-volume digital-encoder market. Typical applications include printers, plotters, tape drives, positioning tables and automatic handlers.

The HEDS-5500 series encoders require only four steps to complete the mounting and assembly of the device on the motor. No follow-up mechanical or electrical adjustments are necessary to enable operation, and the mounted encoder is insensitive to radial and axial play.

Based on the HEDS-9000 series optical-encoder module, the HEDS-5500 series contains a highly collimated LED light source and an integrated circuit with detectors and output circuitry.

The HEDS-5500 series is available in nine standard resolutions: 96 counts per revolution (CPR), 100 CPR, 192 CPR, 200 CPR, 256 CPR, 360 CPR, 400 CPR, 500 CPR and 512 CPR. Other resolutions may be available on a special basis.

For further details contact VSI Electronics, 16 Dickson Avenue, Artarmon 2064.

Budget priced FM translator

Sydney FM transmitter and STL manufacturer Radio Transmission Engineering has released a new FM radio translator module as part of its development of the RTE Kikkert studio-transmitter link system. The new FML series translator module is designed around the receive end of RTE's STL.

The module receives the FM parent station programme off-air, retransmitting it unchanged on a separate translator frequency. The system is simple in operation, low cost and saves the expense of providing studio-transmitter link equipment and the expensive associated antenna hardware without greatly degrading the original programme.

The RTE Kikkert modulation system allows the programme to be retransmitted without demodulation, saving degration in noise, distortion and stereo quality. The translator will also pass on subcarrier information for Ancillary Communication Services (ACS — also known as SCA), now becoming popular.

RTE's Euroframe racking module can be used as a 30 watt stand alone self-powered device, or coupled to FM amplifiers of 100, 300 or 500 watt or larger power outputs.

Further information is available from RTE, 179 Military Road, Guildford 2161.

Locally made lab analyser

TPS has released the new Model 440, a multi-purpose multi-range digital Laboratory Analyser for electrochemistry made in Australia. It measures pH, conductivity, salinity, temperature, dissolved oxygen and millivolts. It can also be used to measure oxidation-reduction potentials (REDOX) and specific ions.

By combining the electronics of separate instruments into a single package, major cost savings have been made without sacrifice of accuracy or stability of measurements. The cost-benefits of the 440 are said to be high for laboratories requiring a wide range of instrumentation facilities, especially where some of these may only be occasionally used.

The analyser is designed for ease of use; the digital display shows the range of operation to eliminate operator errors. Automatic temperature compensation is provided where necessary.

The 440 can also be fitted with an RS-232C computer interface. This allows recording of data by any mainframe or personal computer provided with an RS-232 port and suitable software.

Further information from TPS, 4 Jamberoo Street, Springwood 4127.

Information centre

Radio data link

I would like to connect two computers together using a radio link. Do you know of any project that will allow me to do this, or of any project that I could adapt for this purpose.

The requirement is a two way radio link (half duplex) using RS232 connection. The physical link and circuitry is the only concern. The data communication will be provided by software at both ends. (R.M., Bondi NSW)

• While it is technically feasible to connect two computers via a radio link, there are important legal considerations which need to be taken into account. To put it simply, before a radio transmission of any kind can be made, a licence must be obtained from the Department of Transport and Communications (DOTC).

One of these licences is an Amateur Radio Licence, which allows transmission of many different modes (including digital modes) on a wide variety of frequencies. Radio amateurs around Australia (and indeed, around the world) are already experimenting with packet radio, an error-correcting digital communications system which allows messages to be passed between specified stations, via intermediate stations if necessary. the only catch is, an Amateur Licence does not permit business or commercial communications of any kind, nor is it permissable to encrypt the data in any way to hide its meaning. For further details you could contact the Wireless Institute of Australia or the DOTC.

60/60 amplifier

I have intermittent trouble with my 60/60 Playmaster, which I believe to be earth loops around the tone circuit. Severe crackling, hissing and degradation of signal in the right channel appeared at first to be caused by components soldered onto the front track of the board, the right track (although it is shown as the left track on page 35 of the July 1986 issue, touching the upturned portion of the metal case. After covering this edge with a nylon cover strip, the amp worked well until the front panel and lid were replaced.

Because the case bolt holes did not line up exactly with the face-plate, the bolts cut into the paint on the face-plate and contacted the metal causing the face-plate to earth.

Similarly, paint chips on the lid and non-alignment of holes, have caused, I believe, the lid to earth. The case, supplied by Jaycar is really of poor design and badly made.

The problem only occurs when the tone defeat button is out (tone controls in circuit). As a matter of interest, both IC3's have been replaced.

Could you tell me if the front panel and the lid are supposed to be earthed and if so, by what means. On the other hand, how can these items be satisfactorily isolated? (R.N.A., North Epping NSW)

• It is standard practice in amplifier designs to connect the PCB ground to the chassis at only one point (in this case the earth lug near the transformer). If this system is not adhered to, all sorts of "gremlins" will appear, as you have found.

Conversely, leaving parts of the chassis ungrounded will compromise the safety standards of the amp, and may also lead to hum or RF pickup in the circuitry.

It is generally assumed that the panel fastening screws will "bite" into the chassis when tightened, providing continuity. So all of the case metalwork should be grounded, but the only connection to the PCB ground should be that via the earth lug.

Video fader

In the January 1986 issue you published an article for the construction of a Video Fader. For the assembly of this fader I had to use a self-made PCB, because I could not get a professional one here in Adelaide.

The operation of the fader appears to be satisfactory, with one little drawback: the picture of the receiving VCR shows on the tape — and on the monitor — two broad "misty" horizontal stripes in the lower half of the picture.

Can you assist me to find a way for eliminating the stripes? (E.B., Highbury SA)

• The stripes are probably caused by the vertical sync, which is somehow appearing in the video in a delayed version. We suggest that you check the sync-stripper circuitry (Q8, Q9 and IC1a) and the sync-restoration (Q4,Q5). You should check whether there is an "echo" of the vertical sync, then trace back the source of the echo and eliminate it.

MOSFET amplifier

I built the Playmaster MOSFET amplifier of January 1981 and both channels worked fine. Then one day when I was listening to music, the right channel dropped out — that is, it stopped working. The fault was blown fuses in the right channel.

The reason for this was a 0.1uF capacitor had developed a short. I am not sure which capacitor it was, but it was one of the two capacitors across the output MOSFETs.

I repaired the faulty capacitor by replacing it with a new one. Then I developed a new problem with the amplifier.

When I fired up the amplifier as per the instructions given, I found that both channels of my 50V line were fluctuating between about 30V and 50V. This showed up on a multimeter. I intend to replace all four 2500uF/63V electros in the power supply with new ones, but here in Perth the only caps I can get are 2200uF/63V. Would these work in this circuit? (G.J.H., Tuart Hill WA)

• The problem with the 0.1uF capacitors in your Playmaster MOSFET Amp may be due to overheating. These capacitors, as supplied by some retailers, seem to have a low heat tolerance and can sometimes develop a short circuit immediately after soldering. In your case they may have been slightly overheated during the soldering process, and the operating heat of the amplifier finished them off.

The only other possibility we can suggest is that one channel of your amp may be oscillating at a supersonic frequency, and perhaps blocking. This might explain the supply rail fluctuations, too. You'd need a scope to track down the cause of the oscillations, if this is the case.

We're not sure why you want to replace the electros, but having to

install 2200uF capacitors instead of the 2500uF as specified is not a serious problem. The current capacity of the power supply will be slightly reduced, lowering the available output power into (mainly) 4 ohm leads.

IR remote control

Again I am writing to you with problems with my infrared remote TV sound control (January 1983). I went to Dick Smiths at Tighes Hill, Newcastle yesterday and they pointed out the main source of my trouble. I had installed all the transistors the wrong way. I had used their semiconductor outlines in their catalogue instead of the ones you provided with the circuit.

I bought some new transistors and installed them correctly. The circuit now works but I have to hold the transmitter only two inches away — any further and it will not work. Also if the freezer cuts in or out, or I turn the fluorescent light above my work bench on or off the circuit drops the volume level right down low.

I have not replaced the ICs in the transmitter. Should I? (R.A.G., Hawks Nest NSW)

• Your very low sensitivity could be due to reverse polarity for the BPW50 photodiode, or perhaps reversed connections for the 10uF or 100uF capacitors on the supply line to the diode and preamp.

Interference from the fluorescent light could be due to a problem in the input filter circuit (Q2, Q3 and associated components), which may also account for the lack of sensitivity — so you should check this area of the circuit too.

The interference is most likely to be caused by "spikes" on the mains caused by the light or fridge switching on or off. You could also try installing small value tantalum capacitors (say 1uF) close to the regulator, one between input and ground and the other between output and ground.

Lamp saver

Would you please advise if the Lamp Saver of June 1986 can be upgraded for loads of up to 400 or 500 watts. I wish to use the unit for home unit external security lighting.

Please also advise if the existing circuit or any upgraded circuits you advise can be used with fluorescent lights. (B.G., Ashfield NSW)

• We see no reason why the Lamp Saver cannot be upgraded to handle higher power loads. The SC141D triac may easily be replaced by the SC151D version, which will handle a much higher current. The main PCB tracks may need to be widened to handle this extra current. Please note that we have not attempted this type of modification, so you may have to experiment a little to achieve the desired results.

The circuit itself is not suitable for use with fluorescent lamps, but we described an electronic starter for fluorescent lamps in the October 1982 issue. This unit was designed to prevent flickering and increase lamp life. Copies of the project article are available from this office at a cost of $4, which includes postage and handling.

Notes & Errata

HEADPHONE AMPLIFIER FOR CD PLAYERS (July 1987, File: 1/SA/78): Although the mains wiring is correctly referred to in the text and diagrams of this article, the colours mentioned for active and neutral are reversed. The Active wire connecting to the switch should be brown, and the Neutral wire (direct to the transformer) should have been shown as blue.

EIGHT-CHANNEL IR REMOTE CONTROL (July 1987, File: 2/MC/24&25): The component overlay on page 25 should show the Mute relay as RLA10, its associated diode as D19, and the ON/OFF relay as RLA9. Also, the link shown above IC7 is incorrect. If required, the link is connected from the pin 6 (IC6) pad, to one of the nearby three D latch pads, depending on the options chosen.

Silicon Valley

Continued from page 47

Sculley can't believe what he is hearing, temporarily losing his composure for the first time since he was a little boy. He blasts back: "I made a mistake in treating you in high esteem. I don't trust you, and I won't tolerate a lack of trust."

The confrontation comes down to a "he's-out-or-I'm-out" and each of Apple's stunned executives is forced to choose sides. To the visible shock of Jobs, the executives, one by one, voice their support for Sculley. "I love Steve, but I respect John," says Del Yocam, head of the Apple II division, as he indicates his support for Sculley. Jobs can't believe what he's hearing. He bolts from the boardroom, his eyes glistering.

The next day, Jobs still can't believe he's lost all control of his own company. He even offers Sculley his title of chairman, in exchange for Sculley's presidency. Sculley refuses. A few days later, Jobs signs the necessary papers that made his departure official.

Surely nothing has come out of Hollywood since "One Flew Over the Cuckoo's Nest" that can beat that kind of action. Yet it all happened that way, at least according to John Sculley in his new book: "Odyssee: Pepsi to Apple: which has just gone on sale in the US.

Still remains the question what would have happened if Gassee hadn't known and Sculley would have been canned. We'll never know for sure. What we do know is that Apple's shares at the time were trading in the $US10-15 range. Today they are worth around $US100 each . . .

Electronic Fuse

Continued from page 79

With the fuse reset and the current control set to 0.5A and the power supply still set for 0.5A, the trimpot can be adjusted so that the relay just operates. The 10A range should not need adjustment, once calibrated.

If you do not have a current limited power supply, the unit can be calibrated by using a power source capable of supply 1A. All that is needed is a resistor and a voltmeter (or current meter). The resistor value will depend on the voltage available. Current = voltage/resistance.

So, for a 12V battery, the resistor needed would be 24 ohms to give 0.5 amps. Or for a 10V supply and a 22 ohm resistor the current would be 0.45 (Note the power rating of the resistor would be 10 x 0.45 = 4.5 watts).

Special Note: The electronic fuse is only designed to replace conventional fuses, and not to be a lab standard! An advantage over conventional fuses, however, is the reaction time. In the fast blow mode as soon as the threshold is reached it only takes milliseconds to switch off, not seconds as for fuses. So your delicate semiconductor will get much better protection.

In the slow blow position it takes about 2 seconds to react.

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.

November 1937

Gigantic PCJ aerial scheme: An interesting engineering feat has recently been carried out by Philips engineers at PCJ, consisting of a remarkable aerial system which will enable the station to switch its beam from one part of the world to another in a matter of a few moments — simply by revolving the complete two-masted aerial structure.

Television not attractive: Notwithstanding that television was for the first time displayed at this year's Radiolympia's radio show in London, the attendance was disappointing, about 36,000 less than last year, and one of the lowest figures on record. The public appears to be becoming indifferent to radio and especially to technical advances. A sorry prospect for the radio industry.

November 1962

A 24-hour hook-up: The next generation of communication satellites — the kind that will provide continuous 24-hour-a-day television programming rather than brief periodic broadcasts — is already in the making under a Government space contract awarded to Hughes Aircraft Company.

Only one of the new spacecraft will be needed to link the four continents of North America, Europe, South America and Africa into a vast communications network operating around the clock, according to Dr Allen E. Puckett.

Solar energy: Solar energy, in which France has taken the European lead, will be commercially feasible for certain uses by 1965. By then the centre Nationale de Recherche Scientifique's new oven at Odeillo, in the eastern Pyrenees, will be in operation. It is claimed to be the largest in the world.

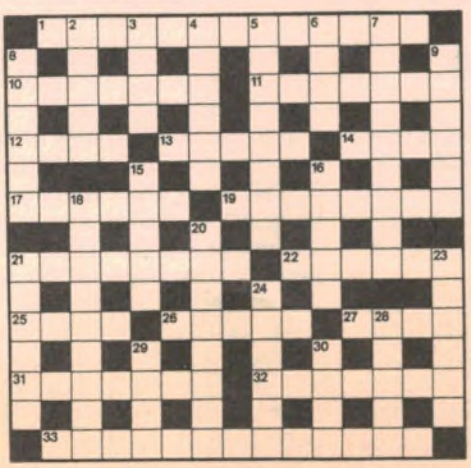
Braking Failure: An instrument giving visible warning to drivers of any defect in the braking system has been developed by an Israeli engineer.

The instrument can be used on any motor vehicle having an hydraulic braking system. It gives drivers early warning of any oil leakage in the braking system, however small, by means of a lamp on the instrument panel and shuts off the flow of oil to any part of the system where a serious leakage is taking place.

NOVEMBER CROSSWORD

ACROSS

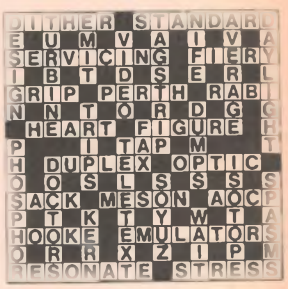
1. Early source of electrochemical energy. (9,4)
10. RAAF aircraft. (7)
11. Said of certain liquid crystals. (7)
12. Computer data unit. (4)
13. The —— particle may be detected in radioactive decay. (5)
14. Prefix indicating value of 10^{15}. (4)
17. Notes and ———-, an EA department. (6)
19. Capable of effectively reproducing sound. (8)
21. Use working replica to represent another situation. (8)
22. TV adjustment. (6)
25. Part of raster. (4)
26. Automation. (5)
27. Person operating a computer. (4)
31. Complete a telephone circuit. (7)
32. Atlas, Titan, Blue Streak, etc. (7)
33. Said of a satellite with a "fixed" position. (13)



DOWN

2. Printer's type style. (5)
3. Radiation seen over the horizon. (4)
4. First name of Tesla. (6)
5. Portable. (4-4)
6. Focussing aberration. (4)
7. Eavesdropper for the rubbish-dropper? (9)
8. Mains wire. (6)
9. Range of frequencies. (6)
15. Specification for output of printer. (5)
16. Force units in c.g.s. system. (5)
18. Residual magnetism. (9)
20. Ore of strontium. (8)
21. Join tape. (6)
23. Rocket variable. (6)
24. Inventor of the planar process. (6)
28. Lateral force. (5)
29. Cyclotron components. (4)
30. Sweep with a beam, etc. (4)

SOLUTION FOR OCTOBER



EA marketplace EA marketplace

ADVERTISING RATES FOR THIS PAGE

SMALL ADS: The minimum acceptable size of 2 centimetres x one column costs only $40. Other sizes up to a maximum of 10 centimetres are rated at $20 a centimetre. CLASSIFIEDS: $4 for 40 letters. Just count the letters divide by 40 and multiply by $4, ROUND UP TO NEAREST WHOLE NUMBER. CLOSING DATE: Ads may be accepted up to the 18th of the month two months prior to issue date. PAYMENT: Please enclose payment with your advertisement. Address your letter to THE ADVERTISING MANAGER, ELECTRONICS AUSTRALIA, PO BOX 227, WATERLOO, NSW 2017.

FOR SALE

AMIDON FERROMAGNETIC CORES: Large range for all receiver and transmitter applications. For data and price list and 105X220 SASE to: R. J. & U. S. Imports, P.O. Box 157, Mortdale, N.S.W. 2223. N.S.W: Geoff Wood Electronics, Lane Cove. Webb Electronics, Albury. A.C.T.: Electronic Components, Fyshwick Plaza, Vic.: Truscott Electronics, Croydon. W.A.: Willis Trading Co., Perth.

EX-ABC AUDIO TAPES: ¼" wide on 10½" **Standard** metal spool $6.85. **Robust** metal spool $12.85 7" spool $2.85. 5" spool $1.25. Post extra. Also in stock ½", 1" and 2" tapes. Waltham Dan, 96 Oxford St., Darlinghurst, Sydney. Phone (02) 331-3360.

REALISTIC DX200: Band Communications Receiver, 150KHz 30MHz bandspread AGC variable BFO 500 KHz marker for calibration of main and bandspread tuning. 4/14 Gretel Close, Nelson Bay. Ph: (049) 81 3907 $150.

BACK ISSUES: EA & ETI 1956 to 1986. Offers to P.O. Box 102, Campbell 2601.

VECTORSCOPE & WAPHONE MONITOR: Matched pair, excellent professional model, made by Systems Video England. $3,850 for both, will split. Phone Ross (07) 801-1321.

VZ USERS: Short basic program saves binary tapes to tape AND disk. Send $5 to P. Brennan, P.O. Box 334, Mordialloc 3195.

Build the AEM MARCH 87: STAR PROJECT 256K printer buffer and save hundreds of dollars on the cost of any commercially available unit. Double sided board, Eprom & inst. $39 plus $3 P&P. Optional boards to suit buffer include Serial converter board @$18, Printer switch @$18, and computer switch @$12 IBM type printer cables $15 plus $3 P&P. Components also available. For more info. Send SAE to Don McKenzie, 29 Ellesmere Cres, Tullamrine 3043.

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*Note: although these articles have been prepared for publication, circumstances may change the final content.

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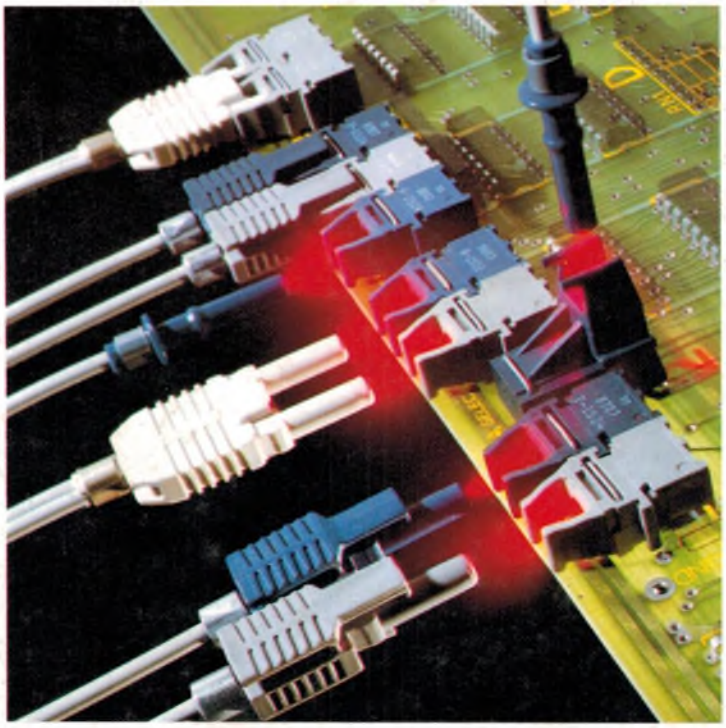

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