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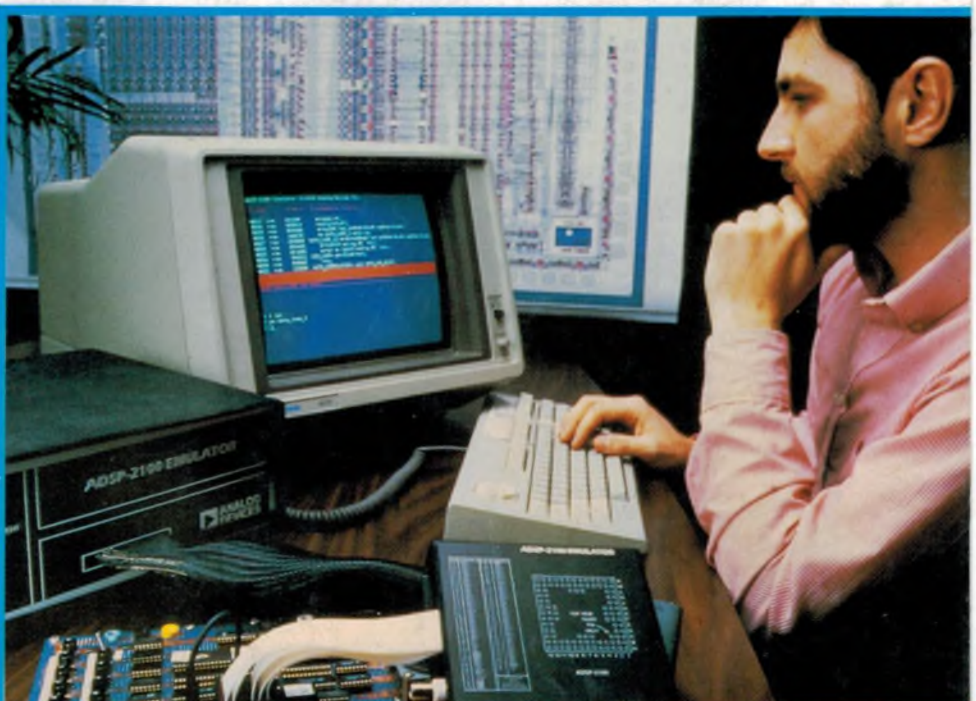

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- Metronome you set by tapping on its case!
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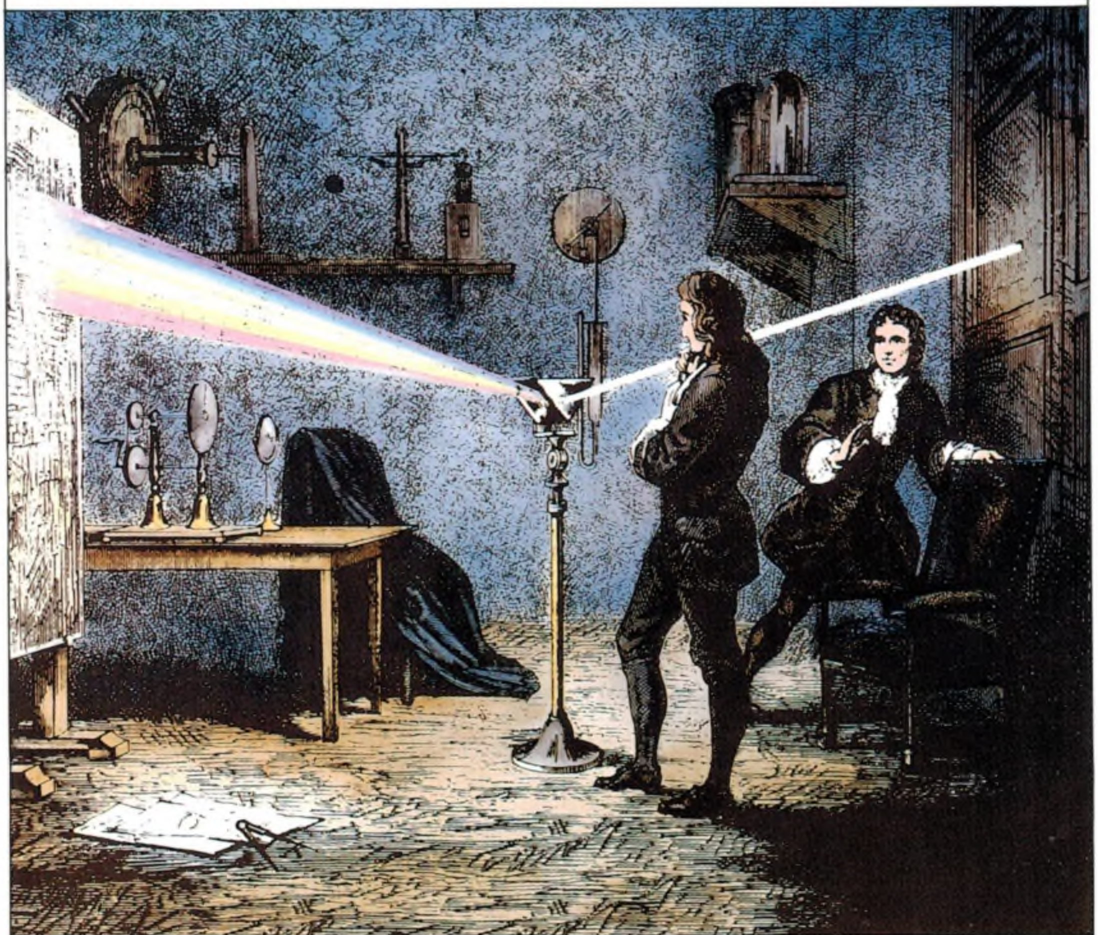

Newton refracts light through a glass prism, circa 1672. "The Bettmann Archive."

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Electronics Australia

Volume 51, No.3

March 1989

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE – ESTABLISHED IN 1922

New satellite comms for Antarctica

Communications links with Australia's Antarctic bases have now been dramatically upgraded, via the ANARESAT satellite system. Tom Moffat tells the story, in our feature starting on page 14.

Projects to build

Our construction projects for you this month include Beat Me, a novel electronic metronome which allows you to set its rate simply by tapping on the case. There's also a low cost MIDI interface for the Apple Macintosh computer, full construction details for our new low-distortion audio oscillator, and a mains driver module for the 16-channel UHF remote control.

Quartz Crystals

Always found quartz crystals something of a mystery? Peter Phillips sheds a good deal of light on these important components in the article starting on page 26.

On the cover

More and more, personal computers are becoming an integral part of many electronic systems, making interfacing techniques quite important. Quartz crystals are also being found in increasing numbers, too. See pages 26, 88. (Photos courtesy Parameters Pty Ltd, Hy-Q International).

Features

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Projects and Technical

News and Comment

Departments

MANAGING EDITOR
Jamieson Rowe, B.A., B.Sc., SMIREE
TECHNICAL EDITOR
Peter Phillips, B.Ed., Dip.Ed., ECC
PRODUCTION EDITOR
Penny Roberts
EDITORIAL STAFF
Rob Evans, CET (RMIT)
Mark Cheeseman
CONTRIBUTORS
Neville Williams, FIREE, VK2XV
Ian Pogson, VK2AZN
Ron Cooper
Jim Lawler, MTETIA
Bryan Maher, M.E., B.Sc.
Ken Pohlmann, M.S., B.S.
DRAFTING
Karen Rowlands
GRAPHIC DESIGNER
Brian Jones
ART PRODUCTION
Alana Horak
PRODUCTION
Kylie Prats
SECRETARY
Allison Tait
ADVERTISING PRODUCTION
Brett Baker, Lynda Webb
ADVERTISING MANAGER
Selwyn Sayers
PUBLISHER
Michael Hannan
HEAD OFFICE, EDITORIAL & ADVERTISING
180 Bourke Road, Alexandria, NSW 2015
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Melbourne: 221a Bay Street, Port Melbourne, Vic. 3207. Phone: (03) 646 3111
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Phone: (08) 352 8666
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Perth: 48 Clieveden Street, North Perth
Phone: (09) 444 4426, Des McDonald
New Zealand: Rugby Press, 3rd Floor, Communications House, 12 Heather Street, Parnell, Auckland New Zealand.
Phone: 796 648 Telex: NZ 63112 'SPORTBY'
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Letters to the editor

Amiga projects

I am writing to you with a few project ideas. Perhaps you are unaware of the outstanding success of the Commodore Amiga range of computers, particularly the A500. Despite their success, they seem to be ignored as far as projects are concerned. (Not everyone owns an Apple or a Microbee!).

The following are a few ideas, that could be utilised as projects by your magazine:

1 512K RAM expansion (fitted into slot provided).
2 Internal RAM expansion (up to 9 Meg boards are available overseas).
3 Modification to enable the computer to boot from an external drive.
4 MIDI interface.
5 FAX – RTTY – Morse decoder.
6 Hard disk controller.
7 2400/2400 MODEM (now available commercially).
8 A project to be able to decode weather satellite pictures.

I do hope you will give thought to some of the above projects as there are a lot of people just waiting for an electronics magazine to 'adopt' the Amiga.

Bob Hodson
Heatley, Qld

Comment: We will give these suggestions careful consideration, as you ask, and will see what can be done. Perhaps other Amiga owners may have some ideas as well.

MEK is not MEKP

I read with concern on page 5 of the December issue, a letter concerning MEK and its use as a solvent cleaner. The article from 'Aviation Safety Digest' refers to MEKP (methyl ethyl ketone peroxide), which is quite different from MEK (methyl ethyl ketone).

It's a bit like saying don't eat salt (sodium chloride), because it contains sodium! Please tell VK2ARZ to stop worrying. I have worked with MEK for years. It is a relatively safe solvent, providing it is kept away from heat and flame.

Alan Robinson,
Blairgowrie, Vic.

Comment: Thanks for the comment, Alan. See this month's Information Centre for a complete discussion on this subject.

KX-14CP1 Sony in EGA?

It was good to see your review of the Sony KX-14CP1 monitor in the October issue. I have had one of these excellent monitors for almost 12 months and have been very pleased with it. It is always nice to see a piece of equipment that one owns receive a favourable review in a magazine like *EA*.

My reason for writing though is this: In the second column on page 103 you mention you had the monitor working on EGA, which operates at 21.8kHz of course. Please help me. How did you get it to work? Everytime I go into the EGA mode the monitor loses lock. According to my EGA card manual, the CGA sync polarity is + +. I'm not sure whether horizontal or vertical sync is indicated first but it doesn't matter as they are both positive anyhow. But when in EGA mode running at 21.8kHz, one of the pulses is positive and the other negative. I believe this is for multisync type monitors to detect the type of input and to switch accordingly.

Of course if you are using an EGA card that is in CGA mode the signal is still at 15.75kHz. So if you were in EGA mode, have you done anything to make it work correctly – i.e., invert one of the syncs? I'd like to be able to get my monitor to work on EGA and haven't had any success. I hope I have done something stupid and you can enlighten me.

Wayne Bertram
Clearview, SA

Comment: Your puzzlement is quite understandable, regarding how we supposedly used this monitor with an EGA video card. The answer is that we didn't – even though we thought we had, at the time! In reality we had been 'fooled' by a multi-mode video card, which had in fact been slipped into CGA mode by the software we were using. (A note to this effect appeared in the December issue, on page 157).

We apologise for this inadvertently misleading error. To the best of our knowledge, the KX-14CP1 won't operate in EGA mode. Sony also confirms this, sad to say. So you didn't do anything stupid, Wayne – it was us.

VHF-UHF amplifier

I am concerned that your attempts to convince readers of the quality of the Improved VHF-UHF Masthead Amplifier (*EA* Dec. '88) may have been unfair to previous designs, including those developed and sold through Oatley Electronics. Your article infers that this new amplifier is technically better than any of those previously published.

For example, quoting the article '...the R&D people at Dick Smith Electronics have spent a great deal of time and effort to investigate the problems with earlier designs..' To clarify the definition of 'earlier designs', the article states 'There have been quite a few designs for VHF-UHF masthead amplifiers, in various magazines.'

It may be that the intention was to merely compare the new design to those previously developed by the Dick Smith team, which is fair enough. But this should have been stated in the article, and I can only conclude that my designs are lumped into those being compared.

In fact, in a close examination of the new design I suggest that, while it no doubt works well, several things could have been improved. For example, the prototype appears to have the capacitors and the IC installed with little concern for minimising the lead length. Also, there is no input protection, and the use of a 12V regulator is unnecessary.

I have had two different VHF/UHF amplifiers published. My first design used an OM335, but without input protection. This design has since been discontinued from our range, due to its susceptibility to destruction during a thunderstorm. The second design uses the OM350, and has input protection. This design has proven to be very successful, and none have been reported as failing during a storm.

The method of housing the DSE unit is somewhat similar to my design, although I elected to bring all leads from one end, rather than both. This makes for a more weatherproof enclosure.

I am concerned that the adverse reference to 'other designs' will influence the sales of my unit, which has been proven as a reliable, effective unit.

B. Justic
Oatley Electronics Oatley, NSW

Comment: It was not our intention to imply that the new amplifier is better than all other designs, simply that earlier designs were examined as a reference. As far as we know, your own designs were not included. We agree this is not made clear in the article, and hope this now corrects the omission.

Editorial Viewpoint

Communications leading us to a truly global outlook

Working away here in our cramped little temporary office after last year's fire, battling to get out each issue, it's easy at times to forget that the fruit of our labours – the magazine itself – is read each month by a lot of people. Most of you are within Australia and New Zealand, of course, but it's surprising at times to learn just how far afield the magazine can reach.

I was especially gratified this month to learn that my Forum column in the December issue (on oxygen-free copper cables) was read – and apparently appreciated – as far away as London.

In the column I referred to an article written by Douglas Self, a respected British professional audio designer, in the July 1988 issue of *Electronics and Wireless World*. This seemed relevant because he had discussed the problem of 'subjectivism' in audio engineering, and made a particularly convincing case against it.

Following my reference to the article Mr Rod Hibberd, a friend of his living in Sydney, had apparently sent Mr Self a copy. Mr Hibberd also very kindly sent me a copy of his reply, a few days ago, and it made interesting reading.

As it happens, he seems to agree with me that the various theories so far offered to support the use of OFC in audio are rather less than convincing – despite all the marketing hype. But to me what the letter also demonstrated was that true professionals everywhere are happy to consider ideas on their objective merits, regardless of their origin.

To people with this kind of constructive outlook, the world really is a global village. And thanks to today's burgeoning communications technology, it's now possible to exchange ideas with anyone almost anywhere on the planet in virtually real time. When you think about it, this surely holds enormous potential for future co-operation and human development (or the opposite, if we're not careful).

I was reminded of this again while editing Tom Moffat's excellent feature article for this month's issue, on the new satellite communications system linking Australia's Antarctic bases with the mainland. Only a couple of years ago, the only link to these bases was via SSB transmissions on HF, riddled with static and fading. But now they can call just about *anywhere* with 'across the street' quality, send and receive fax, or log into mainland computers.

The same applies today for almost any remote location, and even on ocean liners. The technology for a communications 'world village' is just about in place, without a doubt. Let's hope humanity can put it to constructive use.

Jim Rowe

What's New In Entertainment Electronics

Philips & Sony complete CD-I specs

Philips and Sony have completed the final development work on the full functional specification for the Compact Disc interactive system (CD-I). This final specification, otherwise known as the Green Book, is now being made available to licensees worldwide.

The CD-I system, a joint development by Philips and Sony, features the wide interactive use and application of data and information, such as text, audio (music and narration), still image and motion video, animation, graphics and computer programming. As with CD digital audio and CD-video, CD-I is based on international standards for full compatibility and creates the opportunity for the development of a wide spectrum of software for entertainment, information, and education.

The first provisional CD-I specification was issued in June, 1986, and the proposed full functional specification was announced in June, 1987. The release of the Green Book comes as a result of extensive testing of prototype systems, and incorporates the input Philips and Sony have received from both hardware manufacturers and software developers.

This release is expected to accelerate preparations to introduce CD-I software and hardware products in the near future.

6-disc CD player

Pioneer Electronics has released a new multi-play compact disc player, the PD-M900. The flagship of Pioneer's multi-play CD player range, it combines advanced features with the convenience of a six disc multi-play unit.

The PD-M900 has the capacity for random programmed play of 32 tracks for 6 discs. Effectively, this means that the unit can supply up to six hours of continuous music, played in random order from the six discs loaded into the magazine. This makes it an excellent choice for parties or as general background music.

Accurate and quality sound is assured through the inclusion of an 8-times oversampling digital filter along with a twin 'glitch-less' linear-envelope D/A converter system. The player has been constructed with a copper-plated honeycomb chassis and large insulators to protect against resonance. Four separate power supplies have been provided, eliminating any fluctuation of the power supply.

Other features include time fading editing, digital level control with memory and a full-function remote control unit with multi-cartridge programming capability.

The PD-M900 is available at an RRP of $1099.00.

LCD video projectors hit Japanese market

At least four major Japanese consumer electronics firms have announced the release of large-screen colour video projectors using LCD panels to generate the three colour images, a development which could produce a significant expansion of the large-screen video market.

The firms concerned are JVC, Toshiba, Seiko Epson and Sanyo. The projectors so far demonstrated by each firm are significantly smaller than earlier types using cathode-ray tubes, yet produce very high picture brightness and definition. All appear to use a tungsten-halogen lamp as the light source, with a system of dichroic mirrors to split the light into the three primary colours, and three separate transmission LCD panels to achieve modulation. The images are then recombined by dichroic prisms, before passing to a single high-efficiency lens system.

All image convergence is therefore preset inside the equipment, with only a single control required to focus the final image on the screen. Operation is therefore much simpler than with earlier colour video projectors.

Perhaps the most impressive unit so far is the Toshiba LCV, which uses three amorphous silicon TFT/LCD panels measuring 69mm square. It can produce images up to 100" diagonally, with a brightness of no less than 250 foot-lamberts for a 40" picture. The picture resolution is 350 x 240 pixels.

The JVC and Seiko Epson units appear to be very similar. Both use active-matrix TFT/LCD panels 32mm square, and can again produce images up to 100" diagonally. Resolution is 320 x 220 pixels and the units measure only 420 x 266 x 125mm, with a weight of 7.6kg.

Sanyo's projector uses LCD panels 150mm square, and achieves a brightness of 60 foot-lamberts for an image of 100" diagonally. It also appears to have the highest picture resolution, achieving 640 x 480 pixels.

VHS-C camcorder has 12:1 zoom lens

The new Sharp VLC750X camcorder has a 12-times variable-speed power zoom lens, letting the user move closer to a distant subject than ever before. It also has a completely automatic one-touch operation to set all major functions.

The VLC750X records on small and easy to store VHS-C cassettes and the unit comes with an adaptor which allows the cassettes to be played back on a normal recorder/player without delay.

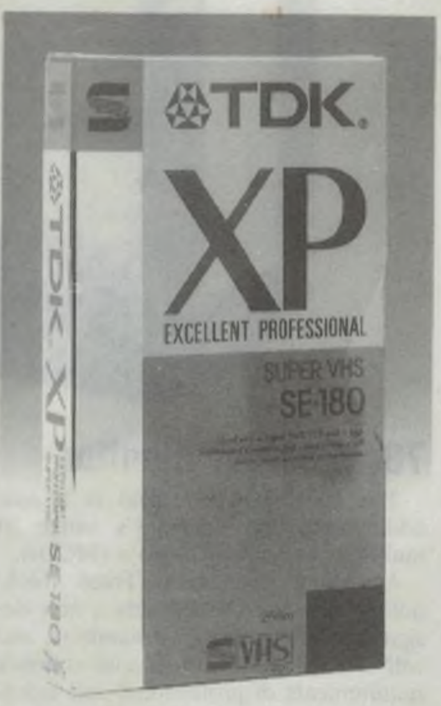
Additionally the VLC750X has automatic focusing, white balance and a high speed 1/1000th-second electronic shutter for fast action. A further feature is a self timer which has two modes of operation: It allows you to be in the picture even though you are operating the Camcorder – simply press the button once and the camera waits 10 seconds before recording for 20 seconds. Press the button twice and the camera waits for 10 seconds before recording until the end of the tape – or until the stop button is pressed.

A fade control allows both video image and audio sound-track to fade in and out, whilst the flying erase head ensures smooth, noiseless scene transitions. Then, when filming has been completed, the audio dub feature permits users to dub a new sound-track over the existing video image – giving them total creative licence.

The VLC750X has a liquid crystal display which provides a variety of information including a warning when the battery is low, if there is no tape left, if the dew level is too high and other data such as tape speed, tape counter, focus mode, white balance mode, recording speed mode and shutter speed mode.

Sharp's VLC750X retails for below $3000.00.

S-VHS videotape from TDK



TDK (Australia) has released its new S-VHS 'XP' video tape, claimed to offer unprecedented refinements in tape development, offering 425 horizontal lines of resolution.

The modified circuitry in an S-VHS recorder relies on a shorter head gap. The head gap has been reduced from 0.3 microns to 0.25 microns compared to conventional VCRs. Although this may not sound much, it makes a tremendous difference in picture resolution and detail. Also the tape surface must be smoother than premium grade conventional VHS video tape to prevent dropouts and assure vital head to tape contact.

To ensure minimisation of spacing loss between the head and the tape, critical for consistent short wavelength recording, the S-VHS XP tape has been manufactured using TDK's specifically designed ultra-fine Super Avilyn particles. These have a coercivity 30% higher than TDK's highest VHS grade tape – HD-XPro.

A heavy duty binder, new back coating and anti-static shell all assure long term drop out protection. The S-VHS XP is available in 180 minute playing time and has an RRP of $29.95. It is available at selected TDK dealers and department stores.

Record-once CD may overtake DAT

Seemingly trapped in an impasse over software copyright, digital audio tape (DAT) may be overtaken by yet another form of the ubiquitous compact disc: CD-R, or discs that can be recorded once using a simple recorder.

Japanese components maker Taiyo Yuden has produced discs that can be recorded using a laser power of only 7 – 9mW, and then played back using virtually any normal CD player. With the typical CD player laser power level of less than 0.5mW, recorded CD-R discs can be played more than 20,000 times without any degradation of the recording.

Operation of the discs depends on an organic pigment layer. This is highly transparent initially, but darkens when hit by the recording beam, producing the equivalent of a 'pit' on a normal CD.

This month Taiyo Yuden begins pilot production of CD-R discs, in a plant capable of producing up to 200,000 discs per month. When in mass production the discs are estimated to cost around $7 each.

Compact Aust-made subwoofer

The Monolith 1000 is part of the Ultimate range of subwoofers, which are designed, constructed and tested in Melbourne by GNP Acoustics.

This model uses twin 250mm edge-wound Neoflex voice-coil drivers, in a push-pull arrangement to cancel distortion. A -3dB frequency of 33Hz is obtained from the modest-sized system, which measures 340 x 340mm in floor area and 750mm high, and is styled rather like a plant stand.

Overall weight of the system is 18kg, the cabinet being made from 25mm high density craftwood and heavily braced. The two-pack high gloss polyurethane finish is in black and white.

Sensitivity of the Monolith 1000 is 92dB/1W/1m, and it has a rated power handling capability of 50-150W RMS per channel. Nominal impedance is 6 ohms. With a frequency response of 33 – 120Hz, it is suitable for crossover frequencies in the range 70 – 100Hz.

GNP Acoustics is a member of the Oz-Fi Manufacturers Guild, and in addition to the Ultimate range of subwoofers also makes two ranges of full-range systems – the Designer series and the Reference series. Further information on its products is available from GNP Acoustics, 2 Berwick Street, Reservoir 3073 or phone (03) 470 3171.

70cm colour monitor

The Barco OCRM 2840 is a new addition to the company's range of multi-purpose colour displays (MCDs).

Australian distributor Trace Technology says the OCRM sets a new design standard in universal monitors, and will suit the most various and complex requirements of professional and industrial end-users.

The monitor's compact dimensions allow it to be installed almost anywhere; yet it boasts a screen size of fully 70cm, with a 0.68 pitch and horizontal resolution of 600 pixels. Three video inputs allow a variety of video sources – including the widely accepted Super VHS – and an automatic switching power supply enables the unit to work on either 110V or 220V power.

Other significant features of the Barco OCRM include full function remote control, and stereo sound with 2 front and 2 side loudspeakers, with connection for external loudspeakers.

Further details are available from Trace Technology, 200 Rouse Street, Port Melbourne 3207 or phone (03) 646 5833.

Inside today's video tapes

Much of the impressive performance of the latest video recorders, camcorders and personal video players is derived from recent developments in magnetic tape technology. Ian Graham reports here on the proliferation of high grade blank video tapes and how they achieve their improved performance.

Recent VHS-C and standard VHS videocassette tapes released in Australia by JVC, illustrating the various grades of tape.

Do you know your Particle Fineness Factor from your Picture Purity Index? And does a video tape's BET value mean anything to you? As video cassette recorders have improved over recent years and video users have become more discerning, recording tape technology has had to advance too, to keep pace. Most video tape manufacturers now offer at least two different grades of blank video tape, with a bewildering array of new terms to describe their properties and performance.

The development of video recording tape made from smaller and smaller magnetic particles has made it possible to manufacture a range of different grades of video tape, where before there was only one. Smaller magnetic particles in the tape and closer packing of the particles translates into better quality picture and sound recordings.

The tape manufacturers have adopted a confusing variety of names for their tapes – Premium High Quality, XL-HIFI, Extra High Grade, High Definition Grade, Super XG, etc. Some of these grades are of equivalent quality, but it's almost impossible to tell from the names alone. Manufacturers have developed ways of measuring the capabilities of different grades of tape. But as is usual in the video industry, different manufacturers use different standards which are difficult to compare.

BET value

TDK's 'BET' value indicates the size and packing density of the particles on the tape, but in a rather roundabout way. As the tape's magnetic particles are made smaller, the total number required to make up a certain weight increases. The more particles there are in a given weight, the greater is their surface area. The BET value is the surface area of one gram of the magnetic particles, measured in square metres per gram. So, a tape with a BET value of 35 means that one gram of its magnetic particles has a surface area of 35 square metres.

A tape with a higher BET value indicates that its magnetic particles are smaller and packed together more closely, and so the tape should be capable of improved recording quality.

Particles per line

Maxell uses a different measurement – the *Particle Fineness Factor* (PFF). This is the total number of particles in the magnetic layer of a tape required to record a single line of a television picture.

Higher quality tapes have smaller particles packed more closely together, and so more of them are used to record a line of a picture. A larger Particle Fineness Factor therefore indicates that the tape should be capable of better recording quality. As a rough guide, a basic grade blank video tape might have a PFF of 50-100 million. By comparison, a hi-fi quality tape such as Maxell's XL-HIFI has a PFF of 330 million, while a top grade tape such as Maxell's RX (PRO) has a PFF of 510 million.

The quality of a television picture or video recording is judged by signal-to-noise ratios (S/N). In this context, noise doesn't mean crackles or hisses coming from the loudspeaker. A 'noisy' television picture looks grainy or it may be covered in white speckles or streaks, or any combination of these.

The *luminance* S/N ratio determines the picture's sharpness and clarity. The *chrominance* S/N ratio affects picture quality two ways – AM (Amplitude Modulation) is concerned with colour intensity and PM (Phase Modulation) affects the picture's colour tones.

TDK has developed a picture quality

rating that takes all three of these parameters into account. Called the Picture Purity Index (PPI), it is calculated by:

PPI = Luminance S/N x Chrominance S/N (AM) x Chrominance S/N (PM) x 100.

A basic grade blank video tape might have a Picture Purity Index of just over 100. A high grade tape (with a BET value of 35) such as TDK's E-HG, has a PPI of 188. The highest quality TDK tape (HD-X PRO) with a BET value of 50 has a PPI of 266.

No matter how wonderful the tape's magnetic layer is, the picture quality of a recording will suffer if the tape does not run smoothly through the recorder. If the friction between the tape and the capstans and rollers that guide it varies abruptly, the tape jitters and hiccups its way through the recorder. These sharp changes in the tape speed and position at the video heads show themselves as sound distortion and flickering or worse in the recorded picture.

To minimise this, tapes now have a fine coating of carbon on their back surface. The carbon lubricates the tape, to enable it to move smoothly. It also dissipates any static electrical charges that might otherwise build up on the tape and attract dust and dirt.

Hardware developments

Four video recorder developments in particular have spurred these advances in tape technology – HQ, hi-fi video, the camcorder and Super VHS (S-VHS).

HQ (High Quality): This is an improved recording system that processes the picture electronically to make it clearer and sharper. Recorders with the system usually have an 'HQ' emblem printed prominently on the control panel. HQ places greater demands on tape performance.

Hi-Fi Video: Before the hi-fi video recorder came along, sound was recorded in a long strip along one edge of the tape. For stereo sound, the strip was divided into two tracks, each less than half the width of the original single mono sound track. Sound quality suffered.

Video information was and is still recorded across the width of the tape. A VHS tape plays at a linear speed of 23.39mm per second – slow compared to an audio tape cassette's 47.5mm/sec. Because of the video tape's low speed, the sound quality of a recording is well below hi-fi standards. The introduction of long play video recorders, capable of doubling a tape's record/playback time by running it at half the speed, worsened the problem. Noise reduction systems helped to reduce the high level of tape hiss, but this is only part of the problem.

To improve stereo sound quality to something approaching hi-fi standards, a new way of recording the sound had to be developed.

An immediate improvement in sound quality could be made by recording the sound in the same way as the pictures – that is, by tape heads mounted in a spinning drum, laying down audio tracks across the width of the tape at a considerably higher writing speed. Of course the major problem in trying to develop this sort of system is that the area of the tape where one would like to record sound is already occupied by video tracks.

It would be relatively easy to develop a system which recorded audio and video tracks alternately across the tape, but it would be incompatible with all the existing VHS recorders and tapes. As VHS is such a dominant video format throughout the world, manufacturers naturally wanted any new system to be compatible with all existing VHS recorders and tapes.

The answer was to provide two ways of recording sound on the tape. The existing 'linear' tracks along the edge of the tape were preserved. But additionally, sound tracks were recorded in the same place on the tape as video information but at a different 'depth' in the tape.

The sound is recorded first. Then the video tracks are laid down on top of the sound. The higher frequency video signals do not penetrate the tape as deeply as the audio signals. The top layer of the tape contains only video information, which has erased the sound tracks down to a certain depth. Below this, the sound recording is intact. Although the two signals exist together in the same piece of tape, they can be recovered separately quite easily.

Like HQ, this system requires more of the video tape. It has to be of a predictable high quality not only at the sur-

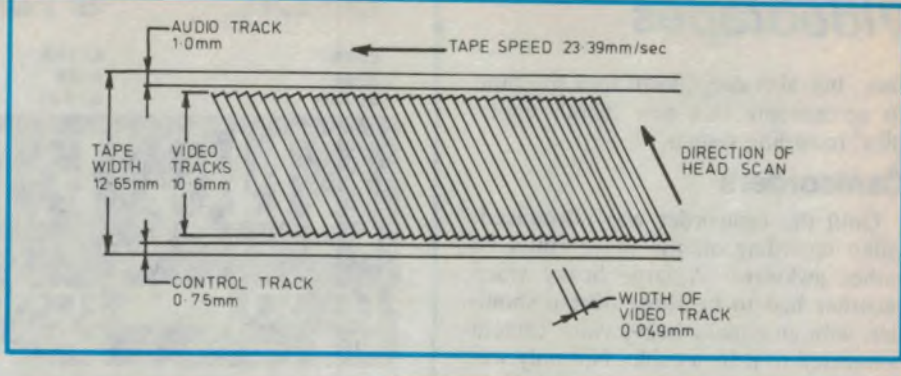


Fig.1 (above): Video recorders store the picture information in tracks across the tape.

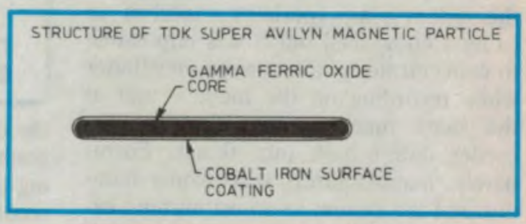


Fig.2 (right): Each magnetic particle is a needle-shaped ferric oxide crystal between 0.2 and 0.5 micron long.

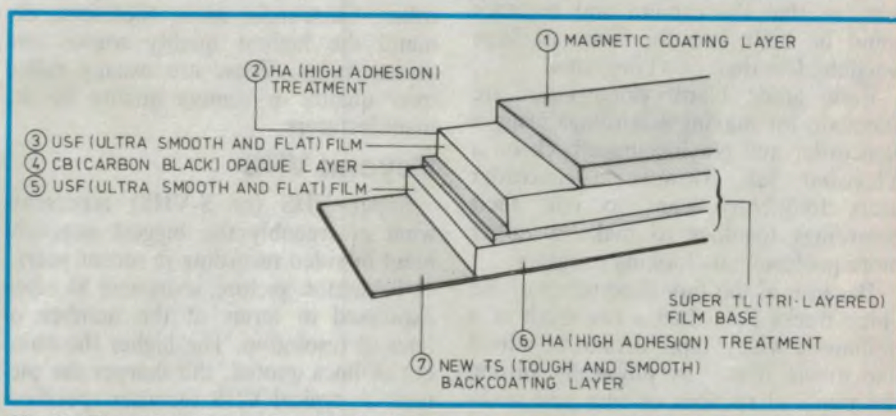


Fig.3: The structure of a high quality tape – here TDK's HD-X PRO grade, which consists of no less than seven layers.

face, but also deep down into the tape to accomodate this new 'depth multiplex' recording system.

Camcorders

Until the camcorder was introduced, video recording on the move could be rather awkward. A large heavy video recorder had to be slung over a shoulder, with an equally heavy video camera connected to it by a cable. Not only was the system heavy (perhaps a total of up to nine kilograms) but it was impossible to concentrate on the camera viewfinder while recording on the move – and at the same time ensuring that the recorder didn't bash into things. Fortunately, manufacturers successfully miniaturised the system to an astonishing extent, so that the camera and recorder could be built into the same package weighing less than two kilograms.

Basic grade blank video tapes are adequate for making recordings using a camcorder and playing them back on a television set. However, camcorder users frequently want to edit their recordings together to make a rather more professional– looking program.

Because of the tiny dimensions of the video tracks (less than a twentieth of a millimetre wide), tapes cannot be edited like movie film – by physically cutting the required sections of film and sticking them back together again in the appropriate order. Video tapes are edited entirely electronically, by copying the required parts of the recordings from the original tapes onto the 'master' program tape. Any shortcoming in recording quality is compounded every time a recording is copied from one tape to another. Camcorder users, therefore, demand the highest quality source and master tapes. These are usually called 'pro' quality or *camera* quality by the manufacturers.

TDK has recently released VHS-C videocassettes with its middle-range E-HG formulation. The company's rating system is shown below.

Beyond VHS

Super VHS (or S-VHS) represents what is arguably the biggest improvement in video recording in recent years.

Television picture sharpness is often expressed in terms of the number of lines of resolution. The higher the number of lines quoted, the sharper the picture. A typical VHS recorder specification might reveal a figure for horizontal resolution of around 250 lines, whereas a typical television set can resolve about 400 lines horizontally. Video recorder manufacturers have been trying to close the gap between these two figures.

Super VHS recorders improve picture quality by keeping the picture's colour and black-and-white information further apart than normal. This reduces the amount of interference between them, and eliminates one common picture fault called *cross-colour*.

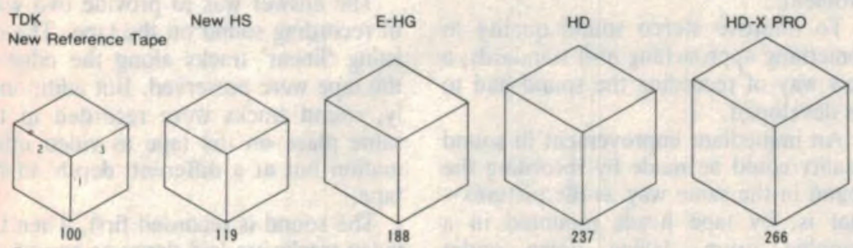
The colour and black-and-white information from which the picture is constructed are recorded as signals of two different frequencies. With normal VHS the two normally overlap slightly. A high frequency black-and-white signal produced by a very fine pattern comes very close in frequency to a low frequency colour signal. Sometimes the television set gets it wrong and actually decodes the signal as colour. This causes the shimmering false colour effect sometimes seen in a television presenter's finely patterned clothes. By increasing the frequency separation of the two signals, this fault is eliminated.

Super VHS recorders can deliver a resolution of over 400 lines when viewed on a television specially made to accept colour and black-and-white signals separately. Even a normal television set can resolve around 300 lines from a super VHS recorder – still an improvement.

A rival system from Sony, called ED-Beta, uses the same method for improving picture quality. Sony is also developing a 'Super' version of its mini video format – Video 8. JVC has already developed a 'Super' version of its mini video format – VHS-C.

So, just when you thought that the turbulent video market was settling down, the manufacturers have set off on another technology war – bringing us Super VHS, Super VHS-C, ED-Beta, Super Video 8 and a range of different grades of video tapes. Here we go again!

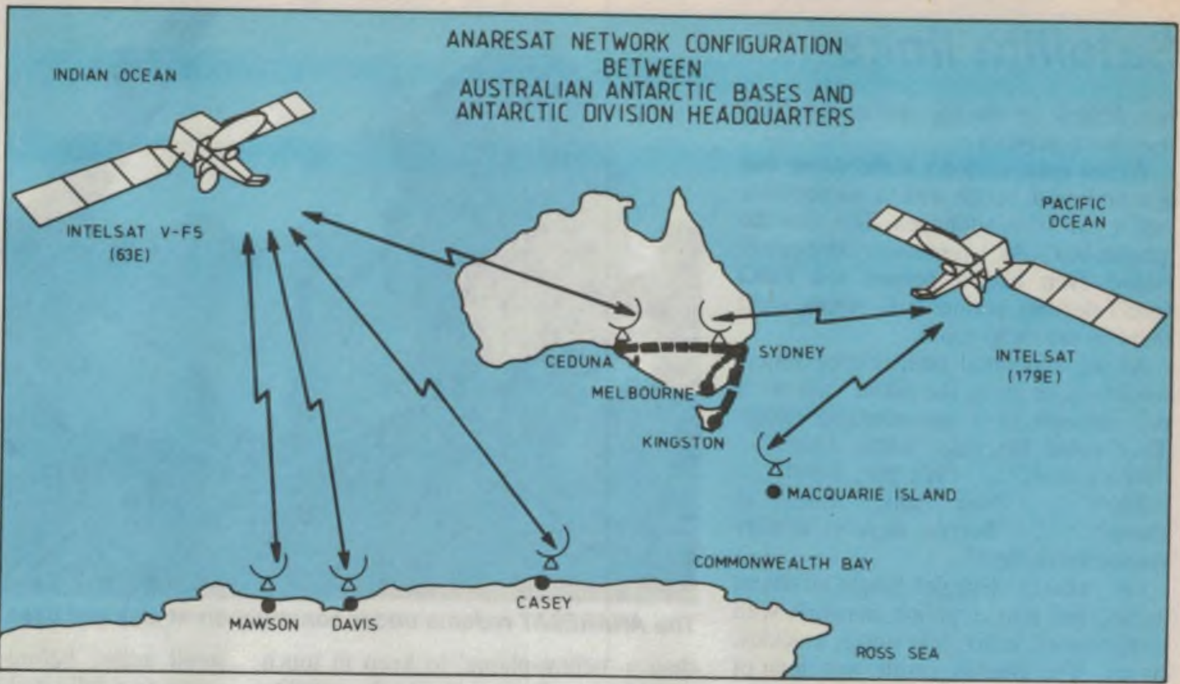
●"Cubic" Comparison of Picture Purity



①luminance S/N ②chrominance S/N(AM) ③chrominance S/N(PM)

●Picture Purity Indexes for TDK Video Cassette Tape

tape / picture purity factor	TDK New Reference Tape	New HS	E-HG	HD	HD-X PRO
factor 1 luminance S/N (brightness picture sharpness)	0dB (×1.0)	+0.5dB (×1.06)	+2.0dB (×1.26)	+3.0dB (×1.41)	+3.5dB (×1.50)
factor 2 chrominance S/N(AM) (color saturation vividness)	0dB (×1.0)	+0.5dB (×1.06)	+2.0dB (×1.26)	+2.5dB (×1.33)	+3.0dB (×1.41)
factor 3 chrominance S/N(PM) (hue tone fidelity)	0dB (×1.0)	+0.5dB (×1.06)	+1.5dB (×1.19)	+2.0dB (×1.26)	+2.0dB (×1.26)
Picture Purity Index: ①×②×③×100	100	119	188	237	266



Basic linking involved in the new ANARESAT system, which uses transponders on two Intelsat satellites.

relay to stations of other countries in the area, and personal messages.

All traffic for Australia was relayed through the Casey Station (but no longer through Macquarie Island). So Casey was a busy place too, and there were always lots of jobs in Antarctica for skilled radio operators.

From the expeditioner's point of view, personal traffic was the most important function of these stations – messages home. Because of the intense traffic load on the circuits, expeditioners were limited in the number of words they could send each month. An encoding system was set up, so that common sentences could be reduced to a five-character code group. So something like 'WYABC' might mean "we had a big blizzard here yesterday" or 'WYDEF' might mean "I fell down a cravasse and broke a leg". These messages were called *Whizzers*, probably after the code 'WYZZA' which means "I love you and miss you very much".

Getting a Whizzer was always a big buzz for any expeditioner. You were handed a little sheet of paper out of the teleprinter with all these five letter code groups typed on it, and you spent the next few minutes ploughing through the Anare code book to see what the message meant. The entire session would be punctuated with roars of laughter or whoops of joy as each little code group revealed itself.

The code book had a blank back page, which clever expeditioners used to record 'special' codes they had cooked up for communication with a loved one prior to leaving home. Some of these codes had quite intimate meanings, and you could always tell when one of your friends had come across one by the colour of his face!

The completed ANARESAT radome at Mawson base. In the foreground is the Inmarsat terminal, which will act as a standby for ANARESAT.

The HF radio system also had a single-sideband facility which allowed 'RADFONE' phone calls back to Australia from the Antarctic stations, and these were usually a real adventure. Each station had a couple of 'sked' times every day, during which a radio operator at OTC in Sydney would patch the Antarctic signals through to a number dialled up on the Australian STD telephone network.

Within each station's radio room was a soundproof booth with a microphone and a pair of headphones. This was the 'phone box'. As I remember Macquarie Island even had a proper red PMG (pre-Telecom) phone box, sitting right there in the radio room.

At the appointed hour, expeditioners would queue up as the phone calls were put through in a pre-arranged order. Then came the fun: "Hello Mum!"... "Who's that?" ... "It's me, John!" ... "Who?"... "Your son, John, at Davis!!" ... "Sorry, there's nobody named Davis here".

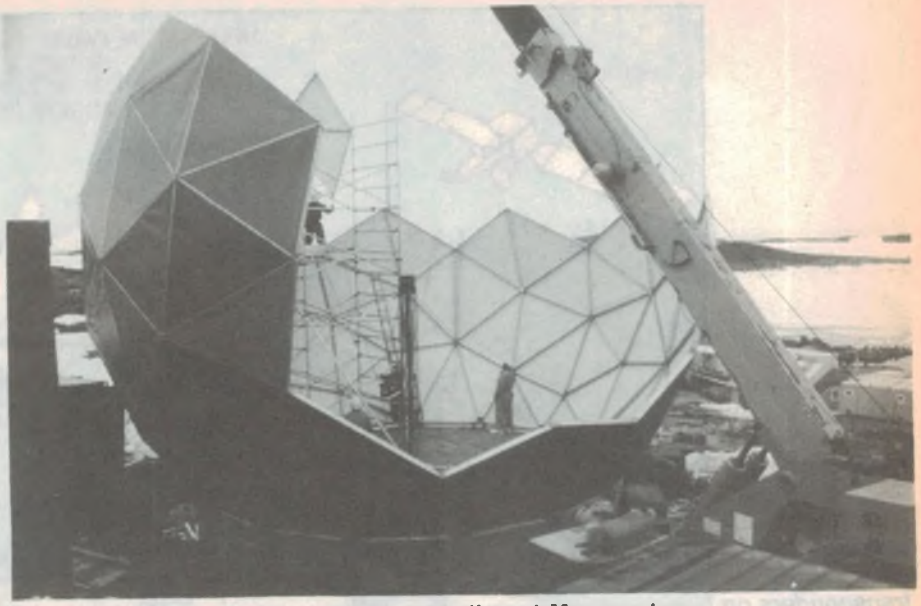
Oh, what a struggle! Single sideband audio, fed into a phone network with compressors, echo, line noise, crackles, bangs. The overall result was lots of frustration, repeats, and wasted telephone time, as expeditioners tried to carry on normal phone conversations with home. I remember blowing an entire three-minute phone call from Macquarie Island once just trying to convince my wife it was me calling her.

But even with all the problems, RADFONE calls were worth it just to hear a few words from a loved one, and the system was always fully booked.

The single-sideband facility could also be used for direct communication between Antarctica and the Antarctic Division's headquarters at Kingston near Hobart, without the need to go through OTC. The headquarters building has an Icom M700 marine transceiver in its communications room, connected to a gigantic rotatable log-periodic antenna. This equipment has provided good reliable contact with stations down south, and in the early stages of the satellite system it still keeps a listening watch on the primary Antarctic HF frequency.

As time went on, the Antarctic HF radio system, although using the very best of equipment, suffered more and more problems as more and more pressure was put on it. The location of the stations on the Antarctic continent meant they were constantly affected by auroral disturbances and increased solar influence on the ionosphere. And with scientific and administrative activities increasing all the time, data flow through the low-speed telex circuits multiplied.

There was increased demand for high-resolution picture transmission via fax, and to cap it all off, modern expeditioners were expecting something better than a 'bellow-phone' to keep in touch with home. It was definitely satellite time.



The ANARESAT radome under construction at Mawson base.

ANARESAT to the rescue

ANARESAT is implemented within Intelsat's VISTA system. VISTA is a low density telephone service which provides about 300 full duplex voice grade channels for use by small communities in isolated areas. Examples are places like Christmas and Cocos Islands, which now have a total of ten telephone circuits connecting them into the international telephone network via the Ceduna earth station in Australia. For the first time islanders can direct-dial ISD calls to anywhere in the world, over circuits that provide 'across the street' telephone quality.

The VISTA system looked a natural for the Antarctic stations – after all, they *are* small communities, and there's no question that they're isolated! VISTA would provide high quality telephone circuits, especially when compared with HF radio, and it opened the door to high-speed data transmission as well. But could the Antarctic stations be able to access the satellites?

Because Intelsat satellites orbit over the equator, and the Antarctic stations are so far south, the 'look angle' to the satellites is very low. There was concern that the proximity of much of the signal path to the ground would cause rapid fluctuation of signal strengths. This is known as 'scintillation effects'.

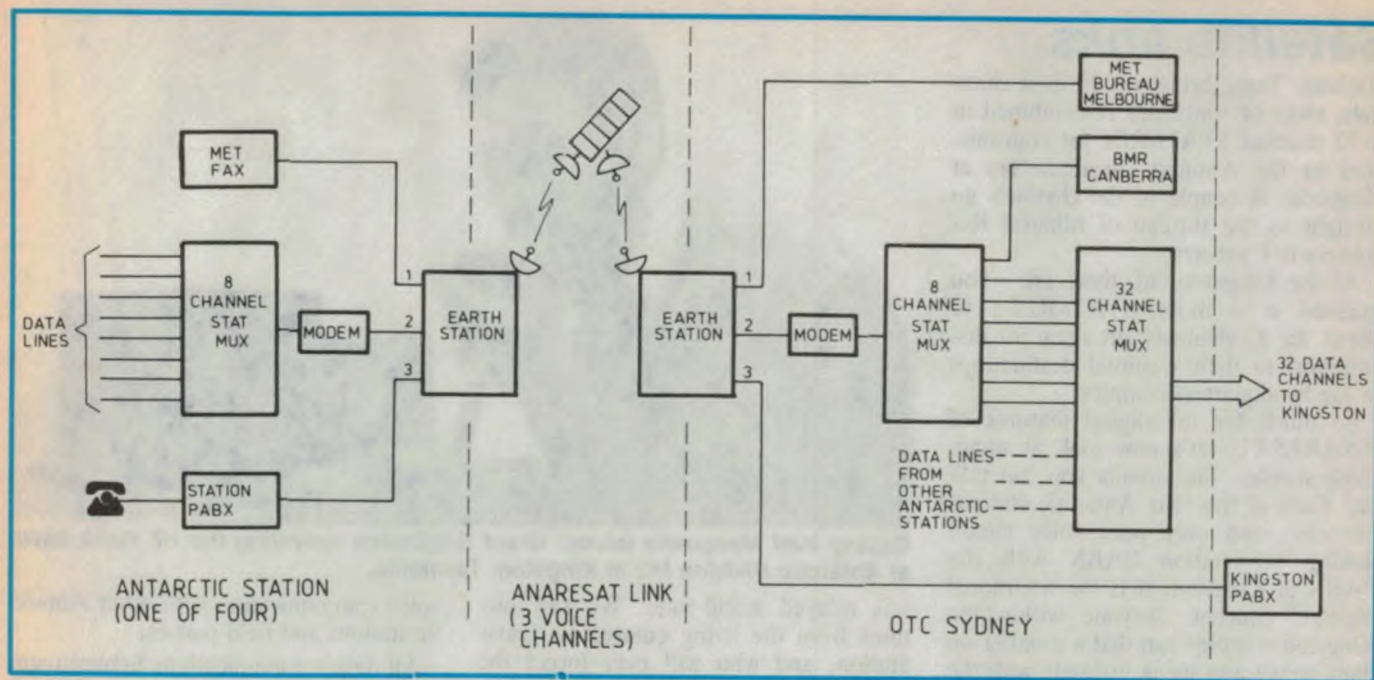
There was also considerable worry about trying to operate earth stations in areas affected by sub-zero temperatures, violent winds, and snow. So the Antarctic Division decided to try the idea on a small scale, before committing themselves to a full-sized VISTA system.

Tests were made using the Inmarsat system, a service designed primarily for communication with ships at sea. Marine-type earth (water?) terminals were installed at the Antarctic coastal stations, and although their dishes were very small, they still proved that the idea of satellite communications with Antarctica was a goer. An interesting spinoff from the tests was the discovery that scintillation effects are directly related to the sunspot cycle. Scintillation experiments are still being carried out at Casey.

With such promising results from the Inmarsat tests, OTC was given a contract in 1986 to go ahead with the full ANARESAT system. Teams of OTC engineers were sent to Antarctica, to erect ground stations consisting of 7.3 metre fixed-mount antennas housed within 12 metre diameter radomes. The radomes were designed to withstand winds of 325km/h, with less than a 2% risk of failure over an earth station's design life of 15 years. All electronic equipment within each earth station is fully redundant.

The stations at Mawson, Davis and Casey bases all work through the Intelsat V-F5 satellite stationed at 63°E over the Indian Ocean. This satellite relays to the OTC's earth station at Ceduna, which in turn connects via broadband bearer to OTC's International Exchange at Broadway near Sydney.

Macquarie Island, being much further east, works through the Intelsat stationed at 179°E over the Pacific. This satellite relays direct to the OTC earth station at Sydney. At OTC's Broadway



Above: block diagram of the overall ANARESAT system.

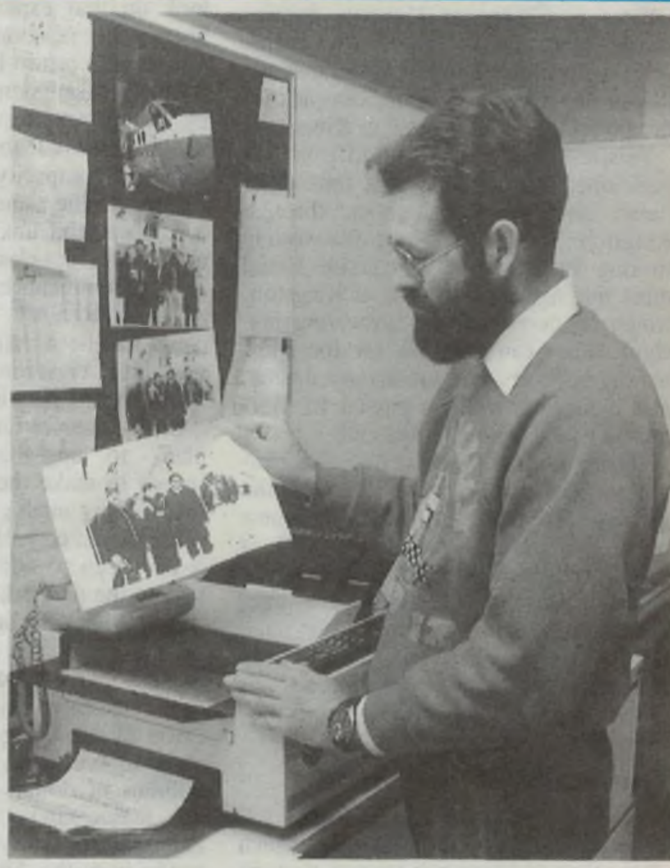
exchange, various signal paths make their way to the Weather Bureau's Melbourne office. The Bureau of Mineral Resources in Canberra, and the Antarctic Division's headquarters at Kingston near Hobart.

At the moment, each Antarctic station has three voice-grade analog telephone circuits connected. The system has been set up to allow expansion to six channels each in the future, or even upgrading to a high capacity, fully digital path to each station with a data speed of two megabits per second.

Although the three voice channels per location are on a similar scale to the Christmas and Cocos Islands systems mentioned earlier, the channels are utilized in much more sophisticated ways.

All the stations have similar arrangements. One voice channel at each location is dedicated to weather operations, to exchange facsimile data with the Met Bureau in Melbourne. Another channel is hooked up to the telephone PABX at each station. This is the channel used by normal voice telephone calls back to Australia, as well as standard office fax and data uses.

The third voice channel hits a modem immediately after emerging from the earth station, and from here on all operations on this channel are digital. Signals are split up into eight different paths by a device called a 'statistical multiplexer' or STATMUX. These paths become full duplex data circuits running at 1200, 2400, or 4800 baud, and they are wired around to various laboratories and other scientific facilities at the stations. Some connect to standard data terminals, and others feed on-site PDP-11 minicomputers.



Kingston Comms Officer Grant Brightman holds a photograph transmitted by fax from Casey base, via ANARESAT.

It is now possible to sit at a terminal at Davis or one of the other stations, and operate on-line in real time into the big VAX computers back at Antarctic headquarters at Kingston. This is a far cry from when I visited the Antarctic stations in 1983, six short years ago. Back then there were a few Commodore Pets and Apple II's in some of the more advanced scientific labs, and we were mighty impressed to see real working computers, all the way down in the Antarctic.

Meanwhile, back in Sydney, there are four 8-channel STATMUX's in the OTC exchange, each one a mate to a STATMUX in one of the four Antarctic

Satellite links

stations. These bring out 32 data channels, most of which are re-combined in a 32 channel STATMUX for transmission to the Antarctic headquarters at Kingston. A couple of the channels go straight to the Bureau of Mineral Resources in Canberra.

At the Kingston end, there are – you guessed it – more STATMUX's to break the 32 channels out again for distribution to their eventual destinations in the headquarters complex.

So much for the digital features of ANARESAT, let's now look at something simpler, the circuits you can talk on. Each of the four Antarctic stations has one, and only one, voice circuit linking the station PABX with the PABX at Kingston. It is the traditional 'tie-line' concept. Anyone within the Kingston complex can dial a number on their phone and speak instantly with the Officer in Charge at Mawson, for instance (who, for the first time ever this year, is a woman). Or Ms Patterson, sitting at her desk at Mawson, can pick up her phone and ring anyone at Kingston.

Personal phone calls to and from expeditioners are handled on a time-share basis, and every call goes through Kingston. Someone in Australia wishing to ring Joe Blow at Macquarie Island must ring a special number at Kingston, which connects with an answering machine. They can then ask for Joe Blow to ring back at some pre-arranged time, and a message will be passed to Macquarie Island arranging the call.

During normal business hours in eastern Australia, the phone lines to the stations are used for official business only. But during lunch times and at night, the system is switched through at Kingston so that the station tie lines have access to the normal Australian STD/ISD phone network. Callers from Antarctica can then ring friends or family and chat with them, as if they were just across town.

The future

Usage of ANARESAT is already following Boyle's Law of Gasses, which states that anything will expand to completely fill the space available for it. Antarctic traffic is no exception, and there's now serious consideration being given to making the whole ANARESAT system – phones and all – totally digital.

This was proved practical during a rather spectacular experiment on January 1, 1988, when the first ever live television transmission from Antarctica was relayed world-wide. We saw pictures from the living quarters at Davis Station, and who will ever forget the look on that expeditioner's face when he saw his newborn child for the first time on the return link from Australia!

This transmission was made possible by taking over the entire satellite bandwidth allocated to Davis, as well as some extra capacity from another transponder on the same satellite, to provide a 2.34 megabit link. Although the exercise made first-class television viewing, its real significance was in proving that an ANARESAT broadband channel could handle a data stream exceeding 2 megabits per second. So a fully digital, high speed system is quite practical.

In the shorter term there are already plans to upgrade data transmission speeds to make the best possible use of the existing analog voice channels. Because of the cost, the Antarctic Division is not keen to add more VISTA channels to the network.

And what's to become of the old HF radio system? The Antarctic service was the last point-to-point HF radio service to be operated by the OTC, and because of operating costs they won't be sorry to see it go. It was costing OTC millions of dollars per year to operate one leased circuit to Macquarie Island and one to Casey (remember that all traffic from the Antarctic Continent was relayed through Casey).

Because it's no longer necessary to work Australia on HF, the old 10kW transmitters at Casey have been retired and modern remote-control 1kW units have been installed at both Casey and Davis. Modern receivers have also been installed at all stations, and most of the high gain antenna systems have been retained. This equipment is now used for voice communication with other Antarctic stations and field parties.

Calling VJM Macquarie Island! Grant Brightman operating the HF radio base at Antarctic Division HQ in Kingston, Tasmania.

All data communications between stations is now relayed via ANARESAT through the VAX computer system at Kingston. Mawson has kept its 10kW transmitters, since it must still provide communications with stations of other countries as part of the worldwide weather data collection system.

In the event that the VISTA system should fail, the Inmarsat system will still be available as a backup. Each Intelsat satellite is equipped with spare transponders, should one fail. The Intelsat system provides enough redundancy to cover the failure of the VISTA system, on its operating transponder and/or satellites. In the very unlikely event of a total satellite failure, another 'in orbit' satellite is activated to replace it. For instance the 66° and 177° E satellites are designated as backups for the VISTA services on the 63° and 179° E satellites respectively.

Then, there's the familiar feeling among some of the Antarctic old timers who would prefer that ANARESAT would quietly go away. They loved the sense of isolation that working in the Antarctic provided. Once you were on the ship and away from Australian shores, you were well and truly away. But with ANARESAT, as one old hand told me, "Now, any time they've got a problem at Kingston, they can just ring you up!"

So much for getting away from it all.

Picture credits:

Photos in Antarctica by E.Saworak and P.Haddock, Antarctic Division.

Photos at Antarctic Division Headquarters, Kingston, by Tom Moffat.

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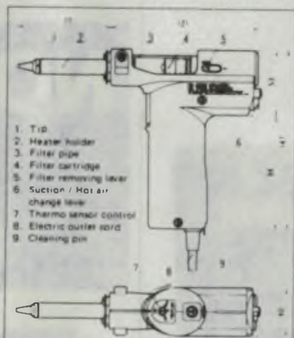

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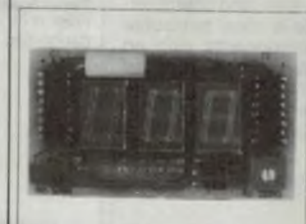
LED 3 Digit Panel Meter Bargain



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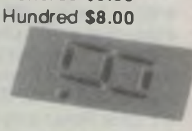

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Maximum Input Voltage: 600Vp-p or 300V (DC+AC Peak)
Channel Isolation: Better than 60 dB at 1KHz.

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

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

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

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

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

Cat. Q12105 .... **only $695**
(tax exempt only $630)

Bulk orders, schools, and tax exempt inquiries, please phone (03) 543 2166 for special low pricing.

METEX 3800 MULTIMETER

Compact, rugged, battery operated, hand held 3½ digit multimeter
Features...
- ½" high contrast LCD
- Automatic over-range indication with the "1" displayed
- Automatic polarity indication on DC ranges
- Diode testing with 1 mA fixed current
- Audible Continuity Test
- Transistor hFE Test

SPECIFICATIONS
Maximum Display: 1999 counts 3½ digit type with automatic polarity indication
Indication Method: LCD display.
Measuring Method: Dual-slope in A-D converter system
Over-range Indication: "1" Figure only in the display
Temperature Ranges: Operating 0-C to +40-C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat.Q91530 ...... **Normally $109**
SPECIAL $79

METEX M-3650 MULTIMETER

20A, 3½ digit frequency counter multimeter with capacitance meter and transistor tester.

Features include a frequency counter (to 200kHz), diode and transistor test, continuity (with buzzer), capacitance meter, up to 20 amp current measurement.

CHECK THESE FEATURES....
- Audible continuity test
- Transistor test
- Diode test
- Quality probes
- ½" High contrast LCD
- Full overload protection
- 20 Amp
- Built in tilting bail
- Capacitance meter
- Instruction manual

Q91550 ...... Normally $165
Special, only $129

ANALOGUE KT370 MULTIMETER

FEATURES:
- Fuse and diode protection
- hFE measurements 0 - 1000 (by x 10 range)
- Mirror scale for more accurate reading

SPECIFICATIONS....
RANGES:
DC Voltage: 0 - 0.1, 0.5, 2.5, 10, 50, 250, 1000V (20k ohm/V)
AC Voltage: 0 - 10, 50, 250, 500V, 1000V (8k ohm/V)
DC Current: 0 - 0.05, (50uA), 2.5, 25, 250mA
Resistance: 0 - 2K, 20K, 2M, 20M ohm
Load Current: 0 - 150uA, 15mA, 150mA
Load Voltage: 0 - 3V
Volume Level: -10 - +22dB - +62dB
DC Current Amplification Factor (hFE) 0 - 1000
ACCURACY
DC Voltage & Current: +-3% f.s.
AC Voltage: Within +/-4% f.s.
Resistance: Within +/-3% of arc
Battery: 1.5V (um-3) 2pcs 9V (oo6p) 1pc
Fuse: 0.5A, 5o x 20mm
Diode: 4148 x 2
C.C. .04uf x 50V
Size: 147 x 99x 57mm

Q11030 ..... **only $34.95**

NORTHCOTE SHOP!

425 HIGH ST, NORTHCOTE
PHONE (03) 489 8866

METEX 3530 MULTIMETER

Compact, rugged, battery operated, hand held 3½ digit multimeter
Features...
- ½" high contrast LCD
- Automatic over-range indication with the "1" displayed
- Automatic polarity indication on DC ranges
- Capacitance measurements to 20uF
- Diode testing with 1 mA fixed current
- Audible Continuity Test
- Transistor hFE Test

SPECIFICATIONS
Maximum Display: 1999 counts 3½ digit type with automatic polarity indication
Indication Method: LCD display.
Measuring Method: Dual-slope in A-D converter system
Over-range Indication: "1" Figure only in the display
Temperature Ranges: Operating 0-C to +40-C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat. Q91540 ...... **Normally $139**
SPECIAL $109

METEX 4500H MULTIMETER

10A, 4½ digit multimeter with digital hold, transistor tester and audible continuity tester.

CHECK THESE FEATURES...
- Readout hold
- Transistor Tester
- 4½ digit x ½"(H) LCD
- Audible continuity tester
- Quality set of probes
- Digital readout hold
- Built in tilting bail
- Instruction manual
- hFE test
- Diode Tester
- Vinyl case

Q91560 .... Normally $175
Special, only $159

PORTASOL PROFESSIONAL

- Four tools in one: Blow Torch, Hot Blow, Hot Knife
- No Cords or batteries
- Heavy duty, tip temperature adjustable up to 400°C.
- Equivalent to 10-60 watts
- Hard working. Average continuous use 90 minuters
- Refills in seconds
- Powered by standard butane gas lighter fuel
- Range of easily replaceable screw tips included
- Includes metal stand for the soldering iron when working
- Cap features built-in flint for igniting Portasol tip
- Includes snap case for storage

Cat. T12639 ...... **$89.95**

PORTASOL PROFESSIONAL TIPS

4.8mm (T12610)	**$12.50**
3.2mm (T12612)	**$12.50**
2.4mm (T12614)	**$12.50**
1.0mm (T12616)	**$12.50**

ROYEL THERMATIC

Different tasks obviously require different tip temperatures. With these Royel Thermatic soldering irons you simply dial the temperature you require with a small flat screw driver and the Thermatic iron will maintain the correct soldering temperature. The control system uses solid state electronics for monitoring tip temperature drop and automatically corrects it.

ROYEL THERMATIC TR-30 (40 WATT)

- Controlled temperature
- 3mm tip
- 60 second heat-up
- 240V operation, no transformer required
- Safety Standards Approved

Cat. T12680 .... $64.95

ROYEL THERMATIC TR-50 (50 WATT)

- Controlled temperature
- 5mm tip
- 60 second heat-up
- 240V operation, no transformer required
- Safety Standards Approved

Cat. T12685 .... $69.95

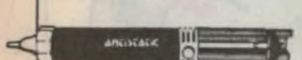
ROYEL THERMATIC TR-60 (60 WATT)

- Controlled temperature
- 6.5mm tip
- 60 second heat-up
- 240V operation, no transformer required
- Safety Standards Approved

Cat. T12690 .... $74.95

AEROSOLVE SPRAYPACKS

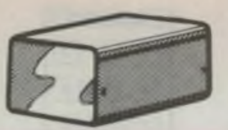
PCB Coating '201' Cat.N11040	$6.95
Freezing Spray '202' Cat.N11042	$6.95
Insulating Varnish '203' Cat.N11043	$7.95
Electric Motor Cleaner '204' Cat.N11044	$6.95
Electronic Super Clean '205' Cat.N11047 (Freon)	$7.50
Flux Remover '206' Cat.N11049	$6.95
Elec Contact Cleaner & Lube '207' Cat.N11051	$5.95
Silver Cote '208' Cat.N11054	$6.95
Formula "66" '535' Cat.N11057	$5.95
Clear Coat Plastic Spray '540' Cat.N11059	$6.95



ECONOMY ANTISTATIC SOLDER SUCKER

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

Cat. T11281 .... $13.95



HORWOOD ALUMINIUM CASES

H10382 3 x 4 x 2 inches	$ 5.50
H10383 3 x 4 x 3 inches	$ 6.50
H10384 3 x 4 x 4 inches	$ 7.50
H10385 3 x 4 x 5 inches	$ 7.95
H10386 3 x 4 x 6 inches	$ 8.50
H10387 3 x 4 x 7 inches	$ 9.50
H10388 3 x 4 x 8 inches	$10.50
H10389 3 x 4 x 9 inches	$10.95
H10390 3 x 4 x 10 inches	$11.95

ENORMOUS RANGE!

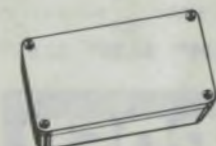
HORWOOD METAL INSTRUMENT CASES (ROUND HANDLES)

84/6/V
H10461 153 x 102 x 203mm $18.95

84/8/V
H10462 203 x 102 x 203mm $19.50

84/10/V
H10463 254 x 102 x 203mm $19.95

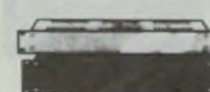
84/12/V
H10464 305 x 102 x 203mm $22.95



DIECAST BOXES

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

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



MASTER RACK MOUNTING CABINETS

These superb rack mount cabinets will give your projects a real professional appearance!
Just look at these features.

- All dimensions conform to the International Standard
- All aluminium construction
- Choice of black or natural finish
- Deluxe brush finish anodised front panel
- Removeable top and bottom lid
- Ventilated lid

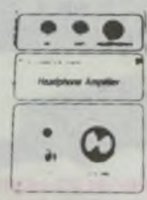
Horizontal Depth: 254mm
A = External front panel height mm
B = Mounting hole centres mm
C = Internal chassis height mm

A	B	C	Finish	Cat.No.	Price
44	34	38	Natural	H10401	$59.50
88	57	82	Natural	H10402	$69.50
132	89	126	Natural	H10403	$79.50
44	34	38	Black	H10411	$65.00
88	57	82	Black	H10412	$75.00
132	89	126	Black	H10413	$85.00

LAB SUPPLY

Fully variable 0-40V current limited 0-5A supply with both voltage and current metering (two ranges 0-0.5A/0-5A). This employs a conventional series-pass regulator, not a switchmode type with its attendant problems, but dissipation is reduced by unique relay switching system switching between taps on the transformer secondary.
(ETI May 83) ETI 163

Cat.K41630 .... $269



HEADPHONE AMPLIFIER

PRACTICE WITHOUT ANNOYING THE FAMILY!
If you play any type of electronic instrument, this headphone amplifier will surely interest you. It will let you practice for hours without upsetting the household, or you can use it to monitor your own instrument in the midst of a rowdy jam session. (EA Feb. '84) 83MA11

Cat.K84111 .... $39.95

AEM DUAL SPEED MODEM KIT

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

Cat.K34600 .... $169

12/240V 40W INVERTER

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

Cat.K82050 .... $69.95

TRANSISTOR TESTER

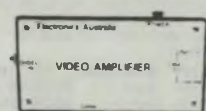
Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. '83) 83TT8

Cat.K83080 .... $18.95

MODEL ENGINE IGNITION SYSTEM KIT

Get sure starts every time, without glow plug burnouts on your model engines
(ETI June 83) ETI 1516

Cat.K55160 .... $49.50



VIDEO AMPLIFIER

Bothered by smeary colours, signal beats and RF interference on your computer display? Throw away that cheap and nasty RF modulator and use a direct video connection instead, it's much better! The Video Amplifier features adjustable gain and provides both normal and inverted outputs. Power is derived from a 12V DC plugback supply.
(EA Aug '83) 83VA8

Cat.K83081 .... $24.95

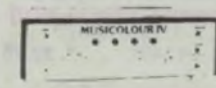
MAIL ORDER 008 33 5757

PLACE YOUR ORDER FROM ANYWHERE IN AUSTRALIA FOR THE COST OF A LOCAL CALL. (STRICTLY ORDERS ONLY)

ELECTRIC FENCE

Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automotive ignition coil, it should prove an adequate deterrent to all manner of livestock. Additionally, its operation comforms to the relevant clauses of Australian Standard 3129. (EA Sept. '82) 82EF9

Cat.K82092 .... $19.95



MUSICOLOR IV

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

Cat.K81080 .... $115

50 W AMPLIFIER MODULE (ETI 480)

Cat.K44880 .... $31.80
(Heatsink optional extra)

100 W AMPLIFIER MODULE (ETI 480)

Cat.K44801 .... $34.80
(Heatsink optional extra)

POWER SUPPLY TO SUIT
Without transformer $22.95

PC DRIVEN FUNCTION GENERATOR

Here's a simple and low cost little unit which lets you use your PC to generate signals with almost any conceivable waveform. It hooks up to the computer via a standard Centronics type parallel printer port, making it compatible with almost any kind of computer. Building and using it will also give you valuable insight into the growing trend towards computer driven test instruments, too!
(EA Jan '89) 88pfg11

Cat.K87104 .... $49.95

LISTENING POST KIT

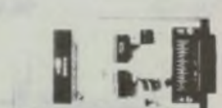
This device attaches between the audio output of a shortwave receiver and the input port of a computer. It allows decoding and printing out of morse code, radioteletype (RTTY) and facsimile (FAX) pictures using the computer. It has been designed from readily available parts. Details for writing the software program are included.
(AEM 3500, July '85)

Cat.K83500 .... $37.95

RS232 FOR COMMODORE

A simple project to give your Commodore RS232 compatibility.
(ETI 1601, ETI July '86)

Cat.K56010 .... $18.95



MICROBEE SERIAL-TO-PARALLEL INTERFACE

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

Cat.K46750 .... $39.50

ROD IRVING ELECTRONICS

ROD IRVING ELECTRONICS

U.S. TELEPHONE EXTENSION CABLE
- U.S. plug to U.S. socket
- Length 10 metres

Cat. Y16024 .... **$7.95**

U.S. TELEPHONE EXTENSION CABLE
- U.S. plug to 2 U.S. sockets
- Length 10 metres

Cat. Y16028 .... **$9.95**

TELECOMMUNICATION CURL CORD
- U.S. plug to U.S. plug
- Replacement hand set cord
- Length 4.5 metres

Cat. Y16023 .... **$6.95**

12V DC FANS
80 x 80 x 25.4mm
12V DC, 1.7 Watt, 0.14 Amps
T12469 **$12.95**
10 + fans only $11.95 each

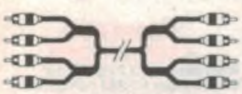
BRAND NEW FANS
Quality, new fans for use in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air!

240V 4 5/8"	Cat T12461	**$12.95**
115V 4 5/8"	Cat T12463	**$12.95**
240V 3 1/2"	Cat T12465	**$12.95**
115V 3 1/2"	Cat T12467	**$12.95**

10+ fans (mixed) only $11.95 each

FAN GUARDS TO SUIT
4 5/8"	Cat. T12471	**$3.95**
3 1/2"	Cat T12475	**$3.95**

BALL BEARING FANS
Quality, new ball bearing fans suitable for power amps, computers, hotspot cooling etc. Anywhere you need plenty of air!
240V 4 5/8" T12464 **$14.95**
10 + fans only $13.95 each



4 WAY RCA LEAD
4 RCA plugs to 4 RCA plugs
Flat shielded cable
Length 1.2 metres
P32108 .... **$6.95**

RCA GOLD PLATED PLUGS AND SOCKETS
For those who need the ultimate in connection. Essential for compact disc players to get that fantastic sound quality.
Plug (P10151) **$2.95**
Socket (P10150) **$2.25**

RCA GOLD PLATED CHASIS SOCKET
For the ultimate connection!
Cat. P10229 .... Normally $1.75

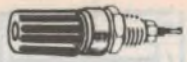
1-9	10+	100+
$1.00	**$0.90**	**$0.85**

SEMICONDUCTORS!
ALWAYS CHECK OUR PRICES BEFORE YOU BUY!

	1-9	10+
4164-12	$5.95	$5.50
41256-12	$19.95	$19.50
27C64	$4.20	$3.95
27C128	$6.95	$6.50
27C256	$7.20	$6.70
27C512	$17.50	$17.00

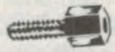
NEW LM12CLK
150W OP AMP **$39.95**

SP0256 SPEECH CHIP
$21.95



DELUXE BINDING POSTS
HALF PRICE!!
P10263 Green P10266 Yellow
P10264 Red P10267 White
P10265 Black P10268 Blue

1-9	10 plus
$0.60	**$0.55**



DB STAND OFFS
AT DIRECT IMPORT PRICES!
2 Pack (P10930) **$1.00**
10 Pack (P10932) **$3.95**
100 Pack (P10934) **$20.00**

STANMORE SHOP!
74 PARRAMATTA RD, STANMORE
PHONE (02) 519 3134

LOW PROFILE IC SOCKETS
Save a small fortune on these "Direct Import" low profile IC sockets! PCB mounting solder tail. All tin plated phosphor bronze or berryllium and dual wipe for reliability.

Cat.No.	Description	1-9	10+
P10550	8 pin	$0.20	$0.15
P10560	14 pin	$0.25	$0.20
P10565	16 pin	$0.35	$0.20
P10567	18 pin	$0.40	$0.30
P10568	20 pin	$0.40	$0.30
P10569	22 pin	$0.40	$0.30
P10570	24 pin	$0.40	$0.30
P10572	28 pin	$0.50	$0.40
P10575	40 pin	$0.50	$0.40

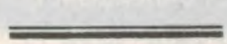
UV EPROM ERASER
Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less time for less chips). High UV intensity at chip surface ensures EPROMS are thoroughly erased.
(Dimensions 217 x 80 x 68mm)

WITHOUT TIMER
Cat. X14950 .... Normally $97
Special, $79

WITH BUILT-IN TIMER
Cat. X14955 .... $139
Special, $99

INSULATION DISPLACEMENT TYPE HEADER PLUGS
Gold plated ribbon cable plug that plugs directly into PCB mounting IC sockets. All include press-fit cap that fits into bottom half of plug over IDC cable.

Cat.No.	Description	1-9	10+
P12114	14 pin	$1.50	$1.40
P12116	16 pin	$1.60	$1.50
P12124	24 pin	$2.95	$2.75
P12140	40 pin	$5.95	$5.75



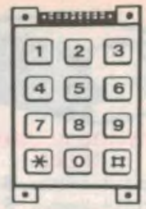
FERRITE AERIAL ROD
200mm x 9mm
Cat. L11401 .... **$2.75**

CD TO CAR CASSETTE STEREO ADAPTOR
Enables a portable CD player or portable TV to be played through any car speaker system by using the cars cassette player. Reduces the risk of theft. Just plug in when required, and remove when you are finished. Hard wiring not needed.
A10011 .... **$29.95**

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**



NUMERIC KEYPAD
Unencoded keypad, 10 digit keys plus two utility keys. Light grey in colour.

OUTPUT ARRANGEMENT:

Output Pin N°	Symbol
1	N.A
2	Shield plate
3	Column 2
4	Row 4
5	Column 3
6	Row 1
7	Column 1
8	Row 2
9	Row 3
10	N.A

Cat C19030

1-9	10+	100+
$2.95	**$2.50**	**$1.95**

IEC MAINS LEAD
3 pin mains plug to 3 pin IEC plug
1.8 metres long
P10252 .... **$5.95**

IEC LINE SOCKET
3 pin, male line socket. 250V, 6A
P10252 .... **$6.95**

IEC SOCKET
3 pin, male chassis socket. 250V, 6A
P10250 .... **$2.50**

IEC PLUG
3 pin, female line plug. 250V, 6A
P10251 .... **$2.95**

KEY SWITCHES
Cat S12500 .... 1-9 Normally 10+ $7.95

1-9	10+	25+
$4.95ea	**$4.25ea**	**$3.95ea**

MAIL ORDER
008 33 5757
PLACE YOUR ORDER FROM ANYWHERE IN AUSTRALIA FOR THE COST OF A LOCAL CALL. (STRICTLY ORDERS ONLY)

BIG MOUTH CAR ALARM
FEATURES.....
- Easy installation
- Automatic on/off
- Loud alarm signal
- Auto reset
- Low Price!

SPECIFICATIONS:
Power: DC 12V battery
Current Consumption: 10mA at 12V DC
Dimensions: 139 x 165 x 136mm
Exit Delay: 60 seconds approx.
Entry Delay: 12 seconds approx.
Auto reset: 90 Seconds approx.
S15048 .... **$39.95**

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

A13014 .... **$79.95**
SPECIAL, ONLY $69.95

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

Cat. S15071 .... **$24.95**

PASSIVE INFRA-RED DETECTOR
(WP-800)

FEATURES:
- Walk test LED indicator
- Wall/corner/ceiling mount
- Micro switch tamper proof protection
- 24 detection beams in 3 different ranges
- N.C. silent S.P.S.T. dry relay contact output
- Alarm auto reset approximately 3 seconds after triggered
- Superior RFI immunity protection
- Very low power consumption
- Adjustable mounting bracket
- Easy installation and adjustment
- Dual element, low noise, high signal to noise ratio pyroelectric
- Detection degree indicator
- D.C. 8-16V power operating

S15079 .... **$89.95**

PIN SWITCHES
- Self tapping and adjustable
- Suitable for car doors, hoods, trunks
- Single lead hook up
- Easy to use, easy to install
- Length: 45mm

S12522 .... **$3.95 pair**

10W HORN SPEAKERS
White durable plastic. 8 ohms
Cat. C12010 ... **Normally $11.95**

1-9	10+
$9.95	**$8.95**

ARGUS ADJUSTABLE MAGNIFIER WITH LAMP

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

- Magnifies 1.75 times
- 40 watt incandescent lamp
- 2 external spring-balanced arms, extendable to 800mm
- Adjustable head for optimum viewing angle
- Variety of mounts available but not included

Cat.T10015 .... **Only $99**

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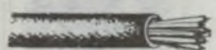
MasterCard VISA

10 TURN WIRE WOUND POTENTIOMETER

Spectrol Model 534 1/4" shaft.
Equivalent (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 **$10.95** 10+ **$10.50**



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.
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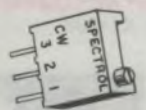
We have too many of the following panel meters, so we're selling them to you at bargain prices. Don't miss out!

Cat.No.	Description	Price
Q10500	MU45 0-1mA	10.50
Q10502	MU45 0-50uA	12.50
Q10535	MU45 VU	10.95
Q10533	MU52E 0-5A	14.50

P.A. SPEAKERS

Low dual cone, wide range 200mm (8in.). Ideal for public address, background music, etc. Tremendous Value at these prices! Cat.C12000
1-9 **$5.95** 10+ **$5.50**

DISCOUNT PRICES!



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

RECHARGEABLE 12V 1.2AH GELL BATTERY

Leakproof, long service life batteries ideal for security systems, emergency lighting or as a computer backup power supply, etc.
Cat. S15029 .... **Normally $19.95**
1-9 **$13.95** 10+ **$12.95**

PLUG IN POWER PACK

- 240V AC to 6/9/12V DC - 300mA
- 1.6 metre cord with unique plug adaptors
- Plugs: 2.5 & 3.5 phone plugs, 2.1 & 2.5mm DC plug.

Cat. M19001 ...... **$11.95**

ENORMOUS RANGE!

HOOK UP WIRE

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

PRICES PER 100 METRE ROLL
1-9 **$5.95** 10+ **$5.00**

W11260 14/.20 RED
W11261 14/.20 BLACK
W11265 14/.20 BLUE
W11268 14/.20 WHITE
PRICES PER 100 METRE ROLL
1-9 **$12.00** 10+ **$10.00**

W11270 24/.20 RED
W11272 24/.20 BLACK
W11274 24/.20 GREEN
PRICES PER 100 METRE ROLL
1-9 **$14.00** 10+ **$12.00**

W11280 32/.2 BROWN
W11282 32/.2 BLUE
PRICES PER 100 METRE ROLL
1-9 **$20.00** 10+ **$18.00**

RELAY AND BASE

Can carry 10A at 28V DC or 5A at 240V AC. Supplies with Chassis Mounting Socket with screw terminals. Great for school projects and demonstrations, switching DC power supplies, central circuits and with contacts parallel up to 20A can be switched.
Cat S14074 .... **Normally $8.95**
SPECIAL $6.95

SOLDER ROLLS

Top quality, 60/40 Resin cored

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

POWER ADAPTORS 1 AMP POWER PACK

- 240V AC to 6/7.5/9/12V DC
- Ideal for workshop
- DC connections via unique multi plug adaptor system
- Sizes: 2.5, 3.5mm phone and 2.1, 2.5mm DC plug
- Cord 1.6 metre long

Cat. M19010 ...... **$36.95**

RS232 BREAK OUT BOX

A simple way of monitoring RS232 interface lead activity. Interface powered, pocket size for circuit testing, monitoring and patching. 10 signal powered LED's and 2 spares. 24 switches enables you to break out circuits or reconfigure and patch any or all the 24 active positions.

SPECIFICATIONS:
Connectors: DB25 plug on 80mm ribbon cable and DB25 socket.
Indicators: Tricolour LED's for TD, RD, RTS, CTS, DSR, CD, TC, RC, DTR, (E)TC.
Jumper Wires: 20 pieces.
Power: Interface power.
Dimensions: 85 x 95 x 30mm
X15700 .... **$94.95**

DUAL DB25 SOCKET WALL PLATE

- Fitted with 2 x DB25S sockets (RS232)
- Anodised aluminium plate
- Includes mounting hardware

P10948 .... **$19.95**

DB25 SOCKET WALL PLATE

- Fitted with DB25S socket. (RS232)
- Anodised aluminium plate.
- Includes mounting hardware.

P10947 .... **$11.95**

DB25 PLUG WALL PLATE

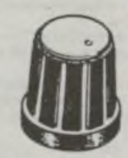
- Fitted with DB25P plug. (RS232)
- Anodised aluminium plate
- Includes mounting hardware.

P10944 .... **$11.95**

DB9 WALL PLATE

- Fitted with DB9S (9 way 'D' connector socket.
- Anodised aluminium plate
- Includes mounting hardware.

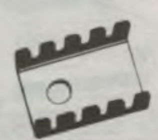
P10942 .... **$11.95**



NEW COLOUR KNOBS!

Standard metric fluted shaft with black dot marker and available in six different colours!
Dimensions: 17.2mm high, 12.8mm top diameter, 17mm bottom diameter

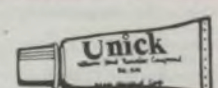
Cat.	Colour	1-9	10+
H10070	Black	$0.75	$0.65
H10071	Blue	$0.75	$0.65
H10072	Green	$0.75	$0.65
H10073	Grey	$0.75	$0.65
H10074	Red	$0.75	$0.65
H10075	Yellow	$0.75	$0.65



MINIATURE HEATSINK

A great little fellow if you are short of space. Great price too, because we import direct so you save!
Size: 19(L) x 13(W) x 9(H)mm

Cat.No	1-9	10+
H10606	$0.40	$0.35



HEATSINK COMPOUND

Heatsink compound is applied to the base and mounting studs of transistors and diodes. It maintains a positive heatsink seal that improves heat transfer from the device to the heatsink, thus increasing overall efficiency.
H11800 (10g) **$2.95**
H11810 (150g) ... **$17.50**

CB SPEAKER

- 10cm (4") speaker
- 3 metre cord with 3.5mm plug
- Impedance 8 ohms
- Power 5 watts
- Complete with mounting bracket

Cat.A12074 .... **$24.95**

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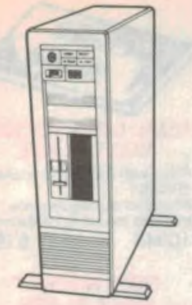


386 TOWER PC

The 386 Tower PC is a high performance system that's IBM* AT* compatible. However, the 386 Tower PC gives you 2-5 times the performance.

FEATURES:

- Intel 80386 16MHz microprocessor
- Switchable 16/20 MHz
- 2 M/Byte fitted. Total memory expandable up to 16 M/Bytes
- Up to 2 M/Byte or 8 M/Byte RAM modules on system board or on RAM card
- Option for 80287 & 80387 co-processor socket
- Operates in page mode with interleave memory subsystem
- Shadow RAM supported to allow system BIOS to be executed on system memory instead of slower EPROM
- Four 16-bit I/O slot. Three 8-bit I/O slot, and one 32-bit memory slot
- 8042 keyboard controller interface for AT* compatible keyboard
- Seven direct memory access (DMA) channels
- Chips and Technology chip set
- AMI 386 BIOS/Phoenix 386 BIOS/ AWARD 386 BIOS (AMI fitted)
- 50 M/Byte hard disk. 42 M/Byte formatted. Fast access
- EGA card

.... **$5,995**

BABY AT* COMPATIBLE COMPUTER! 2 M/BYTE $2,695

- Final assembling and testing in Australia!
- 4 M/Byte Main Board, 2 M/Byte installed
- Switchable 8/10/12 MHz
- 1.2 M/Byte Floppy Disk Drive
- 80286 CPU
- Colour Graphics Display Card
- 8 Slots
- Floppy & Hard Disk Controller
- Printer Card and RS232
- Keyboard
- 200W Power Supply
- Manual
- 6 Months Warranty
- Size: 360(W) x 175(H) x 405(D)mm

With 20 M/Byte Hard Disk $2,695
With 40 M/Byte Hard Disk $2,895
With 80 M/Byte Hard Disk CALL

RIPPER STRIPPER

Remove ugly paper feed edges quickly and cleanly with this simple little gadget.

C21085 .... **$9.95**

IBM* XT* COMPATIBLE COMPUTERS FROM $995

Check these features and our prices. We're sure you'll agree they're exceptional value for money!

- Final assembling and testing in Australia!
- Fast TURBO Motherboard
- AT* style keyboard
- Tested by us for 24 hours prior to delivery!
- 8 Slot motherboard
- 12 months warranty!
- 150W power supply

*$995 WORKSTATION COMPATIBLE COMPUTER

256K RAM, Single Drive, Graphics and Disk Controller Card. ... **$995**

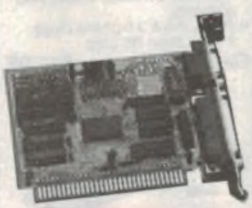
640K RAM TURBO COMPATIBLE COMPUTER

2 x 360K Disk Drives, Multifunction Card, Colour Graphics, Disk Controller, 1 Serial, Parallel Port (Includes Timer Disk) **$1,195**

WITH 20 M/BYTE HARD DISK:
& single 360K Disk Drive **$1,495**
& dual 360K Disk Drives **$1,695**

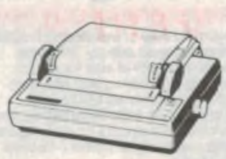
WITH 40 M/BYTE HARD DISK:
& single 360K Disk Drive **$1,695**
& dual 360K Disk Drives **$1,895**

WITH 80 M/BYTE HARD DISK:
& single 360K Disk Drive **CALL**
& dual 360K Disk Drives **CALL**



IBM* COMPATIBLE CARDS

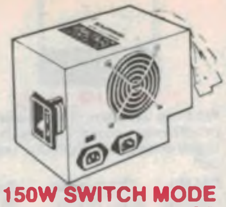
EGA Card	only $330
PAL/EPROM Prog. Card	$245
Extended 3.5 M/Byte (AT)	$299
Colour Graphics	$99
Floppy Disk Controllers	
360 K	$52
360K/1.2/1.44MB	$139
Printer Card	$29
Multi I/O Card	$145
Mono Graphics Printer/TTL	$109
Games Card	$29
RS232 Card	$55
RS232 & Clock Card	$65
Hard Disk Controller Card	$195
XT 8 MHz Turbo Motherboard excluding RAM	$169
XT 10 MHz Turbo Motherboard excluding RAM	$199
Serial/Parallel/Games	$115



EPSON LX-800 PRINTER

- NLQ Mode
- 180 C.P.S. & 25 C.P.S.
- Tractor or friction feed
- Proportional printing
- Convenient push button control panel
- Standard Parallel interface

.... **$495**



150W SWITCH MODE POWER SUPPLY FOR IBM* PC*/XT* & COMPATIBLES

DC OUTPUT: +5/13A, -5V/0.5A +12V/4.5A -12V/0.5A

Cat. X11096 .... **$129**

200W SWITCH MODE POWER SUPPLY FOR IBM* AT* & COMPATIBLE

DC OUTPUT: +5/16A, -5V/0.5A +12V/5A -12V/0.5A

Cat. X11097 .... **$199**

180W SWITCH MODE POWER SUPPLY FOR BABY AT* COMPATIBLES

Cat. X11098 .... **$169**

IBM* XT* COMPATIBLE CASE

XT* size and styling. Features security key switch, 8 slots, and mounting accessories.
Size: 490(W) x 390(D) x 140(H)

Cat. X11090 ... **only $69**

IBM* XT* COMPATIBLE CASE WITH AT* STYLING

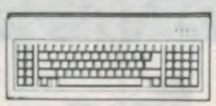
Now you can have AT* styling in a XT* size case. Features security key switch, 8 slots, and mounting accessories.
Size: 490(W) x 145(H) x 400(D)

Cat. X11091 .... **$99**

BABY AT* STYLE COMPUTER CASING

Compact foot space. Features security key switch, 8 slots, and mounting accessories.
Size: 360(W) x 175(H) x 405(D)

Cat.X11093 .. **ONLY $99**



IBM* XT* COMPATIBLE KEYBOARD

- 100% IBM* PC*, XT* compatible
- Low profile keyboard design
- Proper placement of shift keys with large key tops to suit professional typists
- 3 step height/angle adjustment
- Cherry brand TS-M00001 19mm low profile switches, meet 30mm ergonomic requirement and provides high performance and maximum reliability
- Curl lead plugs straight into PC
- 3 Status displays

Just like the "Real McCoy" only at a fraction of the price!

Cat.X12020 .... **only $89**

PANASONIC KX-P1081 DOT MATRIX PRINTER

- 120 C.P.S.
- Pica or Elite character set
- Print Modes: NLQ, Dot Graphics, Draft, Proportional Font
- Reliable and Compact
- Proportional Printing
- Logic Seeking
- 1K Printer Buffer

C20035 ...... **ONLY $379**

SAMSUNG 20MHz COMPOSITE MONITOR

X14516 AMBER **$109**

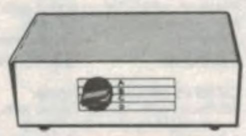
GOLDSTAR 12" TTL MONITOR

X14502 AMBER **$119**

RITRON MULTISYNC VGA COLOUR MONITOR

Quality Auto VGA, EGA, CGA monitor without the high price tag!
Display Tube: 14 inch 90° deflection P22 Non-glare, tint. 0.31mm Dot pitch,
Active Display Area: 245 x 185mm
Resolution: 800 dots(H) x 600 lines(V)
Display Colour: TTL input
TTL input: 8/16/64 colours
Analog input: unlimited colours

.... **only $945**



DATA TRANSFER SWITCHES

If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.

- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector

2 WAY RS232 X19120 ...... $69
4 WAY RS232 X19125 ...... $79
2 WAY Centronics X19130 ... $69
4 WAY Centronics X19135 ... $79

PRINTER LEAD

- Suits IBM* PC/XT, compatibles
- 25 pin "D" plug (computer end) to Centronics 36 pin plug

P19029 (1.8 metres) **$14.95**
P19030 (3 metres) **$19.95**
P19032 (9.5 metres) **$39.95**

PRINTER RIBBONS TO SUIT:

CP80, SX80, DP80, BX100 MB100
1-9 (C22036) 10+
$8.95 **$7.95**

MX/80 FX/80 RX/80
1-9 (C22031) 10+
$8.95 **$7.95**

MX100, FX100, RX100
1-9 (C22002) 10+
$19.95 **$18.95**

LX80
1-9 (C22003) 10+
$9.95 **$8.95**

LQ1000
1-9 (C22012) 10+
$27.60 **$25.00**

MOUSE

MICROSOFT* COMPATIBLE!

- Auto-Selection and Auto-Transfer between Mouse System PC Mouse Mode and Microsoft Serial Mouse Mode
- Microsoft Serial Mouse and Mouse System compatible
- Super high tracking speed: 600mm/sec
- Super high resolution: 200 D.P.I. (0.12mm/dot)
- Silicon rubber coated ball
- Optical rotary encoder

Cat.X19952 .... **$94.95**

WITTY MOUSE

- Three buttons, user definable
- Silicone coated steel ball
- High resolution movement of 195 dots/inch. Smaller table space and less hand movement required
- Optical rotary encoder
- Max. tracking speed: 200m/sec
- Mouse resident firmware
- Size: 116 x 66 x 34mm
- Mouse Driver Software included, allowing you to install with all popular software packages. Also included is the handy Pop-Up menu software that allows the user to integrate the mouse with the keyboard, DOS, and other popular software packages

Cat.X19950 .... **$59.00**

JOYSTICK FOR IBM

Features Selectable "Spring centring" or "free floating". Electrical trim adjustments on both axis. 360 degree cursor control

C14205 .... **$39.95**

APPLE* II SERIES COMPATIBLE JOYSTICK

These joysticks have adaptor connectors to suit the Apple II, IIc, IIe and II+ computers. Features include selectable "spring centring" or "free floating". Electrical trim adjustments on both axis, 360° cursor control and dual fire buttons

C14201 ..... **only $39.95**

ENCLOSED PRINTER STAND

- Keeps your paper and print-outs neat and orderly
- Transparent cover makes it easy to check on paper supply
- Paper can be fed from the centre or the rear according to the design of the printer
- Removable drawer which allows paper to be changed without moving the printer
- Retractable rear basket makes print-out collection fast and convenient
- Suitable for most printers

C21055 .... **$59.95**

Shedding light on the 'black art' of

Quartz Crystals

Mention the word 'crystal' and thoughts of medieval mystery, of hi-tech, Superman's house and other wondrous bits of fantasy probably come to mind. Are crystals such a black art? Maybe so – but they're inside almost everything, from the watch you wear to the computer you use – a marvellous quirk of nature that has made possible so many things. In this article we try to unravel the mystery.

by PETER PHILLIPS

When I examined some literature sent to *EA* recently by the Australian crystal manufacturer, Hy-Q International, it was with the intention of mentioning some of their products in our New Products section.

But the more I looked, the more it became apparent that here was information that should be given its own section. A phone call to John Munday at Hy-Q resulted in even more documentation, allowing me (previously a babe in the woods when it came to crystals) to put it all together in this article. Most of the material is therefore from Hy-Q – resulting in an article that I hope may separate the magic from the technology. Yes Virginia, there is magic in the world, but a lot of it is man made...

Piezoelectric effect

The direct piezoelectric effect, the production of electricity by the application of physical pressure, was discovered by the brothers Paul-Jean and Pierre Curie in 1880. The converse effect, in which applying an electrical force will cause physical distortion of the crystal, was predicted by Lippmann in 1881, and confirmed by the Curies in the same year.

The first major application of piezoelectricity was in Langevin's work on submarine detection using quartz transducers to generate and detect underwater acoustic waves, which was started in 1917. In 1919, Nicolson described several devices, such as loudspeakers, microphones and sound pick-ups based on the piezoelectric properties of Rochelle salt. This was followed by Cady's publication in 1921 of papers describing the first quartz crystal controlled oscillator. From this time considerable research effort was devoted to the field of quartz crystals.

In 1926 radio station WEAF in New York became the first broadcast transmitter to use quartz crystal control. The problems of stabilising the operating frequency with changes in temperature were considerable, but the introduction, in 1934, of suitable 'cuts' of the crystal removed this obstacle. Parallel work on crystal filters was also under way, and by 1939 these devices had become an essential component in telephone transmission systems.

World War II gave considerable impetus to the need for crystals, and in 1945 some 1.5 million units were produced in

Various stages in the manufacture of a quartz crystal, from a large raw crystal in the background to sawn disks in the foreground. (Courtesy Hy-Q International)

England alone.

And so the development of the quartz crystal has continued. The increasing use from the 1950's of crystal filters in mobile radio systems as well as the introduction of the monolithic crystal filter in the middle 1960's has made the quartz crystal almost as common as mud.

What is quartz?

Quartz is a crystalline form of silicon dioxide, SiO_2. It is a hard, brittle, transparent material with a density of 2649kg per cubic metre, and has a melting point of 1750°C.

When quartz is heated to 573°C, its crystalline form changes. The stable form above this temperature is called *beta-quartz* (also high-quartz) and the stable form below is known as *alpha-quartz* or low-quartz. For resonator applications, only alpha-quartz is useful. Quartz is insoluble in ordinary acids, but soluble in hydrofluoric acid and in hot alkalis.

Despite being one of the most common naturally occurring crystalline minerals, crystals of sufficient size and purity for processing into quartz resonators are very rare. For this reason, natural quartz has long been superseded by the use of cultured quartz in resonator applications.

The history of cultured quartz initially dragged on until a chronic shortage of natural quartz meant an intensive effort, almost in a do-or-die fashion, during the war years. Cultured quartz is now routinely grown from aqueous alkaline solutions, under conditions of high pressure and temperature in massive underground steel autoclaves. (An autoclave is a heavy vessel in which chemical reactions take place under high pressure.)

The lower part of the autoclave is maintained at a temperature of about 400°C and contains 'nutrient' in the form of pure silica. At this temperature and under a pressure of the order of a thousand atmospheres, the solubility of silica is relatively high and a saturated solution is formed.

Convection currents transport the saturated solution up to the upper part of the autoclave, which is maintained at a slightly lower temperature of about 350°C. At this lower temperature the solution is supersaturated and quartz is deposited on seed crystals suspended in the cooler region of the autoclave. Over periods of many days or even weeks, crystals of substantial size can be grown.

Alpha quartz

Not all quartz is suitable for use as a resonator. A *lack of a centre of symmetry* within the crystal is necessary, if it is to exhibit the piezoelectric effect. Alpha quartz belongs to the crystallographic class 32, and has what is known as a single axis of threefold symmetry (trigonal axis) as well as a further three axes of twofold symmetry (digonal axes). The digonal axes are spaced 120° apart and are polar axes, which imply the lack of a centre of symmetry.

The digonal axes are known as the electric axes of quartz, since in the original experiments of the Curies the electrical polarisation produced by pressure was developed along a polar axis. In crystals with fully developed natural faces the two ends of each polar axis can be differentiated by the presence or absence of the *s* and *x* faces, as shown in Fig.1.

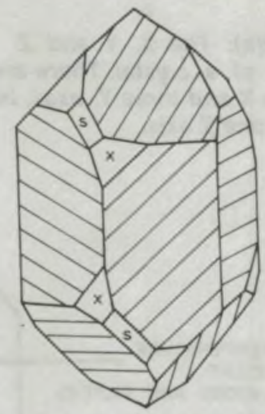


Fig.1: The s and x faces of a raw crystal

When pressure is applied in the direction of the electric axis a negative charge is developed at that end of the axis, being modified by these faces. The trigonal axis, also known as the *optic* or c-axis, is not polar, since the presence of digonal axes normal to it means that the two ends of the trigonal axis are the same. Thus no piezoelectric polarisation can be produced along the optic axis.

Alpha-quartz is an optically active material. When a beam of plane-polarised light is transmitted along the optic axis a rotation of the plane of polarisation occurs, the amount of the rotation depending on the distance traversed in the material. The sense of the rotation can be used to differentiate between the two naturally occurring forms of alpha-quartz, known as *left quartz* and *right quartz*.

In right quartz the plane of polarisation rotates clockwise when seen by an observer looking towards the source of light, and in left quartz it rotates anticlockwise. In crystals with fully developed *s* and *x* faces, their orientation with respect to the major prism faces also provides a means of differentiation between right and left quartz, as shown in Fig.2.

Quartz resonators

A piezoelectric resonator consists of a piece of piezoelectric material precisely dimensioned and orientated with respect to the crystallographic axes of the material, and equipped with one or more pairs of conducting electrodes.

By means of the piezoelectric effect, an electric field applied between the electrodes excites the resonator into mechanical vibration. The amplitude of the vibration is negligibly small, except when the frequency of the driving field is in the vicinity of one of the resonator's normal modes of vibration, and resonance occurs.

Near resonance, the amplitude of vibration increases and again by virtue of the piezoelectric effect, the electrical impedance of the device changes rapidly.

Compared to other resonators, for example LC circuits, mechanical resona-

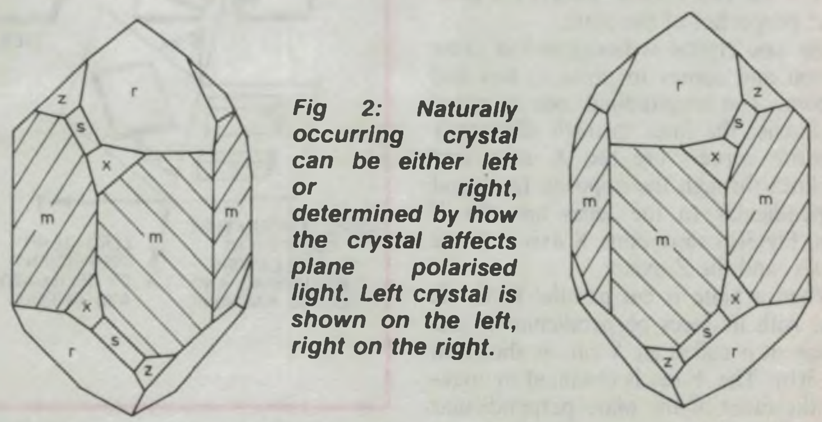


Fig 2: Naturally occurring crystal can be either left or right, determined by how the crystal affects plane polarised light. Left crystal is shown on the left, right on the right.

Quartz crystals

tors such as tuning forks, and piezoelectric resonators based on ceramics or other single-crystal materials, the quartz resonator has a unique combination of properties.

For example, it is extremely stable, and highly repeatable from one speci-men to another. The acoustic loss or internal friction of quartz is particularly low, leading directly to one of the key properties of a quartz resonator – its extremely high Q factor. The intrinsic Q of quartz is *10 million* at 1MHz. Mounted resonators typically have Q factors ranging from tens of thousands to several hundred thousand, orders of magnitude better than the best LC circuits.

The second key property of the quartz resonator is its stability with respect to temperature variation. Depending on the shape and orientation of the crystal blank, many different modes of vibration can be used and it is possible to control the frequency-temperature characteristics of the resonator to within close limits by an appropriate choice of 'cut'.

The third essential characteristic of the quartz resonator is related to the stability of its mechanical properties. Short and long term stabilities manifested in frequency drifts of only a few parts per million per year are readily available, even from commercial units. Precision crystal units manufactured under closely controlled conditions are second only to atomic clocks in the frequency stability and precision levels achieved.

Crystal cuts

To take advantage of the piezoelectric effect, small 'plates' need to be cut from the raw crystal. The plane in which these plates are cut, with respect to the axes of the raw crystal, affects the electrical properties of the plate.

The raw crystal is hexagonal in cross section and comes to point at top and bottom. The longitudinal axis is called the *Z* axis; the lines through *diagonally opposite* corners are the *X* axes, and the lines through the opposite faces and perpendicular to the faces are the *Y* axes. Fig.3(a) shows one X axis and one Y axis, and the Z axis.

When a plate is cut parallel to the Z axis, with its faces perpendicular to the X axis, it is called an *X cut*, as shown in Fig.3(b). The *Y cut* is obtained by making the faces of the plate perpendicular to the Y axis, as shown in Fig.3(c).

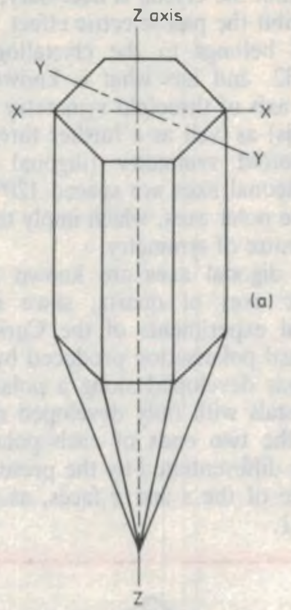


Fig.3(a): The X, Y and Z axes of a crystal. There are three X and three Y axes, but only one Z axis.

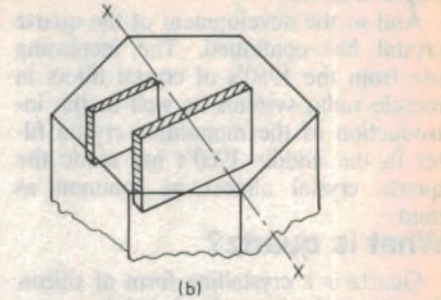


Fig.3(b): The X cut, where the faces of the plate are perpendicular to the X axis and parallel to the Z axis.

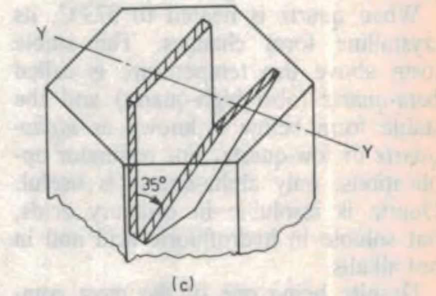


Fig.3(c): The Y cut, with the faces of the plate perpendicular to the Y axis. Rotating the cut 35 degrees from the Z axis gives the AT cut.

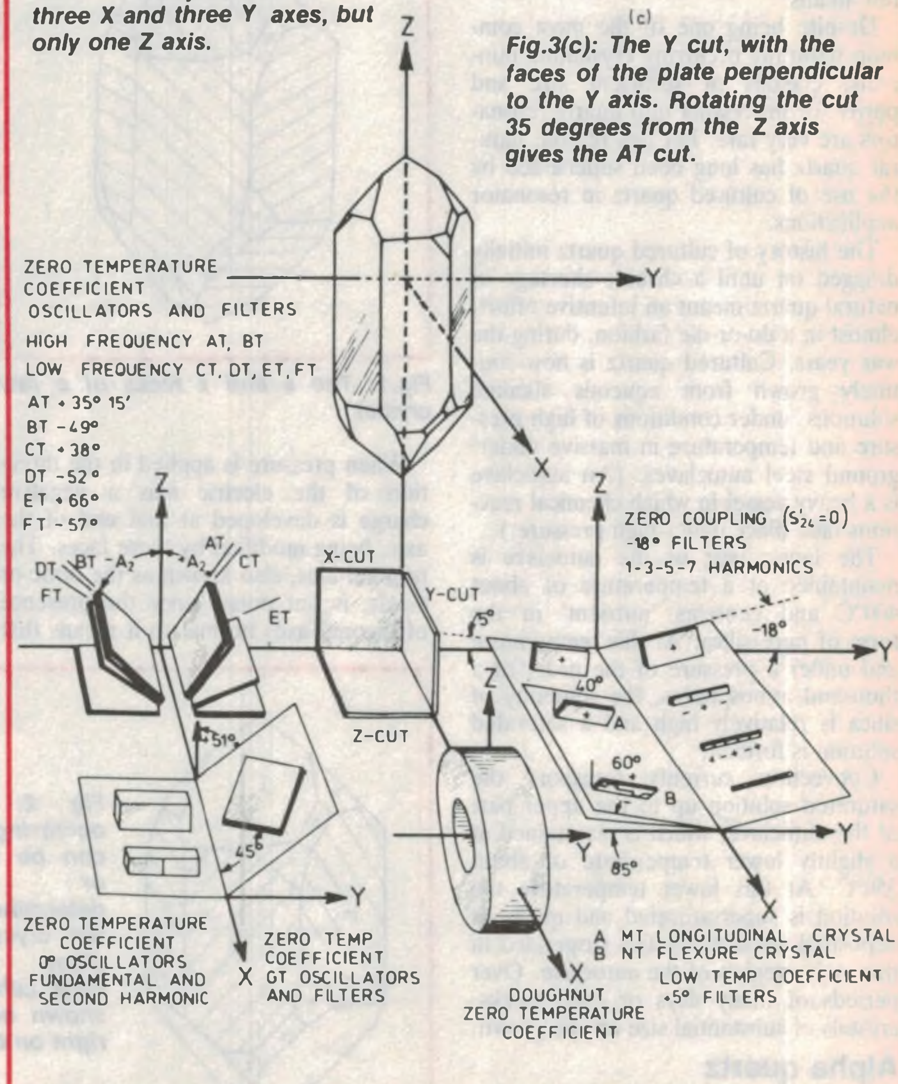


Fig.3(d): Oriented quartz crystal cuts in relation to the natural crystal

By rotating the plane of the cut around one of more axes, a variety of cuts such as the AT, BT, CT, etc., are obtained. For example, if the Y-cut plate shown in Fig.3(b) is rotated clockwise away from the Z axis by 35°, the AT cut results.

The type of cut and mode of vibration have a great effect on the natural resonant frequency of the plate. Frequencies as low as 6kHz are possible (with the NT cut flexural mode) and 30MHz is typical for the AT thickness shear cut.

For operation above 30MHz, the plates become quite thin and fragile. However, the upper frequency range can be extended by finishing the plates so that they can be excited at the third or fifth harmonic of the fundamental frequency. This technique is called the *overtone mode*, and crystals capable of operating up to 200MHz are possible using this mode.

Fig.3(d) shows some of the many ways of cutting a raw crystal, some of which are described as follows.

The AT cut. This is the most common cut, where the quartz blank is in the form of a thin plate cut at an angle of 35° 15' to the optic axis of the crystal. This cut has a frequency-temperature coefficient described by a *cubic* function of temperature, which can be precisely controlled by small variations in the angle of cut. This cubic behaviour is in contrast to most other crystal cuts which show *parabolic* temperature characteristics, and makes the AT cut well suited to applications requiring a high degree of frequency stability over wide temperature ranges.

This cut, operating on the fundamental and all odd overtones (1,3,5,7,9, etc.) is used over the frequency spectrum from 750kHz to 200MHz. Having the lowest of all temperature coefficients and an extremely high Q, plus a low cost, this cut is common for most oscillator applications.

The SL cut. This one is used to get the best temperature-frequency characteristics for low frequency resonators. The frequency range is 300kHz to 1MHz, and the resulting small size of the crystal allows packaging to suit miniaturisation.

The DT cut. The DT cut finds wide usage in both filters and oscillators over its frequency range of 180kHz to 400kHz. The temperature coefficient is quite good over reasonable ambient temperature ranges.

The +5° X cut. The low temperature coefficient and a large ratio of stored mechanical to electrical energy makes this cut the preferred one for filter networks in the 50kHz to 200kHz range. It is popular because it has good ageing, temperature coefficients, resistance and price.

The NT cut. This cut is a length-width flexure type crystal, used primarily for the frequency range of 10kHz to 150kHz. This element is preferred for very low frequency oscillators which are subjected to wide temperature ranges, and finds use in narrow single and multiple frequency filters.

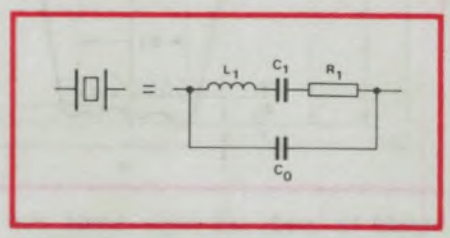


Fig.4: The equivalent circuit of a crystal near its operating point.

Crystal characteristics

A quartz crystal is intrinsically an electro-mechanical circuit having a high Q. Fig.4 shows the conventionally accepted equivalent circuit of a crystal resonator at a frequency near its main mode of vibration.

The inductance L1 represents the vibrating mass, the series capacitance C1 the compliance of the quartz element and the resistance R1 the internal friction of the element, mechanical losses in the mounting system and acoustical losses to the surrounding environment. The shunt capacitance C0 is made up of the static capacitance between the electrodes, together with stray capacitances of the mounting system.

There are various characteristics for crystal resonators, of which *frequency* is probably the most important. Frequency is a direct function of the dimensions of the quartz and its mode of operation in the circuit.

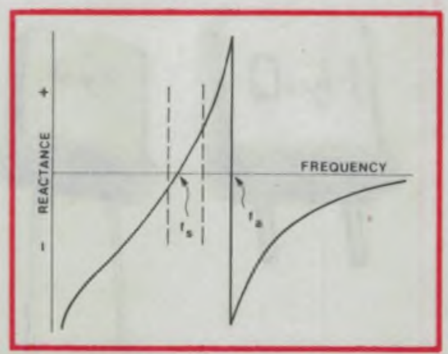


Fig.5: The two zero-phase frequencies of a crystal. The series resonance (fs) is used in oscillator applications; fa (anti-resonance) is often used in filter applications.

As shown in Fig.5, there are two zero-phase frequencies associated with the circuit of Fig.4; one at series resonance *fs*, the other at anti-resonance *fa*. Series resonance is the main mode of operation for an oscillator circuit, and is the point at which the crystal has minimum resistance (R1) and when the crystal is moving the greatest amount.

Anti-resonance is the mode commonly used for filters, and is sometimes (incorrectly) called the parallel mode of operation. At this point, the crystal represents a high impedance, and is moving the least. In a filter application, the crystal will form part of a band-pass network.

When used in an oscillator, crystal resonators will operate at any frequency within the range indicated by the dotted lines of Fig.5, as determined by the phase of the maintaining circuit.

By varying an external trimmer capacitor, the crystal frequency may be trimmed to a limited extent. The degree to which this frequency may be varied (frequency pulling) is inversely proportional to the capacitance ratio C0/C1.

Many practical oscillator circuits make use of a load capacitor (C_L) in series or parallel with the crystal, either to provide a means for final frequency adjustment, or perhaps for modulation or temperature compensation purposes. This capacitor shifts the operating frequency of the crystal by an amount dependent on the value of C_L and the values of C0 and C1.

The fractional difference in frequency between the load resonance frequency F_L and the series resonance frequency F_S is known as the load resonance frequency offset (L.O.). The equation relating this is shown in Fig.6.

$$L.O. = \frac{\Delta f C_L}{f_s} = \frac{f_L - f_s}{f_s} \simeq \frac{C_1}{2(C_0 + C_L)}$$

Resonant resistance

Another important aspect of Fig.4 is the resistor R1 – a value representing motional resistance. This parameter controls the Q of the crystal, and defines the level of oscillation in any maintaining circuit.

The *load resonant resistance* for a given crystal depends on the load capacitance with which the unit is designed to operate, and is the equivalent impedance of the crystal in the operating circuit. The activity of the quartz and required drive levels to excite it are dependent on the resonant resistance – the lower the resistance the more activity from the quartz and the less drive required.

Quartz crystals

This resistance will be higher than R1 and, for the AT cut, can be calculated using the equation shown in Fig.7 if the value of the load capacitance (C_L) is known.

$$R_L = R_1 \left(1 + \frac{C_0}{C_L}\right)^2 \text{ ohm}$$

The equivalent parallel resistance (for the AT cut) at the load resonant frequency can be found with the equation of Fig.8.

$$R_p = \frac{1}{R_1 \left[\omega (C_0 + C_L)\right]^2}$$

where $\omega = 2\pi f$

The frequency of oscillation is the same in either a series or parallel connection of the load capacitance, but the load resonance resistance varies as indicated by the two equations above.

Other characteristics

There are other characteristics of quartz crystals, including temperature coefficient and ageing. Temperature coefficient refers to the frequency stability of the crystal to changes in temperature and is determined by the angle at which the quartz is cut.

Ageing is a general term applied to any cumulative process which contributes to the deterioration of a crystal unit and which results in a gradual change in its operating characteristics. Many factors contribute to ageing – minute leakage through the container, corrosion of electrodes, ionisation of the air within the container, absorption of moisture, wire fatigue and a few others.

The effects of ageing can be reduced if certain precautions are followed. For example, the final processes of lapping, etching, cleaning and mounting of the crystal need to be carefully controlled. Also, the sealing of the container is an important factor to protect the crystal.

How the crystal is driven will also determine the useful life of the crystal. Generally, the lower the drive level, the longer the useful life of the crystal. Higher drive levels make the factors contributing to ageing more pronounced. Therefore, the drive level should be the lowest practical level consistent with circuit requirements for reliable operation.

The actual output frequency of the crystal oscillator circuit is also dependent on the stability of the oscillator circuit components. For high stability, parts with good temperature coefficients should be used, and steps should also be taken to prevent electrical changes due to mechanical variations.

The actual circuit layout is also important, and all leads should be kept as short as possible. The circuit should be designed to be isolated from any high amplitudes of RF, or any external interference.

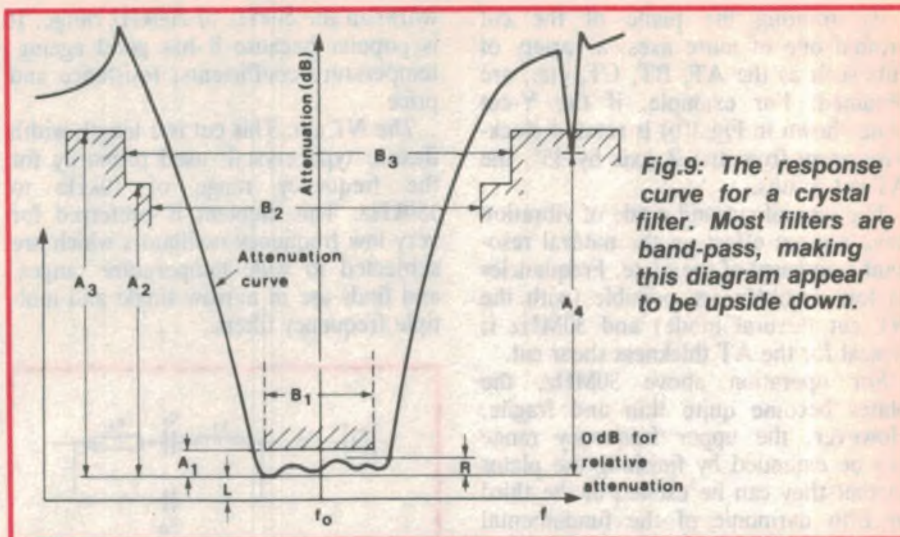


Fig.9: The response curve for a crystal filter. Most filters are band-pass, making this diagram appear to be upside down.

Crystal filters

A filter is a circuit that either passes *(bandpass)* or rejects *(bandstop)* a particular band of frequencies. Crystal filters may be either, depending on how they are designed, but are usually *bandpass* filters, meaning they pass the specified band of frequencies.

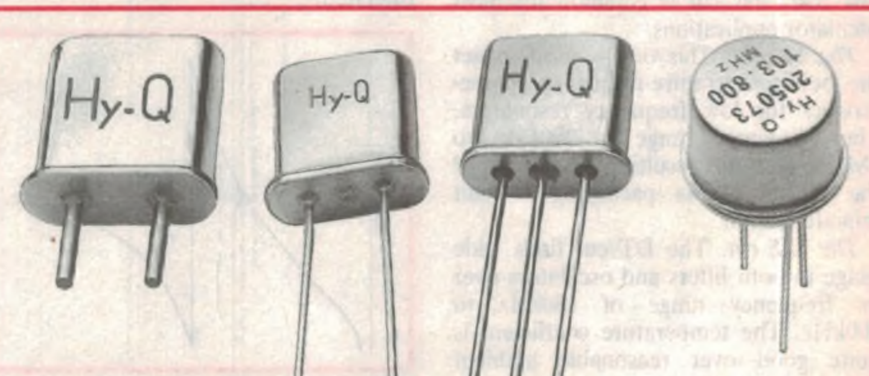
Crystal filters are the best choice where the application requires selective narrow band filtering at high and very high frequencies. Because of the extremely high Q of a quartz resonator, crystal filters with a bandwidth of 0.01% to 0.5% of the centre frequency can be realised.

Crystal filters are usually constructed with two or more crystals in the package. There may be two, four or eight crystals, and even single crystals with four connections rather than the usual two.

There are numerous terms associated with crystal filters; and the following definitions refer to Fig.9. This diagram may appear to be upside down considering the application is for a band pass filter. However, this is the accepted standard for describing crystal filters.

The first term is the *reference frequency*, which is usually the centre frequency of the filter – denoted as fo on Fig.9. For SSB filters, the reference frequency is the carrier frequency (fc).

The *relative attenuation* of the filter is the difference between the attenuation at a given frequency and the minimum attenuation in the pass band or the attenuation at the reference frequency. The *pass band* is the range of frequencies (B1 in kHz for Fig.9) at which the relative attenuation is equal to or less than a specified value, shown as A1 (in dB). All frequencies either side of the



Crystal packaging comes in various forms. These from Hy-Q illustrate a few variations on the packaging theme.

pass band will be attenuated by an amount greater than A1.

The *pass band ripple*, shown as R (in dB) is the greatest difference between the maximum and the minimum attenuation within the pass band.

The *insertion loss* (L in dB) for a specified frequency is the attenuation resulting from the insertion of a filter into a transmission system, i.e., the logarithmic ratio of the power delivered to the load before insertion of the filter to the power delivered to the load after insertion of the filter. This term is often loosely used to refer to the minimum value of the attenuation in the pass band.

The *stop band* is a term used to describe those bands of frequencies at which the relative attenuation is equal to or greater than certain specified values. The stop band is, of course, those frequencies *not* passed by the filter.The *stop bandwidth(s)* refers to the separation of frequencies B2 and B3 (in kHz) at which the relative attenuation first exceeds the specified minimum values. These two characteristics effectively describe the shape of the response curve.

Spurious response attenuation is the minimum attenuation A4 (dB) guaranteed for spurious responses in the stop band. Spurious responses usually occur at frequencies higher than the centre frequency. The *guaranteed attenuation* is the minimum attenuation (A2 or A3 in dB) that is guaranteed for specified frequency ranges.

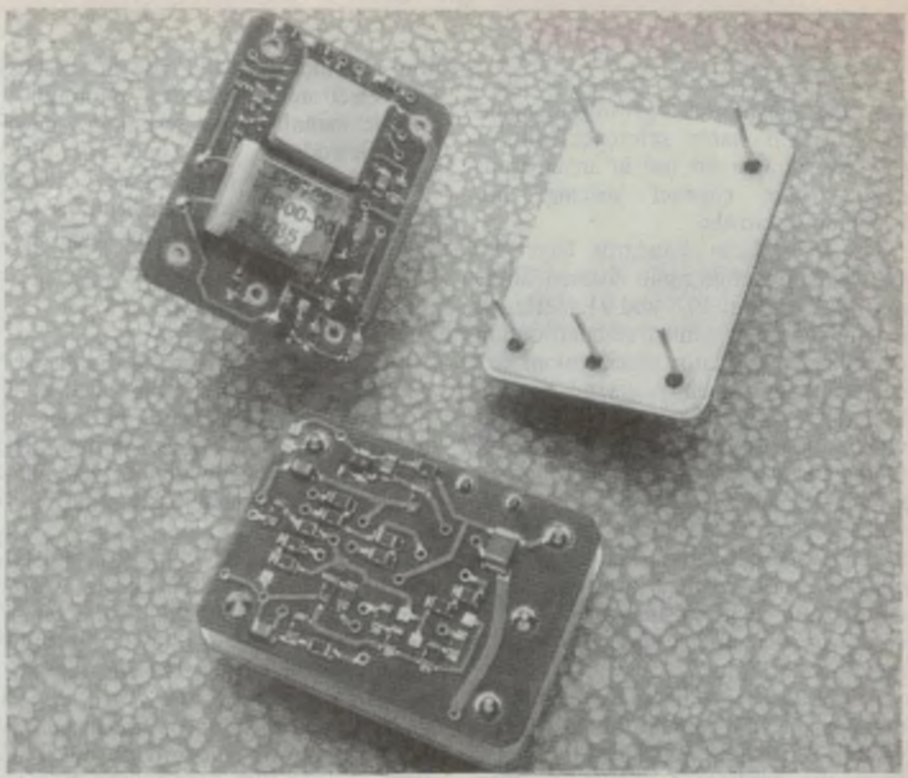
The *terminating impedance* is the impedance presented to the filter by the source and load, usually expressed in terms of a parallel combination of resistance and capacitance.

Crystals today

Despite the high demand for crystals, traditional methods of crystal manufacture have been dictated mainly by the requirements for many different frequencies, with relatively small quantities on any particular frequency. The typical end use was that of a multi-channel radio set requiring two crystals per channel, one for transmit, one for receive.

Generally, different users operated on different channel frequencies, and therefore needed channel crystals unique to themselves. The result was a manufacturing philosophy oriented to small batch production with quick turn around.

The impact of frequency synthesis techniques has reduced the overall requirement for individual channel crys-



Crystal controlled clock oscillators for computers are now commonly available in IC form, and typically operate from a single 5V supply. They usually comprise a TTL inverter type oscillator, and are available in various packages and operating frequencies.

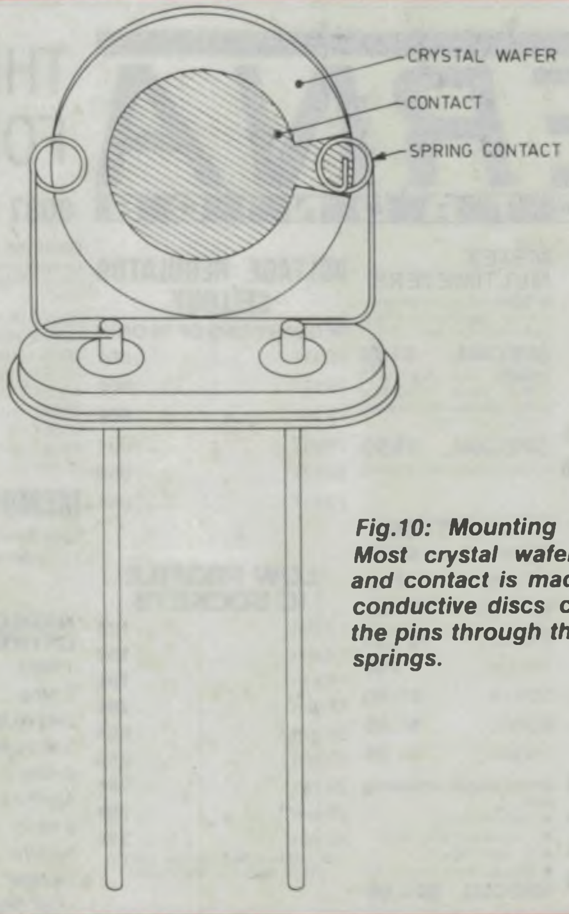


Fig.10: Mounting the crystal. Most crystal wafers are circular, and contact is made with two conductive discs connected to the pins through the mounting springs.

tals, and substituted a growing demand for a single stable reference with a stability suitable for use in an environment where channel spacings are becoming narrower.

Just as defacto standards have developed for mobile radio channel filters on frequencies of 10.7 and 21.4MHz, so it is likely that a similar standardisation of packaged oscillator specifications will come about. Currently, crystals for colour television, clocks and watches, for video tape recorders and for all kinds of timing application such as microprocessor clocks, are all required in high volumes and on fixed frequencies. Similarly, packaged oscillators, known as *clock oscillators* are tending to replace discrete component crystal oscillators for many of the timing applications just mentioned.

All of these products are essentially mass-produced commodity items, representing a major fundamental change from the traditional crystal products business. A further feature of the transformation of the crystal market brought about by these new products is that in pursuing the objective of miniaturisation, specifically in the case of crystals for electronic watches, photolithographic manufacturing techniques have been introduced that have in turn spawned a whole range of new miniature crystal units with applications far beyond that originally envisaged for watches.

Summary

In the century or so since the discovery of piezoelectricity, the history of quartz crystal devices can be roughly divided into five periods. In the first period, from 1880 to about 1920, piezoelectricity remained a scientific curiosity.

The second period from 1920 to 1939 can be described as the classical periods, when the foundations were being laid for the forced growth, in the third period, World War 2. The 20 years immediately following the war, up to about 1965, constituted a fourth period of steady growth and orderly development, and the fifth period, from 1965 to the present has seen a succession of fundamental changes in both user requirements and the technology. One could ask where will it end...

Hy-Q

As most of the material in this article has originated from Hy-Q International, it seems appropriate to describe this wholly owned Australian company, who are now a world leader in crystal technology.

Hy-Q International is actually a group of companies dedicated to the manufacture of products for frequency management and control systems. The parent company was formed in Australia in 1969, by a group of engineers skilled in crystal technology, and commenced with a total of 25 employees.

Today, Hy-Q has production facilities in Melbourne, Singapore, Cambridge (Great Britain) and a newly opened plant in Kentucky (USA). Each location has its own marketing, production engineering and purchasing departments, making each one totally self-supporting. The company now employs around 350 people, and is well placed when it comes to purchasing the raw materials needed for the production lines.

We at EA are certainly grateful for the friendly assistance given by John Munday from Hy-Q in the production of this article.

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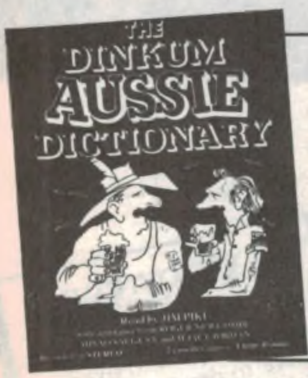

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6. The competition commences on 28th February, 1989 and closes with last mail on Jun 30, 1989. The draw will take place in Sydney on July 3, 1989, and the winner will be notified by telephone and letter. The winner will also be announced in The Australian on July 7, 1989 and a later issue of this magazine.
7. The prize is a Satcom II Midrange System consisting of 3.7 metre dish antenna with mounting pedestal and AZ/EL mount, feedhorn, low-noise amplifier and block down-converter, a Grundig STR 201 Plus Satellite TV Receiver/Monitor, plus all necessary cables and connectors, and FREE installation up to the value of $1200. Prizes to be installed at a mutually agreed date within six months of winner being notified. Installation free up to $1200. (Average cost of installation.) Total value of prize including installation is $11,580.
8. The promoter is the Federal Publishing Company, 180 Bourke Road, Alexandria, NSW 2015. Permit No TC89/0000 issued under the Lotteries and Art Unions Act 1901: Raffles and Bingo Permit No 890000 issued on 00/00/89 ACT Permit No TP890000 issued under the Lotteries Ordinance 1964.

TV RECEIVING SYSTEM

FORUM

Conducted by Jim Rowe

Have we ended up with the components & hardware we deserve?

This month I'm kicking off discussion of a different topic – whether or not there's been a drop in the quality and range of components and hardware available for electronics construction in Australia, and if so why. You mightn't like my preliminary conclusions! There's also discussion of yet another letter on responsibility for kit problems.

If you're in my own age group, or even younger, you'll probably remember that back in the late 1960's and early 1970's, components and hardware for projects never seemed to be a problem. There was a very wide range available, at what seemed to be quite reasonable prices, and – wonder of wonders – many of them were even made in Australia!

Although we didn't realise it at the time, perhaps those really were the golden days as far as electronics construction was concerned. Not only were there lots of parts available, and at reasonable prices, but generally they seemed to be of quite high quality.

Perhaps I'm remembering it all through rose-coloured glasses, but I can't recall a brand-new rotary switch having fallen apart during tightening of the mounting nut, for example – something which happened to me only a few weeks ago. Nor can I recall headphones which became intermittent (and unrepairable) within about six weeks of buying them, as has happened to me on about three occasions during the last year. They weren't really 'cheap' models, either!

On the availability side, I can't recall having any difficulty finding reasonably well-made and sturdy metal instrument cases, to enclose a project such as an audio oscillator. Nor did there seem to be any problem in finding vernier reduction drives, knobs or dials to suit standard pots – or for that matter, ganged pots of almost any standard value. Nor in getting low temperature-coefficient 'NPO' ceramic capacitors – or even any capacitors of specified temperature coefficient. Yet all of these things have given us headaches in the last few weeks, while we've been working on project prototypes.

Somehow, it seems to me that at least in some areas of electronics we're rather worse off in the late 1980's than we were back in the 1960's. Certainly we have an excellent range of ICs and other active devices available nowadays, and some passive components such as low-power resistors, polyester capacitors and even small electros. Even things like relays and connectors are probably rather easier to get than ever before, and in a wider range of sizes and ratings.

But try getting a sturdy and attractive metal case for a hifi amplifier or test instrument project, and you'll find things aren't nearly so easy. And much the same happens if you try getting a 10W (or even higher rated) resistor, or a 150pF NPO ceramic capacitor, or a 50-ohm trimpot, or a traditional air-dielectric tuning capacitor, or a reduction drive to suit almost any standard pot, or even a 3-pole 8-position rotary switch.

In fact try getting almost any rotary switch with more than 12 positions, shared among its poles (i.e., 1 x 12, or 2 x 6, or 3 x 4, or 2 x 6) – nowadays they're like hen's teeth!

Now I'm not saying that any of these things are not available. They probably are, if you're prepared to hunt around quite a bit, and pay rather more than normal. But they're much more of a problem than they once were.

Why should this be? I can think of a couple of possible reasons, although not necessarily enough to explain all of the problems.

One possible factor may be the growth of relatively large retailing chains, and a corresponding reduction in the number of smaller components 'dealers' of the traditional broad-range variety – rather like the way supermarket chains have frozen out a lot of the old 'corner shop' grocery stores.

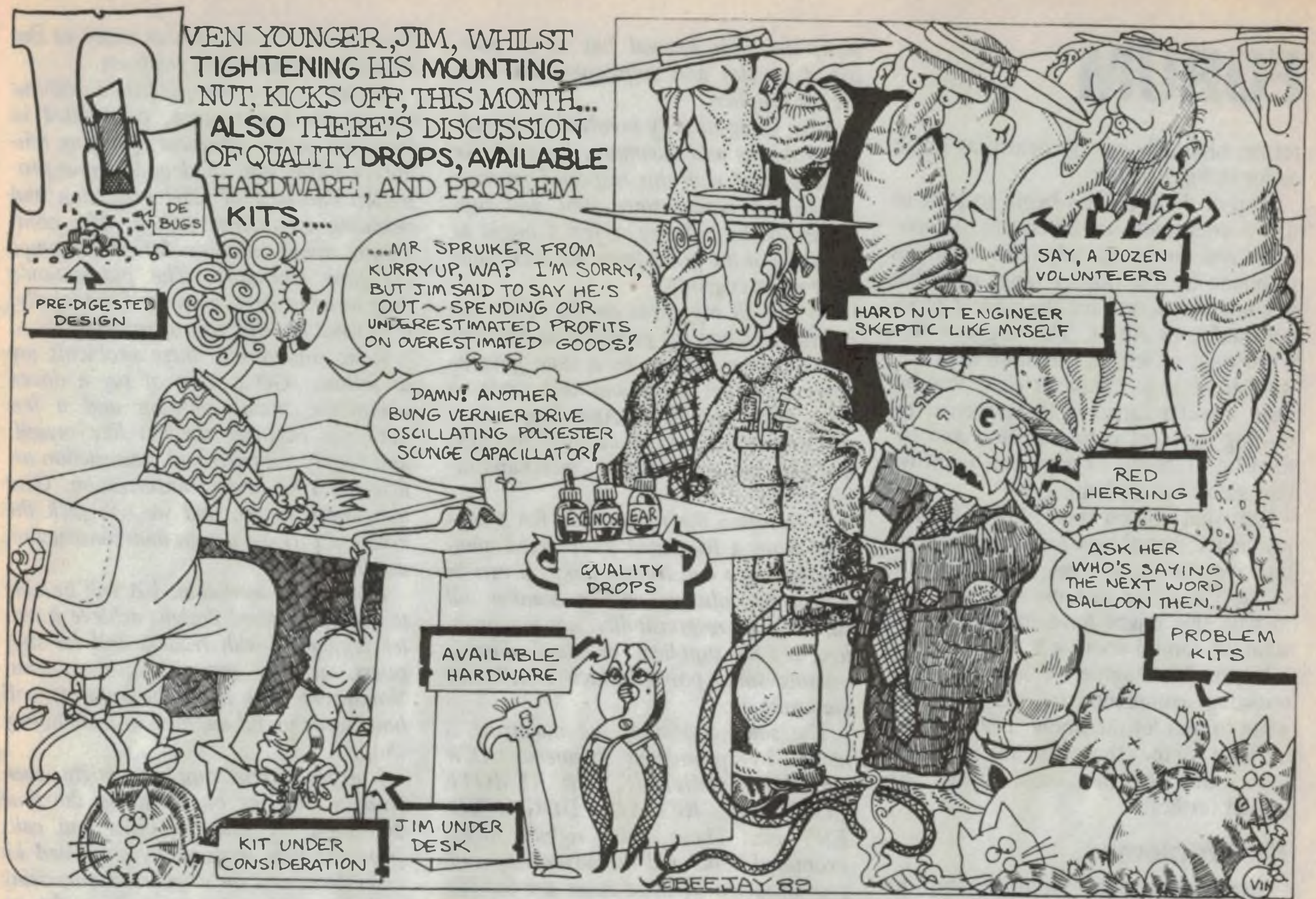
No doubt in itself the growth of the larger chains has been a good thing, bringing a significant increase in the overall number of component supply outlets. However I'm almost certain that it has also produced an overall reduction in the number of product lines readily available, because big companies running 10's or even 100's of outlets simply can't afford to manage as many product lines as a small single outlet.

For example when I spent a few years working at DSE in the early 1980's, that company made every effort to maintain its stock list at no more than 3000 product lines. This was because Dick Smith and his managers knew that the more product lines they tried to carry, the harder it would be to manage them all and try to keep them all in stock. Or looking at it another way, the higher became the overhead costs of stock management.

So larger retailers are simply forced by sheer economics to limit the number of product lines they carry, compared with those carried by smaller 'mom and pop' stores. Basically this is done by pruning out the slower-moving lines, and stocking only those that sell in reasonable volume.

And because the slower-moving lines tend to be those with higher prices, this same factor also tends to produce a trend towards lower-priced products. In other words, an emphasis on 'bargain priced' lines, rather than 'quality' lines.

By the way, don't get me wrong. I'm not saying that the big retailing chains



are to *blame* for this tendency to stock cheaper, fast-moving lines. Cheaper lines ARE faster moving, because a majority of customers are apparently more interested in the lowest possible price than they are in quality.

So in that sense, the retailing chains are simply giving us the components that a majority of us have 'voted' for, with our wallets. They're simply responding to this market force, and sheer economic pressures probably force them to do so.

This reasoning suggests that we get the components we deserve, so we have no-one to blame but ourselves if there has been a reduction in component variety and quality. Sobering thought, isn't it?

Another possibility that occurs to me is that since the 1960's, various economic pressures have gradually killed off most of our local component manufacturers. There are a few notable exceptions, but by and large our components are now imported – and mostly from large manufacturers whose product lines are tailored for the global market. Perhaps this has also produced an effect rather like that operating with the retailing chains, where stock lines must again be limited to mainly the fast-moving 'jellybean' or 'commodity' products.

So some of the more specialised product lines simply might not be available any more, even if the retailing chains wanted to carry them. I suspect this might be the case with things like air-dielectric tuning capacitors, for example.

But surely this wouldn't apply in the case of multi-pole rotary switches, I hear you ask? I tend to agree. You'd think these would still be used in enough equipment globally to justify them being made by the big overseas manufacturers, and that the same would tend to apply in the case of NPO ceramic capacitors and reduction drives.

This suggests that many of these parts are still being manufactured, and would be available – if there was enough demand to justify them being imported and stocked by the retailing chains. In other words, they're basically not available because not enough of us have wanted to buy them...

I suspect it's been much the same with hardware like instrument cases, although here the end result may be even harder to change.

Because there was a diminishing demand for reasonably solid metal cases, whose prices were inevitably rather higher than the now ubiquitous plastic moulded variety, most of the local manufacturers tended to either drop them or go broke.

So now, even though developments in metal-bashing technology over the last decade have probably made it possible to produce quite competitively-priced metal instrument cases, there are now almost no local manufacturers left – or at least none with any interest in producing for such a modest market.

In this case there's possibly a further factor, too: because the prices of components like ICs, resistors and capacitors have fallen dramatically over the years, we have all tended to expect the same order of reduction in the price of metal cases. And as any manufacturing engineer will tell you, this simply isn't possible.

So there has probably been a widening gap between the prices that we've all been expecting to pay for our amplifier and instrument cases, and the prices that the manufacturers have had to charge. In other words, at least some of the reason for the slump in demand has been unrealistic expectations about pricing.

Incidentally, I suspect that the cost of metalwork and other hardware has actually gone down over the years, in real

FORUM

terms, although not by nearly as much as for things like ICs.

Overall then, it does begin to look as if we consumers of electronic components and hardware only have ourselves to blame for the poorer range available in some areas, and for the poorer product quality in others. This suggests that if we want to see the situation improve, we'll have to (a) make it clear that we want a wider range of components, including those of better quality; and (b) then be prepared to buy 'em, to prove that we're fair dinkum.

But what do you think? Am I right in my belief that things aren't as good as they were in these areas, or not? And if so, do you agree with my suggestions as to why this might have happened, and what we can do about it?

If you don't agree, or have some interesting comments to make, please write in and let me know. I hope you'll at least agree that it's an important topic, and one that ought to be discussed further.

Kit problems

I can't end up this month without discussing a letter that turned up a few days ago, re-opening that thorny debate we had early last year, about who's to be held responsible when there are problems with published project designs or kits marketed for them.

Actually it's not surprising that this subject keeps on cropping up, because it's obviously one of considerable importance to quite a lot of readers. It also happens to be one where there are simply no clear-cut, unequivocal or realistic answers to make everyone happy.

In fact it's one of those topics where almost *no-one* ever ends up happy, no matter how long you discuss it. So it simply keeps on bouncing back time and again, like the proverbial bad penny...

But enough philosophising. The reader who has re-opened the subject is Mr Leonard Spyker, of Karrinyup in Western Australia, who certainly raises quite a few interesting points in a fairly lengthy letter. But you're going to see them all for yourself, as Mr Spyker has stipulated that his letter can only be published in total:

I have read with considerable interest and increasing disquiet the arguments that have been presented in EA's 'Forum' regarding the responsibility (or lack) that this journal has to its published articles and subsequent kits and the kit supplier.

After being directly involved in friends kit problems and dilemmas, I would like to take issue with this respected journal. As an EA reader since 1961 and supporter of the industry, I feel I ought to try and put the point from the user angle a bit more cogently.

To put all my cards on the table, my brother has had the portfolio as Minister of Consumer Affairs in a state government in recent times and this tends to open one's eyes a bit. Attending a Law of Contract course for the small business did likewise, especially re 'merchandisable goods'.

Quite often the request for EA's support from a frustrated flummoxed amateur and pro constructor alike, is met in EA letter columns with a blanket 'all care and no responsibility, not our problem, it's the suppliers' problem'. That is missing some points, which I will now elaborate on.

The sales appeal of the magazine is aided by prominent banners 'NEW 500MHZ COUNTER', 'I/R REMOTE CONTROL', 'RF CAT & DOG MINDER', etc. These quite rightly highly promoted items and the advertising support attracted by these items are the lifeblood of any organisation. People are offered goods and services by or via your magazine, whose technical standing is a major factor in a consumer's decision to part with their sheckels to purchase EA designed or approved goods, from EA's advertisers.

The EA magazine has the technical and financial capacity, either in house or without, to make sure the articles and subsequent kits are of merchandisable quality. Try licensing kits to suppliers etc. That should raise an excellent furore.

My simple specification as a consumer of kits is that they work, first time, even! That is not unreasonable. Regrettably in several articles you have actually published statements by designers, SIC, in the style of, "I used an old zener from my scrap bin and it works great", IN THE ONLY ONE HE/SHE EVER BUILT. Well that sort of statement is ludicrous for an intended mass user item, meaning that tolerances have to be considered even in a kit, especially in a kit? Great care should be taken to allow for maximum user error in purchasing and assembly and alignment.

The definition of quality, is defined by one company as, 'Supplying the goods to the specifications laid down by the buyer'. That definition, by the way, is from the IBM company, as stated at Big Blue's own purchasing seminars.

Circuit designs are published without any supply bypass caps, or omitted in later kits, to the detriment of having reliably working kits. Inadequate input protection and lack of EMI protection and shielding is another failing. The complaints about unstable MOSFET amps are now legendary. The publication's duty to its readers, morally if not legally, is to weed out that sort of rubbish.

Some solutions to these problems are as follows. Get a team of say a dozen volunteers, mainly novices and a few hard nut engineer skeptics like myself, and supply the parts and construction article for a kit under consideration. Give us a week or so, and we will pick the eyes out (of) the design and construction details.

If the kit is workable, EA will be able to publish a good design, achieve a better reputation with readers and kit suppliers, at only materials cost to you. Volunteers who could be rotated, will have some useful adjuncts to their hobby shop.

I expect some suppliers might even chip in with the bits to avoid the time and money consuming visits and calls from the now increasingly frustrated kit assembler, and an even more surprising call from the consumer affairs department.

Well, there it is. Mr Spyker is obviously a frustrated and unhappy man, and no doubt representative of a significant number of readers, who are still unhappy with what they see as an unsatisfactory situation. Fair enough. The problem is that in his worthy attempt to describe the position of those unhappy readers, he seems to me to both misrepresent our own position, make unrealistic and unwarranted assumptions and throw in the odd red herring as well.

For example the business about 'merchandisable goods' really is a red herring, as far as I'm concerned. The only 'good' that is sold by electronics magazine publishers like our own company is the magazine itself – in this case *EA*. A collection of pages, carrying information printed on them in the form of text and assorted 'graphics'. And surely that 'good' is 'merchandisable' if the pages are all there, they aren't torn, and all of the information is printed so it can be read clearly. I can't see how you could have any other definition, even allowing for that well-known ability of lawyers to make simple things much more complex.

By the way, if you ever get a magazine that *is* missing pages, or is badly printed or whatever, always return it to the publisher. All reputable publishers will replace the faulty copy immediately without question, assuming of course that they are in a position to do so. And returning the faulty copy allows them to see what has happened, in order to try and prevent it from happening in the future.

Of course the point about a magazine is that the physical 'good' we sell you is not really what you're interested in. It's only the carrier or container for what we really provide, which is the intangible *information* itself. And as I see it, that can't be defined as either 'merchandisable' or whatever the opposite of that ugly word may be.

Now for Mr Spyker's second point, that our reaction to all reader complaints is to deny any responsibility and claim that all problems are caused by the component/kit suppliers. This is simply not true, as I've tried to make clear in various previous airings of the same subject.

To my knowledge *EA* has never attempted to deny any responsibility for problems with published project designs. On the contrary, we are happy to admit responsibility where problems may be caused by shortcomings in a published design itself. And where this occurs, we make every effort to correct the situation as quickly as possible.

Where we are NOT prepared to accept responsibility is when the problems are caused not by shortcomings in the published design, but by other causes altogether – such as unwarranted substitution of components by kit suppliers, or mistakes by the constructor themselves. In other words, by causes totally outside our own control.

If Mr Spyker somehow expects us to accept responsibility for problems arising from these causes, frankly I think he's being quite unreasonable. There's a wise old saying which seems to be relevant here: 'no responsibility without due authority'.

My next quibble with Mr Spyker's letter is that as well as trying to expand our area of responsibility in this way, he also attributes to us actions which we simply don't perform.

For example he claims that the magazine itself offers goods and services for sale, as distinct from our advertisers. Strictly speaking we don't, although our parent company does market various books via this magazine and others in the group.

Similarly he claims that we 'approve' goods from our advertisers, which then acts as a major factor in influencing our readers to buy them. This again is not true, as to my knowledge we have never *approved* goods – and certainly not products such as kits.

We certainly *review* a wide range of products, including at various times certain kits. But a review is merely a report of our experiences in trying out and where possible testing the product concerned; it's not an 'approval' of the product, in the normal sense in which that word is used.

But it was Mr Spyker's next claim and suggestion that left me almost speechless with wonder, at the sheer scope of his assumptions. Somehow he has been able to determine, all the way from Karrinyup in WA, that we have the technical and financial capacity even to make sure that all kits sold for our published designs are of 'merchandisable quality'.

Exactly how he has worked this out escapes me, I confess. But frankly he seems to have not only over-estimated the profits to be made from publishing an electronics magazine in Australia's market, but under-estimated the sheer cost of performing the vetting function he suggests.

And his suggestion that we try to enforce a licensing system for kits marketed from our designs is totally unrealistic, I'm afraid. Various other maga-

Interesting claims by hifi dealers

The hifi industry is generally recognised as one in which a higher level of subjectivity tends to prevail, compared with other areas of electronics. It's also one where pseudo-scientific marketing 'puffery' tends to be almost accepted as the norm, unfortunately.

Two recent examples have been spotted by *EA* readers and sent to us for comment, and these do seem particularly dubious. There MAY, just possibly, be some objective reality behind the claims made, but it seems very unlikely.

The first was spotted by Graeme Challinor, of Gundaroo, NSW, who noticed it in an advert by a hifi dealer in a Canberra newspaper. This is the claim:

Incidentally, many people do not realise that new speakers need a few hours to 'run in' – they often sound a little thin and harsh initially.

But perhaps even more interesting are the claims spotted by Cameron Lewis, in another hifi dealer's advert in one of the big Melbourne dailies. In a section of the advert offering what are claimed to be helpful hints on enhancing the performance of a hifi system, the following gems appear:

Amplifier –

1. *Correct AC polarity at the mains plug improves clarity, dynamics and stereo imaging. (Our service department is best equipped to do this).*
2. *All contacts must be clean.*
3. *Use high quality power cable where applicable (MAS Power Master AC cord).*

Compact disc player –

1. *Quality interconnect lead must be used (van den Hul, MAS, Monster).*
2. *Isolation from external vibrations. (Tiptoes, Mission Isoplat).*
3. *Special disc damper will produce more solid stereo focus and better definition (Modsquad CD Damper).*
4. *AC mains power polarity (as with amplifier).*

Mr Lewis relates that when he rang the dealer about having his amplifier 'tuned' for correct main polarity, he was told that "Oh yes, it gives a smoother sound and better clarity and everything." The charge quoted for this 'service' was $20. The same dealer was offering special high-purity silver speaker cables, at up to $700 per metre.

Mr Lewis suggests that the performance enhancements given are almost all pure marketing hype, with no objective justification whatever. He feels that these kinds of claims are becoming more and more outlandish, and would like to see those making them forced to justify them with 'something more substantial than meaningless marketing gibberish'.

I'm inclined to agree – but what do you think?

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zines have tried schemes like this in the past, and they've all failed. Not because they raised 'an excellent furore', as Mr Spyker claims, but because the kit suppliers simply refused to submit to this type of control. They merely stopped producing kits for the designs published by the magazines concerned!

That's the only result likely to be achieved by Mr Spyker's suggestion, I'm afraid – and I suspect that's not quite what he would want to achieve.

Now for Mr Spyker's specification that kits should work, and work first time. On the surface this may seem fair enough, I agree. But despite the claim that it is 'not unreasonable', I'm afraid it simply isn't reasonable when you analyse the situation further.

The problem is that an electronic project kit (or any other construction kit, for that matter) is *not* a simple product or 'good' bought in its entirety over the counter, like a frypan or a food mixer.

As I've tried to explain before, when you buy a kit you're merely buying a collection of components – hopefully all of the parts needed to produce a certain piece of equipment. But the kit of parts forms only *one* ingredient of that final piece of equipment. There are two other ingredients: the design which directs how the parts are to be assembled, and the skill and labour used in the assembly itself.

All three ingredients play essential roles in determining the final outcome. If the design itself has a shortcoming, this may well cause a problem. Similarly if there are incorrect parts in the kit, this may again cause problems. And thirdly if the constructor themselves makes mistakes in the assembly, this can also cause problems.

Now in the case of kits marketed for projects published in a magazine like *EA*, each of these three ingredients is provided by a different participant. We may provide the design, a component supplier may provide the actual kit of parts, but the constructor themselves – you – provides the skill and labour used in the assembly. And this is why it becomes very difficult to attribute responsibility when there are problems with the operation of the final gadget.

Incidentally, you'll note that I wrote 'operation of the final gadget' – not 'operation of the kit'. Strictly speaking, it doesn't even make sense to expect a kit to 'work'. A kit is just that: simply a collection of separate components, sitting passively in a bag or box. Assuming they're good quality parts, and as specified for the design concerned, the kit itself must surely be 'merchandisable'. The concept of it 'working' isn't even relevant, because only the assembled piece of equipment is even capable of working.

This isn't just an exercise in semantics, by the way. What I'm getting at is that even if we did have the technical and financial resources to thoroughly and exhaustively test all published designs, and to vet all kits offered for sale, this STILL wouldn't ensure that all equipment assembled from those kits worked first time. And for the simple reason that we still wouldn't have any control over that third ingredient: the way the kits are assembled.

So that's why Mr Spyker's specification that kits should 'work', and first time, isn't reasonable. Not just because a kit *can't* work, but because that vital third ingredient in the final product is supplied by the constructor themselves – and is totally beyond the control of either the magazine or the kit supplier.

It's for this reason that overseas magazines often feature a disclaimer regarding responsibility, like this one that appears in the respected US magazine *Radio-Electronics*:

As a service to readers, RADIO-ELECTRONICS publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, RADIO-ELECTRONICS disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Mr Spyker's next comment, about the need to allow for the widest possible component tolerances in project designs intended for home construction, is fair enough. In fact we have always tried to follow this rule ourselves, and will continue to do so. But to be realistic, it's almost impossible to come up with a design which will always work properly, no matter what odd-ball components are used.

In fact it often isn't easy to come up with a design which can cope with the full range of component tolerances, even with readily available new components. Sometimes the closer-tolerance parts that would really be required for fully predictable operation simply aren't available, or not at an acceptable price.

IBM's comments about the definition of product quality again seem to be a red herring, here, because their definition can't really be applied to a kit.

And finally, we get to Mr Spyker's grand plan for us to organise teams of volunteer enthusiasts, and provide them with parts so that they can pre-build and 'pick the eyes out' of our projects and articles, before we ever publish them.

It all sounds great, in theory. Fully pre-digested and debugged project designs, described perfectly in multiple revision articles – so that constructors would never have any problems, and all kits would work perfectly first pop. Trained kit experts by the dozen, able to advise their local electronics shop regarding the non-existent problems. Ah, just to think of it!

There's only one small problem, I'm afraid. The costs to implement such a scheme, in terms of both time and money, would be far beyond the resources of any existing electronics magazine. If *EA* or any of our competitors were forced to implement such a testing, evaluation and revision scheme before we published any construction projects, it would almost certainly send us broke.

And even if it didn't, the delays in publishing project designs would grow so long that many of our designs would be obsolete before you saw them. You only have to look at the industry's 'learned journals', world wide: they use this kind of scheme to vet their papers, and the delays in publication are quite often up to 2 years!

So I'm sorry, Mr Spyker, your suggested solution to kit problems just isn't realistic. If it's that or nothing, you could well end up with nothing – either no magazines at all, or none prepared to publish project designs for home construction.

Surely that would be a bit drastic?

In ending up I guess I should point out that despite the fact that we can't build up and test numerous prototypes, or employ Mr Spyker's system of multiple revisions, most of our project designs don't give any problems. If the specified parts are used and they're assembled with reasonable workmanship (workpersonship?), they work well. So in practice, things aren't nearly as grim as Mr Spyker's letter might suggest.

Of course a few problems do slip through our checking system from time to time, but these are really the exception rather than the rule.

High Performance In Your Shirt Pocket!

See Review in EA December '88

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	10A	10mA	1.5%+5dig
Aac	200mA	100µA	1%+5dig
	10A	10mA	2%+7dig
Ohms	200Ω-2MΩ	0.1Ω	0.75%+1dig

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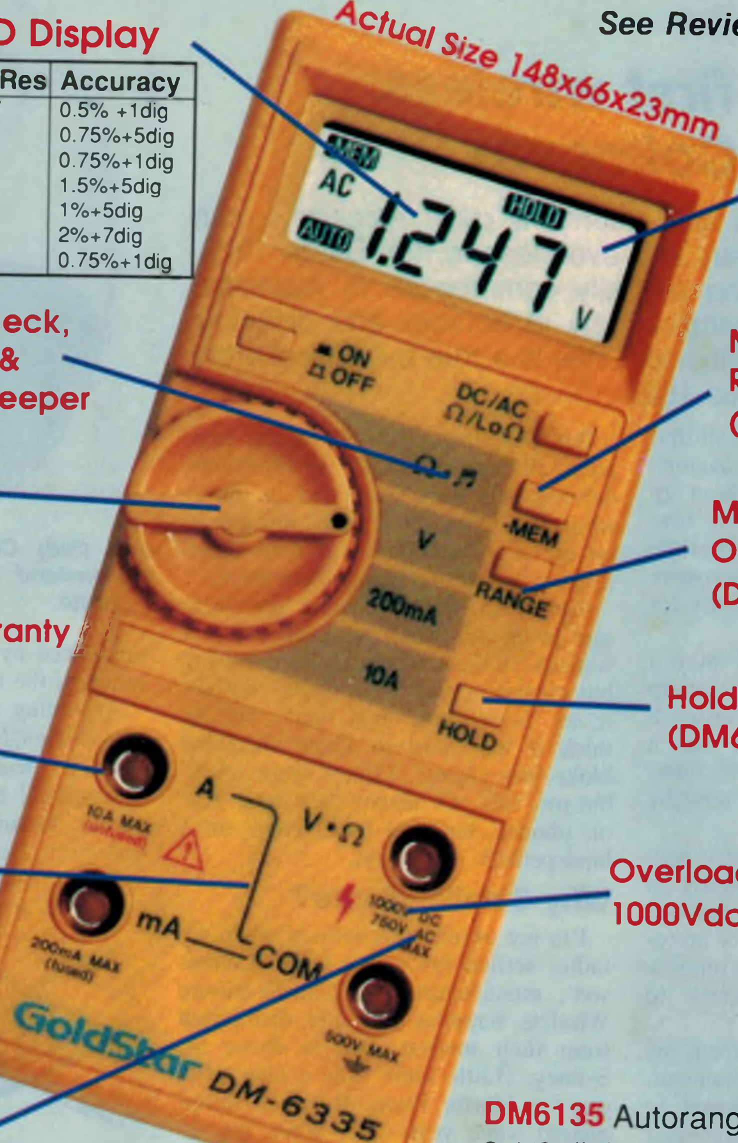

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When I Think Back...

by Neville Williams

Our family's first wireless: a four-valve Colmovox

These days, a wireless set – sorry, a radio receiver – can cost next to nothing to buy and even less to run. But in 1923, when public broadcasting officially commenced in Australia, wireless sets were expensive, few in number and distinctly unpredictable in their behaviour. This is a true but typical story behind one such set, circa 1925.

In the early '20s, there wasn't all that much to do after dark, in the average working class country home. Clean up after the evening meal, sit by the fire, talk a bit and perhaps read for a while by the pale yellow light of a kerosene lamp. Then it was off to bed, ready for an early start next morning.

Occasionally, someone might play a couple of records on the wind-up phonograph. But records only lasted a few minutes apiece and there was a limit, anyway, to the number of times one could repeat the same old scratchy songs and monologues.

It was little wonder that country people in particular responded eagerly in 1923 to the prospect of regular wireless broadcasting, with the promise of up-to-date news, market and weather reports, plus regular talks and concerts to brighten the evening hours.

How do I know? Because I spent my boyhood in just such an environmment. The four-valve Colmovox referred to above was the first radio receiver ever to enter our family home – and it was a memorable occasion.

To buy a wireless set at all was no light decision for my parents. Like most other people in the small country town, they worked hard and lived from one pay packet to the next, with little opportunity to save much in between.

To them, the cost of even a modest wireless set represented about two month's wages, plus the recurring expense of ordering heavy duty 'B' batteries from the city every two or three months. The only way they could ever own a set was to scrape together enough for the deposit, and sufficient after that to meet the weekly payments.

But what kind of a set? In the complete absence of formal specifications, wireless sets were evaluated in purely subjective terms, as often as not passed on by neighbours who had read something or heard something about them.

Rightly or wrongly, some sets were said to be too 'weak' to receive distant stations. Others were 'more powerful' but expensive and 'a bit heavy' on batteries. Some were 'real loud', but 'so thick it was hard to know what the bloke was saying'. Others were 'clear' but too 'soft'. Or maybe they were 'OK' on phones, but 'not much chop' on a loudspeaker. And so on.

Why Colville-Moore?

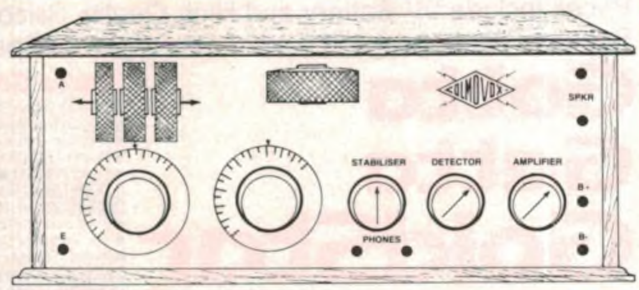
I'm not exactly sure why or when my father settled for a four-valve 'Colmovox', manufactured by Colville-Moore Wireless Supplies Ltd and distributed from their modest shop in Rowe St, Sydney. (Little more than a lane adjacent to Martin Place, Rowe St disappeared some years later when the famous old Hotel Australia was demolished and redeveloped.)

The chances are that he, along with many other prospective customers, was influenced by the well established reputation of the respective proprietors.

S.V. (Sid) Colville, founder of the Queensland branch of the Wireless Institute.

According to the *Australasian Wireless Review* for January 1923, S.V.(Sid) Colville had earlier founded the Queensland branch of the Wireless Institute, becoming its first secretary and organiser. He had begun experimenting with wireless in 1912 and in that same year had acquired a spark transmitter

The logo of Colville-Moore Wireless Supplies Ltd, well known in the Sydney area during the battery set era of the '20s.



An artist's sketch of the four-valve Colmovox, dating from 1925.

and a receiver using a coherer type detector. He subsequently changed to a crystal detector and later still to a valve circuit.

He had installed a valve transmitter at the Wireless Institute rooms, achieving

Also an avid enthusiast and pioneer, A.L. Moore was the holder of a Commercial Wireless Certificate.

ranges of up to 80 miles (130km) using two type V24 valves. Says the *Wireless Review*: "Transmitting is his forte and the firm is turning out a very compact transmitting set".

A.L.Moore, Colville's partner, had also built up a reputation as an enthusiast with many years of experience, starting off with a loose coupler crystal set and progressing to transmitters and valve equipment. The holder of a Commercial Wireless Certificate, his pride and joy in 1923 was said to be a three-stage RF amplifier set covering a range from 150 to 25,000 metres (2000 – 12kHz) using plug-in honeycomb coils!

With the motto 'Everything in Radio', the Colville-Moore shop in Rowe St had become a mecca for enthusiasts, even before the inauguration of official broadcasting, based on the activity of amateurs and occasional demonstration wireless concerts.

In the same issue of the *Australasian Wireless Review* which carried their biographies, a 2-column advert featured a crystal set capable of covering the long-wave and medium-wave bands from 150 to 1600 metres (2000-187-.5kHz). Also featured was a range of 'Col-Mo' variable condensers (capacitors) from 100 to 2000pF, and a 'Col-Mo' Amplihorn – a metal horn which could be clamped over a headphone to double as a modest loudspeaker.

Colmovox sets

Try as I may, however, I have not been able to verify from accessable literature my recollections of their 4-valve receiver – the first ever to enter the Williams household, circa 1925.

The nearest I've come to it is a 3-valve ready-to-run Colmovox 'Junior' kit, as advertised in *Wireless Weekly* for August 13, 1926. The basic kit, including 'polished maple cabinet', engraved 'pure bakelite' panel and sundry components cost £6.5.0. Essential accessories, including headphones (but no loudspeaker) plug-in coils, valves, batteries and aerial fittings added another £5.6.10.

In today's currency that's directly equivalent to about $24.00, but in 1926 it represented something like six week's wages – for a modest kit which still had to be wired. (For a complete 7/8-valve receiver near the top of the Colmovox range, the figure would have been five to six times as much!)

The 'Junior' kit used a regenerative triode detector tuned by a 0-100 dial, set below a group of three panel-mounted plug-in coils. Of these, the fixed centre coil almost certainly provided the main tuning circuit; the swivelled coil on the left would have been for variable aerial coupling and the one on the right for 'reaction' (regeneration).

Other controls on the front panel included a rheostat to vary the filament voltage (and gain) of the detector, and another for the filaments of the two audio amplifiers.

In addition, there were terminals for Aerial, Earth, Phones, Loudspeaker, B- and B+. The idea of having the last two on the front panel was to keep them well away from the filament connections at the rear, to minimise the risk of error and of 'blowing' all the valves!

The valves supplied with the kit offered a choice of Radiotron, Philips, Geco or De Forest. They would most likely have been 4-pin 'UV' types (see illustration), fitting into tubular sockets not unlike an over-size lamp socket.

Vital extra stage

As distinct from the kit, the four-valve set that my father actually bought had an extra tuning dial and capacitor, and an extra plug-in coil at right-angles to the other three. Including the slightly projecting base and lid, it measured 7-7/8 x 20-1/4 x9 inches (H x W x D), or 200 x 510 x 230mm.

While the extra components clearly indicated a tuned RF stage ahead of the detector, I am hazy about the internal layout or circuit arrangement; in particular, whether it provided any form of neutralisation for the RF amplifier.

I certainly remember a knob marked 'Stabiliser', looking rather like a third filament rheostat. It was, however, a 400-ohm potentiometer, which (I think) swung one or more grid return circuits progressively from filament negative to positive. By thus modifying the effective grid/filament bias, it probably served to vary the gain of the RF and/or detector stages.

As with the kit, there were two transformer-coupled audio stages and provision for using phones or loudspeaker. As I remember, using the phones involved only the first two valves, with much reduced current drain. For the loudspeaker, the full audio system had to be used.

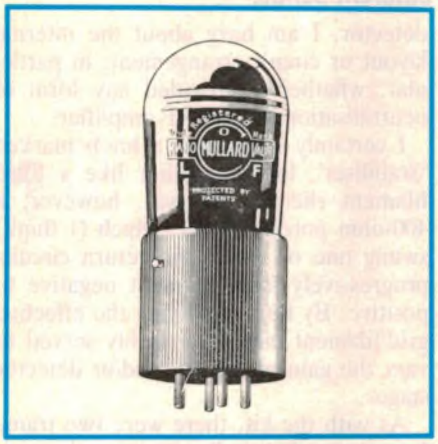
The plug-in coils (as pictured) were a heritage of the early '20s, when there

A typical plug-in 'basket-weave' coil. The type shown was available in steps from 25 to 150 turns, to suit different bands.

A 'honeycomb' wound plug-in coil, available in 8 steps, from 25 to 250 turns. When tuned with a 1000pF capacitor, its coverage extended down to 4150 metres or 72kHz.

was some doubt as to how the various stations would be distributed across the long- and medium-wave bands. So also were the large 1000pF tuning capacitors, on sale at the time and fitted to many early receivers.

Details aside, my lasting impression of the four-valve Colmovox is that Messrs Colville and Moore must have got the design right. It was loud enough for comfortable family listening and clearer than most. On the southern highlands, about 100km south-west of Sydney, it could receive Sydney stations reliably by day, and plenty of interstate stations on lightning-free nights – without costing the earth to run!



A typical triode from the early/mid '20s with a 'UV' bayonet style base. Note the locating spigot on the side.

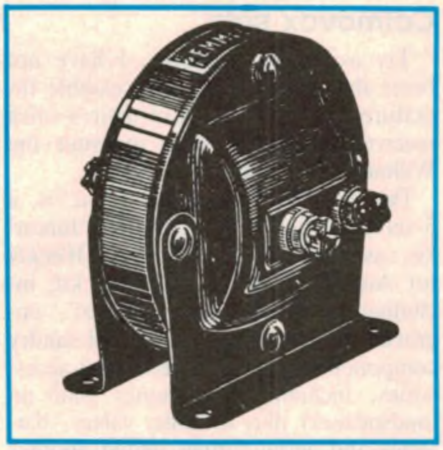
First things first

But I am getting ahead of myself. Before wireless reception could become a reality for the Williams's or anyone else in the country, we had to provide the obligatory outdoor aerial and earth, complete with aerial switch and lightning arrester.

In those days, most broadcast stations used horizontal wire aerials strung between tall towers – an arrangement that tended to radiate a large proportion of the signal skywards. While this provided interstate listeners with interesting night-time signals, it was at the expense of the ground wave serving listeners within 100km or so.

The depleted ground wave, plus limited transmitter power and none-too-sensitive receivers made it essential for country listeners to provide a large outdoor aerial and an effective earth return, to capture a sufficient level of signal.

In our case, it meant scouring the



Over the years, the family Colmovox was refitted with various replacement audio transformers, usually because of burnt out primaries. Typical was this popular Australian-made EMMCO.

nearby bush for a couple of tall saplings, felling and stripping them and dragging them home, to be erected in the open near the house. Passers-by, at the time, didn't need to be told that we had ordered a wireless from 'the big smoke' (Sydney).

Without getting too involved in the detail, accepted wisdom was that aerials had to be at least 60ft (20m) long and supported between porcelain 'egg' or pyrex glass insulators, at least 25ft (8m) above the ground. An insulated stranded steel and copper lead-in ran from the near end of the aerial, through a small porcelain tube set in the wall, to an aerial switch and thence to the receiver.

In the absence of a reticulated water supply, an impatient enthusiast might simply clamp the earth wire to an odd length of galvanised water pipe driven into (hopefully) moist soil.

In our case, if I remember rightly, the wire was rivetted and soldered to an offcut of galvanised roofing iron which was then buried deeply in a handy garden plot. In dry weather, it became something of a ritual to keep it moist with waste water.

Lightning arrester

On an indoor window frame near where the aerial entered the listening room, my father mounted a knife switch-cum-lightning arrester. With the switch in the up position, the aerial was connected to the set. In the down position, it was isolated from the set and connected directly to the earth wire – the preferred position when the set was not actually in use.

But the switch assembly also included two small brass tabs, with serrated edges which almost bridged the gap between the aerial and earth connections. The idea was that any electrical pulse or charge that might appear on the aerial would jump the sub-millimetre spark gap to earth, instead of damaging the set, or causing a flash-over in the house, or initiating a possible lightning strike.

Looking back, it might seem that we were rather hung up about lightning in those days – but not without reason. Over the years no less than three large gum trees were struck by lightning, within 100 metres of the family home, and blown to pieces by having their internal moisture flashed suddenly into steam.

Three huge explosions like that breed a certain respect for the elements, as did the experience of opening the knife switch and watching an almost constant electrical discharge across the arrester points.

Perhaps it was because, in an area devoid (at the time) of any overhead phone or power wiring, tall trees and lofty aerials in cleared areas were that much more exposed to natural electrostatic charges.

And, if you need to be further convinced, let me quote from page 9 of *Wireless Weekly* for March 9, 1923:

COMPULSORY IN USA

Lightning arresters are now a necessity of radio equipment and have been made the subject of a special ruling by the National Board of Underwriters. Each installation must be provided with an arrester that will operate at a potential of 500 volts or less.

Even today, lightning is still lightning, as I was reminded recently when, from my back porch, I saw and heard a direct strike on the studio tower of ATN-7 in Sydney, a few streets away. It's just that, buried in a jungle of overhead wiring, with powerful local signals, sensitive receivers and indoor antennas, we are much less aware of it.

Static, fading & 'DX'

But if local thunderstorms were an occasional hazard, lightning activity at much greater distances was a constant bugbear to country listeners in the mid '20s. Reliant on relatively weak signals and notoriously inselective receivers, even distant lightning could produce annoying bursts of static.

With magazines like *Wireless Weekly* carrying both local and interstate programs, my parents would search each issue for what, to them, were the highlights. Hopefully, they would be from Sydney but, inevitably there would be desirable sessions that they might manage to receive from Brisbane, Melbourne or Adelaide.

Unlike today, listening had to be strictly rationed to conserve the B-batteries and to avoid flattening the filament accumulator too often.

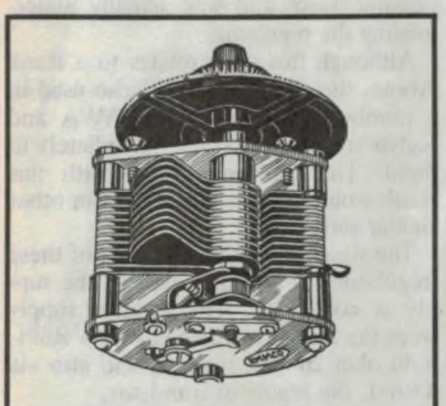
Quite early in the life of the Colmovox, I learned the art of tuning wanted stations with the filament rheostats turned well back. Anybody could get loud signals with the valves full on; it took an expert to get results with the filaments almost off!

But many were the occasions when planning and miserly operation alike were nullified by storm activity somewhere in eastern Australia; or by even more pervasive atmospheric effects that caused night-time signals to fade and distort, due to interference between ground and sky waves.

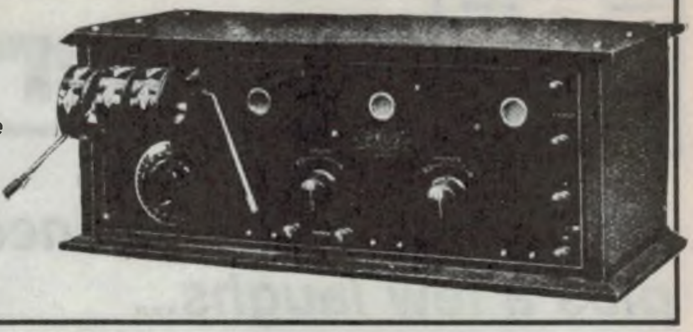
Frustrating as they were, such experiences were balanced by other occasions when programs would be heard from totally unexpected sources. It wasn't long before a carefully prepared log card appeared on top of the Colmovox, recording the knob settings for what had been received at some time or other, and therefore might be heard again under favourable conditions.

As the number of sets in the town gradually multiplied, the content of those log cards became something to boast about – certainly for the fathers, but often for the kids as well. A set that could regularly receive 7ZL Hobart was obviously better than one that couldn't!

Even station personnel were quite flattered to receive reports of long distance (DX) reception. Did it not indicate the extent of their coverage?



Another popular EMMCO product – a tuning condenser and dial, available either 'plain' or fitted as shown with a concentric knob and provision for vernier tuning.



Not the four-valve Colmovox, but the three-valve 'Junior' model.

Improvements

Not surprisingly, all this had the effect of adding an enthusiasm for wireless to my father's many other interests – an enthusiasm that must have rubbed off on myself.

Deciding quite early that he had no use for the long-wave coverage, my father stripped down the redundant long-wave honeycomb coils and removed half the plates from the 1000pF tuning capacitors to bring them down to around 500pF – more suitable for the medium-wave band.

Valves that failed or were suspect were gradually replaced by others that were reputed to be better, or that seemed like a bargain too good to be missed.

The original, rather unpretentious horn loudspeaker was replaced by the latest goose-neck Amplion – which I still have, and which still works in a fashion.

Annoyed by an interstage audio transformer that suffered an untimely open-circuit primary winding, he carefully removed the secondary winding, exposed and repaired the break in the primary, rewound the whole thing (by hand) and restored it to normal operation. That's a feat at which I never cease to marvel, and which I have never aspired to emulate!

When the great depression hit the town, money ran out and there simply wasn't enough to buy new B-batteries. Determined not to be deprived of his beloved Colmovox, my father collected several dozen medicine bottles, an equivalent number of discarded dry cells, a fistfull of scrap sheet zinc and the wherewithal to make a sal-ammoniac solution.

The medicine bottles were duly beheaded with a hot wire and cold water, and installed in a home-made wooden crate. A carbon rod and de-polariser bag from a dry cell was inserted in each to serve as the positive electrode, along with a strip of zinc for the negative pole.

When the cells had all been suitably connected in series, he poured in the sal-ammoniac. The homemade B-battery worked like a charm, but it did smell a bit and it did grow an impressive crop of slimy green verdigris – which soon began to threaten the linoleum. I was not party to the reason for the subsequent disappearance of the home-made B-battery, but I gather that it was the subject of a marital edict of the 'that or me' kind.

The depression was also responsible for many of the sets in the area becoming temporarily illegal, when there was no longer any money to pay the obligatory licence fee. If the Colmovox seemed strangely muted around 1930, it was more likely to have been the result of discretion rather than any technical problem.

End of the line

But the days of the faithful four-valve Colmovox really were numbered when, shortly afterwards, my family moved to the city. Designed for the bush, the set didn't like being so close to so many stations. It couldn't reasonably be adapted to work from the power mains, and the once-prized goose neck Amplion speaker seemed as out of place as Dad Rudd in parliament house.

So the faithful old set was pensioned off, too old to be worth keeping but too young to be a relic of the past. Pretty soon, I had pinched some of the bits to build a crystal set, and the bakelite panel for another constructional project that seemed more important at the time. I kept the Amplion loudspeaker for sentimental reasons but the valves, sockets and audio transformers ended up, along with other unwanted bits, in a private museum in the Blue Mountains.

That left the polished maple box with base and lift-up lid. My father fitted it with a 3-ply panel and used it for fishing tackle. When he passed on, some years ago, it ended up as an oddment box in my brother's workshop.

If you were wondering, that's how I was able to quote its exact dimensions!

The Serviceman

Assorted faults explained, plus a few laughs...

This month we will have a break from the usual workshop troubles. Instead, I'd like to acknowledge some reader feedback, commenting on stories I've related here in recent months. I thought we'd also have a giggle, with some lighthearted thoughts from our regular contributor, J.L. of Hobart.

The letters, and the replies, point out the diversity of understanding among people who work in electronics. Some of us just write about the subject. Others work at the domestic level, while others toil at the professional level. Each of us can contribute to the other's knowledge, and each can help others to resolve their day to day problems.

From time to time these Serviceman stories throw up a quandary – just what did cause a certain set of symptoms? Often, even though the fault is found and the repair completed, we are not able to explain why the set behaved in the way it did.

This is never more apparent than in the pursuit of intermittent faults. It's not often that we are lucky enough to find an intermittent component in its broken-down state. More often than not, the culprit restores itself to normal as soon as the power is switched off and we are left to deduce its likely effect, based on our knowledge of circuit operation.

Unfortunately, some elaborate circuit designs are so complicated that logic breaks down and we are left with nothing but imagination to help us find the component responsible. And imagination is not much help if the circuit is so devious as to obscure the function of the various parts.

In several recent Serviceman stories I have been compelled to confess "I don't know how or why!". I have simply stated the symptoms as I found them, and how I went about finding the ultimate cause of the trouble.

One of these stories was published in the May '88 edition. It concerned a Philips K9 that killed the tripler, the line output transistor and the line output transformer. Even after all this had been corrected, the power supply was still hiccupping.

I persevered for some days, trying to find out what was wrong with the supply, then one day it came good by itself and has caused no trouble since.

I expressed great puzzlement over this job, and to this day I still do not know for sure what the trouble was.

Nevertheless, there are other people who are a bit brighter than I am, and one of them has written in with a possible explanation. The set has never come back, so I can't confirm his suggestion. But it's worth remembering for any future occurrence of Philips hiccupping.

The explanation comes from Mr Ian Wilson, of Bateau Bay, NSW. In his own words, he writes:

A possible cause of the problem would be an intermittent capacitor C179A. If this cap goes open, the 155V rail will go low, because of the inductive input to the filter, via S183.

The supply may have been readjusted to 155V by a previous technician. However, this results in a longer duty cycle for the chopper, and may be interpreted by the control module as an over-current situation, causing hiccupping.

If, after readjustment, the cap came good, the HT would rise – causing the crow-bar to operate. (You did mention the voltage into the dummy load was 180V) This also causes hiccupping.

Whilst I have not encountered quite the same symptoms as you describe, a look at the secondary side of the supply may be worthwhile if the set 'bounces'.

Finally, a tip. I find a useful check is to monitor with a CRO the gate of the BT100 crowbar protector, when unfathomable faults occur. If it rises above zero volts, you have an overvoltage condition. Regards, I.W.

If my arthritic knees were not so stiff, I'd go down on them to Mr Wilson. He has presented a near perfect explanation for the symptoms I found with that Philips. As I said earlier, the set hasn't bounced yet, so I can't prove his point. But on sheer logic, I'll bet he's right.

I'll also take note of his suggestion about monitoring the gate of the crowbar SCR – a wise move. It may not finger the exact culprit, but it will at least point in the right direction.

Another story that produced reader response was the one about a Rank Arena model 2204, which appeared the month after the Philips, in June '88.

This time the response has come from Mr Glen Moore, of Loxton, SA. Mr Moore is an engineer, usually involved with transmitters and transmission lines. He says he reads the Serviceman to get a glimpse of what goes on at the other end of the transmission path.

Mr Moore's letter is too long to quote verbatim, but the gist of it is a blow-by-blow explanation of why I got such silly results when running the 2204's power supply into a dummy load.

If you remember, I had two power regulator boards – a good one and a bad one – neither of which would regulate into a dummy load. Eventually, I repaired the bad board and found that both boards worked perfectly in the set, but not on dummy load.

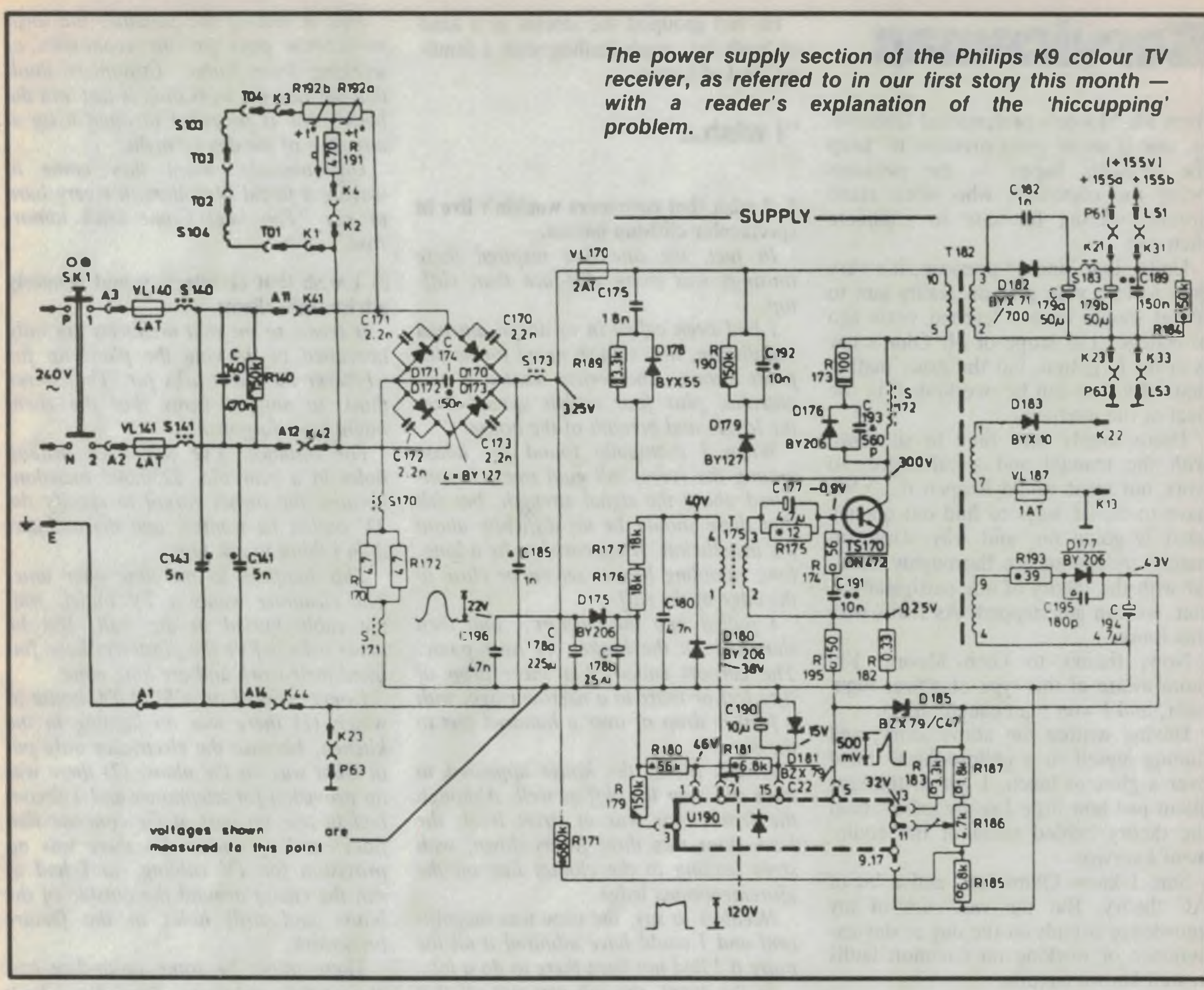
Basically, Mr Moore's explanation shows that I had miscalculated the dummy 'load' and was actually underloading the regulator.

Although this story relates to a Rank Arena, the circuit design is also used in a number of other brands; AWA and Sanyo are two that come immediately to mind. The problems I had with this Rank would be just the same with other similar sets.

The significant thing about all of these 'regulators' is that only part of the supply is controlled. The positive supply from the bridge rectifier flows via R691, a 40 ohm 20 watt resistor, and also via TR691, the regulator transistor.

The design philosophy is, presumably, that the transistor/heatsink assembly can be smaller and cheaper if it does not have to handle the full HT current.

When you come to think of it, this is not unreasonable because a significant



The power supply section of the Philips K9 colour TV receiver, as referred to in our first story this month — with a reader's explanation of the 'hiccupping' problem.

part of the load current is steady state and does not need to be dynamically regulated. It's only the widely varying current of the line, vertical and audio output stages that makes a regulator necessary in the first place.

Thus, the feed resistor R691 can take care of the base load, and the transistor need then only iron out the fluctuations over this level. So, where did I go wrong?

Mr Moore suggests that I miscalculated the value of the lamp used in the dummy load, then complicated the matter by reducing the value instead of increasing it. He's quite right, of course, but then I hadn't appreciated the significance of the two-path supply.

His explanation gives the problem the full mathematical treatment, which I will have to abstract for this paper.

Imagine a rectifier bridge output of 160 volts. The required HT is 110 volts. Therefore R691 will have to drop 50 volts and this can only occur at a current of 1.2 amps. As Ohm's law states, $I = E/R$ so that if $E = 50$ volts and $R = 40$ ohms, then I cannot be anything other than 1.2 amps.

At this level of current, TR691 cannot afford to contribute anything at all, otherwise the output will be more than 110 volts. Imagine that the transistor contributes 100mA to the load current. Now only 1.1 amps will flow through R691, and the voltage drop would be only 44 volts, giving an output of 116 volts instead of the required 110.

This 1.2 amps is the 'steady state' current and R691 will never carry more than this. As more current is required by the set, the extra flow is via TR691, which contributes enough current to keep the drop across R691 to 50 volts. If R691 carries less than the 1.2 amps, then TR691 is turned off and the output voltage must rise.

My mistake was to miscalculate the load presented by the lamp. Mr Moore points out that the lamp's consumption of (say) 100 watts is only accurate at 240 volts. It would consume considerably less than this with only 160 volts across it.

The nett result is that I was not drawing enough current from the supply to fully load the resistor, let alone turn on the transistor. The supply simply can't regulate until the current is large enough to drop 50 volts across R691.

It wasn't the different *kind* of load that upset the regulator, but simply the lack of *enough* load.

This argument does not apply to any supply where the whole load current passes through the regulator transistor. And don't get caught by those supplies using a parallel 'start-up' resistor. This is invariably a fairly high resistance, and only about 1 watt capacity.

Now that the theory of the Rank supply has been pointed out to me, as well as the mistakes I made in dealing with it, I can only hang my head in shame. But in the service workshop, as distinct

Serviceman

from Mr Moore's professional laboratory, one is under great pressure to 'keep the peasants happy' – the peasants being the customers who often stand around waiting for one to complete their job.

Under that kind of pressure, it's very easy to lose your grip on reality and to forget simple lessons learned years ago at college. The scope of Mr Ohm's law is never forgotten, but the exact mathematical values can be overlooked in the heat of the moment.

There simply isn't time to sit down with the manual and a calculator, to work out what would happen if...? We have to devise ways to find out quickly what is going on, and why. Unfortunately, unless we are thoroughly familiar with the theory of any particular circuit, we can get trapped. As I was with this Rank.

Now, thanks to Glen Moore, I'm more aware of this type of power regulator, and I won't get caught again.

Having written the above story, and finding myself in a philosophical mood over a glass of lunch, I got to thinking about just how little I really know about the theory behind some of the equipment I service.

Sure I know Ohms law, and a bit of AC theory. But the vast sum of my knowledge is built on the day to day experience of working on common faults in well known circuits.

When I am faced with an unusual fault or a strange circuit, and I'm thrust back onto theory, the through-put in my workshop drops off dramatically.

A couple of jobs like that and my workshop could be dead for a week. A dead workshop pays no wages and then all I can do is to pray for a run of easy ones next week.

Contributions from folk like Ian Wilson and Glen Moore can make life a whole lot easier. Thanks fellas!

Now, after that somewhat heavy going, let's have something in lighter vein.

J.L., of Hobart, is apparently a fairly typical kind of serviceman, just managing to scratch a living from the idiosyncracies of his customers. He tells me that most of the ideas for the following notes come to him while he waits at traffic lights, en route from one job to another!

Whatever their origin, they show a different view of the life of the self-employed serviceman.

He has grouped the stories as a kind of 'wish list', each dealing with a familiar kind of hassle:

"I wish..."

1. I wish that customers wouldn't live in spectacular cliff-top houses.

In fact, the one that inspired these musings was more cliff-face than cliff-top.

I had been called in to do an antenna installation, in a suburb noted for its difficult terrain. The owner wanted a new antenna, plus four outlets spread over the length and breadth of the house.

When I eventually found the house among the (very) tall gum trees, I wondered about the signal strength, but felt that there should be no difficulty about the installation. It appeared to be a long, low, rambling house, set on or close to the edge of the cliff.

I pulled into the carport – and then slammed on the brakes, in near panic. The carport ended at a sheer drop of fifty feet or more to a narrow ledge, with a further drop of over a hundred feet to the sea.

What's more, the house appeared to have slid over the cliff as well. Although the front door was at street level, the back door was three floors down, with steps leading to the clothes line on the aforementioned ledge.

Needless to say, the view was magnificent and I could have admired it all the more if I had not been there to do a job.

In the event, the job was not all that difficult, since I was able to work from narrow sundecks at each floor level. Still, it was rather unnerving to work from a step ladder propped against a wall, a hundred and fifty feet above the waves crashing on the rocks below.

Incidentally, the signal strength at this site was too weak to provide good pictures at all four outlets. I was able to overcome the problem with the aid of a small antenna booster supplied by the HPM company.

The booster, catalog number 406/B28/TV, can add 28dBuV to the antenna signal, enough to split four ways in all but the very worst signal conditions. The booster is a domestic version of a Distribution Amplifier as used in large MATV systems.

2. I wish that customers wouldn't come round after tea.

I've just missed the end of an enthralling murder mystery, because a customer called in at 8.45pm to collect his telly.

This is one of the penalties the local serviceman pays for the economies of working from home. Customers think that because the workshop is just 'out the back', one is prepared to open it up at any time of the day or night.

Unfortunately, when they come in waving a fistful of dollars, it's very hard to say "Too late! Come back tomorrow."

3. I wish that architects would properly advise their clients.

It seems to me that architects are only interested in drawing the plans up for whatever the client asks for. They never think to suggest items that the client might have forgotten.

For instance, I've just been drilling holes in a year old, $250,000 mansion, because the owner forgot to specify the TV outlets he wanted, and the architect didn't think to ask him.

This happens to me time after time. The customer wants a TV outlet, with the cable buried in the wall. But he never asks before the plasterers have finished their work and are long gone.

I once worked on a $150,000 house in which (1) there was no lighting in the kitchen, because the electrician only put in what was on the plans; (2) there was no provision for telephones and Telecom had to tear up part of the concrete slab floor; and of course (3) there was no provision for TV cabling, so I had to run the cables around the outside of the house and drill holes in the feature brickwork.

There might be some up-to-date and thoughtful architects, but they don't work anywhere near my patch.

4. I wish that possums wouldn't do their business on my televisions.

That one might sound ridiculous to you city-bound servicemen, but here in Tasmania it's not an unusual wish.

Although I live only 5 miles (or is that 8km?) from the centre of Hobart, I am still on the edge of the bush and every night I have a parade of possums along the fence by my carport.

I sometimes have an overflow of work from the workshop and it is stored along the fence, under the carport, just where the possums park their tails while waiting for my neighbour to feed them.

I wish I had a bigger workshop, so that it could store more TV's, and I wish my neighbour wouldn't feed the possums and I wish the possums wouldn't drop their gruff nuts on my televisions!

5. Still on the subject of animals, I wish that people wouldn't keep uncommon pets.

I had just driven half a mile into dense bushland behind a popular surfing beach. I'd had a call to attend to an ailing Kriesler.

I was on my knees behind the TV when I heard a snuffling noise behind me, and the pitter-patter of clawed feet on the lino. I didn't pay much attention, thinking it was just the family pet coming in to see what I was up to.

I soon wished I had paid more attention, because I was savagely butted in the backside and pitched forward into the telly. When I looked around, I found myself staring into the soft brown eyes of the biggest wombat I've ever seen.

The creature has apparently been hand raised, but lives wild in the nearby bushland. He comes in periodically for a handout, and always to see what any strangers are up to.

I can contend with dogs and cats and little children, but I've never before been called on to work under the supervision of a 50lb wombat!

6. I wish I could predict what my wages would be next week!

The Arbitration Commission spends all its time determining what the wage-slaves will get each week, but it has no interest in us poor domestic equipment servicemen.

In my time, I have been called in to help solve problems for union leaders, police chiefs, judges, managing directors, and even, on one occasion, someone from the Consumer Protection Council!

I am entirely on my own as to what I will charge my customers. The Trade Practices laws even bar me from consulting with my colleagues about what we consider to be a fair charge. If I charge too much I get no business and go broke, and if I charge too little I make no profit and still go broke.

Even if I charge a perfectly fair and equitable fee for my services, my income still depends on how many customers come through the door each week.

As I said before, I wish I knew what next week's wages are going to be!

7. I wish that I had a less dangerous personality!

One day I called in to have a yarn with one of my friends in his workshop. He had just finished fitting a new idler assembly into a JVC video recorder. It seems that even as I walked in the door, the new idler started to squeal just like the old one had been doing. And no amount of adjustment could make it work properly. Of course, I got the blame.

An hour later, I drove in to my local service station, to book my van in for some small repairs. I waited while my mechanic friend completed the fitting of a new water pump to the car he was working on. Then he started the motor, to be greeted with a most horrible squealing rattle. It seems that the new pump had a faulty seal. Of course, I got the blame.

Later, I went along to the bank to make a deposit. (Yes, I do sometimes deposit – it's not always taking it out!) I joined the queue and waited to be attended to. Nothing happened for some time, and eventually the manager came over to me and told me that their computer had just 'karked it'.

"You and your so-and-so electronics!" he complained. "This never happened in the pen-and-ink days." He was right, of course, but again I got the blame!

Now my friends have asked me to stay away from their places of business. Instead, they are preparing a Hit-List, of people they would like me to visit!

Of course sometimes – not often, but occasionally – a wish is answered...

I've been wishing for weeks that I could clear out my workshop, but it's still just as cluttered as it ever was.

The trouble is, I can't bring myself to throw anything away. Even if I can't see an immediate use for it, I know of (or hope I know of) someone who can make use of it.

Like six pairs of broken headphones. I don't know anybody with twelve ears, but someday I'll meet him and we'll both be glad I didn't throw out those old 'phones.

And old TV valves. I've still got every valve from every TV I ever junked – hundreds of them. I don't know why I keep them – I'm most unlikely to ever see another valve TV. But I just can't bring myself to throw them away. They must be useful for something.

The trouble is that I grew up in the wake of the Great Depression, and I was taught from infancy to use and reuse and re-reuse everything until it disappeared as dust or smoke.

Our clothes were patched and re-patched until they lost all trace of their original identity. Our radio sets were repaired again and again, even after the cabinet had fallen apart and been used for firewood. I know of a good many radios which lived for half their lives in cardboard cartons, which had replaced the original wooden cabinets.

Nowadays, in the present throw-away society, I am just not fitted to tossing out TV's that only need a new switch, or radios that have only lost a tuning knob. Even bits of wire can be used again, if I can ever find something to use them on.

But I've now had a reprieve. My wish has been answered. I can get rid of my junk without throwing it away!

There's a charity just out of town called 'Not Junk'. They collect and store all kinds of domestic and industrial cast-offs, then sell them cheaply to the clever people for all manner of handcrafts.

Bits of wood, scrag ends of fabric, half used cans of paint, empty plastic drink bottles – anything at all. They were all over me with gratitude when I took in 100 rolls of old, wornout quarter-inch recording tape. There are clever folk who can knit old tape into the most attractive mats and decorative wall hangings!

They can't think of what to do with my hundreds of old valves, but they'll take them anyway. One day someone will come in with a problem that can only be solved by the application of a hundred or so old TV valves.

Thanks, J.L., I for one certainly found your comments struck the proverbial chord. It sounds as if your workshop is much the same as mine, with all sorts of things tucked away in case they're ever needed. And I don't know if I'm pleased or not, that there isn't a branch of the 'Not Junk' organisation near me!

I'm sure that Mrs Serviceman would like me to clear out a lot of my junk – she's always complaining about it. But when you've had some of those things as long as I have, you get a bit attached to them. Funny about that...

Fault of the Month

Sony KV-1612AS

SYMPTOM: Won't start up. Remote control can turn on the stand-by light, but there are no other functions accessible either from the hand-set or front panel controls.

CURE: R603 (47k ohms, 1 watt non flammable) open circuit. This resistor supplies Vcc to the pulse-width modulator and error amplifier in the power supply. Without it, the chopper could never get started.

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 Street, Geilston Bay, Tasmania 7015.

Silicon Valley NEWSLETTER . . .

National Semi to build military chip fab

National Semiconductor announced it has received $US85 million contract from the Pentagon to build and operate a completely new high-performance semiconductor plant, in an effort by the Defense Department to secure the supply of critical components in times of tight supply.

Most details of the contract, even the location of the facility or the types of chips the Pentagon intends to build there, remain secret. But industry observers said it is unlikely the plant will produce DRAM or SRAM memory chips, as it easily costs some $US200 million these days to set up a state-of-the-art memory production facility.

Instead of memory chips, the plant is expected to produce small quantities of highly sophisiticated circuits used in some of the most advanced military weapon systems, communications systems, and specialised computers.

Under the terms of the 45-month contract, National is expected to build the new facility and train government personnel to operate it.

No Mac laptop until late '89

There will be a Macintosh laptop system in 1989. But according to Apple president John Sculley, the system is not likely to see the light of day until late in the year, as technical difficulties with the systems' screen technology have delayed the development of the product.

Sculley made the statement to put a wild flurry of rumours and reports about the system to rest. "We wish we had a laptop now," Sculley admitted in a speech at a Technology Partners Conference in San Francisco.

Sculley then confirmed that the development of the system, which had been expected for launch next month, has been plagued by delays, most of them related to the screen technology. "The screen technology we have to use is different from what we're used to."

Because of the graphics-orientation of the Mac, traditional LCD displays are not feasible. Instead, Apple is reportedly working with new 'active matrix' display technology. Currently, those displays are available in small numbers from a handful of suppliers, most of them in Japan. At today's high prices, the displays would make a Mac laptop far too expensive and Apple may have to wait until prices come down as volume production capabilities improve.

Kodak announces 4-million pixel CCD chip

The development of cameras which take electronically-generated photographs took a quantum leap forward as Eastman Kodak in Rochester (New York) announced the development of a new charge-coupled device chip featuring vastly more pixels than has been achieved to date.

Kodak said its chip contains 4 million pixels, more than twice as many as available in any of today's state-of-the-art CCD chips.

The clarity of any digitally-recorded photograph is directly related to the pixel density. To date, no all-digital cameras have been made available to consumers as no company has been able to develop a sensor with enough picture elements to produce photographs with acceptable clarity.

With 4 million pixels, a camera developed around the Kodak chip would be able to produce pictures that will be comparable to those produced with 110mm film.

H-P breaks $10 billion barrier

Living up to earlier promises of a strong fourth-quarter performance, Hewlett-Packard announced its earnings shot up sharply with a surge in new orders and sales. And on the celebration of its 50th birthday, the company's sales broke through the $US10 billion mark.

The Palo Alto computer and electronics firm said profits during the fourth quarter of 1988 totalled $243 million, up 11% over a year ago, as sales increased 19% to $2.7 billion. For the entire year, H-P earned $816 million, a 27% improvement over 1987, while sales rose to a record $10.9 billion.

"Reaching $10 billion in orders is a major milestone for our company and a momentous achievement for our people," said a jubilant H-P president John Young. "Not only was our business strong in the fourth quarter, but it was based on a broad mix of products."

In particular, H-P's international sales contributed to the successful period. "Order growth was robust across the globe, particularly in the Asian-Pacific region, and in Europe.

Cal Micro – AMI deal appears dead

When California Micro Devices in Milpitas announced last August that it had agreed to acquire the American Microsystems operations from Gould, many analysts frowned, as the tiny firm was trying to swallow an operation four times its own size.

Now, the deal may be dead, as Cal Micro has failed to put a financing package together to consummate the $US70 million deal.

Cal Micro blames the failure of the acquisition attempt on its former banking firm, Van Kampen Merritt, a subsidiary of Xerox. Offficals at Gould or Van Kampen were not available for comment.

'Dick Tracy' wrist radio becomes reality

In the futuristic cartoon strip 'Dick Tracy', the popular detective remains in contact with his office by way of a two-way radio wristwatch. A few weeks ago Dick Tracy technology became reality as AT&E of San Francisco introduced its long-awaited wristwatch-based paging system, which allows users to receive short messages that are displayed on the watch's small LCD display.

The so-called 'receptor' is built around a microprocessor built by Britain's Plessey company, and will retail for $US200. The device will be manufactured by Japan's Hattori Seiko.

A small company in Los Gatos called Caere has developed Omnipage, a revolutionary character-recognition program that runs on either a Macintosh or IBM-compatible computer. Omnipage works in conjunction with a normal graphics scanner, and can identify columns of text, paragraphs and individual letters on a printed page. The IBM version needs a special expansion card.

The receptor permits reception of four short messages, sent by anyone from any telephone. The messages are then transmitted on an SCA subcarrier of an FM radio signal. Messages include such things as 'Call the Office' (or home), and display the number to be called. It can also indicate whether the message is urgent.

AT&E, a company that provides paging services throughout the US, said it had made arrangements with 36 FM radio stations throughout the country to use an SCA subcarrier for the transmission of messages.

National-Fairchild merger looking better

When National Semiconductor announced it would buy Fairchild Semiconductor, customers weren't the only ones nervous about the buyout. Employees of both firms – particularly those who had a counterpart at the other company performing the same job – understandably felt threatened. And investors doubted whether National could turn a profit from money-losing Fairchild, especially if customers abandoned National during the confusion.

At $US122 million, the verdict was unanimous that National got a bargain for the $500 million-a-year Fairchild. But the jury was still out on how well National could capitalise on the purchase from Schlumberger, the New York oil-field services firm.

A year after the deal, National isn't without its problems: Sales and profits are sagging in the face of a slumping personal computer market – National says it will report "significant" operating losses for the last quarter – and its computer systems division continues its year-long struggle.

But most observers agree the company has cleared the hurdles of the Fairchild buyout and has emerged stronger as a result. Fairchild's products broadened National's line of chips, and that should soften the blow of the next industry downturn. For example, National now sells more chips to the military – in fact, it's the Pentagon's largest chip supplier – than it used to.

"Every one of our six product divisions has benefited in some way by the merger," says Ray Farnham, VP of advanced digital and military/aerospace products.

Fairchild also looks brighter than it did. "Fairchild is doing better than it was when it was controlled by Schlumberger," said Drew Peck, an industry analyst at Donaldson, Lufkin & Jenrette Inc. in New York. "Fairchild is profitable now, and that's a lot more than you could say before."

In fact, National turned Fairchild profitable in less than six months – a dramatic turnaround for a company that lost $93 million on sales of $488 million in 1986. Much of that came by moving quickly to combine the two companies' products lines, workforces and equipment and to trim duplicative efforts in those areas.

Seagate lays off 1880

Fall season has come to Silicon Valley and companies are once again starting to shed workers like leaves on a tree.

The biggest blow was delivered by Seagate Technology in Scotts Valley. Others that have started to cut their workforces include Avantek and System Industries.

Seagate Technology is hurting. If that wasn't already clear from the company's most recent financial results, including a huge $US52 million loss, it has become even more apparent in recent weeks as the company shed nearly 2000 of its employees.

The workforce cuts started when the Scotts Valley company announced it would lay off some 800 non-production workers at its plants in Singapore. Production levels at the facilities there have fallen 30% during the past three months. "We have tried to get our costs in line with the volume decrease through natural attrition. But we have found that that was not enough. We believe that this retrenchment will put our workforce in balance with on-going requirements," commented James LeBlock, Seagate's vice president of Finance and Administration in Singapore.

More recently the troubled disk drive maker handed lay-off notices to another 1000 workers, this time at the firm's headquarter facilities in Scotts Valley. The cuts represent 20% of the company's total US workforce. In addition, Seagate also terminated 180 temporary workers at a plant in nearby Watsonville.

Expecting possible violent reactions to the termination, a number of officers from the local police department were on hand at the company when the notices were given. No disruptions occurred however.

Some of the anticipation of possible violence was based on the resentment among many Seagate workers regarding the huge salaries which top managers in the company are continuing to draw, despite the firm's continually declining financial conditions. In particular security personnel feared some laid off workers might take their frustration out on the large assortment of new Porsches, Mercedes, and other luxury sports cars which can be found parked outside Seagate's headquarters office.

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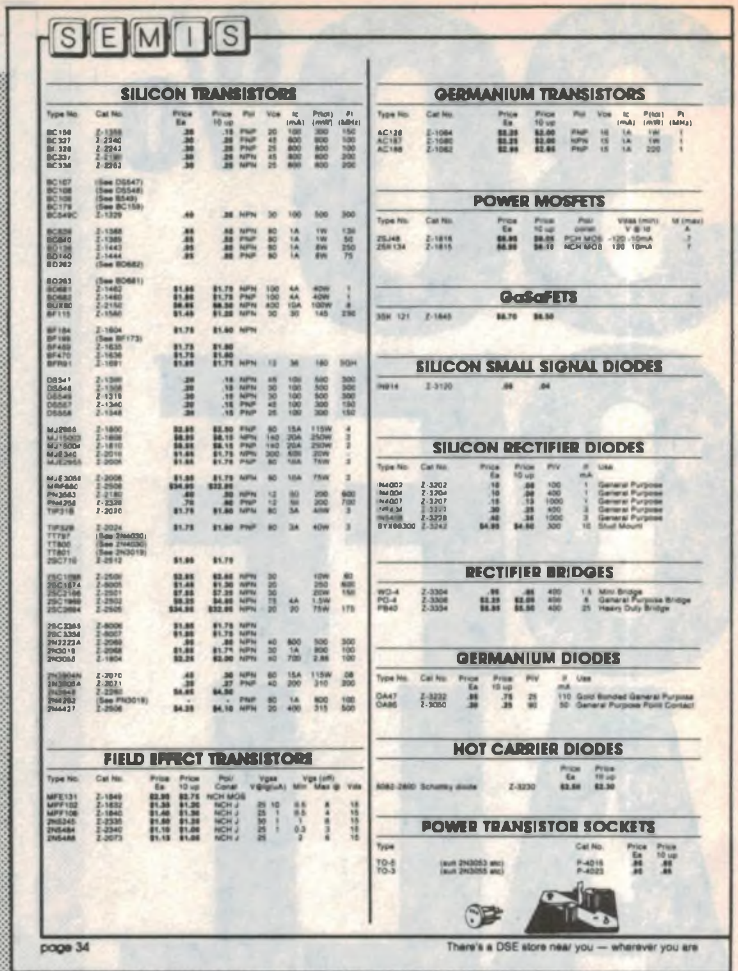

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News Highlights

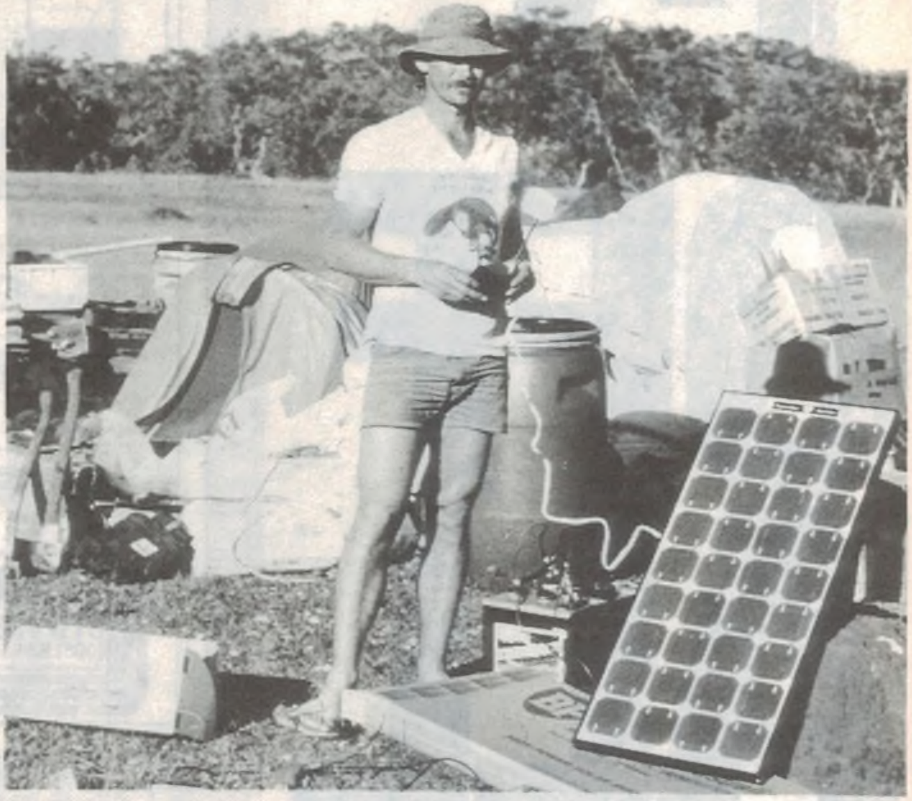
BP solar for wilderness couple

An Australian couple who have just completed a year-long experiment in wilderness living have claimed the experiment would have failed without solar power.

Mike and Susan Cusack took part in the experiment in the remote Kimberley region of Western Australia for Dick Smith's Australian Geographic magazine. They lived in the bush without additional supplies and without any outside support in an attempt to gauge human reaction to such isolation.

The couple used a BP solar power module to provide power for radio communications, lighting, a small electronic typewriter and video camera used to record the experiment. The purpose of the wilderness living experiment was to determine how a couple who normally lived in a city enviroment would cope with a year in isolation and a harsh environment without the conveniences of home.

The Cusacks used a BP solar 45 watt solar module coupled to two six volt batteries. The solar module kept the batteries at full charge throughout the twelve month experiment.



Satellites help fight bush fires

Authorities tackling major bush fires and floods will be able to track their progress with greater precision, following the installation of systems in Alice Springs and Canberra that receive and process data from two new generation, high resolution satellites.

Accurate digital and photographic images of natural disasters will be sent on magnetic tape, as film or by microwave link to emergency services organisations after being captured by the US Landsat 5 and French SPOT satellites.

While emergency service organisations will be critically important users over short periods, major day-to-day customers are oil and mineral exploration companies, research organisations, universities and Federal and State Government agencies with an involvement in natural resources.

The new systems have been installed on equipment operated by the Federal Government's Australian Centre for Remote Sensing (ACRES) which has its headquarters in Canberra.

News Briefs

- Ron Koenig has been appointed as hardware development engineer for ***Australian Test & Measurements***. Ron has had extensive experience with the instrumentation and development of data communications products, having just completed a two year stint at Netcomm in the research laboratory. Prior to that he was responsible for modem design at Modem Technology.
- Computer peripherals group, ***IPL Datron*** has appointed Mr Robert Macphail as the southern region sales manager. He will be responsible for OPL's range of printers, monitors, disk drives, memory devices and other electronic products. Before joining IPL, Robert was national sales manager for Tech Pacific.
- A comprehensive three day DSP course involving lecture sessions and hands-on exercises will be conducted by ***CIMA Electronics*** on April 26th to 28th, 1989. Further enquiries can be directed to Dianne Hunt on (03) 563 1699.
- ***Avisun***, an Australian PCB importing company, has established its own design bureau. Called Avisun Design Services (ADS), the company is situated at 1-AMP Bldg., 19-21 Watt Street, Gosford, 2250.
- Pending the availability of new premises, ***Rohde & Schwarz*** have temporarily relocated their Sydney operations to Building 5, 35 Doody Street, Alexandria, 2015.
- ***ACEL Information***, supplier of specifically targeted technical information, is offering free copies of its new Electronics Yearbook. The aim is to show users the quality and usefulness of the book which provides a comprehensive guide to suppliers in the electronics industry. For a free copy, phone (02) 922 6088 or write to ACEL Information, PO Box 1040, North Sydney 2059.
- A new division, called MM Cables has been formed by ***Metal Manufactures***. The division has been formed out of several cable companies that recently became members of the Metal Manufactures Group, including Cable Makers Australia (CMA) and Austral Standard Cables (ASC).

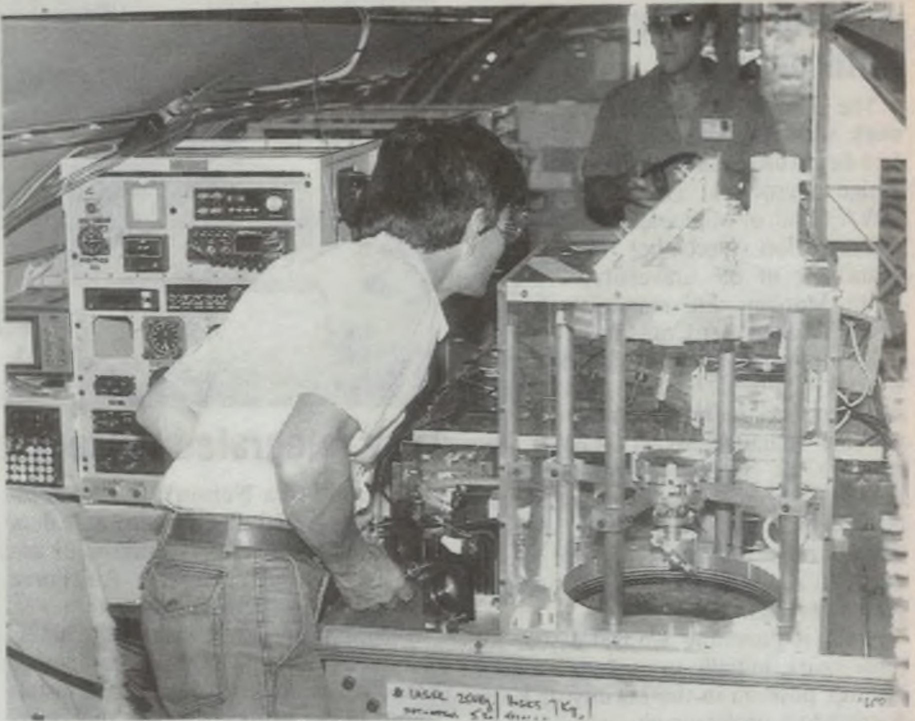
First air tests for CSIRO remote sensing laser

Remember our feature story in the July 1988 issue, describing pioneering work being done by Australia's CSIRO in developing an airborne rapidly-tuned CO_2 laser for remote mineral sensing? Well, the laser had its first series of airborne tests during December, in the F27 Fokker aircraft VH-CAT operated by Dr Ken McCracken's CSIRO Office of Space Science and Applications (COSSA).

Project leader Dr Lew Whitbourn described the air tests as "Very promising, although we still have some fine tuning to do before the system's full potential will be realised. The equipment all worked quite well during the tests, and we obtained a lot of data to analyse back at the lab."

The airborne testing involved a great deal of work by Whitbourn and his team members Dick Phillips and Greg James, as the laser requires a considerable amount of power supply, cooling and control equipment, as well as the data acquisition system.

Further airborne testing is planned for this month.



Dr Lew Whitbourn making an adjustment to the laser, during its first airborne tests. The receiving telescope is at right, with Dick Phillips in the background.

BAT bores through earth, transmits views

A new device developed at Los Alamos National Laboratory will allow geologists and other researchers to finally 'see' what no one has ever seen before, deep in the Earth.

The instrument, called a borehold acoustic televiewer, or BAT, is used to study features in a high-temperature, high-pressure geothermal well more than two miles beneath the Earth's surface.

The BAT also may be used to further oil exploration and oceanographic research, said Bert Dennis, an electrical engineer in the Los Alamos Earth and Space Sciences Division. Dennis led the team of researchers who developed the instrument.

The instrument holds promise because it is much more rugged than other acoustic televiewers. It can withstand temperatures as hot as 600°F, high enough to fry the circuitry of the televiewers commonly used in the oil industry.

"It works by transmitting and receiving sound waves much like sonar, or like the night-flying mammal of the same name," said Dennis, of the BAT.

Sound waves picked up by the instrument are digitised and relayed by cable to the surface, where researchers can watch a live television picture of the borehole as the BAT moves through it.

Australia-China space agreement

Officials from the Australian Space Office and the Chinese Academy of Space Technology have signed a five-year agreement on space commerce and technology.

The memorandum of understanding, signed in Melbourne, includes co-operation in remote sensing, satellite ground support and meteorological and oceanographic satellites. AUSSAT is to use the China Great Wall Industry Corporation's Long March 2E rocket to launch Australia's two second-generation communications satellites.

Senator Button, the minister for Industry, Technology and Commerce, said that the signing was a major event in the development of Australia's space industry capability. "China is a major 'space power' and what they've said to us in signing the agreement is that they acknowledge our expertise. This agreement makes it possible for us to be involved in future satellite design and other joint technical and commercial ventures with the Chinese."

Microwave facility

As a major step in the development and commercialisation of Australia's microwave industry, a national facility has been opened in Sydney which will provide expertise, education and local industry resources in this area of high technology.

The Sydney Microwave Design Resources Centre (SMDRC), established by the University of Sydney and the University of Technology, Sydney, in association with Hewlett-Packard Australia Limited, will develop Australian expertise and technology in the applications of microwave science.

Microwave technology has been identified as a key area for sustained growth in the information industry. Some avenues of research to be undertaken at the new centre will include space and earth-based communications, solid-state electronics devices and digital techniques, Gallium Arsenide integrated circuits, computer-aided design and manufacturing of microwave circuits.

The new centre, located at Sydney University's Department of Electrical Engineering, will provide an Australian focus for the development of this industry, and the education provided will also help to alleviate the current critical shortage of skilled microwave engineers and technicians in this country.

News Highlights

AWA-university joint venture

The University of Newcastle is to work with AWA to develop Newcastle as a key Australian centre for advanced-design microchips. The creation of the AWA Chair of Microelectronics was announced last December by the vice chancellor of the university, Professor Keith Morgan, and managing director of AWA, Dr Peter Crawford.

The university will also work closely with AWA in developing new designs and products in integrated circuits for possible manufacture at AWA's new plant in the Sydney suburb of Homebush Bay. The $65 million plant is Australia's most advanced facility for the design and manufacture of state-of-the-art ASICs – Application Specific Integrated Circuits.

AWA is providing $25,000 a year for three years, initially to upgrade a senior lecturer position in the Faculty of Engineering to a professorship, which will be known as the AWA Chair of Microelectronics. The university will also have access to AWA's new Homebush Bay fabrication plant.

Quantum effect transistor

Research physicists at Texas Instruments in Dallas have fabricated the world's first quantum effect transistor. With critical dimensions 100 times smaller and transit speeds more than 1000 times faster than conventional transistors, the device operates on fundamentally different principles, known as quantum mechanical effects, which dominate the behaviour of matter and energy at dimensions of 0.02 micron (20 billionths of a metre) and below.

Called a 'bipolar resonant tunneling transistor', it becomes the first device to directly contact and control a 'quantum well' base – an ultra-thin layer of the device which allows only electrons with certain discrete energies to pass.

"Although quantum devices are strictly a laboratory development at this time, future chips incorporating quantum effect transistors might contain 100 times more functions in the same space and consume far less power than today's devices," notes Dr George Heilmeier, senior vice president and chief technical officer at TI. "Practical applications are about a decade away, but one day we might see a laptop supercomputer that runs on flashlight batteries."

New integrated voice and data LAN at Tindal

A Local Area Network (LAN) combining integrated digital voice and data via circuit and packet facilities is in use at a new Royal Australian Air Force base in the Northern Territory.

According to AWA and MM Cables, the RAAF's new Tindal base near Katherine is among a handful of installations in the world to successfully operate a network of this type. Tindal will be home to many of the RAAF's new FA-18 Hornet jet fighters.

MM Cables supplied optical fibre cable for an AWANET, the backbone of the base's air traffic control system. Special features of the AWANET include a redundant path capability (RPC) which reduces the possibility of total system failure by having two cables running between each point in the network. For greater physical protection, nylon jacketed optical fibre cables were laid in steel reinforced conduits and buried. "The cables basically run between two buildings – the control tower and the technical equipment room, where most of the actual LAN equipment is housed," said AWA project engineer, Neil Macdonald.

Tindal's air traffic control system comprises VHF and UHF radio equipment, providing communications between ground controllers and civil and military air traffic in the area. The system provides intercoms between air traffic controllers at Tindal and civil controllers at Darwin. It puts Tindal controllers in direct touch with all aircraft handling, communications and radar maintenance operations on the base, and integrates with the internal telephone system.

Optical fibre trials

Telecom Australia has commenced Phase II of its residential optical fibre trials in Sydney's Centennial Park Area.

Phase II involves multi channel video distribution, with participants in the trial receiving ABC and SBS transmissions and Telecom produced educational videos. Provision has also been made for a fourth split-screen channel to give viewers a 'run down' on all programs available.

Transmission of these signals via an optical fibre network means a clearer picture quality and less sound distortion, even in those areas which currently experience difficulty in picking up the ABC and SBS programs because of high-rise buildings or electrical interference.

The signals are transmitted from the respective television stations to the television operating centre in Telecom's City South exchange where signal quality is closely monitored. From there the signal is transmitted to the East exchange and on to the customer's premises. One significant advantage of optical fibre is that no modifications are necessary to television sets or aerials. The optical fibres are connected to a decoder box placed at a convenient location and from there normal coaxial cable is run to the television set.

Phase I of the trial involved the provision of basic telephone to the sixty participants in the trial with the current program, available to about 10% of the participants, scheduled to run for two years. The success of the trials will bring Australia one step closer to the 'intelligent home', with interactive information videos, home video conferencing, electronic mail and the ability to electronically transfer funds for the payment of electricity, telephone, gas and many other accounts.

Voice-data network

Retailing giant Coles Myer has selected Datacraft's Megacraft 2 megabit voice and data system for its private integrated voice and data network that proposes to be the largest of its kind in Australia.

Datacraft won the lucrative tender against fierce competition and will begin the installation of the network early in the new year. The first stage of the project is expected to be operational by mid-1989, creating a national network backbone linking major Coles Myer centres. Later stages will progressively connect the retailer's stores to the network,including existing international operations.

Coles Myer's Manager of Communications Services, Mr Bob Weaver, said that Datacraft had demonstrated that the Megacraft system could provide the networking services required by Coles Myer in line with the company's strategic directions.

"We believe that Datacraft's strategies are aligned with our own. With Megacraft, they have been able to demonstrate a sophisticated operating system with the required level of centralised network management," he said. "In addition, Megacraft's use of advanced technology sets it apart from its competitors."

The managing director of Datacraft (Aust), Mr Peter Prior, said winning the Coles Myer tender was "an important success to Datacraft that clearly supported the company's decision to pursue a strategy based on integrated voice plus data technology."

Oki in Australia

Japanese electronics giant Oki Electric Industry has established an office in Sydney. The office is the first formal representation of the company in Australia and was officially opened by Oki's executive vice-president, Mr Chikatomo Mitsuyasu.

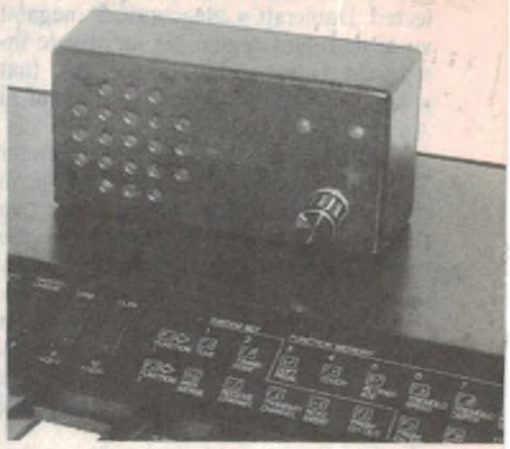
Oki is one of the world's largest electronics groups with a substantial presence in the fields of telecommunications, information processing and general electronics devices. In 1987 the company achieved nett sales in excess of $US3.6 billion.

Oki products have been marketed in Australia over the past 10 years through a range of local distributors including computer peripherals group IPL-Datron, facsimile machines group GEC, and mobile telephones group RACAL Electronics. Oki expects to achieve sales revenues in Australia in excess of $30 million in 1988-89.

Construction Project:

Beat-me

Here's a device that will literally take a beating.. but only to beat right back at you. It's an easy to train metronome for any musician, and it won the author a runner-up prize in our recent EA/Dick Smith Electronics 'Grand Aussie Hobby Electronics Contest'.



by PAUL THOMPSON

Anyone who plays a musical instrument will know the value of a mechanical metronome as an aid to practising. Those of you who have owned an old ticker will also know how tedious they can be to set to precisely the right speed. To set Beat-me is a breeze. Simply tap out the required speed on the target and away it goes, beating back at you in time with the set-up taps.

The set up procedure requires just four taps. The first gets Beat-me's attention (and lights the SET LED). Subsequent taps set the speed and the fourth extinguishes the SET LED. After that Beat-me will beat out the rhythm on its speaker and flash the Beat LED. The required tap strength is easily gauged as the Beat-me will 'beep' with every tap it 'hears'. Anything from a fingernail to a drumstick may be used.

This device was designed to fill a need for an easily settable, precise timing device. It uses a piezo crystal transducer as its microphone and a handful of MSI ICs as its 'brain'. As most of the ICs are CMOS the current drain on the battery is a low 10mA even at a reasonable volume. The beat speed may be set at anything from approximately 60 milliseconds to almost 2 seconds.

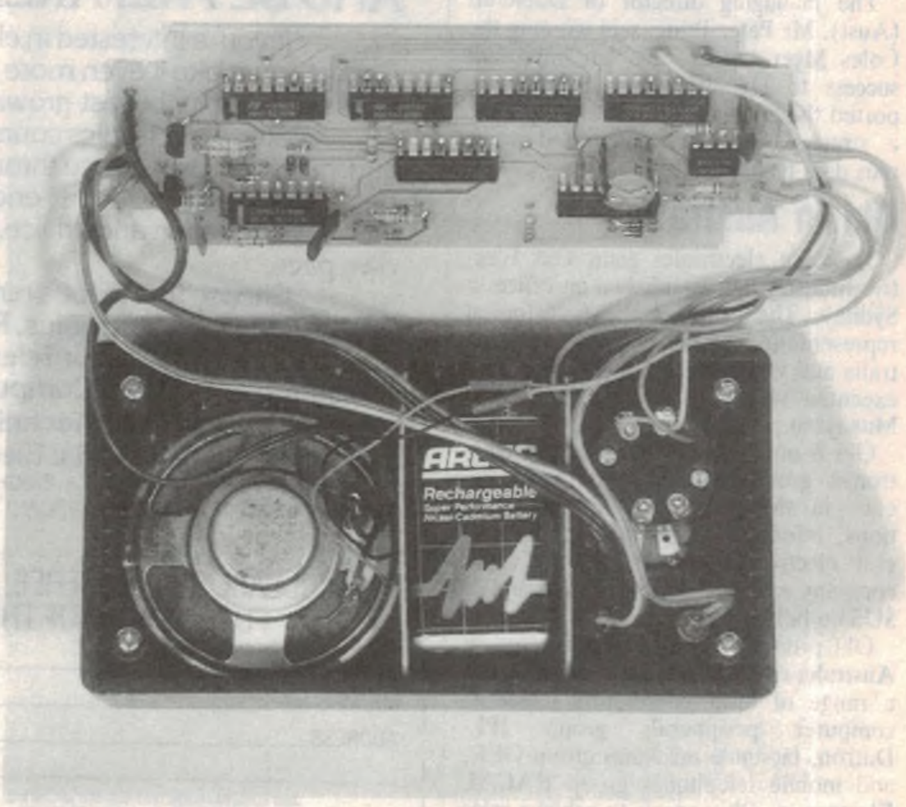
The circuit

Although it's possibly the most complicated electronic metronome ever made, Beat-me's circuit can easily be understood when it is broken down into constituent building blocks. These blocks are: the input monostables, the setup beat counter, the main counter, the latch, the comparator and the output monostables.

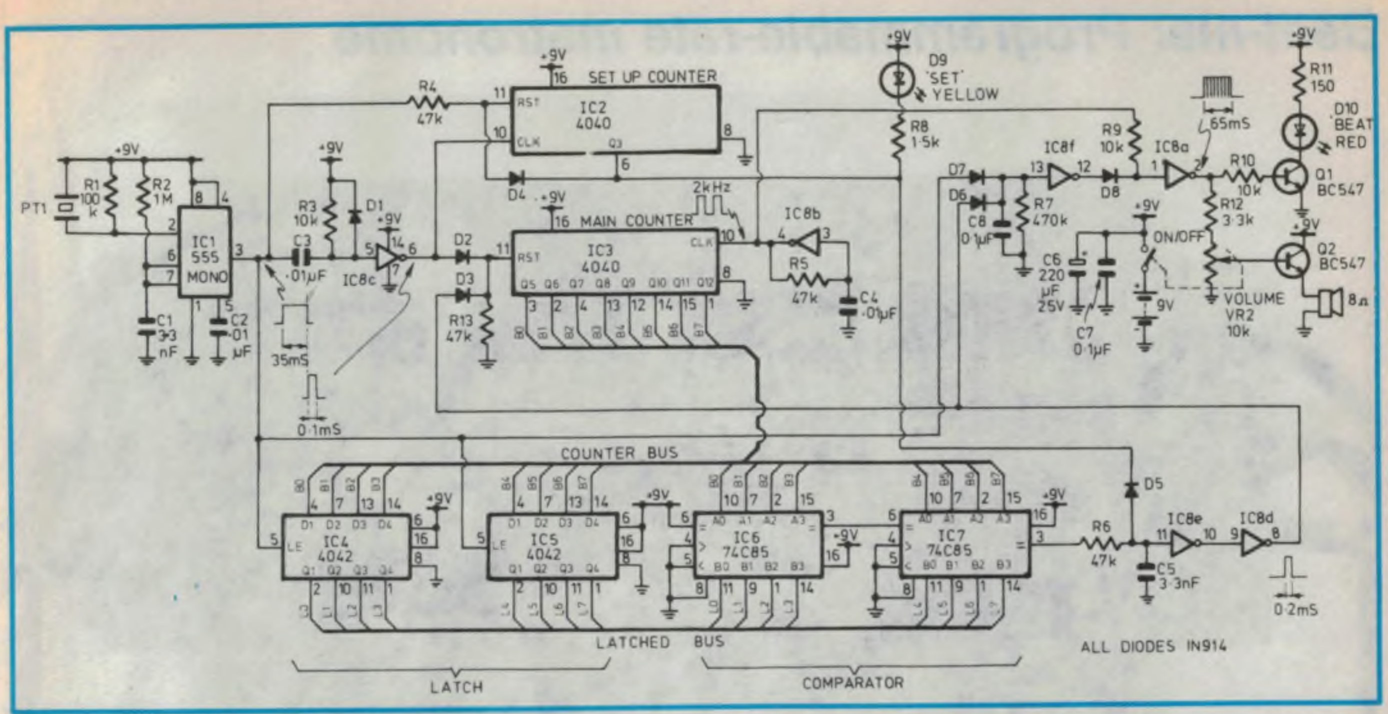
In simple terms the circuit operates as follows. In the set up mode (set up counter contents less than four) one input pulse from the piezo transducer resets the main counter. The next pulse latches an eight bit number from the main counter into a latch. The number stored in the latch then represents the elapsed time (since the last tap).

When the set up counter contents equal four, the main counter will free run until reset by the comparator at a point where its output equals the previously stored number. At the point when the main counter is reset, the 'equals' signal from the comparator is used to produce an audible burst of tone and flash a LED.

Now for a more detailed description. Signal from the piezo transducer PT1 is applied directly to the first of the two input monostables. This consists of a standard 555 monostable with a period of 35ms. When struck, a piezo or crystal transducer such as the one used in Beat-me may produce a voltage at its terminals of some tens of volts. This transient spike is damped by R1 and applied to the trigger input of IC1. The purpose of IC1 is to debounce the input signal to ensure that only one pulse proceeds to



This photo shows how compact the device really is. The battery compartment is made with cardboard.



The circuit diagram. The functional blocks have been shown to clarify its operation.

subsequent elements in the circuit.

The output of IC1 is applied to another monostable consisting of IC8(c) and its associated RC network. The output of this second monostable will produce a pulse after it sees the negative-going edge from IC1. So at this point a single tap on PT1 will produce one 35ms pulse from IC1, followed immediately by a smaller pulse from IC8(c). These pulses are then used in a number of different places in the circuit.

Firstly the output from IC1 is fed to IC2, the *Set Up Counter*, which is configured to count from zero to four and then reset again. This is achieved by applying feedback from output Q3 to inhibit the reset pulse until the count reaches four. When the count is at four and Q3 is high, a pulse from IC1 will reset it to zero. It will then be immediately clocked to one by the second input pulse from IC8(c). Subsequent pulses from IC8(c) will clock the counter up to four again. At this point the SET LED will be extinguished, which represents the normal (or running) mode.

The pulse from IC8(c) is also used to reset IC3, the *main counter* which is an eight bit binary counter. This counter is clocked by an oscillator, IC8(b), which is set to run at approximately 2kHz. The eight bit bus generated by the main counter is applied to the inputs of both the latch and comparator.

The latch, made up of two four bit 4042's, IC4 and IC5, latches the counter bus on receipt of a pulse from IC1. This occurs just before the counter is reset. The outputs from this latch form another eight bit bus which is applied to the other input of an eight bit magnitude comparator (IC6 and IC7).

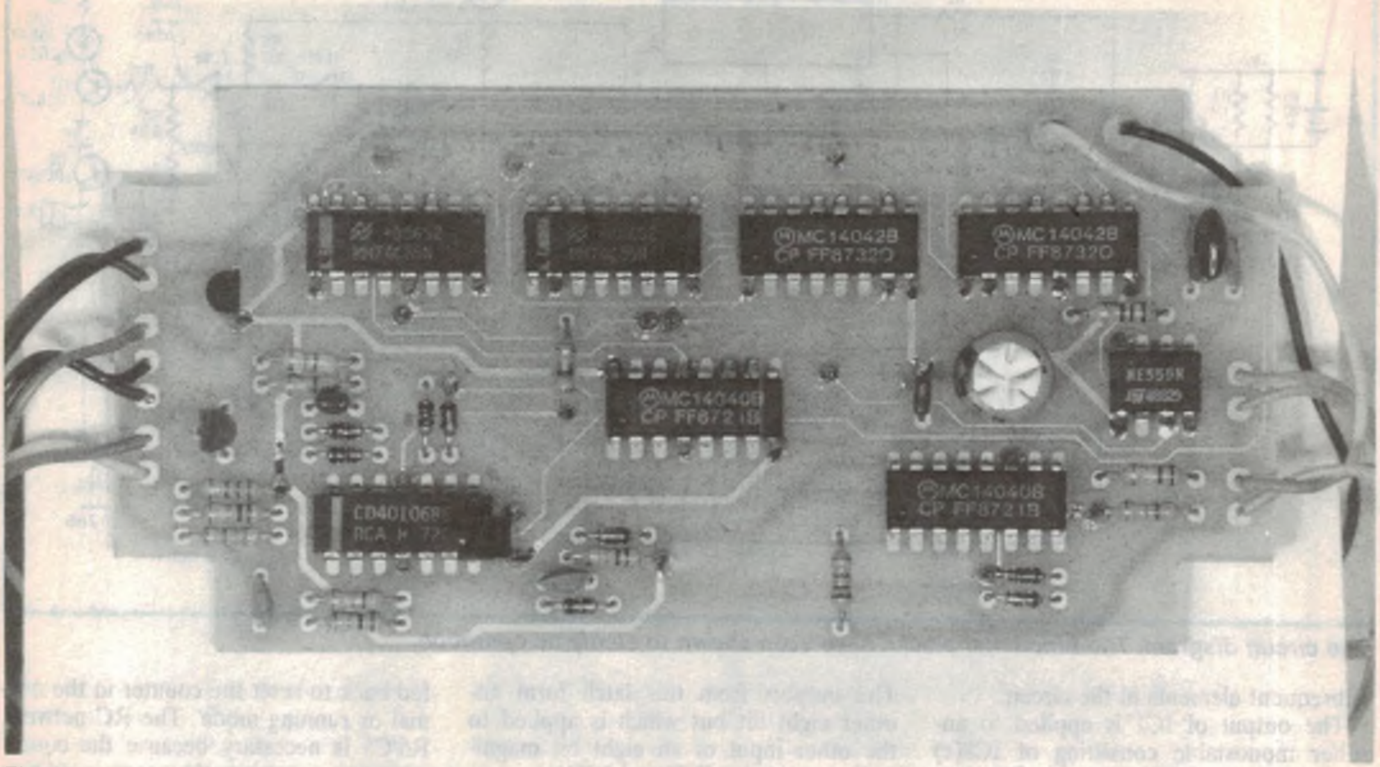
The comparator is also made up of two four bit devices, 74C85. It will produce a high signal at the *equals* output when the two buses contain the same eight bit number. The equals output is inhibited via D5 by the set up counter in the set up mode, but is delayed and fed back to reset the counter in the normal or running mode. The RC network R6/C5 is necessary because the *equals* output is clearing the very condition which allows it to appear. Thus the small delay between IC7's pin 3 going high and the main counter being reset enables the equals pulse to be used elsewhere.

You may have noticed that the output from the comparator resets the main

QUICK DEBUGGING GUIDE

STATE	ACTION
No action at all.	Check that power is reaching all ICs. Check piezo transducer connection to PCB.
Set LED does not light.	Check D9 polarity. Check Q1 polarity.
Set LED does not extinguish on the fourth beat.	Check D4 polarity.
No sound but Beat LED flashes.	Check Q2 polarity.
It sounds a continuous tone.	Check D8 polarity. Check that the output from IC1 is 'normally low'.
The beats slow at full volume.	The battery is flat. Increase the size of R12 if battery not flat.
It beeps by itself even when the set LED is on.	Check D5 polarity.
The 'beep' sounds like two sharp clicks but no tone.	Check the oscillator output with a meter (it should be about half the supply voltage).
It sometimes takes less than four beats to set it immediately after turn-on.	That's a 'feature' not a bug!

Beat-me: Programmable-rate metronome



The prototype. The double sided PCB has some components soldered on both sides.

PARTS LIST

1 PCB (60mm x 125mm)
1 Switch pot 10k log
1 Small speaker
1 Piezo transducer DSE Cat L7022

Semiconductors
1 555 universal timer
2 4040 12 stage counter
2 4042 quad clocked D latch
2 74C85 4-bit magnitude comparator
1 40106 hex Schmitt trigger
2 BC547
1 Red 5mm LED
1 Yellow 5mm LED
8 1N914 diodes

Capacitors
1 220uF/10V electrolytic
1 0.1uF monolithic
1 33nF polyester
3 10nF ceramic
1 3.3nF polyester

Resistors
All 1/4 watt: 1 x 150 ohm, 1 x 1.5k, 1 x 3.3k, 3 x 10k, 4 x 47k, 1 x 100k, 1 x 470k, 1 x 1M

Miscellaneous
Zippy box (UB3), battery clip, 9V battery, knob, hook-up wire.

counter via a diode D3 driven by IC8(d). The network D2, D3 and R13 forms a simple logical OR function. Another diode-resistor OR function consisting of D6, D7 and R7 is used to OR the input and equals signals into the final 'audio' stages.

Capacitor C8 stretches these pulses to approximately 65ms. The output of IC8(f) is then used to gate the oscillator tone into IC8(a). This signal is applied to Q1 to drive the 'Beat' indication LED and also to Q2 via R12 and volume control VR2.

The 'audio' output stage is a simple emitter follower which applies an adjustable level of square wave to the speaker. The maximum level applied to the speaker must be kept below the point at which the supply rail becomes affected by the high instantaneous drain (not to mention the ear splitting sound).

Construction

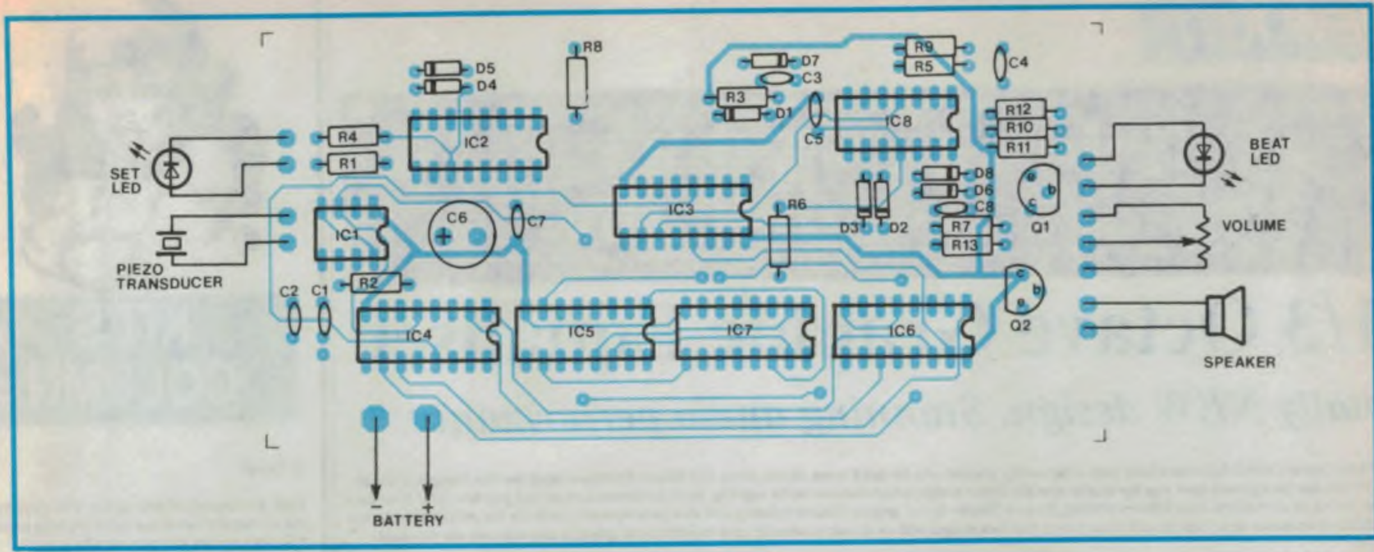
Due to the number of ICs on this small PCB the circuit board is double sided. This requires some component leads to be soldered on both sides of the board and seven points between layers to be linked. Start construction of the PCB by loading the smallest profile devices first, (the diodes), followed by the resistors, transistors and then the ICs.

Before inserting the ICs, identify those points that need soldering on both sides, as the component side tracks may be hidden by the IC.

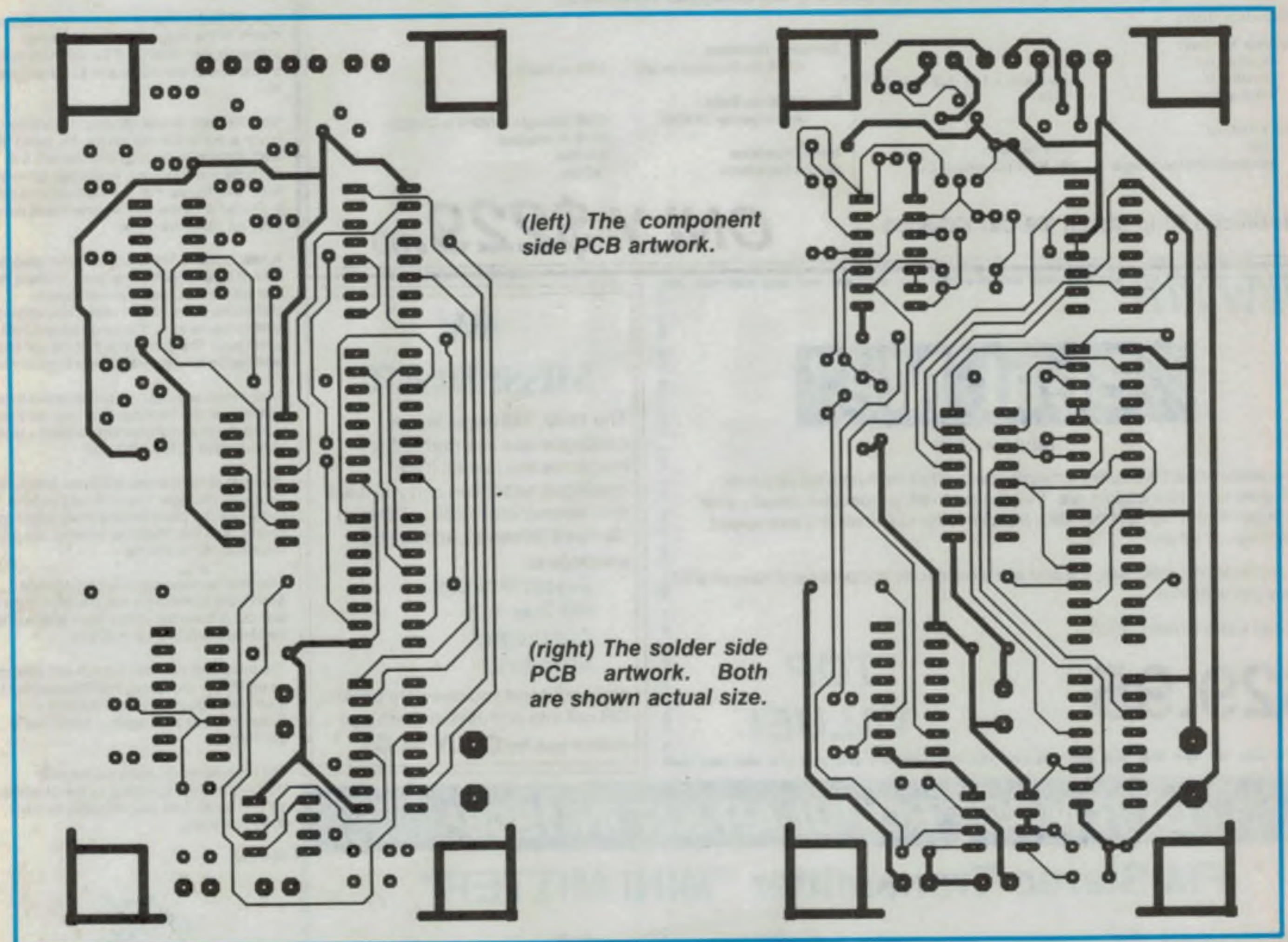
The speaker, piezo transducer, LEDS and volume potentiometer are fitted to the base of the enclosure. Remove the piezo sensor from its plastic case before attaching it to the box, to give good mechanical contact. Be sure to solder colour coded leads (of about 150mm length) to these devices before fixing them to the base. A small amount of epoxy resin was used for this purpose on the prototype. The flying leads from these components may now be soldered to the associated points on the PCB.

Once all components and links have been soldered, pass a critical eye over your soldering handiwork. Re-work any suspect joint after removing the solder. Look also for solder bridges on both sides of the board, and check that all pads are soldered and that the pads are fully covered with solder.

Connect a battery to the battery clip and place a current meter between the poles of the off/on switch (while it is still off). The meter should read about 15mA. If the current is drastically higher remove power quickly and recheck all polarised components.



The layout shows the components relative to the component side of the double sided PCB



(left) The component side PCB artwork.

(right) The solder side PCB artwork. Both are shown actual size.

The next step is to see if the device is alive. Turn the volume up to about half-way and give the target a sharp tap. The speaker should emit a short 'beep' with each tap. If all is well turn it off and load the battery into the enclosure, fixing its position with some cardboard cards (see photo). The circuit board will now set into the recess immediately under the lid.

The quick debugging guide should help if your Beat-me doesn't work. Make sure all 'vias' between the top and bottom PCB layers are connected and that all devices are correctly orientated. You may need to experiment with the type of tap required to set Beat-me going. However, once you get the feel for it Beat-me should prove to be a versatile device that is easy to set, and easy to practice with.

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Refer Silicon Chip Jan 89

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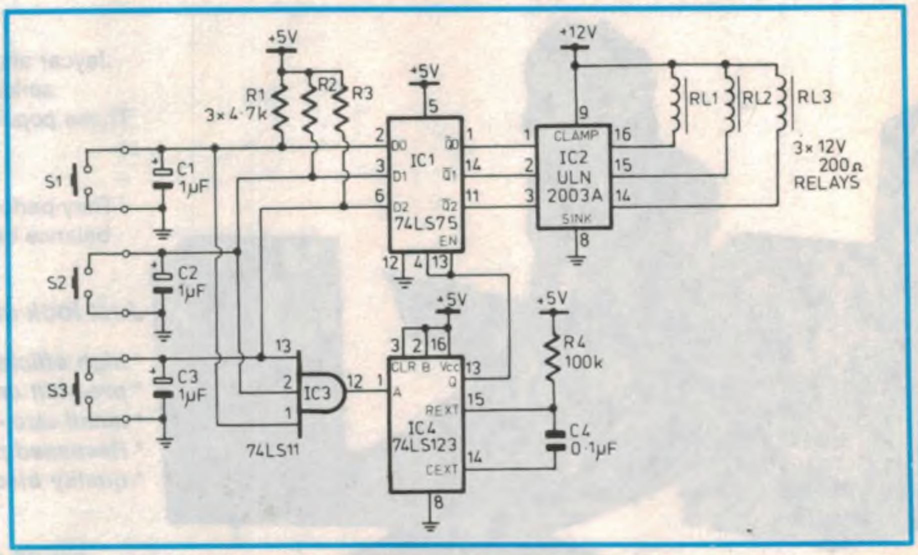
Circuit & Design Ideas

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.

Switch interlock

The purpose of this circuit is to mimic the action of mechanically linked pushbutton switches, in which selecting one button releases the one previously locked in.

The main advantage here is that the switches can be remote from each other, such as in separate rooms. This would allow the user to redirect an intercom, speaker outputs and so on without having to do it from the main unit. The circuit works like this:



Pressing either S1, S2 or S3 takes the respective data input of IC1 low, at the same time triggering the monostable IC4 via the AND gate IC3. Resistor R4 and capacitor C4 set the pulse duration to approximately 5ms at the Q output of IC4, which is sufficient to strobe the enable input of IC1 while the button is still being pressed.

During the strobe period, the state of the data inputs is latched into the outputs, (in my case I used the Q-bar outputs of IC1 to drive IC2) and consequently only the button being pressed will be at a logic 0, so any previously latched outputs will now revert to the 'off' state.

IC2 is a seven-channel Darlington array, capable of switching inductive loads, and will comfortably handle a 200 ohm, 12V relay. C1 – C3 eliminate bounce problems that could cause double switching.

The circuit can be expanded to any number of switches, providing only one monostable is triggered by any of the switches, and that it in turn clocks all data latches simultaneously.

Barry Shaw,
Sans Souci, NSW.

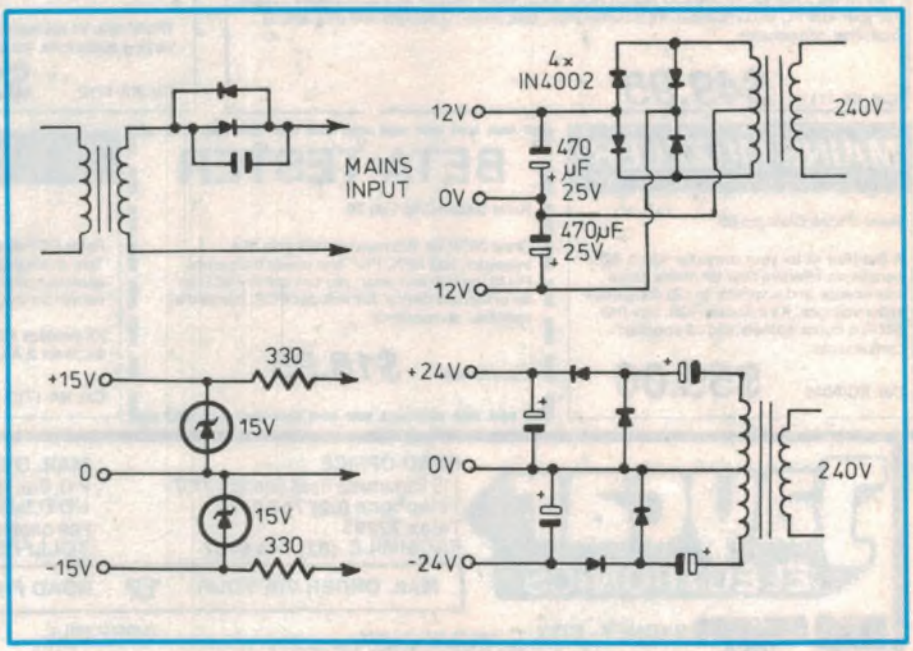
$50

Transformer tips

Due to the high efficiency of C core and toroid mains transformers, even a small amount of DC on the mains supply may magnetise the core, causing lamination buzz. The circuit of Fig.1 in series with the transformer will cure the problem.

For transformers up to about 150VA, 1 amp diodes can be used, and 3 amp diodes should be OK for ratings between 150VA and 500VA. The capacitor is a conventional electrolytic of around 1000uF, 6VW.

In another application, I needed a dual polarity 15V power supply, capable of supplying around 25mA. Looking through my spares box, I found that I had rescued some mains transformers from old portable radios, except they had 9V-0V-9V secondaries, giving a dual supply of only 12V-0V-12V (DC) with the circuit of Fig.2.



Using the two additional electrolytics shown in Fig.3, the circuit gave 24V-0V-24V, which I then stabilised to 15V-0V-15V using two 15V zeners.

Stewart Farrant,
Edgewater, WA

$25

1-chip audio mixer

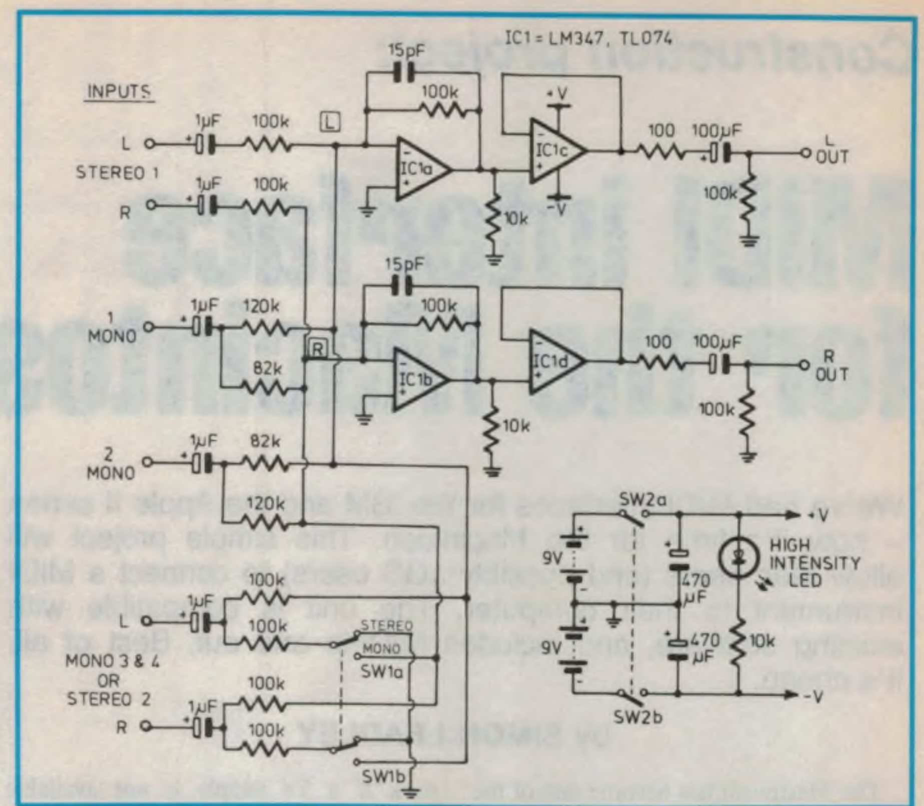
This design stemmed from the need for a mixer for a combination of electronic piano (stereo), drum synthesiser and electronic organ (both mono), and a spare mono/stereo input.

The mixer stages (IC1 a & b) employ virtual earth mixing, with the gain being set by the ratio of the feedback resistor (100k) to input summing resistor (100k for stereo 1 input). For the stereo 1 input, gain equals -1, so that the output voltage equals the input voltage, but phase reversed. This applies to both the L and R signals.

The remaining two inputs (mono 3 and 4) incorporate a network to switch (SW1) from two mono sources (with equal L and R outputs) or one stereo source. The switch is shown in the stereo position.

Input impedance for mono inputs (1 to 4) is approximately 50k, and is 100k for stereo. The 15pF capacitors in parallel with the feedback resistor restricts the high frequency response to 100kHz. The 10k resistors at the output of IC1(a) and (b) can be replaced by 10k ganged potentiometers to serve as a master level control.

IC1(c) and (d) are output buffers with unity gain, ensuring a low output impedance. The 100 ohm resistor isolates the output of the op amp from possible capacitive loads. Balanced supply rails are provided by two 9V batteries, although dual 15V rails could be used if the mixer is mains powered.



Peter van Schaik,
Gilgai, NSW.

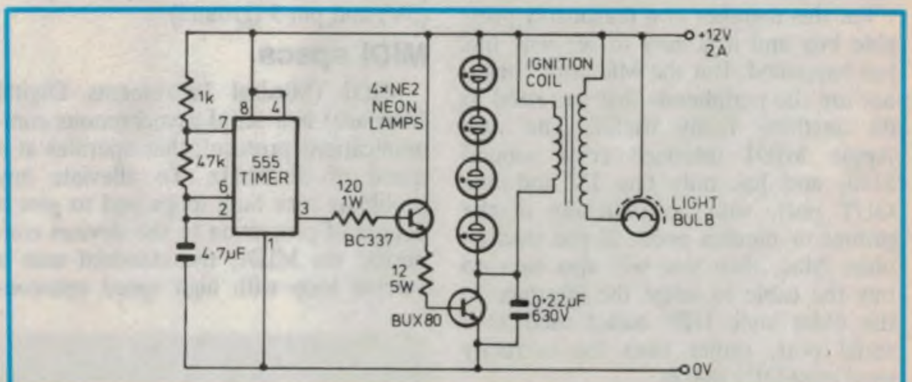
$40

$20 plasma display

This plasma display should suit anyone who doesn't want to pay more than about $20 for parts. The circuit uses a car ignition coil instead of a more expensive high voltage transformer, which brings the cost down. A solid state switching circuit such as that used in a transistor assisted ignition circuit is required, as a relay won't last more than a few minutes before the contacts weld together.

The oscillator driving the circuit consists of a 555 timer connected to a BC337, which can supply up to 1 amp of base current for the output transistor. This transistor is a high voltage type, such as a BUX80 or BU126, or any similar type that can withstand 400V and a current of 4 amps. The output transistor is protected by a series string of neon lamps, which limit the back EMF to around 300V. The 0.22uF/630V capacitor serves to increase the spark voltage and energy.

The plasma discharge is through an ordinary 40 to 100 watt clear light bulb. One electrode of the secondary of the coil is connected to the filament of the bulb, and the other goes to a loop of wire around the outside of the bulb. The loop of wire must be in contact with the glass bulb, although it doesn't matter where on the bulb it is placed.



Jeffrey Harrison,
Mt. Waverley, Vic.

$30

Dreamed up a great idea?

If YOU have developed an interesting circuit or design idea, like those we publish in this column, why not send us in the details? As you can see, we pay for those we publish – not a fortune, perhaps, but surely enough to pay for the effort of drawing out your circuit, jotting down some brief notes and popping the lot in the post (together with your name and address). Send them to Jim Rowe, Electronics Australia, PO Box 227, Waterloo 2017.

Construction project:

MIDI interface for the Macintosh

We've had MIDI interfaces for the IBM and the Apple II series – now it's time for the Macintosh. This simple project will allow Mac users (and possibly //GS users) to connect a MIDI instrument to their computer. The unit is compatible with existing software, and includes MIDI-in and out. Best of all, it's cheap.

by SIMON LEADLEY

The Macintosh has become one of the most popular choices for the professional musician. This is in part due to the famous Mac software interface, which allows anyone to become computer literate without months of training. And also because of the large amount of music-related software that has been written for the Mac.

Put this together in a reasonably portable box and it is easy to see why this has happened. But the Mac isn't cheap, nor are the peripherals that you need to do anything really useful. The new Apple MIDI interface costs around $190, and has only one IN and one OUT port, with no switching of the printer or modem ports. If you own an older Mac, then you will also have to buy the cable to adapt the interface to the older style DB9 outlet used as a serial port, rather than the currently used mini-DIN socket.

But enter the *EA* Macintosh MIDI interface. This neat little unit can be built for under $50, and fits into a small metal or plastic box. If you wish, you can add your own switching to allow selection of a modem or printer. The device will operate on the Mac 512k, 512k E, the plus and the Mac 2. It also has selectable clock speeds to allow it to run with a variety of programs. You could even build two and have dual MIDI in and out, by using both serial ports.

The unit is built on a small PCB that contains everything, including an onboard 5V regulator to allow the circuit to be powered by an external power pack if a 5V supply is not available from the computer.

Although not tested on a //GS, because the serial ports for this computer and the Mac are the same, it is probable it would also work on the GS. In this case, use the 1MHz clock setting, and power the unit from the games port, which has a 5V supply at pin 2 (5V) and pin 3 (ground).

MIDI specs

MIDI (Musical Instruments Digital Interface) is a serial asynchronous communications protocol, that operates at a speed of 31.25kHz. To alleviate any problems with hum loops and to give a degree of protection to the devices connected via MIDI, the standard uses a current loop with high speed optocouplers.

The Macintosh require an external clock reference and bi-phase data signals for the input, and some buffering for the outputs. The design presented here takes care of all of this.

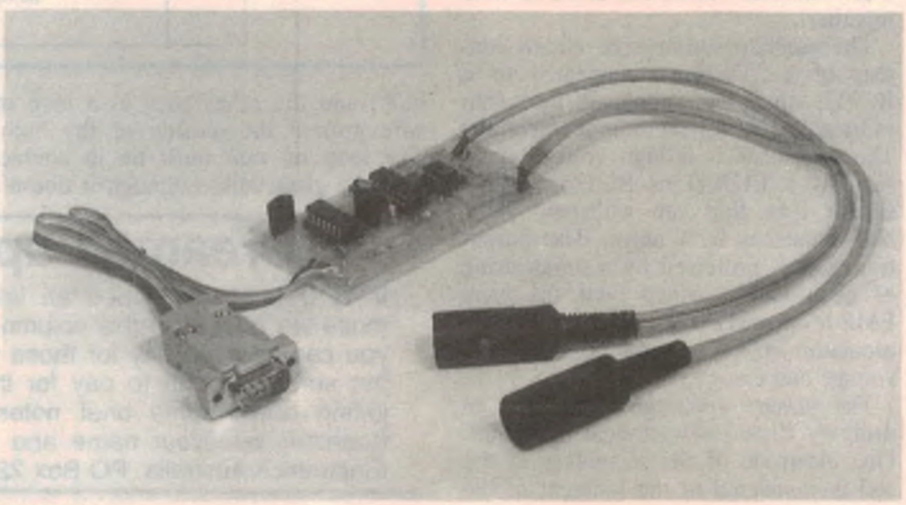
The MIDI specs have been established for some time, and a complete article describing these, and MIDI in general can be found in the article 'Inside MIDI', *EA* January 1988.

The design

The circuit uses a conventional crystal oscillator to provide a stable 4MHz clock, which is then divided by the 74LS93 counter. The divider can be configured to divide by 2, 4 or 8 to give a 2MHz, 1MHz or 500kHz signal respectively, which is then applied to the handshaking input (HSK) input at the Mac's serial port.

Most Mac programs allow you to chose which of these clock rates you want, although some older programs require a fixed clock rate. This rate can be set with a jumper on the PCB to suit.

The MIDI input signal is fed to a 6N138 optocoupler. This device is more



expensive and somewhat harder to get than other, slower, optos, but is recommended for best reliability. The diode D1 across the inputs protects the opto against reverse voltages. Resistor R2 is the collector load for the optocoupler, and converts the current change in the internal photo-sensitive transistor to a voltage change. The two inverters IC1(c) and IC1(d) provide the bi-phase signals needed by the Mac.

The output signals from the Mac are buffered by IC1(e) and (f), and then sent to the MIDI out. Resistors R4 and R5 are standard values for a MIDI interface, to limit the current flowing in the current loop.

The whole circuit has only three ICs and a few passive components. To keep things simple, I have not included any indicators to show MIDI activity, although constructors could add this if required. As well, you could add switches to allow a modem and a printer to be used without having to swap plugs.

You might like to have a duplicate MIDI interface connected to the other serial port. In this case, you need only duplicate the MIDI in and out sections, as the clock from the first unit can connect to the HSK pin on the other port.

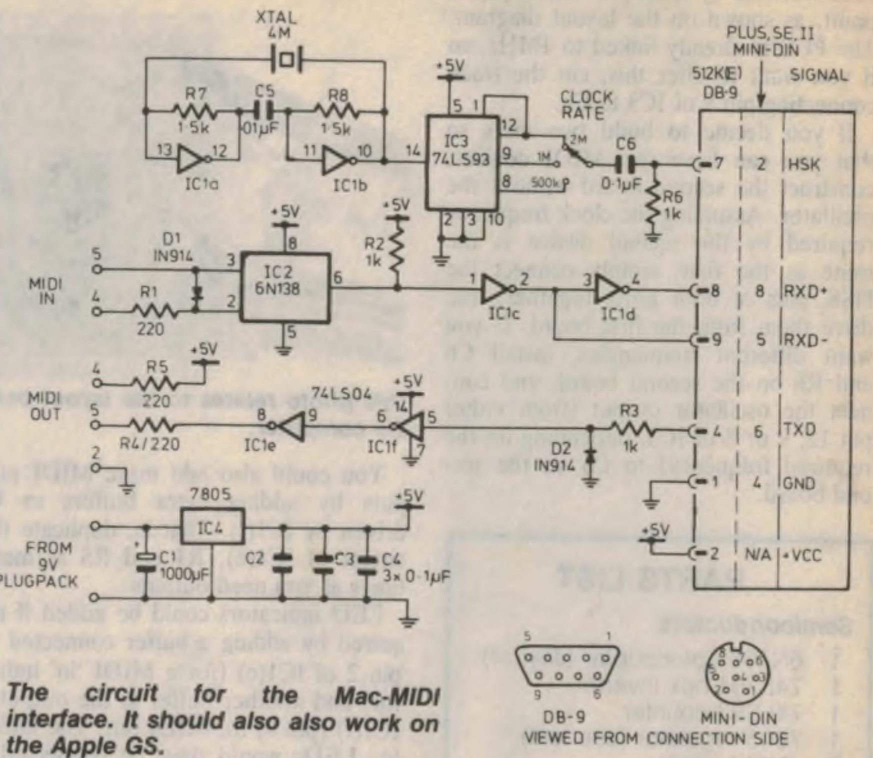
Construction

The construction is very straightforward, since everything is on the one board. Just be very careful to orientate all the components correctly. If you have a Mac 512, you won't need to build the power supply section, as power can be derived from the DB-9 socket (pin 2).

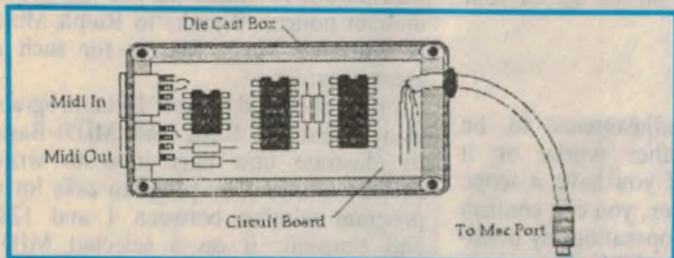
Otherwise, if you cannot derive a 5V supply from anywhere else, install the 5V regulator IC4, C1 and C2, and connect a 9V DC plug-pack to the board.

Refer to the circuit diagram for the pin connections for the two types of connectors used in the different Mac models. Note that no 5V supply is available from the mini-DIN connector used on the Plus, SE and II.

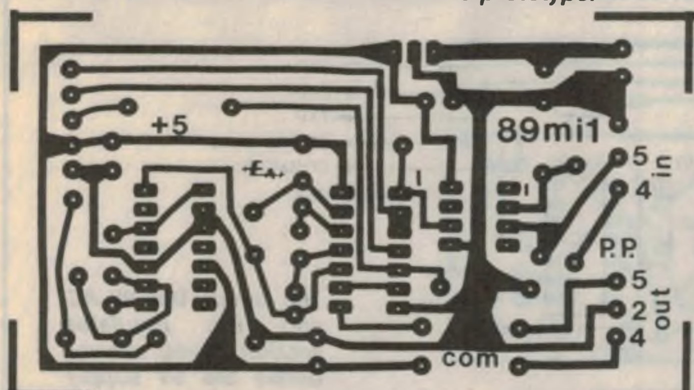
Select the clock frequency required by



The circuit for the Mac-MIDI interface. It should also also work on the Apple GS.



A Mac 'simulation' of the unit. Fit either panel mount DIN sockets or line sockets as shown on the prototype.



The PCB pattern (actual size) for those who can make their own.

```
LIBRARY "midibasic"
  Midiopen 100,100
    midiport 3
    midiport 1
loop:
WINDOW 2, "Midi Page",(50,100)-(450,250),1
   BUTTON 1,1,"Send Program Change",(5,25)-(200,40),2
    BUTTON 3,1,"Quit",(5,75)-(200,90 ),2
      WHILE DIALOG (0)<>1: WEND
     Buttonpushed =DIALOG(1)
   IF Buttonpushed=3 THEN GOTO Done
  ON Buttonpushed GOSUB Midisend
 GOTO loop
Done:
    WINDOW CLOSE 2
    LIBRARY CLOSE
END
Midisend:
INPUT"Program Number";Y%
    IF Y%<0 THEN GOTO Midisend
      IF Y%>127 THEN GOTO Midisend
      x%=192
      midiout x%
    midiout Y%
   PRINT "midi Sent"
RETURN
```

A simple test program for the Mac to test the interface.

your software by linking to the required point, as shown on the layout diagram. The PCB is already linked to 1MHz, so if you want to alter this, cut the track connecting pin 9 of IC3 to C6.

If you decide to build two units so that you can have two MIDI devices, construct the second board without the oscillator. Assuming the clock frequency required by the second device is the same as the first, simply connect the HSK pins of both ports together, and drive them from the first board. If you want different frequencies, install C6 and R6 on the second board, and connect the oscillator output (from either pin 12, 9 or 8 of IC3, depending on the required frequency) to C6 on the second board.

PARTS LIST

Semiconductors

1 6N138 optocoupler (Jaycar)
1 74LS04 hex inverter
1 74LS93 counter
1 7805 regulator (see text)
3 1N914 diodes

Resistors

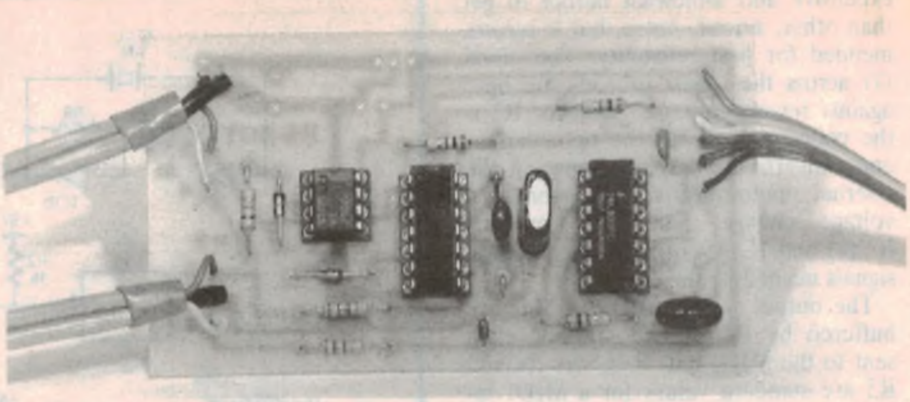
all 1/4 watt. 4 x 220 ohm, 4 x 1k

Capacitors

1 0.01uF polyester
1 0.1uF polyester
3 0.1uF monolithic
1 1000uF electrolytic (see text)

Miscellaneous

1 4MHz crystal
1 PCB coded 89mi1, 90 x 50mm
2 5 pin DIN connectors (plugs or sockets to suit application)
1 DB9 plug (for 512k, E)
1 9 pin mini DIN (other Macs, //GS)
co-ax cable, rainbow cable, 9V 50mA DC plug-pack (if needed)



This photo relates to the layout below. The prototype derived its power from the computer.

You could also add more MIDI outputs by adding extra buffers to be driven by IC1(f). That is, duplicate the circuit of IC1(e), R4 and R5 as many times as you need outputs.

LED indicators could be added if required by adding a buffer connected to pin 2 of IC1(c) (for a MIDI 'in' indicator) and another buffer at the output of IC1(f) (pin 6) for MIDI out. The indicator LEDs would then be connected in series with a 330 ohm resistor between the 5V supply and the output of the added buffers.

The whole unit can then be fitted into a small box (a diecast box was used in the prototype), and the connecting cables arranged to exit the box at either ends. To complete the whole thing, spray paint the box either off white or platinum, depending on the age of your Mac.

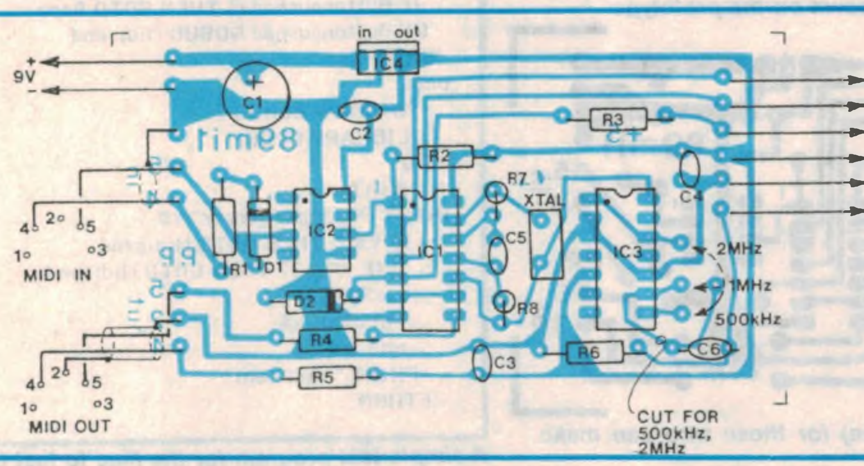
Testing

There are no adjustments to be made; the unit either works or it doesn't. However, if you have a scope or a frequency counter, you can confirm that the oscillator is operating, by monitoring the signal at the HSK pin.

To really test the unit, you need some Mac MIDI software. There are sequencers, patch librarians, effects editors, and even third party Microsoft Basic extensions that enable you to write your own MIDI software. I have a rather nice MIDI test program that is public domain from Ralph Muha (from Kurzweil in America), that is ideal for testing the interface, or simply as a means of learning a bit about MIDI.

The program shows all incoming bytes and will also allow you to send MIDI over the modem or the printer ports. Readers who want a copy can send a 3.5" disk, and a return addressed, stamped envelope, to Simon Leadley c/o Midisoft, 9 Edgecliff Rd, Bondi Junction, 2022. The disk contains all the documentation, and users are free to distribute it to others (as per the public domain notice). Thanks to Ralph Muta at Kurzweil Music System for such a great program.

I have included a short Basic program using Microsoft Basic and MIDI-Basic to illustrate how easy it is to write MIDI routines. The program asks for a program number between 1 and 128, and transmits it on a selected MIDI channel.



The layout. Use 9V AC and the regulator section if you cannot derive the 5V supply from the computer.

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You'll need a sound knowledge of electronics theory and practice, and lots of **enthusiasm.** You'll also need to be able to express yourself clearly, in writing. But apart from that, we have no preconceived ideas about your background. You might be a student, a technician, a fully qualified engineer or just a keen enthusiast.

If you believe you're the person we're looking for, ring Jim Rowe on (02) 693 6620, or send your resume to him at Electronics Australia, Federal Publishing Company, 180 Bourke Road, Alexandria 2015.

Jack O'Donnell, Managing Director of Altronics says, "In '89 the bottom line is quality - quality products, quality service, quality delivery."

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Superb West German made 19mm Dome Tweeter with polymer diaphragm. Very smooth clean response to 20KHz. High power handling and excellent damping. Use with speaker systems to 70 Watts.

C3010 $29.50ea
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These are $39.50 In our 1989 Cat.
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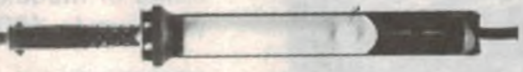

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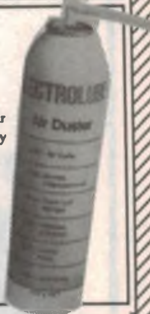

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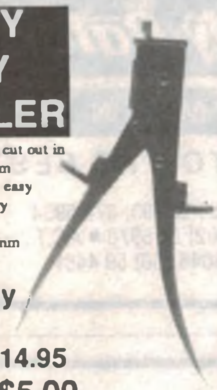

Cuts any shape cut out in steel, aluminium or plastic. Very easy to use. Capacity steel 1mm aluminium 1.6mm
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16 Way Parts Drawer Set

See through acrylic parts drawer. Slide-in Ident. card fronted drawers. Ident. cards supplied. Sturdy steel construction. Value Plus!
H 0240 WAS $29.95 NOW ONLY $20 *SAVE $9.95*

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VIFA 2 Way 100 Watt Weatherproof Speaker

Look for product review feature in Electronics Australia Magazine April/May '89
The heart of the system is the now famous 5" VIFA Woofer/Midrange, computer optimised for use in a 5 litre Bass reflex cabinet.
The classic VIFA 19mm ferro fluid Dome Tweeter is incorporated with the crossover network as employed with the SA-50 bookshelf system.
Has unique overdrive protection enabling amplifier input of up to 100 Watts without damage.
Overall performance and appearance is superior to any competitive weatherproof speaker on the Australian market.
Each speaker is supplied complete with mounting brackets.

C 0970 Black, C 0972 White, ONLY **$399.00 pr**
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Utility Parts Case

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Extra Heavy Duty PCB Relays

Low profile 25mmH 12V DC coil.
HUGE 5A contact rating at 240V AC. DPDT.
S 4085 were $5.95ea
10 up $5.50ea
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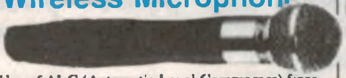
HEAR THIS! FANTASTIC MICROPHONE BARGAINS

Mylar Stereo Phones With Dynamic Mic

Simply brilliant Mylar Stereo headsets &dynamic mic combination.
Headphone: 20Hz - 20,000Hz, 32Ohm, 3.5mm stereo jack, 6.35mm stereo jack, adaptor.
Microphone: Dynamic type, 300Ohm, 100Hz-15,000Hz, 3.5mm mono jack.
C 9055 $29.95 VALUE!

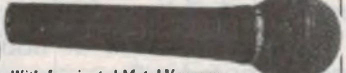
High Performance ALC Wireless Microphone



Use of ALC (Automatic Level Compressor) fixes all overmodulation distortion problems.
Specifications:
- Cardioid-Uni Directional Pick-Up pattern
- Frequency Response: 50Hz-15KHz
- Carrier Frequency: 88-108MHz adjustable.
- Capsule: Electret condenser microphone
- Battery Compliment: 4 x AA • Weight: 235g

Fantastic New Model Has Built-In Antenna
C 0328 NORMALLY $129.50
NOW ONLY $99.00

Ultra Cardioid



With Laminated Metal Vacuum Evaporated Film diaphragm
Simply superb entertainers' microphone. Inbuilt wind filter eliminated "Pops". Balanced line circuit enables long mic cable runs.
Cardioid, 250 Ohm, 70-15,00Hz (useable to 18KHz) Sensitivity -7 + 3db
On-Off Switch with built-in lock
Sturdy carry case included
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Noise Cancelling Microphone

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For Professional 2 way Radios on Aircraft, Boats, Vehicles & also Industrial PA Systems.
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Thumbwheel Switch

BCD 0-9

Panel mount BCD coded units that simply slot together to produce switches of required size.
PCB's are gold plated copper on epoxy fibreglass, continuous load 1A max. Panel cutout for one unit 16mm x 30mm. Allow further 8mm per extra
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Charge Rate 45-50mA for AA, 20mA for AAA, 10-15mA for 9V 120mA

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Pocket size tester will check just about every Battery known to modern man!
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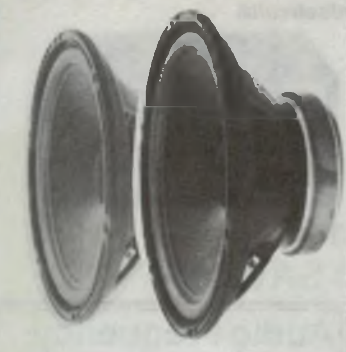
Ultra High Power Capacity

Polypropylene Bass Drivers

Our ALL NEW "Black" polyprop cone Bass Drivers exhibit quite astonishing low register reproduction. Power ratings quoted are conservative. Not the cheapest but definitely the BEST VALUE we know of - ANYWHERE.

The really exciting news is that these 12" and 15" models are available at such a low discount price for this month - but be quick - stocks are limited.



12" (300mm) Model

100 Watts continuous input,
150 Watts intermittent input
Impedance 8 Ohm
Sensitivity 93db
Weight 3620gm
C 3070

Normally $139

NOW ONLY $79

SAVE $60

15" (375mm) Model

Huge 120 Watts continuous input and Massive 150 Watts intermittent input.
8 Ohms impedance
92 db sensitivity
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C 3075

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PROFESSIONAL STEREO CONSOLE MIXER

Ideal for "live" recording, our NEW Audio Mixing Console has truly sophisticated features:

- PA mixing
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- R/L 5 band graphic equalisers
- Talkover facility
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- Individual controls for Microphone, Phono 1&2, Aux. line 1&2, and Master slide level controls.

Blend up to two magnetic or crystal turntables, two tape decks and two microphones - all at once!!

FULLY PROFESSIONAL SPECS:
. Input - Mic 1: 0.5mV, 600 Ohms, Mic 2: 0.5mV, 600 Ohms (Low imp.), 2.5mV, 10kOhms (low imp.); Phono 1&2 (Mag.) 3mV, 50kOhms; Phono 1&2 (Cry.), 150mV, 100kOhms; Tape/Tuner 1&2 150mV, 100kOhms . Equaliser - 5 frequency bands: 60Hz, 250Hz, 1kHz, 4kHz, 12kHz - Boost Cut Range, plus or minus 12db @

A 2570 240V Mains Operated

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VALUE **Increase YOUR SECURITY!** *VALUE*

Infra Red Movement Detector

Pulse Count Type

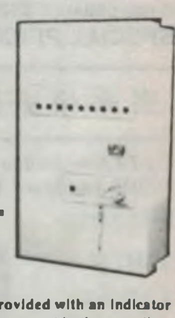
Our 1989 Model IRD now includes pulse count circuitry with a specific time delay between pulse sensing. Three pulses of IR radiation are required to trigger the detector. Providing the detectors are sensibly positioned false triggering is completely eliminated.

Features:

- **Lens simply 'snaps' to either wide angle (range 40ft) for normal use or Narrow angle (and 80ft plus) for corridor applications.**
- **Snazzy integral mounting bracket allows corner 90o mounting.**
- **12V DC Powered**
- **Built-in test lamp.**
- **Relay output SPST 30V 1a max.**
- **9-18V DC**

S 5301 Excellent value *at $79.00*

Multi Sector Burglar Alarm



Protect your Home or Business from Intruders with this "State of the Art" Burglar Alarm System

Over the last few years, House Break-Ins have increased dramatically. The recovery rate of stolen goods is very low. Now more than ever before, it makes extremely good sense to build and install this ingenious Multi-Sector System. This unique Alarm System incorporates the features of the more expensive commercial models - at a fraction of the price.

Features:

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(See EA Jan/Feb'85)

Kit (Less Battery Back Up) K 1900 $149.50

Back Up Battery 12V 1.2AH S 5065 $24.95

Passive Infra-Red Lite Guard Floodlight Control

How often have you thought there could be a prowler outside your door?

Install a Lite Guard & (once armed) any "guest" will be floodlit when detected by this highly sensitive Infra-Red Detector.

The Lite Guard detects a moving person or vehicle by comparing the background temperature with a rapid change of temperature across the detection beams. So when Lite Guard detects movement across the coverage area it will turn on the floodlight(s) for 1-20 minutes as preadjusted.

Security: Prowlers are startled by an unexpected blast of light.

Convenience: Lite Guard will detect your arrival and turn light on to welcome you home.

Energy Saving: Built-in photo cell deactivates unit in daylight.

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Please note: Floodlamps & holders not supplied

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Zinc alloy die-cast housing with stainless steel cap. Key removable in either position. 2 solid brass keys supplied.

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Specifications: Contact Conductive rubber. Rating DC 24V 5mA. Contact Resistance 200 Ohms. Max. Withstand Voltage 250V AC. Bounce 5m sec. max.

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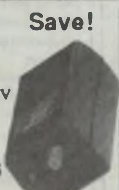

Input Voltage: 240V AC -50Hz
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Output Current: 2A DC
Dimensions: 84 x 68 x 200mm
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.4V at 450mA
Great experiments Solar Module. Connect in parallel or series as you wish. Terminal strap enables easy interconnection to other cells.

A 0210 previously $5.98ea
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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 - 30MHz 25mV - 100mV
10MHz - 150MHz 100mV - 300mV
Power requirement 9V DC @ 100mA
Use our 9V Plug Pack M 9004

Q 1520 **Value at $199.00**

Special $149.00 YOU SAVE $50

Digital Multimeter *With Built-In Capacitance Meter*

All the normal ranges of current, resistance and voltage plus a convenient and simple to use capacitance meter in five ranges, plus transistor tester. Check the features of this top quality digital multimeter from the Labtech range.: • Continuity Test • Buzzer Sound: Less than 200 ohm • Capacitance: 5 Ranges 2000pF - 20uF • Transistor Tester

DC Voltage	.2, 2, 20, 200, 1000V
DC Current	200uA, 2mA, 20mA, 200mA, 2A, 10A
AC Voltage	.2, 2, 20, 200, 750V
AC Current	200uA, 2mA, 20mA, 200mA, 2A, 10A
Resistance	200, 2K, 20K, 200K, 2M, 20M

General: Display: 3 1/2 digit LCD, 0.5" height, with polarity and LO-BAT indication • Overrange Indication
Maximum Common Mode Voltage: 500V peak
Power: 9V alkaline or carbon-zinc battery.
Dimensions, Weight: 170mm x 87mm x 42mm, 350 grams

Specifications: Input Impedance: 10M on all ranges
Normal Mode Noise Rejection: 46db at 60Hz (1K unbalanced)
Common Mode Noise Rejection: 100db at 60Hz
Overload Protection: 1000V dc or peak on all ranges
Response Time: less than 1 Second.

Q 1065 **USUALLY $139.00**
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Audio Frequency Generator

In testing audio circuitry it is necessary to have an accurate audio signal source. It even allows you to test 455KHz IF stages!

Specifications: **SAVE $50**

Frequency Range 10Hz 1MHz
Accuracy +/- 3% +2Hz
Output Waveforms: Sine: 8V RMS
Square: 10V P-P
Output Attenuator: -20db, -40db and fine adjust.
Q1540 was $249.00 NOW $199

We have lots of specials we couldn't fit. Come in and look around and make sure you have our NEW 1989 Catalogue

USEFUL, INTERESTING, PRACTICAL - FABULOUS KITS

Door Minder

(See SC Feb'88)
Will sense a door opening in a large or small room and will sound a two-tone chime. Does not have to be anywhere near the doorway as it detects pressure change. Ideal for use in shops, office, doctors surgeries, Chemists etc.

K1915 was $45.00
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Telephone Line Grabber

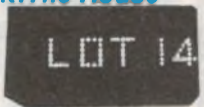
(See Silicon Chip Mar'88)

The telephone Line Grabber prevents interruption from one extension to another. When one extension is being used it automatically mutes the other extension(s). Gives you complete security. Also great for use with modems. One unit required for each extension.

K 1415 **TOP VALUE $19.95**

Led Light: *The House Number*

(See Silicon Chip Oct'88)



Identify your House

The LED light makes your house easily recognisable at night by illuminating your house number. Great for people visiting, easy for taxis and emergency services to locate you at night.
Operates off low voltage plug pack • Automatic operation • Works only at night • Automatic switch off after 4-5 hrs.
Altronic Kit comes complete. 64 LEDs supplied.

K1960 was $59.95 **NOW $55.00**

❊ ❊ ❊ ❊ LIGHT UP YOUR LIFE! ❊ ❊ ❊ ❊

Up To Now Similar Lamps Sold For $1,000 And More **NEW FOR '89**

Plasma Lamp Display

Fantastic pulsating high voltage Plasma discharge continually changes shape and direction. Mode selectable to either fingertip control or sound activated e.g. from voice or sound system. Provides endless fascination as it sizzles and arcs.
Supplied complete with AC Mains Adaptor.

Price Breakthrough for '89
A 0120 $199.00 NOW PRICE
SLASHED TO $150

Beat Triggered Strobe (See AEM July'85)

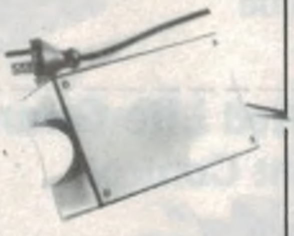
Add More Life To Your Next Party
Flashes in time to your music, or as normal strobe. Exclusively customised by Altronics into our H 0480 Instrument Case. Includes silk screened panel.

K 5790 $79.95 NOW $75.00

For Increased Power Two Tube Option

K 5795 $16.50 NOW $15.00

Line Filter and Conditioner (See EA July '88)



Smooth power for stereo, TV & computers. Altronics customised version housed in strong Jiffy Box. Nickel sprayed for EMI shielding.

K 6040 **was $39.50**
NOW ONLY $35.00

Machined Pin Sockets

Gold Plated Sockets
For applications demanding 100% long life contact reliability.

All 30% OFF!

			NOW
P 0530	8 Pin	$1.10	.99
P 0532	14 Pin	$1.45	$1.00
P 0534	16 Pin	$1.65	$1.15
P 0536	18 Pin	$1.80	$1.26
P 0538	20 Pin	$1.99	$1.39
P 0540	24 Pin	$2.45	$1.70
P 0542	28 Pin	$2.80	$1.96
P 0544	40 Pin	$3.25	$2.25

DC Electronic Fuse

(See EA Nov'87)
Simply clips across the DC Fuse holder. Offers protection adjustable from 0-10A in 2 ranges.

Features:
- Fast blow - slow blow setting.
- Manual reset button.
- LED fuse tripped indicator.
- Operates off 1 single 9V battery (not supplied)
- Two 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.

K 2535 **GREAT VALUE AT $39.50**

Active Direct Injection Box

(See EA Oct '87)
Converts high impedance unbalanced inputs to low impedance balanced outputs. Dozens of studio/PA uses.

Features:
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- Black tough indust. powder coat finish
- Professionally screen printed.
- Earth isolate switch.
- +5db pad.
- Phantom powering plus internal 9V bat.

K 5550 **$45.00 NOW $39.00**

Loudspeaker Protection Kit

Protect your valuable loudspeaker system. This easy to construct kit, provides both DC and overpower protection for your valuable Hi-Fi speakers.
Self-powered unit disconnects the speakers within 1/10th of a second of a fault occuring yet in no way effects the sound quality.
1 unit rack box includes quality silk screened front panel.

K 5050 WAS $125.00 NOW $99.00

SAVE $26.00

PHONEORDER TOLL FREE ALTRONICS 008 999 007

PHONEORDER TOLL FREE ALTRONICS 008 999 007

Utility Timer

(See E.A. March'88)
Time your STD calls and Save Money. Timing is adjustable from 10 seconds to 15 minutes. It features a ten way count down LED display and buzzer. Altronics Kit features full kit and silk screened front panel.

K1425 was $28.50 NOW $25.00 SAVE

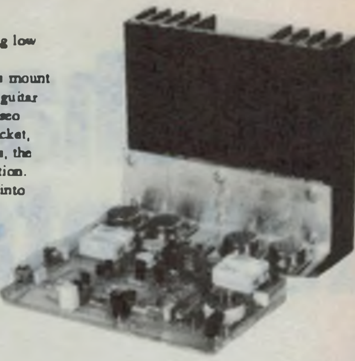
50MHZ Digital Frequency Meter

(See EA May '88)
Fantastic for Work Bench & Tool Box For Less Than $100
Easy to build. Over 50MHz in 5 ranges.
I Features high input impedance overflow LED indicator. KHz & MHz LED Indicators.
All components mount onto a single PCB. Complete with pre-punched & silk screened front panel. Ideal for use in testing CB radios, TV's & AM Radios etc.

K 2510 $99.00 VALUE

Universal High Power Amplifier Module

(See SC Dec'87 or our '89 Cat for full spes.)



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See EA April/May 89
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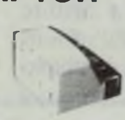

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Construction Project:

16 channel UHF Remote Control – 4

Completing the line-up, we present here the fourth and final article on our versatile 16 channel UHF control system. This month we describe a mains interface unit that will allow the system to control 240V AC powered appliances.

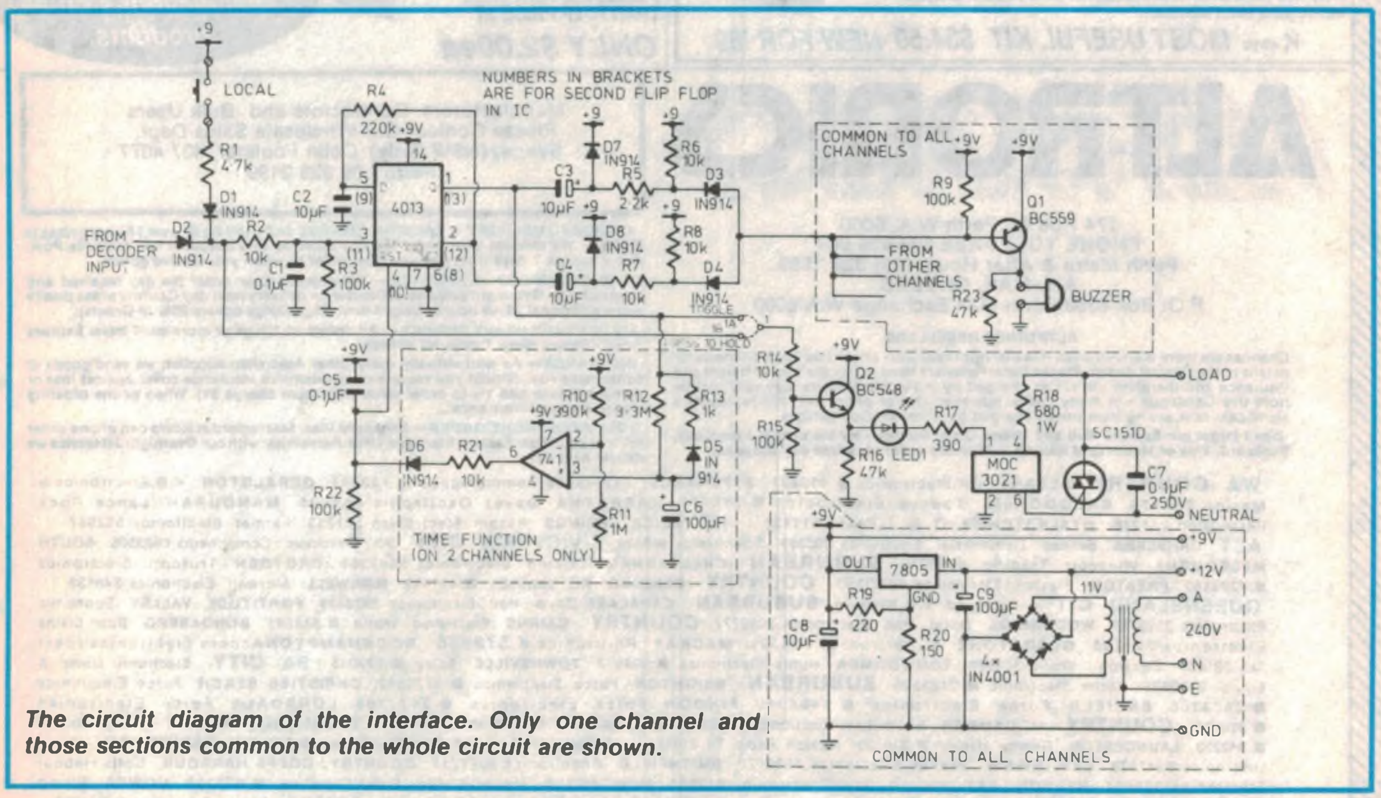
by JEFF MONEGAL

In the January 1989 edition of *EA* we described a four-channel relay unit operated by the receiver/decoder section of the 16 channel remote control system. This unit was designed to drive external low voltage devices only, via relays.

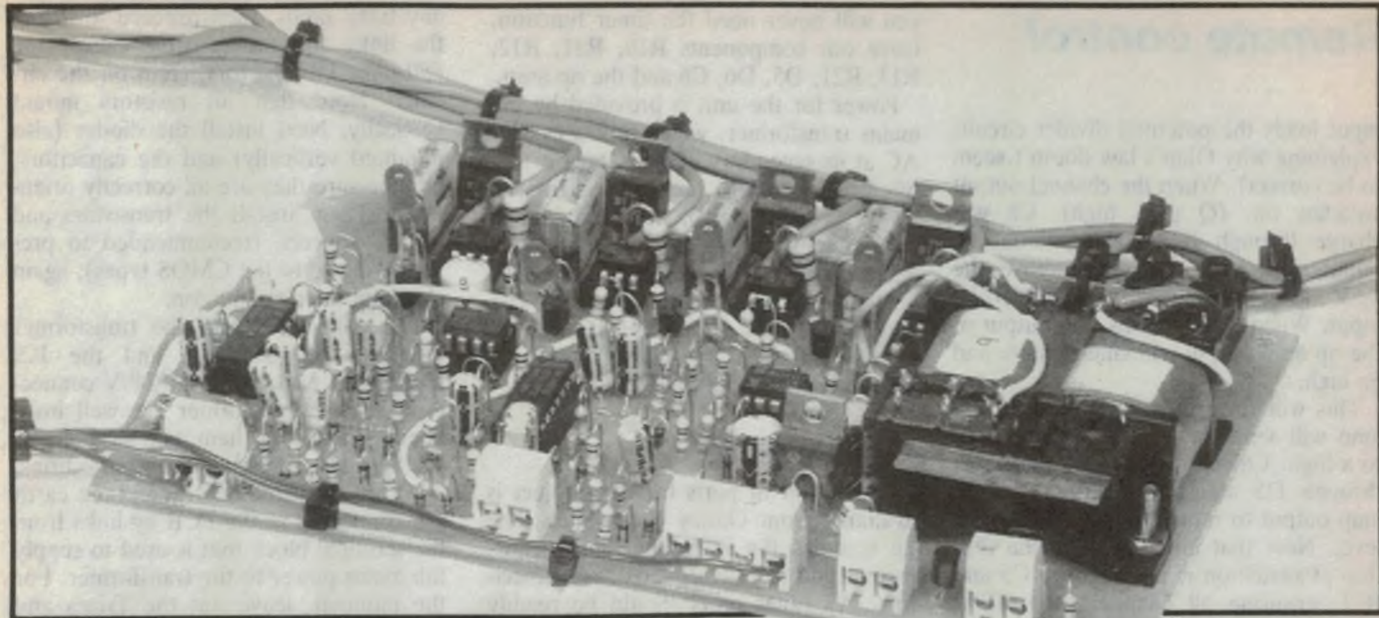
This month we present the final episode, by describing a four channel unit that will drive 240V AC appliances. Because one receiver can control a mixture of interface boards, up to a total of four per receiver, you can have a combination of relay driver boards and mains interface boards, giving an extremely versatile system.

Each of the four channels of the mains interface can be controlled remotely or by a pushbutton connected to that channel. As well, an onboard power supply is provided to power the entire receiver system. So now you can operate most AC appliances directly. Providing the 500VA rating is not exceeded, you should be able to operate lights, TV and radio receivers, motor-driven appliances and so on. We have not actually tested all these appliances, and it may be some appliances misbehave when driven by the interface. However, no damage should occur during any trial period.

Like the previous relay interface, all four channels have *toggle* and *pulsed* modes. Toggle mode means one pulse turns the appliance on and another turns it off, while pulse mode means the appliance is on only while the transmitter pushbutton is being pressed.



The circuit diagram of the interface. Only one channel and those sections common to the whole circuit are shown.



The mains interface can drive up to four 240V appliances, and can also serve as the power supply for the rest of the remote control system.

To give added flexibility, however, two of the channels also have a third mode of operation. This mode incorporates an auto reset timer function, in which the device can be turned on by a pulse from the transmitter, and after a preset time, the device will automatically turn off. For example, you could switch on the outside light (remotely of course) upon arriving home, and have the timer function turn it off after you are inside.

Each channel has a Triac as the output device, operated by a zero voltage switching opto coupler, which gives the absolute minimum of RFI generation. Unless heatsinks are added to the Triacs, the maximum load each channel can control is limited to around 500VA. The mode of operation for each channel is set by wire links that connect the opto coupler input to either the input (pulsed mode) or the output of the 4013 CMOS flipflop (toggle mode).

Normally, the two channels that have the timer function would be set to either 'timer' or 'toggle' modes, as the pulsed mode becomes redundant.

If more than four channels of operation are needed, you will have to construct another interface board. However the power supply for this and any subsequent boards would not be needed; rather the extra boards could be powered from the first one.

How it works

Each channel is identical in operation, although only two have the timer function incorporated as an option. The buzzer driver circuit, made up of transistor Q1, R9 and R23 is shared by all channels through isolating diodes. Also, the power supply is shared by all channels and these shared sections are shown enclosed by dotted lines on the circuit diagram. We will initially describe one channel only, as they all operate in the same way.

IC1a is one half of a 4013 dual D type flipflop, connected in toggle mode. This means that the Q (and Q-bar) outputs change state on every positive transition of the clock. R4 and C2 give a time delay of around 2 seconds between each change, effectively debouncing the local pushbutton.

When the Q output goes low, C3 will charge through the series combination of R5 and R6, allowing Q1 to turn on via diode D3 until C3 is charged. This will cause the buzzer to operate for a short time, giving a beep to indicate that the channel has been turned on.

Similarly, when the Q-bar output goes low (Q returns to high state), C4 will charge through resistors R7 and R8, again turning on Q1, this time through D4. The buzzer will again sound, until C4 is charged, indicating the channel has been turned off. The beep will be longer as the time constant is increased due to the higher value of R7 compared to R5. All four channels are connected to the buzzer, giving an indication of the operation of any of the channels.

The local pushbutton is isolated from the output of the receiver/decoder by D1, D2 and R1. The clock input signal is filtered by R2, C1 and R3 to remove noise.

Transistor Q2 is connected to either the Q output of the flipflop or directly to the output of the receiver/decoder PCB, depending on the position of the link. Resistors R14 and R15 form a potential divider to limit the base current to the transistor.

Q2 drives the opto-coupler through the LED and R17, which in turn provides gate current to the Triac via R18. When the Triac turns on, the load is connected to the neutral, completing the supply path and turning on the load. Capacitor C7 (0.1uF, 250V AC) suppresses transients during switching of the Triac.

Some readers may note that it is standard practice to switch the active line to an appliance, and may feel that switching the neutral is against the SAA rules. If you feel strongly about this, simply reverse the active and neutral connections to the terminal block. The reason the neutral is switched here is to minimise the possibility of an electric shock by keeping the active away from the PCB tracks. However, whatever the connections, there is still a danger.

There are timers associated with two of the channels (see layout for which channels), and both operate in the same way. The timer is based around an operational amplifier connected as a comparator – shown as IC2 on the circuit diagram.

Resistors R10 and R11 bias the inverting input of the op amp to approximately 4.5V. (Note that the op amp input loads the potential divider circuit, explaining why Ohm's law doesn't seem to be correct). When the channel output switches on, (Q goes high), C6 will charge through R12, taking about 10 minutes to reach a voltage above the 4.5V level present at the inverting input. When this happens, the output of the op amp output will change state and go high.

This will reset the flipflop, as the op amp will send the flipflop's clear input to a high. C6 can now quickly discharge through D5 and R13, causing the op amp output to return to its previous low level. Note that initial reset of the flipflop at switch-on is provided by C5 and R22, ensuring all channels are off at power up. D6 is included to isolate the RESET input of the flipflop from the op amp output when this output is low.

If you don't want the timer function for that particular channel, simply leave out the op amp. By installing all components during construction it is a simple task to convert the channel to auto reset by inserting the op amp into the IC socket. Otherwise, if you are certain you will never need the timer function, leave out components R10, R11, R12, R13, R21, D5, D6, C6 and the op amp.

Power for the unit is provided by the mains transformer, which produces 11V AC at its secondary. This voltage is rectified by the bridge rectifier and filtered by C9. The 9V rail is achieved from a 5V regulator by biasing its ground terminal at around 4V by R19 and R20. Further filtering is provided by C8. The unregulated 12V supply is made available as shown in the layout to power the receiver/decoder PCB if required.

Construction

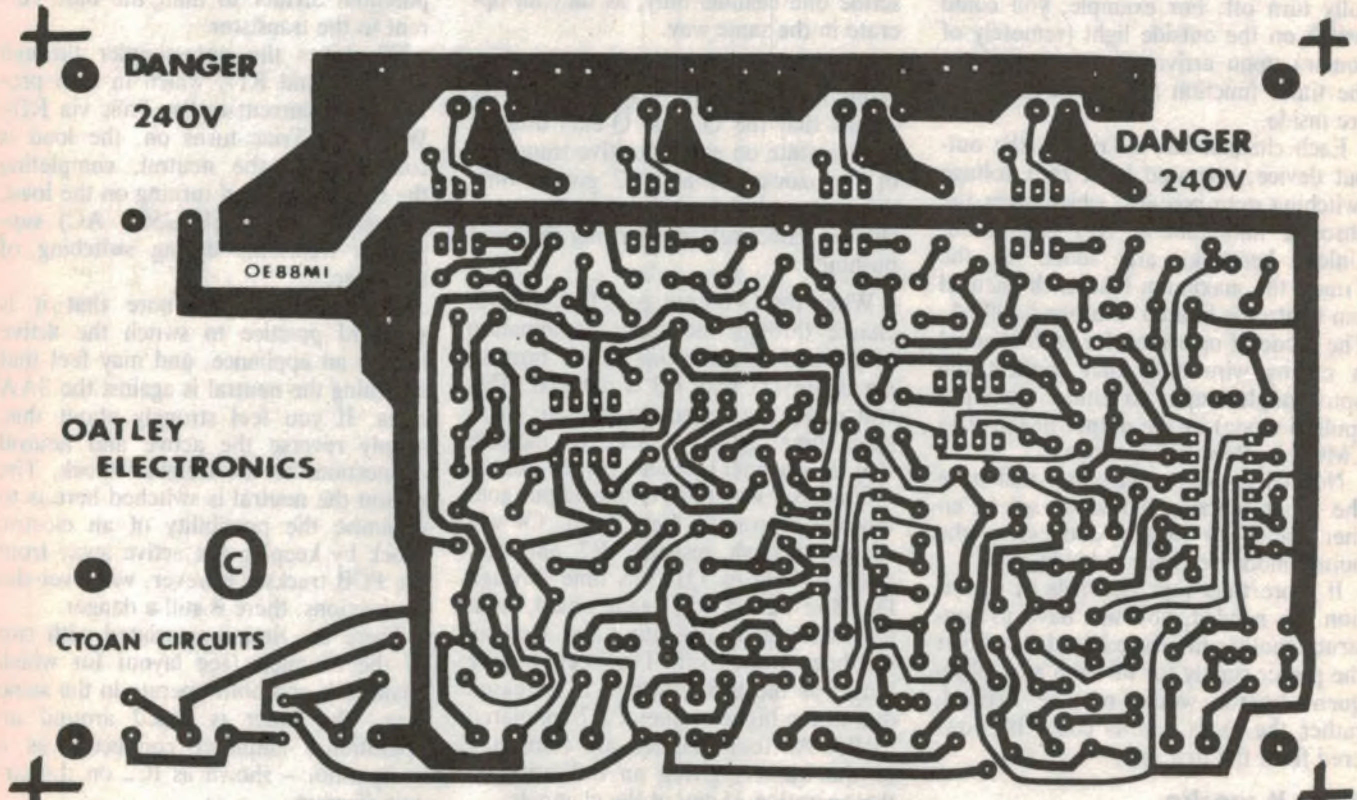
A partial kit of parts for this project is available from Oatley Electronics. The kit contains the PCB, the mains transformer and 4 x 0.1uF 250V AC capacitors. All other parts should be readily available from any parts supplier.

Note that this project connects directly to the mains, and that some parts of the circuit are at mains potential. We recommend that construction of this project be undertaken only by those who are suitably skilled. The possibility of a lethal electric shock is high, and extreme caution is definitely required.

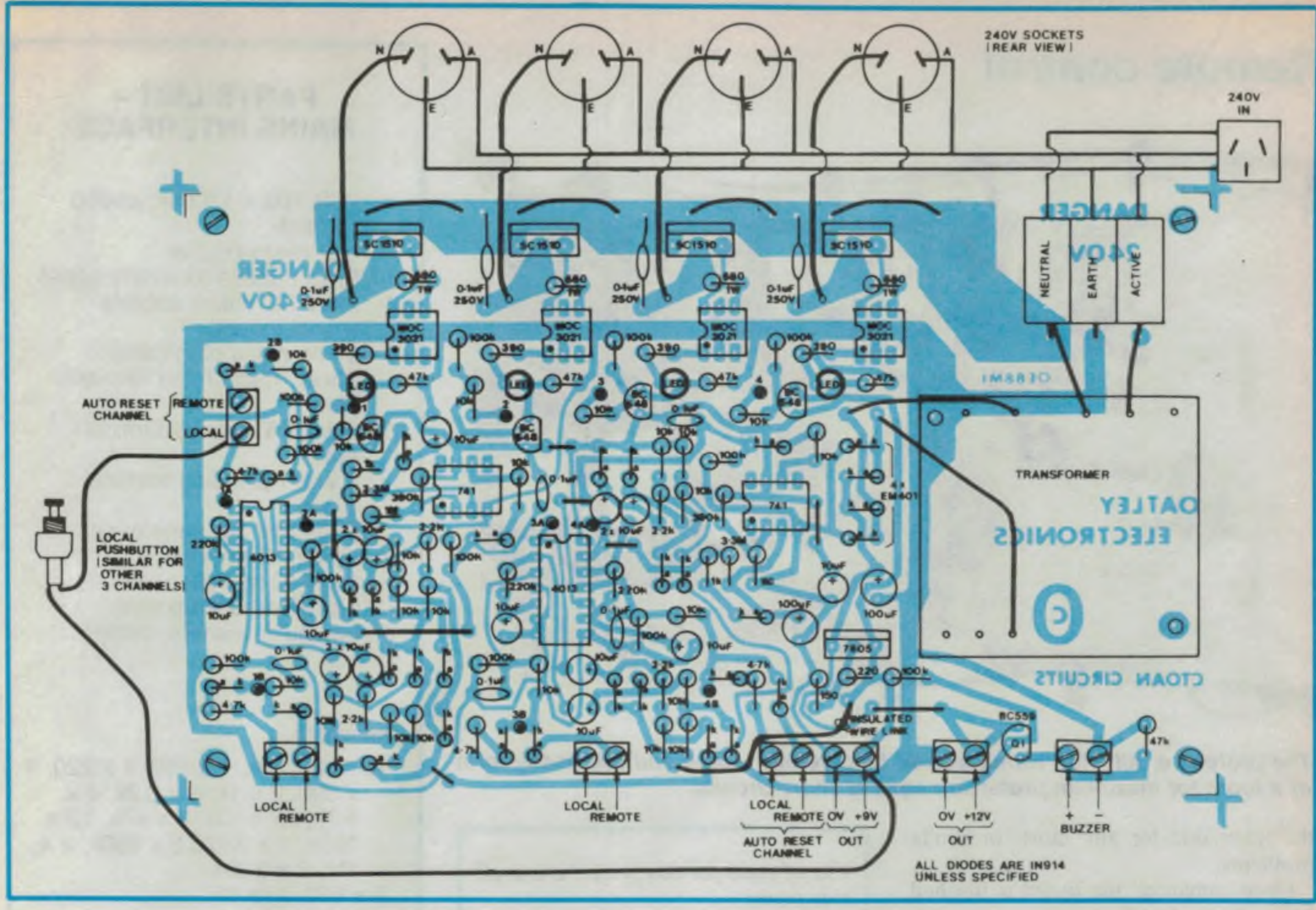
First examine the PCB to check for any track faults, then proceed to install the links and the resistors *except the 680 ohm 1W resistors*, (R18 on the circuit). Note that all resistors mount vertically. Next install the diodes (also mounted vertically) and the capacitors, making sure they are all correctly orientated. Then, install the transistors and the IC sockets, (recommended to prevent damage to the CMOS types); again checking their orientation.

The connectors and the transformer can now be installed, and the ICs plugged in. Make sure the 240V connections to the transformer are well insulated by covering them with suitable insulation after making the connections. Also note that the neutral and the earth are connected to the PCB by links from the terminal block that is used to supply the mains power to the transformer. For the moment, leave out the Triacs and the opto couplers, as testing is required before the application of the 240V AC.

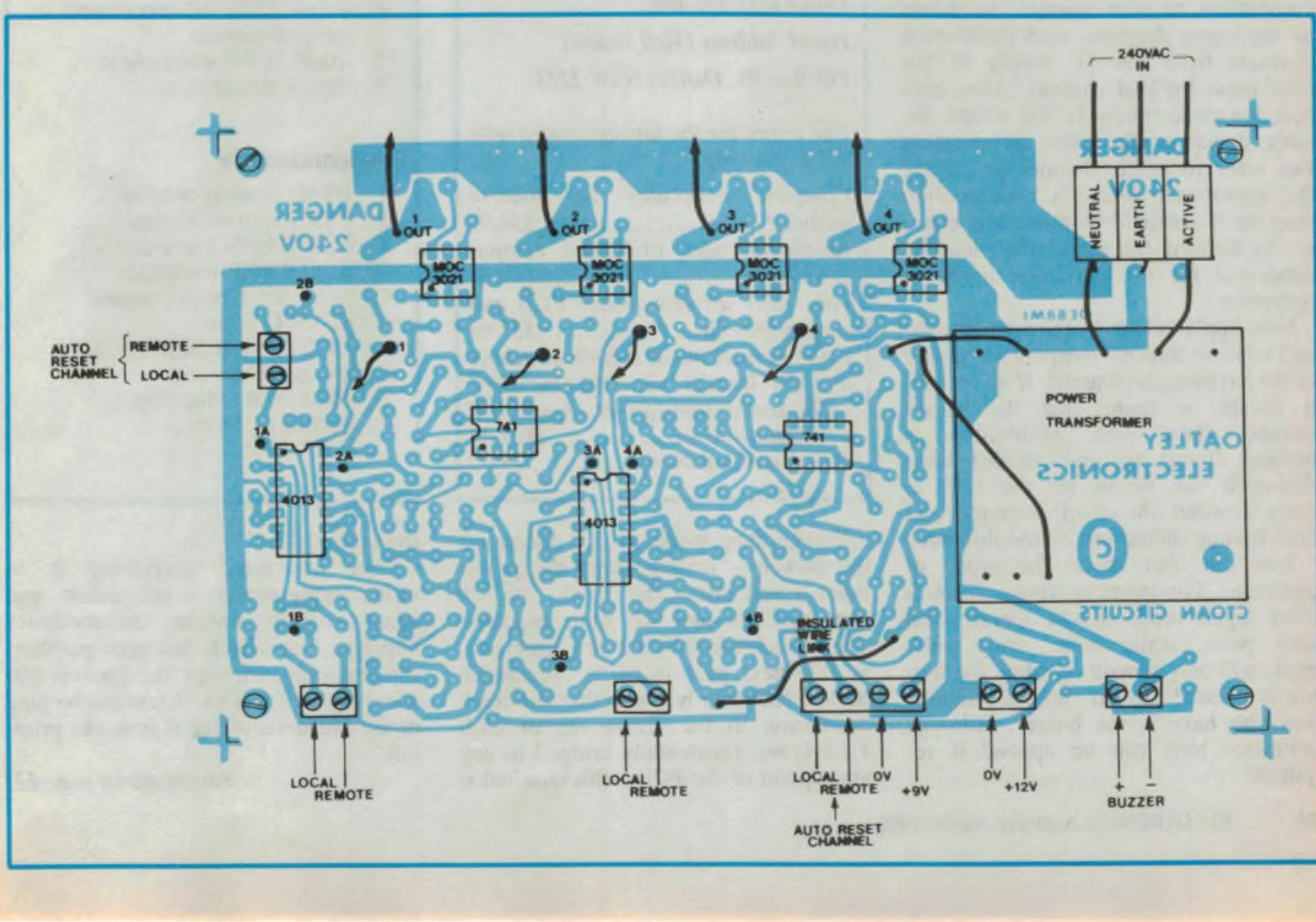
Once all components have been soldered in, double check your work for wrongly orientated components. There are a number of electrolytic capacitors, and it is easy to accidentally put them the wrong way round. Also, make sure all the diodes are connected as shown in the layout diagram. As well, examine

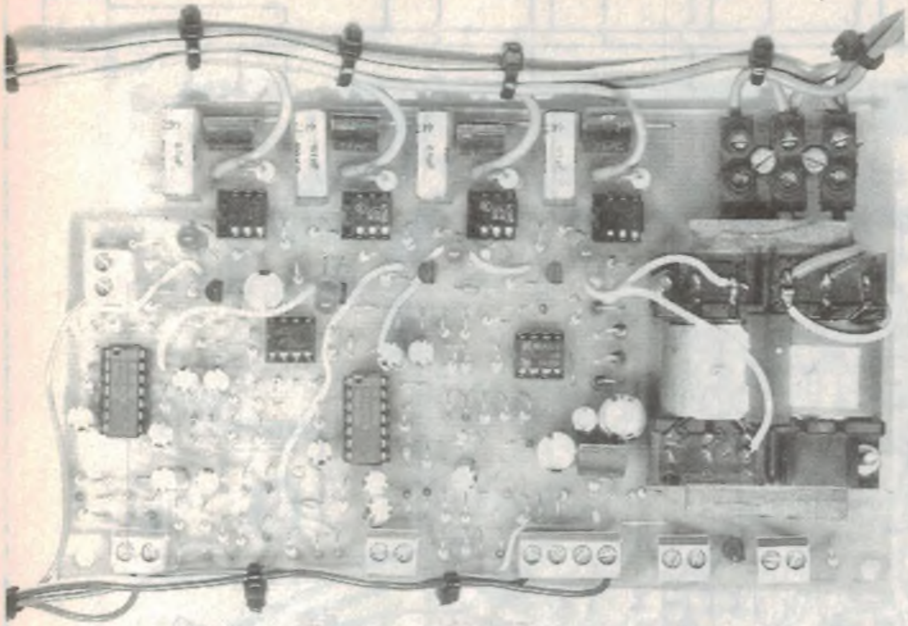


The PCB artwork for those who want to make their own. The artwork is shown full size.



These two diagrams show the layout of the PCB. The diagram above shows the component layout and the diagram below shows the links to select the mode of operation for each channel. For toggle mode, connect the link to the points marked A - e.g., link 1 to point 1A etc. For pulse mode, link to points marked B.





The prototype. All 240V wiring should be carefully routed and tied in the form of a loom for maximum protection against short-circuits.

the track side for any shorts or similar problems.

Once convinced the board is finished, it remains to test it.

Testing

To test the board, first connect the pushbuttons to each channel. As shown on the layout diagram, each pushbutton connects from the 9V supply to the *local* input for that channel. Also, connect the piezo buzzer to the circuit. Finally, decide on the mode of operation you want for each channel and apply the appropriate links. A configuration diagram is included to make this clearer, by showing the points that must be connected for the particular mode of operation.

Now apply power to the transformer, and confirm that no components smoke or do anything unpleasant. If all is well, it should be found that the buzzer sounds when each pushbutton is pressed. If not, try and establish why. Although the layout on the PCB is fairly crowded, the circuit is simple, and fault finding should not be too difficult.

You can also check the mode of operation. For example, those channels using toggle mode should operate with each press, while those using pulse mode will only remain on while the button is pressed. So far, the only indication you have is the buzzer, although voltmeter tests can be applied if required.

Kits of parts for this project are available from:

Oatley Electronics
5 Lansdowne Pde,
Oatley West. NSW. 2223
Phone (02) 579 4985

Postal Address (Mail orders)

PO Box 89, Oatley, NSW 2223

The prices for the kits associated with this project are:

Complete transmitter kit (battery included)............................$34.95
Receiver/decoder PCB and components kit $59.95
Four relay driver/indicator PCB and components kit $37.90
Four channel mains supply switching unit kit (partial kit only, including PCB, mains transformer, 4 x 0.1uF 400V capacitors....................$24.90
Post & packing charge $3.00

If everything works so far, disconnect the power – *unplug from the power point* – and install the Triacs, the 680 ohm resistors and the opto couplers. Then check carefully for any problems, as this next part is when the crunch comes. Particularly check that the track connecting to the centre lug of each Triac is not accidentally bridged to any other point of the PCB – this terminal is the *active*.

Once convinced everything is in order, apply power to the circuit, and again confirm nothing extraordinary happens. Now check that each pushbutton not only activates the buzzer, but also each LED. If so, it remains to plug in an appliance to see if it works properly.

continued on page 123

PARTS LIST – MAINS INTERFACE

1 PCB 100 x 170mm, coded OE88MI
1 12V piezo buzzer
4 Push buttons (normally open)
4 240V AC mains sockets (panel mount)
1 240V mains plug/cable
1 3 way mains rated terminal strip
5 2 way PC mount terminal block
1 4 way PC mount terminal block
1 240V:11V AC transformer
2 14 pin IC sockets
6 8 pin IC sockets
Mains rated hook up wire, screws/nuts/washers, cable clamp

Resistors

All 1/4W, 5%: 1 x 150, 1 x 220, 4 x 390, 2 x 1k, 4 x 2.2k, 4 x 4.7k, 22 x 10k, 5 x 47k, 13 x 100k, 4 x 220k, 2 x 390k, 2 x 1M, 2 x 3.3M.
4 x 680 ohm 1W.

Capacitors

8 0.1uF monolithic
4 0.1uF 250V AC metallised polycarbonate
13 10uF 16VW electrolytic
3 100uF electrolytic

Semiconductors

4 1N401 1 amp diodes
28 1N914 signal diodes
4 BC548 NPN transistor
1 BC558 PNP transistor
4 MOC 3021 opto coupler
4 SC151D Triac
1 7805 5V regulator
2 741 op amp
2 4013 dual D flip flop
4 Red LED, 5mm

DSE Q-1222 digital capacitance meter

Solidly built and compact enough to fit in a service tech's toolbox, the Q-1222 allows accurate measurement of both discrete capacitors and stray capacitance, on its 3-1/2 digit display. Its overall measuring range is from less than 1pF to 20 millifarads.

In the old days, we used to measure the value of discrete capacitors using an AC bridge. The measurement accuracy was reasonable, although barely good enough for the close matching of components intended for critical circuits. And measurements using a bridge were generally quite *slow* – particularly if you were aiming for accuracy.

For measuring stray capacitance in a circuit, the bridge was generally pretty useless, so specialised alternative instruments known (not surprisingly) as 'stray capacitance meters' were developed. These were often based on a small probe, containing an oscillator running at a few MHz, plus a detector circuit and a scheme to compare the impedance at the probe tip with that of a small internal capacitor. The accuracy was quite reasonable, although some of the earlier valve designs tended to drift a fair bit in zero setting as they warmed up.

Nowadays, thanks to digital and IC technology, both kinds of measurement can be performed by a single, compact digital instrument. And they can be performed not only much more accurately, but considerably faster than with a bridge.

The model Q-1222 capacitance meter now being sold by Dick Smith Electronics is a good example of this 'new breed' of compact digital instruments. Measuring only 180 x 83 x 38mm and weighing a mere 300 grams, it provides a total of nine measurement ranges – with full-scale readings ranging from 200pF to 20 millifarads.

The LCD digital display has a 3-1/2 digit format, with high-contrast digits 12.5mm high and very easily read. The maximum reading of 1999 gives a resolution of 0.1pF on the lowest range (200pF), rising to 10uF on the 20mF range.

Basic rated accuracy on all but the two highest ranges is 0.5% of reading, plus one digit – more than enough for all normal (and most abnormal) measurements.

On the lowest range this is also qualified with a further tolerance of 0.5pF, so the effective lower limit for useful measurements is about 0.6pF. Similarly on the 2mF (2000uF) range the basic accuracy halves to 1% of the reading, again plus one digit, while on the highest range it halves again to 2%.

So even capacitors with values above 2mF can be measured to within 2%, corresponding to 200uF at 20mF. Since capacitors with these values generally have very wide tolerances, this again seems more than adequate.

The actual capacitance ranges are selected via a row of slider keys on the side of the instrument, in the same way as manual range switching on some hand-held DVMs. But if you check them from the photo, you'll find there are only 8 keys – so how do you select the ninth range? It's not really a problem: you simply press in the two (physically) lowest keys together.

There are two shrouded banana sockets for connection of the capacitor to be measured, and the Q-1222 comes complete with two matching short clip leads for connecting to large capacitors or components in situ.

In addition to the banana sockets and just above them, there are two groups of pin jacks, to allow rapid testing of small discrete capacitors. This is achieved simply by pushing their pigtails into the most appropriately spaced pin-jacks – very handy.

To allow for zero adjustment of the instrument itself, and also cancellation of the stray capacitance of the clipleads, the Q-1222 has a small zero adjust pot. This has a range of approximately +/- 20pF, and only operates on the three lowest ranges – which are after all the only ones where strays will be relevant.

The test voltage applied to the capacitor being tested is 3.2V peak maximum, with the '+' terminal always more positive than the '-' terminal. This allows it to be used to check electrolytics just as easily as non-polarised types.

Power for the instrument comes from a small 9V battery, which fits inside a small compartment at the bottom rear of the case. Also accessible inside the same compartment is a small cartridge fuse (250mA fast blow) used to protect the input circuitry against damage from charged high-value capacitors.

The current drain is quite modest – typically around 4.5mA, giving an estimated life of about 100 hours for a normal 216-type carbon-zinc battery and about twice that for an alkaline type. When the battery is nearing the end of its life a 'LO BAT' message appears on the display.

What we found

DSE sent us a sample of the Q-1222 to review, and first up we checked it over physically. It seems to be quite sturdily made, with a case moulded in impact-resistant ABS or similar plastic. It is quite obviously made in Taiwan, by

Chung Instrument Electronics (CIE) – a firm which not surprisingly also makes DVMs.

One of the things we noticed shortly after taking the unit out of the box was the fold-out tilting bail on the back. This allows the unit to be propped up on the workbench at a convenient angle of about 45°. A nice little feature!

Inside the case, all of the circuitry is mounted on a single PCB, which appears to be readily removable from the case should servicing ever be needed. The key switches appear to be solidly made and operate quite positively, while the other parts also seem of good quality.

In operation we found the Q-1222 very easy to use. It stabilises within a couple of seconds of switch-on, and can thus be used to make very rapid measurements on discrete caps of almost any size.

We compared its calibration against a couple of close-tolerance caps of known value, and the figures were certainly within the rated accuracy/tolerance range expected. This suggests that the unit meets its specs, and would be more than adequate for the majority of normal measurements – including value checking, selection of precision values, sorting and matching of sets.

continued on page 123

CRYSTAL OSCILLATOR CIRCUITS

Old and new

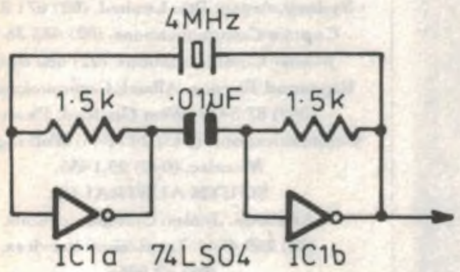
The following crystal oscillator circuits should prove useful to designers and hobbyists alike. The circuits are grouped into those used with logic gates, and those using a transistor as the active device.

The transistor based circuits were originally published in *EA* November 1972 in an article titled Quartz Crystal Oscillator Circuits. This article was written by John Foster and David Rankin from Hy-Q, and as these circuits could be considered standards, it was decided to reproduce them to coincide with the article on crystals elsewhere in this issue.

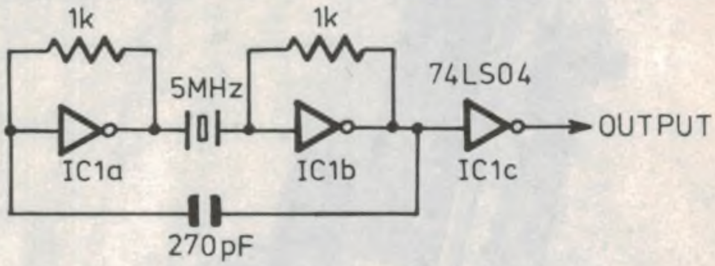
The transistor circuits cover frequencies from 150kHz to 105MHz, and their configurations are all somewhat similar. Component values are tabulated for the different frequencies each circuit can be used for, and details of the construction of the coil for each circuit is also shown.

The logic gate oscillator circuits are from various *EA* projects that incorporated a crystal oscillator. By lumping them all together, you should be able to find a circuit that will fulfil the function you need. Some circuits use CMOS gates, others TTL LS or even TTL. In all cases, the gates are actually connected as inverters, and NOR or NAND gates can be used, connected as inverters instead of actual inverter gates. Note that the specified family should be used as specified, that is, don't mix CMOS and TTL, or TTL and TTL LS etc.

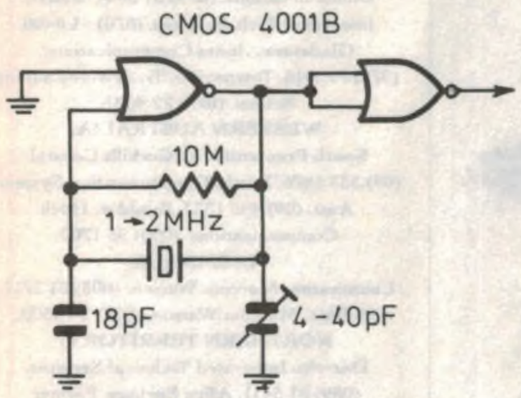
When constructing a crystal oscillator circuit, make sure all lead lengths are kept as short as possible and that stray capacitance is minimised. Very often a circuit will only work when the layout is correct, so don't give up if a breadboard layout doesn't fire up. Sometimes the opposite can occur, and a circuit transferred to a PCB may not operate as it did on the breadboard.



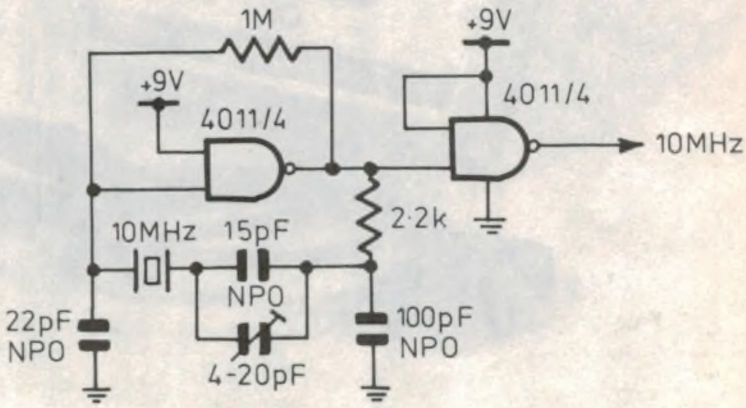
Crystal oscillator using two TTL LS inverters. The capacitor can be polyester or ceramic.



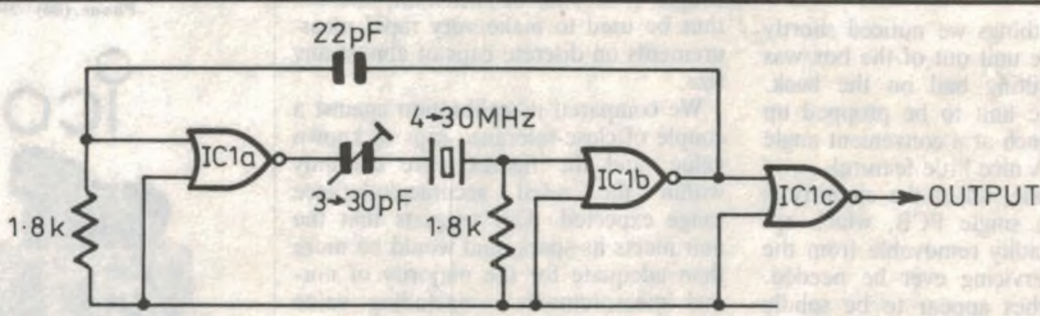
Another TTL LS crystal oscillator circuit, based around the 74LS04.



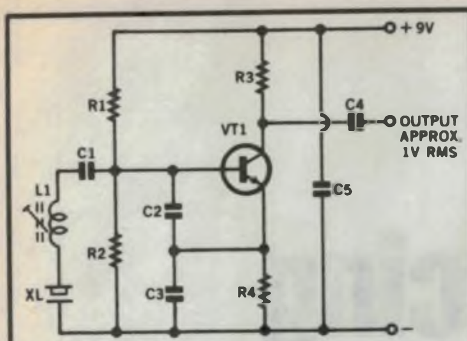
A CMOS based oscillator circuit for around 1 to 2MHz.



Another CMOS based oscillator that isolates the crystal from the voltage and temperature characteristics of the CMOS gate. This circuit can run at 10MHz.



A TTL based oscillator circuit from Hy-Q. The crystal is an AT cut fundamental mode type, which should allow a frequency of operation ranging from 3MHz to around 30MHz.



Recommended circuit for 150-500kHz range

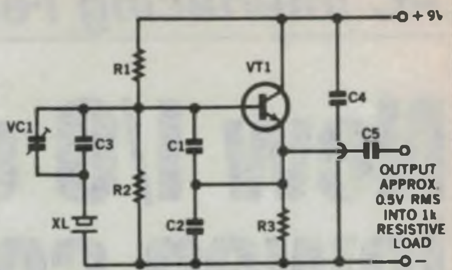
R1	100k	C1	See Note 1
R2	33k	C2, C3	See Note 2
R3	2.2k	C4	.01uF
R4	2.2k	C5	.01uF
VT BC108, SE1002 or similar		XL	Crystal Unit

L1 30 B & S enamelled wire wound on 7.62mm diameter former with Neosid F25 core. See Note 3.

Notes:

1. For crystals calibrated at series resonance, C1 = 0.01uF
   For crystals calibrated at parallel resonance, C1 should be equal to the specified load capacitance, typically 30, 50 or 100pF.
2. For CT cut crystals C2 = C3 = 680pF
   For DT cut crystals C2 = C3 = 1000pF
3. For frequencies between 150 and 300kHz, inductance to be between 800 and 2,200uH (520 turns)
   For frequencies between 300 and 550kHz, inductance to be between 360 and 960uH (280 turns)

Recommended circuit for AT fundamental parallel crystals, 1MHz to 21MHz.

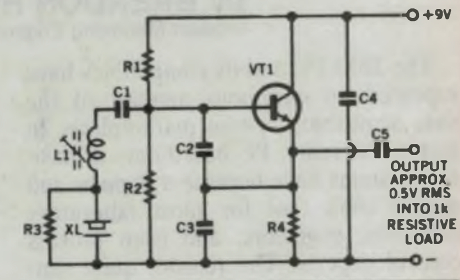


R1	100k	C1, C2, C3	see below
R2	33k	C4	.01uF
R3	See below	C5	4.7pF
VT1 BF180, SE1010 or similar		VC1	60pF trimmer
		XL	Crystal Unit

F (MHz)	R3	C1	C2	C3
0.95-3	3.3k	220pF	220pF	680pF for 50pF crystals * Not required for 30pF crystals *
3-6	3.3k	150pF	150pF)	120pF for 50pF Crystals *
6-10	2.2k	150pF	150pF)	33pF for 30pF Crystals *
10-18	1.2k	100pF	100pF)	Not required. 20pF crystals *
18-21	680 ohms	68pF	33pF)	only for these ranges

NOTE: The terms "20, 30 and 50pF crystals" refer to the capacitance load used when these crystals are measured in standard test sets, and is not related to any static capacitance present within the crystal unit itself.

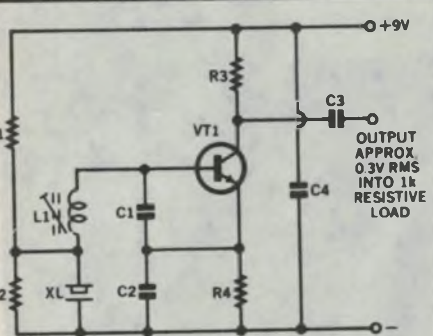
Recommended circuit for AT fundamental series mode, 1MHz to 21MHz.



R1 R2 R3 R4 see below
VT1 BF180, SE1010 or similar
XL Crystal Unit
C1 C2 C3 see below
C4 .01uF
C5 47pF

F (MHz)	R1	R2	R3	R4	C1	C2	C3	L1
0.95-1.65	68k	33k	Not req'd.	2.2k	.0047uF	680pF	680pF	140 Turns
1.6 -2.5	68k	33k	"	2.2k	.0047uF	680pF	680pF	65 Turns
2.5 -4.0	68k	33k	560	1.5k	.0047uF	220pF	220pF	65 Turns
4.0 -6.0	15k	6.8k	560	1.5k	.001 uF	270pF	270pF	40 Turns
6.0 -10.0	15k	6.8k	560	1.5k	150 pF	220pF	220pF	26 Turns
10.0 -15.0	15k	6.8k	560	680	100 pF	220pF	220pF	16 Turns
15.0 -21.0	15k	6.8k	560	680	100 pF	100pF	100pF	10 Turns

L1, close wound with 33 B & S enamelled wire on 7.62mm diameter former with Neosid F25 core.



Recommended oscillator circuit for 50-105MHz fifth overtone AT cut crystals.

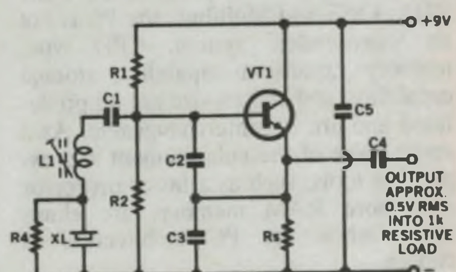
R2	470	C1	12pF
R3	330	C2	18pF
R4	470	C3	33pF
		C4	1000pF

VT1 BF180, SE1010 or similar
XL Crystal Unit

F (MHz)	R1	L1
50-70	2.7k	7 Turns 6mm long)
60-85	2.7k	5 Turns 5mm long)
80-105	1.2k	3 Turns 6mm long)

Wound with 20 B & S enamelled wire on 7.62mm diameter former with Neosid F29 Core

Recommended circuit for 15-63MHz third overtone AT cut crystals.



R1	10k	C1 C2 C3 C4	See below
R2	4.7	C5	.001uF
R3	470	VT1	BF180, SE1010 or similar
R4	560	L1	See below
		XL	Crystal Unit

F (MHz)	C1	C2	C3	C4	
15-20	100pF	100pF	68pF	33pF	12 Turns 30 B & S close wound
20-26	100pF	100pF	68pF	33pF	8 Turns 30 B & S Close Wound
25-31	100pF	68pF	47pF	33pF	8 Turns 30 B & S Close Wound
30-43	100pF	68pF	47pF	33pF	6 Turns 20 B & S Close Wound
42-55	100pF	68pF	47pF	33pF	5 Turns 20 B & S 6mm long
48-63	68pF	33pF	15pF	15pF	5 Turns 20 B & S 6mm long

L1 is wound on 7.62mm diameter former with Neosid F25 core.

N.B. Under no circumstances should a tuned circuit at the crystal overtone frequency be included in the collector circuit of VT1 as this configuration will result in oscillation not controlled by the crystal.

New I/O cards for lower cost interfacing

Using a PC-based system for data acquisition and control generally involves expansion of its I/O facilities. A variety of approaches to this exist, each with its own advantages and limitations. A new approach using modular plug-in cards offers extended flexibility coupled with significantly lower price.

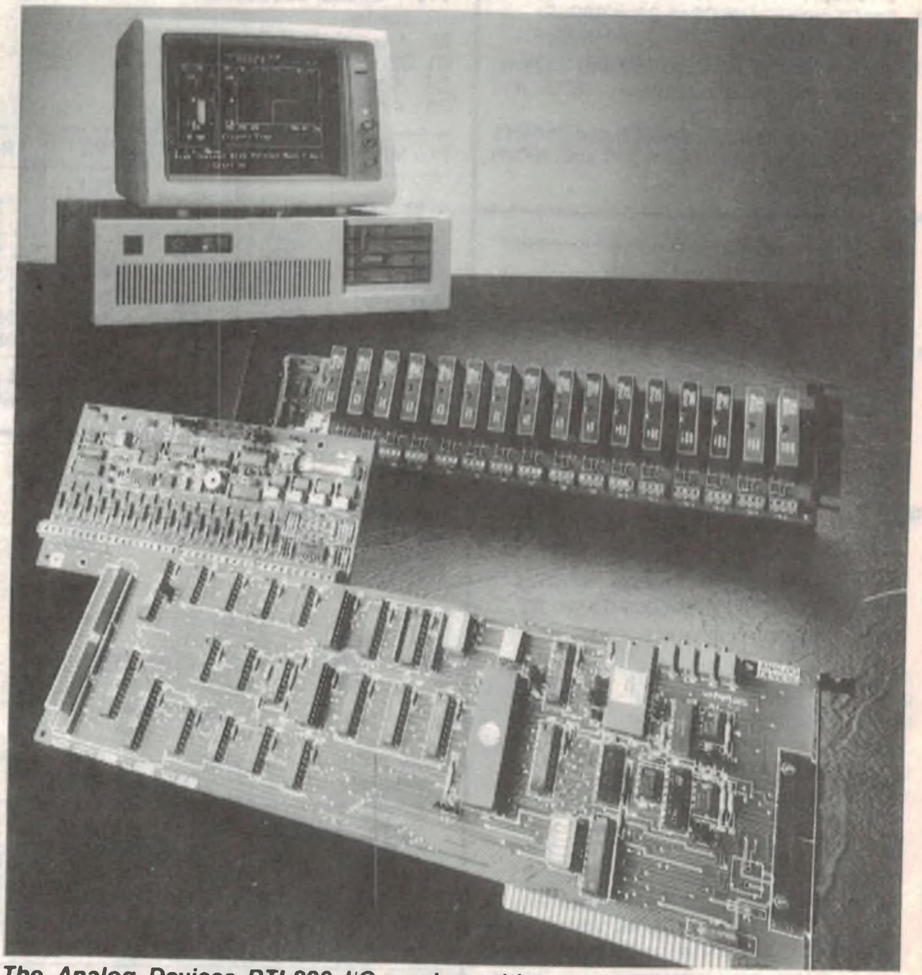
by BRENDON HOWE
Product Marketing Engineer, Analog Devices Inc.

The IBM PC and its compatibles have captured an enormous amount of the data acquisition system marketplace. In just a few years, PC based data acquisition systems have become a popular and widely used tool for most laboratory scientists, engineers, and even process control experts. The reason, quite simply, is the availability of extensive support devices for the computers. Personal computer users can now enhance their standard systems with plug-in peripheral devices and accompanying software, in order to build application specific computing system solutions.

Although the popularity of the PC provides an excellent platform for peripheral enhancement and expansion, its architecture is somewhat limiting. Unlike other bus-based systems such as the STD, VME and Multibus, the PC is not an 'open-ended' system. CPU type, memory expansion capability, storage capability, and chassis size are all predefined and are not interchangeable. As a result some of the enhancement and expansion tools, such as a faster processor and more RAM memory, are eliminated when the PC architecture is chosen.

The standard IBM PC contains 8 I/O expansion slots that provide a 'paralleled' expansion of the computer's internal bus. Analog and digital I/O (ADIO) capability, common to most automation applications, is accomplished by installing an I/O card into one of the eight expansion slots. The card is mapped into the host computer's memory and will, when instructed to, fetch and feed analog and digital I/O data to and from the PC's memory. Most ADIO cards typically provide 16 analog inputs (AIN), 2 analog outputs (AOT), and a small number of digital I/O (DIO) on a single long slot PC board.

Not all of the 8 expansion slots are available for ADIO cards, however. Normally, some of these slots are taken by other peripheral cards such as a colour graphics display card, floppy disk controller card, fixed disk controller card, and a communications/expanded memory card. Since these functions are often critical requirements for automation applications, expansion slot avail-



The Analog Devices RTI-820 I/O card provides the IBM PC and compatibles with a broad range of interfacing possibilities for data acquisition and control.

ability may be cut in half (4 slots maximum). Assuming the standard ADIO card density of 16 AIN, 2 AOT, and 16 DIO, PC based solutions become limited to 64 AIN, 16 AOT, and 64 DIO – certainly not an adequate point count for medium to large scale applications.

It is obviously not cost effective to purchase additional PC's in order to accommodate additional I/O cards. After all, more computing horsepower is expensive and may not necessarily be needed. Two expansion techniques have developed in order to accomodate additional I/O channels into a single PC: (1) external plug-on boxes; and, (2) modular plug-in boards.

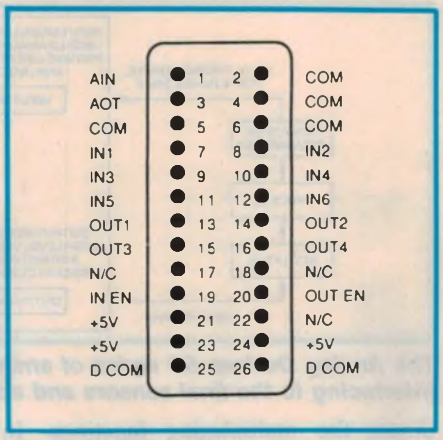
External boxes

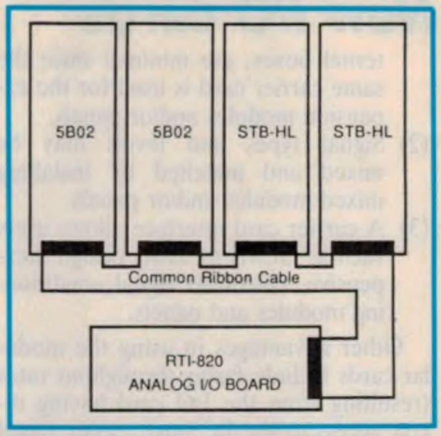
The 'Plug-On' box expansion approach consists of reading remote I/O through an externally mounted box. The box consists of an open chassis, power supply, and the necessary communications control circuitry. Since the plug-on box is self-contained within its own chassis, it is relieved of the slot limitation of the PC and also offers the added benefit of being isolated from the potential power and noise problems often found within the PC.

Most 'plug-on' box solutions are intelligent processing systems with their own independent microprocessor and memory. The on-board processing power is generally used to initiate data acquisition runs, process and reduce data, and control the serial communication link (RS232, 422, etc) back to the PC. This processing power also provides the benefit of reducing the dependency on the PC's CPU to perform critical decision making or housekeeping functions.

A second form of external box that is often used is the PC bus expansion chassis. The expansion chassis is similar to the intelligent box in that it is free of the PC's internal chassis and therefore overcomes the physical slot limitation. Similarly, it also provides protection from potential power and noise problems within the PC itself. The expansion chassis, however, contains no on-board intelligence and is not separately programmable. It communicates back to the PC through internally mounted interface cards that map the box into the PC's RAM memory.

Although the external box approach is an adequate and quite popular expansion technique, it does involve several disadvantages. Intelligent boxes, for example, require a communications link back to the PC, a requirement which severely limits throughput rates because the external box does not have direct





Above left are the connections for the RTI-820's analog I/O bus. To the right is a block diagram of the sub-multiplexing system.

access to the PC bus. In addition, its on-board microprocessor often requires substantial software development, sometimes more than that of the PC itself. The expansion chassis, on the other hand, is limited by the ability to run the parallel bus outside of the PC. Most vendors limit the cable length to 12 feet, severely restricting the location of the external box.

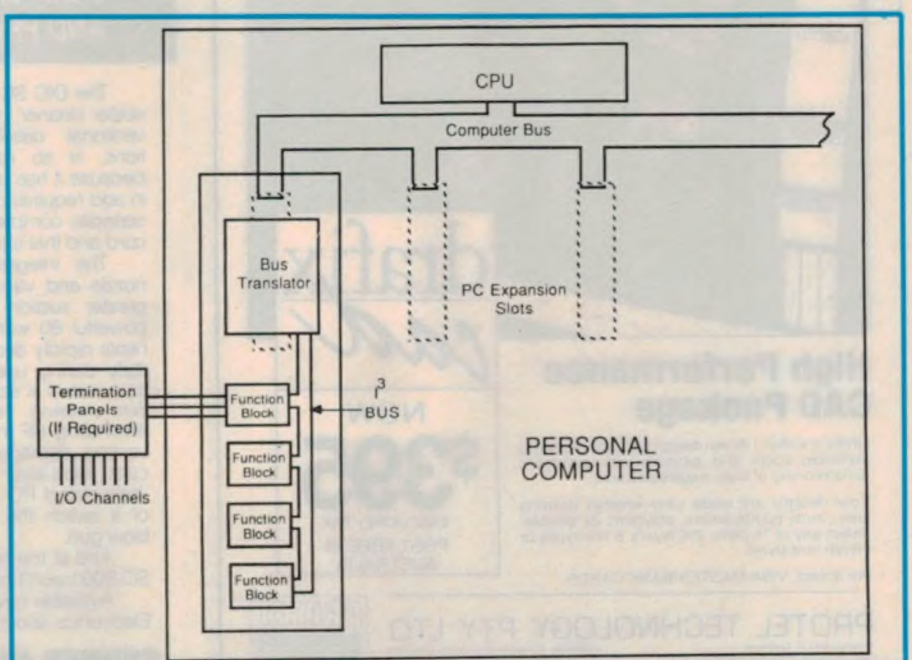
The most significant disadvantage, common to both approaches, is price. Configurations requiring even a small point-count expansion may require purchase of a complete, stand-alone programmable system, sometimes costing up to $9000.00 or more. Even the expansion chassis approach requires the user to purchase an external box, power supply, and the necessary PC interface cards.

Modular plug-in cards

The most recently developed expansion technique for additional I/O channels is the modular card approach. This technique involves the input and output of data through a carrier card mounted in the PC chassis, while separate modules or panels are used to carry in the multiple I/O channels. This card may be in the form of a module carrier card, a bus driver card, or simply an A/D and D/A card, depending on the product selected.

The primary advantage in using the modular card expansion technique is its low cost. The cost effectiveness of this solution is achieved through the following design considerations:

(1) Additional hardware purchases, such as extra carrier boards or ex-



A more detailed diagram showing the way the I/O signal paths are implemented using the RTI-820 board and mating modules.

New I/O cards

ternal boxes, are minimal since the same carrier card is used for the expansion modules and/or panels.

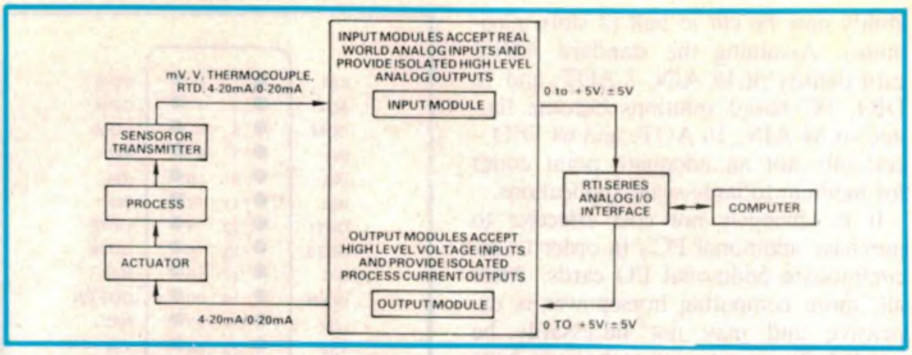
(2) Signal types and levels may be mixed and matched by installing mixed modules and/or panels.

(3) A carrier card interface allows users such as OEMs to easily design inexpensive, customed signal conditioning modules and panels.

Other advantages in using the modular cards include faster throughput rates (resulting from the I/O card having direct access to the PC bus), easier signal termination achieved through off-board termination panels, and the benefit of MS-DOS based software support, since the I/O card is mapped into PC memory.

Sub-multiplexing

Sub-multiplexing is a method of accommodating multiple input and output channels through off-board multiplexers, and is generally the least sophisticated and least expensive of all the modular card designs. The carrier card functions as an analog to digital (A/D) and digital to analog (D/A) converter and also provides the channel addressing and strobe lines necessary to coordinate the multiplexing functions. In this manner, all input and output channels are terminated at remote panels and are input to the base card on a one-by-one basis.



The Analog Devices 5B series of analog input and output modules extend the interfacing to the final sensors and actuators.

The sub-multiplexing approach to analog I/O expansion is implemented on the Analog Devices RTI-820 data acquisition card. The card provides an analog I/O connector that includes a single analog input voltage line, a single analog output voltage line, input and output decoder addressing lines, and the strobe lines necessary to control the timing of the I/O functions. The block diagrams on page 90 show basic and more detailed representations of the sub-multiplexing technique.

The multiplexing is done at the remote panels and is controlled by the base card. Six input and four output decoder lines are supplied to provide up to 64 analog inputs and 16 analog outputs into a single card through daisy-chained external panels. The panel options not only provide for I/O expansion, but also allow a wide range of signal levels to be mixed and matched, since all signals are conditioned into high level voltages at the remote panels.

For further information on expansion for PC based data acquisition, contact Parameters Pty Ltd, Melbourne (03) 575 0222, Sydney (02) 888 8777, Perth (09) 242 2000.

Model	Resolution	No. Channels	Conversion Rate	Data Access Time	F.I.F.O.	Size
AD1332	12 Bit	1	125 KHz max	15 nS	32 word	x 12 Bit
AD1334	12 Bit	4	64 KHz max	15 nS	32 word	x 14 Bit
AD7878	12 Bit	1	100 KHz max	40 ns	8 word	x 12 Bit
AD7672	12 Bit	1	330 KHz max	90 ns		NIL

NOTE: We also have a complete range of A to D converters to suit all Real World conversion applications.

Model	Cycle Rate	Data Memory	Program Memory	Cycle Time
ADSP2100	6 or 8 MHz	16K x 16 Bit (External)	32K x 24 Bit (External)	170 nS (6) 125 nS (8)
ADSP2100A	10 or 12.5 MHz	16K x 16 Bit (External)	32K x 24 Bit (External)	100 nS (10) 80 nS (12.5)
ADSP2101/2	12.5 MHz	1K x 16 Bit (Internal)	2K x 16 Bit (Internal)	80 nS (12.5) 80 nS (12.5)
		Expandable to 64K x 24 Bit (External)		

NOTE: If your application requires faster cycle rate or higher resolution we have a complete range of word slice components.

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Centrecourt 25-27 Paul Street Nth.
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Spring Hill Qld 4000
Tel: (07) 832 1415
Fax: (07) 832 1297

MELBOURNE:
1064 Centre Road,
Oakleigh South Vic. 3167
Tel: (03) 575 0222
Fax: (03) 579 0622

PERTH:
106 Howe Street,
Osborne Park W.A. 6017
Tel: (09) 242 2000
Fax: (09) 242 2150

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PC Interfacing Feature:

Interfacing Products

Data acquisition and control software

National Instruments Corporation has released an enhanced version of its Lotus 'Measure' data acquisition and instrument control software system. The original version of Measure ran on IBM PC/XT/AT personal computers and worked with several of the National Istruments original IEEE-488 (GPIB) boards for these machines. The new 2.0 version supports these same platforms and GPIB boards, but also offers increased performance capabilities using the company's recently announced GPIB and multifunction analog, digital, and timing input/output (I/O) boards for the PC/AT bus and PS/2 Micro Channel.

Measure is a software system for scientific applications that require data acquisition and instrument control. It consists of a set of data acquisition drivers for 1-2-3 or Symphony (both from Lotus) for acquiring, formatting and storing data directly into a spreadsheet. All functions normally available in the spreadsheet are available for immediate data reduction, analysis, and textual or graphical representation.

The software acquires data using GPIB, RS-232, and analog-to-digital (A/D) interfaces. In addition to supporting the National Instruments GPIB-PC11 and GPIB-PC11A IEEE-488 interfaces, the new version of Measure works with the company's high performance AT-GPIB and MC-GPIB IEEE-488 interface boards and its AT-M10-16 and MC-M10-16 multifunction analog, digital, and timing I/O boards.

The AT-M10-16 and MC-M10-16 feature software-programmable gain, a 12-bit A/D converter with 16 single-ended analog inputs, two 12-bit digital-to-analog converters, eight TTL-compatible digital lines, and three 16-bit counter/timer channels.

For more information on Measure, contact Elmeasco Instruments on (02) 736 2888 (Sydney), (03) 879 2322 (Melbourne) or (07) 875 1444 (Brisbane).

IBM-PC output board switches 10 amps

The PC-10-DK is the latest release in Procon Technologies' range of IBM-PC 'real-world' digital I/O boards. Designed and manufactured in Australia, these boards provide eight SPST relay outputs capable of switching 10A at 250V AC or 30V DC.

The externally mounted boards are ideal for OEM applications, with up to 15 boards capable of being connected via computer ribbon cable to the parallel printer port on any IBM-PC or compatible (this provides a total of 120 inputs and 120 outputs). The boards may be mounted up to 30 metres from the computer and are powered from either a 5V DC supply or from a 9 to 12 volt AC or DC source (an on-board regulator is provided).

Supplied with each board are IBM-PC software driver routines for use with GWBASIC, QuickBASIC, TurboBASIC, QuickC and all Microsoft languages. Other I/O options are available, including an industrial version with plug-in screw terminals and plug-in relays.

For further information contact Procon Technology, PO Box 43, Essendon 3040 or phone (03) 336 4956.

Image decompression card for PC-ATs

Brooktree Corporation has announced the Bt70101 Image Decompression Processor, an add-in card for the IBM PC AT and compatible computers. The Bt70101 provides high-speed decompression of CCITT Group 3 and Group 4 digital facsimile encoded images. Applications for this new product will include document filing systems, PC workstations which support image databases and high-speed FAX servers for local area networks.

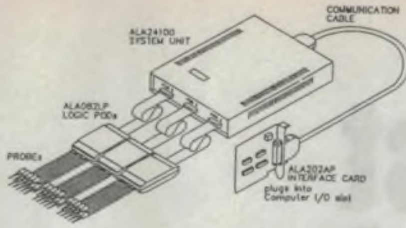
Brooktree developed a new decompression engine, for the Bt70101 which provides 20M bit-per-second decompression rates for high-speed image processing. For standard operation with systems worldwide, the board conforms to CCITT international recommendations on Group 3 and Group 4 facsimile image decoding.

The Bt70101 Image Decompression Processor is the only product of its kind to offer programmable line lengths to 64K bits. The line register, controlled by the PC host, specifies the image line length from 8 to 64K bits. This allows the Bt70101 decompression images as large as 60 inches scanned at 1000 dpi.

The Bt70101 is available with an Evaluation Kit which consists of a User's Guide and a DOS-compatible floppy diskette. The diskette contains comprehensive diagnostics to verify the functionality of the Bt70101, demonstration software and compressed image files.

For further information contact Energy Control International, 26 Boron Street, Sumner Park 4074 or phone (07) 376 2955.

24 channel PC-based logic analyser



The Axelen ALA-24100 PC-based Logic Analyser turns an IBM-PC/XT/AT or compatible into a high performance, user friendly logic analyser for a fraction of the cost of a conventional stand-alone instrument. New software allows the user to view Timing and State diagrams for 24 channels simultaneously. With excellent HELP features provided throughout, operation of the ALA-24100 is simple and requires no memorising of complex commands.

The system requires only a PC with one floppy disc drive, 256K of memory, and any graphics display card. Installation simply consists of fitting the dedicated interface card directly into one of the expansion slots of the PC, and plugging in the ALA-24100. Printout of results can be obtained using the computer's printer at any stage of operation.

The system has a maximum internal clock of 100MHz or can be run using an external clock at up to 25MHz. 2KB of data can be collected per channel, on a maximum of 24 channels using clock rates up to 25MHz, while at high speeds (up to 100MHz INT clock) 8KB of data per channel can be collected over 8 channels.

Complex events are easily captured with the multi-level sequential trigger facilities, which allow the user to specify a series of events to trigger recording. Trigger levels and pre-trigger data capture can also be set. Data Qualification can be enabled to ensure the ALA-24100 captures only those events of interest to the user.

Further information is available from Emona Instruments, 86 Parramatta Road, Camperdown 2050 or phone (02) 519 3933.

Low cost DMMs with data bus

Emtek has released a new range of handheld digital multimeters that have an in-built data bus terminal for interfacing with computers and printers. But more importantly, the LT-Series are practically the same price as DMMs without a data bus.

The measurements can be transferred via the data bus in two ways. The handheld can be directly connected to the LT-Series Printer, to provide stand-alone data logging and recording. Alternatively, the instrument can be connected to a BF-232 bus converter buffer box. This equally low cost adaptor converts the bus information to RS-232C ASCII format, thereby providing a link to any computer with a serial interface.

When used in conjunction with the Data Recorder/Analyser Program, BUSF-V1.0, for IBM-PC/XT/ATs or compatibles, the system becomes immediately useful. The program allows the data to be collected automatically or manually; to be tabulated and printed; and MAX/MIN values to be preset, with warnings given if limits are exceeded.

The LT-Series extends to a range of portable digital instruments measuring AC/DC volts and current, AC wattmeter, milliohm meter and LCR meter.

For further information contact Emona Instruments, 86 Parramatta Road, Camperdown 2050 or phone (02) 519 3933.

Computer Kit Review:

Uni-X low cost PC/XT clone kit

We recently put together this IBM compatible machine offered by the Uni-X company of Queensland, and found it a very simple task. The final result is a high performance XT style computer at a very reasonable price.

by ROB EVANS

The proliferation of IBM compatible computers in the marketplace has caused some fierce competition between the various manufacturers and distributors. They have been either forced to cut their prices to the bare bones and rely on high volume sales, or offer extra facilities and higher performance in their machines.

The Uni-X company seems to have achieved both of these aims by cutting costs at the assembly stage – allowing you, the lucky buyer, to complete the final work!

However it should be pointed out from the start that assembling this type of kit is really quite straightforward, and should only take an evening of leisurely work. This is because the actual construction is little more than mounting the various pre-tested modules in the metal case, and plugging in their interconnection cables. It only takes a little patience, a pair of pliers (or preferably an 1/8" nut driver) and a Philips head screwdriver.

To encourage confidence in a 'build-it-yourself' computer, the Uni-X people provide a limited warranty (backed by Honeywell Ltd) with the basic kit, and offer an optional 12 months warranty for those who need the extra security. However, providing the assembly instructions are followed carefully, there should be no problems with the final result.

Features

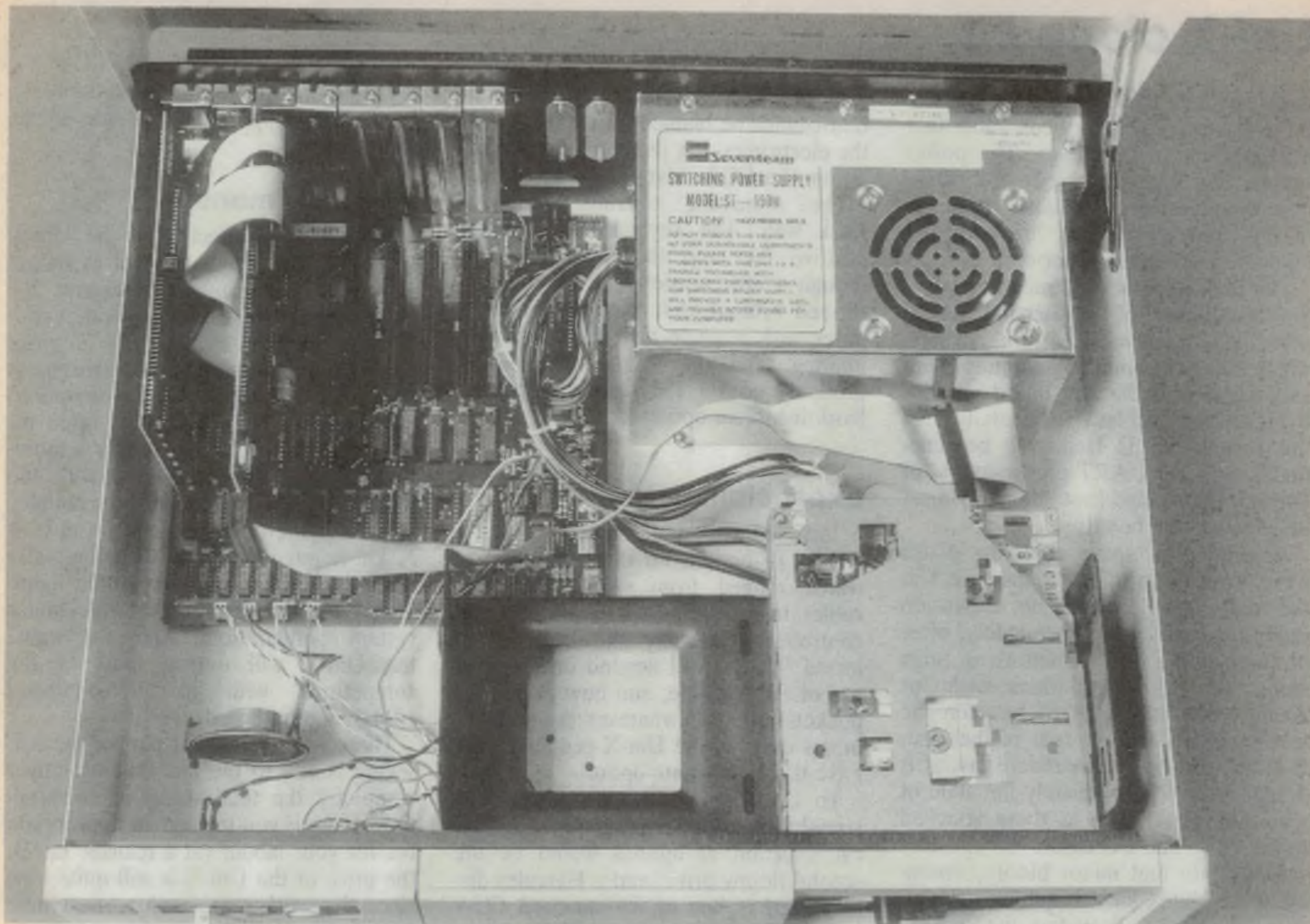
The 'Super-10 XT' as supplied by Uni-X is equipped with an 8-slot 4.77/10MHz motherboard with the full 640K complement of RAM (120ns). The main processor is an NEC V20 device, which is fully compatible with a standard 8088 processor, yet will execute a large part of the instruction set in less clock cycles. Ultimately, this enables the machine to run up to 50% faster (depending upon the program) for the same clock frequency.

The motherboard also contains a recognised brand BIOS chip (Award), which should ensure IBM software compatibility, plus an interesting VLSI component which appears to replace a large number of chips in the usual XT-style motherboard. This custom chip is a very small flat pack device with 100 connection pins, and has allowed the designers to reduce the overall component count by a large degree. The end result is a compact, yet relatively powerful motherboard.

Another standard feature of the Uni-X is the multi-function I/O card which includes two RS-232 serial ports, a parallel printer port, floppy disk controller, games adaptor and a battery backed clock/calendar. Also supplied is a standard colour graphics adapter (CGA) card, one 360K floppy disk drive and the usual XT-style 150 watt power supply.

All of the above mounts into an AT-style fliptop case incorporating a keyboard lock facility (which doesn't lock

The completed Uni-X super 10 XT – from a number of parts to parting numbers in less than an hour!



A look under the bonnet of the Uni-X. Note the compact motherboard and mounting bracket for the extra disk drive(s).

the lid, incidentally), plus turbo and reset buttons. The final interface to the rest of the world is via an AT-style 84 key keyboard, and a Magna dual frequency TTL monitor.

To assist constructors, the kit is supplied with an assembly instruction manual which incorporates extra expansion and troubleshooting sections (a nice touch), and individual booklets for the three main circuit boards. The assembly manual appears to have been written locally and is quite effective, whereas the three booklets which come from the (presumably Taiwanese) card manufacturers provide some useful information – despite their intriguing use of the English language!

Building it

The Uni-X kit arrived in two cartons; one for the monitor screen and the other containing the metal case and a number of smaller boxes, which in turn held the individually packaged modules and hardware. Unpacking each box revealed quite generous amounts of protective packaging, which should safeguard the components against any rough handling during transit.

A quick inspection of the circuit boards indicated that the various DIP switches were already at the correct settings for booting-up a machine with one floppy drive, 640K of memory, and a colour graphics adaptor (CGA) card. Similarly, an examination of the metal case showed that the rubber feet, power supply, disk drive, speaker, indicator LEDs and keylock switch were already installed. This means that the actual construction of the sample kit only involved installing the three cards (the motherboard, graphics and I/O cards), and plugging in the various cables between the modules.

The first step in assembling the Uni-X is to mount the motherboard on its six brass spacers, which are screwed to the bottom of the case via oversize holes. This allows the position of the board to be adjusted for the correct alignment within the box.

Next, all of the interconnection leads are plugged into the motherboard, which is the only tricky part of the construction. This is mainly because the two leads from the power supply are terminated in identical sockets, and could easily be plugged into the wrong halves of the motherboard's single multipin connector. However the manual is quite clear on this point, with a number of extra instructions and warnings supplied on a component overlay diagram of the motherboard.

Also, there is no information on the correct orientation of the 'turbo' and 'power' LED sockets, which may be plugged into the two-pin motherboard connectors either way around. This is not much of a problem, and is cured by simple trial and error – if they don't illuminate, just reverse the polarity of the sockets. Naturally the two switches and the loudspeaker will work when connected in either direction.

After that, the video and I/O cards are plugged into the motherboard connector slots, and their mounting plates locked to the rear of the case with the supplied screws. The floppy disk controller is incorporated within the I/O card, and communicates with the drive(s) via its gold plated edge connector and the usual flat ribbon cable that will connect to two drives. The power supply has four standard disk drive power connectors to choose from, allowing plenty of scope for increasing the number of drives at a later date.

The final steps of construction involve the installation of the second RS232 port and the games adaptor sockets, which share a common mounting plate and connect to the I/O board via two flying ribbon cables. Incidentally, for this second RS232 facility to be functional, an 8250 UART plus a couple of line interface chips (not supplied) must be added to the board.

A number of spare mounting plates were provided to fill the blank spaces in the rear panel, where no expansion cards are installed. Unfortunately, most of these plates had a reinforcing ridge along their full length which made for an uncomfortably tight fit between the mother board and the rear of the case. It seems this box/motherboard layout is designed for the completely flat style of mounting plate, such as those attached to the video and I/O cards.

So despite that minor hiccup, assembling the Uni-X kit was quite a straightforward process. Providing the step by step instruction manual is followed, you end up with a low cost turbo XT machine that should work first time. In fact, the sample kit was up and running in less than an hour, and delivered a gratifying self-test 'beep' when initially booted from an MS-DOS floppy disk.

Performance

To test the relative performance of the machine, we used the advanced version of Norton's System Information utility. This delivered a 'computing index' relative to the IBM PC/XT of 4.0 with the Uni-X running at its maximum clock speed (10MHz), while at the standard XT speed (4.77MHz) the machine returned an index of 1.8.

These are excellent figures, and must place the Uni-X amongst the fastest XT-style machines around. This is presumably due to the high clock speed of 10MHz, and the use of the V20 processor chip. The efficiency of the V20 may been seen from the figure returned for the 4.77MHz test, where the Uni-X is almost twice as fast as the original XT for the same clock speed.

From a more subjective point of view, the combination of a CGA card and monochrome monitor is a little hard on the eyes. Of course, the lack of definition cannot be blamed on the quality of the electronics, it's just the limited resolution of a CGA-driven mono screen.

The remaining operator functions work well. The keyboard has a nice positive feel and the disk drive, although a little noisier than others, performed without fault. Naturally, a computer with a single disk drive is rather limiting, and the serious user would probably go for the second floppy or hard disk drive options.

Expansion

Included with the sample kit was a full list of options for the Super-10 XT, which ranged from simple extension cables to a 50Mb hard disk drive and controller. Naturally the options selected (if any) will depend on the final use of the machine, and how deep your pockets are. But whatever the requirements may be, the Uni-X people should have the appropriate option.

To build up a low cost system for straightforward computing tasks, a logical selection of options would be the second floppy drive, and a Hercules display card in lieu of the standard CGA board. This combination will provide a well defined monochrome display and sufficient disk drive capabilities for most spreadsheet and word processing tasks.

To assess the difficulty of this type of update, the above options were installed into the sample machine. This proved to be quite a simple task, and was completed in a matter of minutes. Installing the Hercules card merely involved slotting it in place of the existing CGA card, and setting the motherboard DIP switches to the monochrome display position. Similarly, the second floppy drive was mounted above the existing drive, the spare power and signal sockets connected, and DIP switches set for a twin floppy configuration.

The actual mounting for the disk drives is basically a U-shaped metal bracket, which is about the size of two rows of double stacked standard drives. This means the Uni-X can easily accommodate the familiar twin floppy and one hard disk arrangement, or fit up to four floppy drives. However there is no means of supporting the drives in the centre of the bracket, leaving any drives mounted at the top of the stack only attached on one side. The front panel cutout tends to align the drive to some extent, but a small spacer was required between the top and bottom units to successfully support the free side of the upper drive.

Value for money

So how cost effective is the Uni-X kit? Well, the question is not as simple as it may seem, since comparative XT clones on the market have a wide variation of 'standard options' for a given price. While a particular advertisement may offer a machine for an exceptionally low price, closer scrutiny often reveals that the package may lack a monitor screen, or is only fitted with the minimum 256K of memory for example.

At the time of writing, the basic Uni-X kit is priced at $999 including sales tax, which is a very competitive figure amongst other XT machines with similar system configurations. And as a bonus, the Uni-X will outrun most of the competition with its V20-equipped 10MHz motherboard.

There's no doubt that part of the cost saving is due to the fact that the buyer completes the final stages of construction. Even if you include an appropriate fee for your labour (at a realistic rate!), the price of the Uni-X is still quite low, since the work takes such a short time to complete.

Note however that the basic kit does not include the essential disk operating system (DOS), which may be ordered as MS-DOS version 3.3 from Uni-X for an additional $195.

As mentioned above, a second floppy drive and the alternative Hercules video card would be worthwhile additions to the basic system. These may be ordered for an extra $15 and $195 respectively, raising the total purchase price (including DOS) to about $1400. Once again, the Uni-X tends to come out ahead of the opposition in terms of price and performance, with the added satisfaction of having 'built it yourself'.

Before you rush for your cheque book, there are a couple of final cost aspects to consider. The nice Uni-X people provide free transport of their kits to buyers outside the Brisbane metropolitan area, however they offer optional transport insurance for $10 – this may be worth it for the peace of mind. Also, a 12-month warranty option is available for an extra $60.

For more detailed price information or to order your Uni-X kit, write to: Uni-X CompuPak Division, 16-20 Edmondstone St, Newmarket, Queensland 4051, or phone (07) 356 7866.

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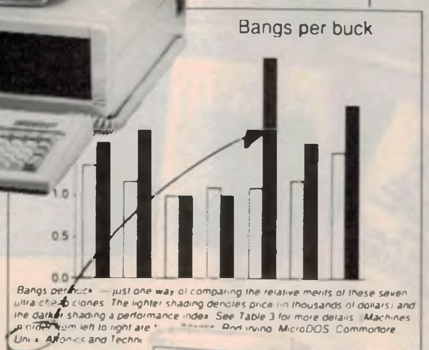

Bangs per buck — just one way of comparing the relative merits of these seven ultra cheap clones. The lighter shading denotes price (in thousands of dollars) and the darker shading a performance index. See Table 3 for more details. Machines ... Uni-x, Atlantis and Techn...

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Processor.

NEC. The Uni-x contains a NEC V20 manufactured by Sony. ... Thus a V20 running at 4.77MHz will outrun an 8088 running at the same clock speed. ... machines examined provided a standard PC clock rate of 4.77MHz as a minimum, although the Uni-x delivered higher than standard performance even on this clock rate by virtue of the V20. The Atlantis and ... machines ...

Performance.

... The Uni-x is fastest overall, providing a 50 per cent boost over the Technology Interface due to the V20. ... interesting of all, there is ...

Display.

... the Uni-x is delivered with a nice INTRA tilt/swivel amber screen. ...

Cost Effectiveness.

As you might expect, the do-it-yourself Uni-x comes up trumps with its low cost and relatively high performance ...

Specifics.

very sensible place ... The Uni-x features a delightfully small motherboard. It has employed a VLSI component to replace the Intel 8253 timer, 8255 PPI, 8237 DMA controller and several other components. This reduced the component count and a simplified motherboard serves to reduce costs ...

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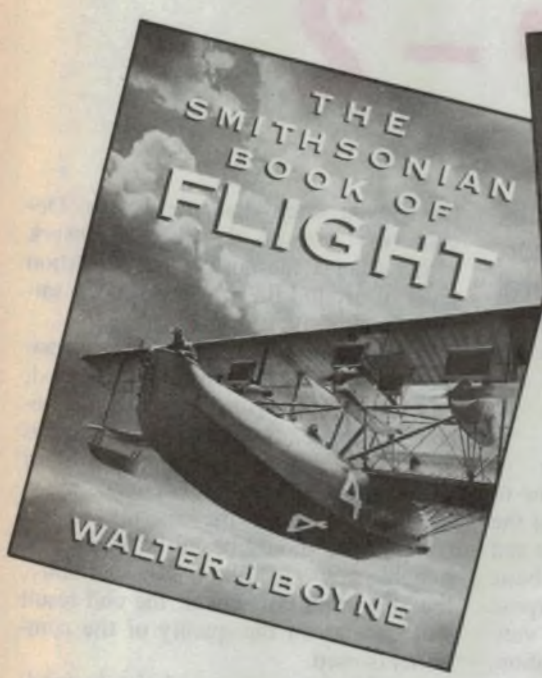

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Construction project:

New low distortion Audio Oscillator – 2

As promised last month, we present here construction details of an inexpensive, easy to build low distortion audio oscillator. This instrument can be built either as an excellent general purpose oscillator, or as a full-featured low distortion instrument.

by PHIL ALLISON and PETER PHILLIPS

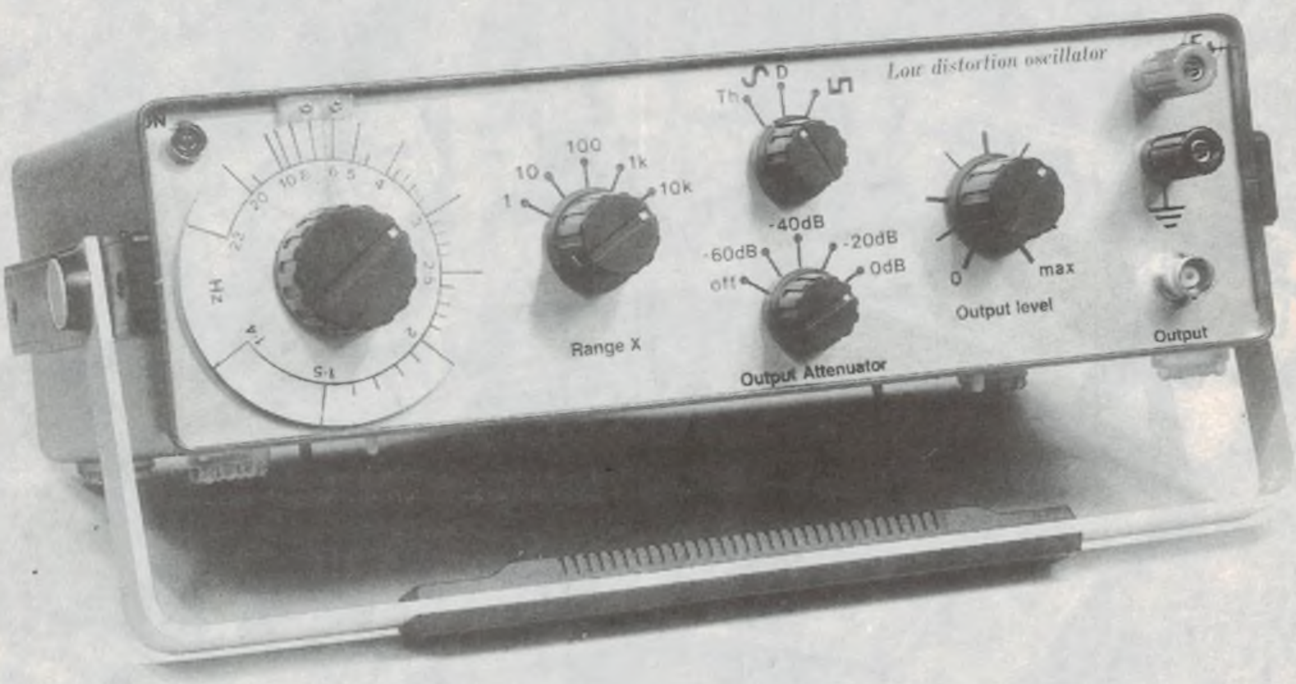
Last month we described the theory behind this rather ingenious audio oscillator. If you have not already done so, we suggest you read the previous article to familiarise yourself with the design concepts.

Recapping briefly, the oscillator uses a phase-shift oscillator with a summing network that effectively cancels harmonic distortion. However, the main feature of the circuit is its simplicity.

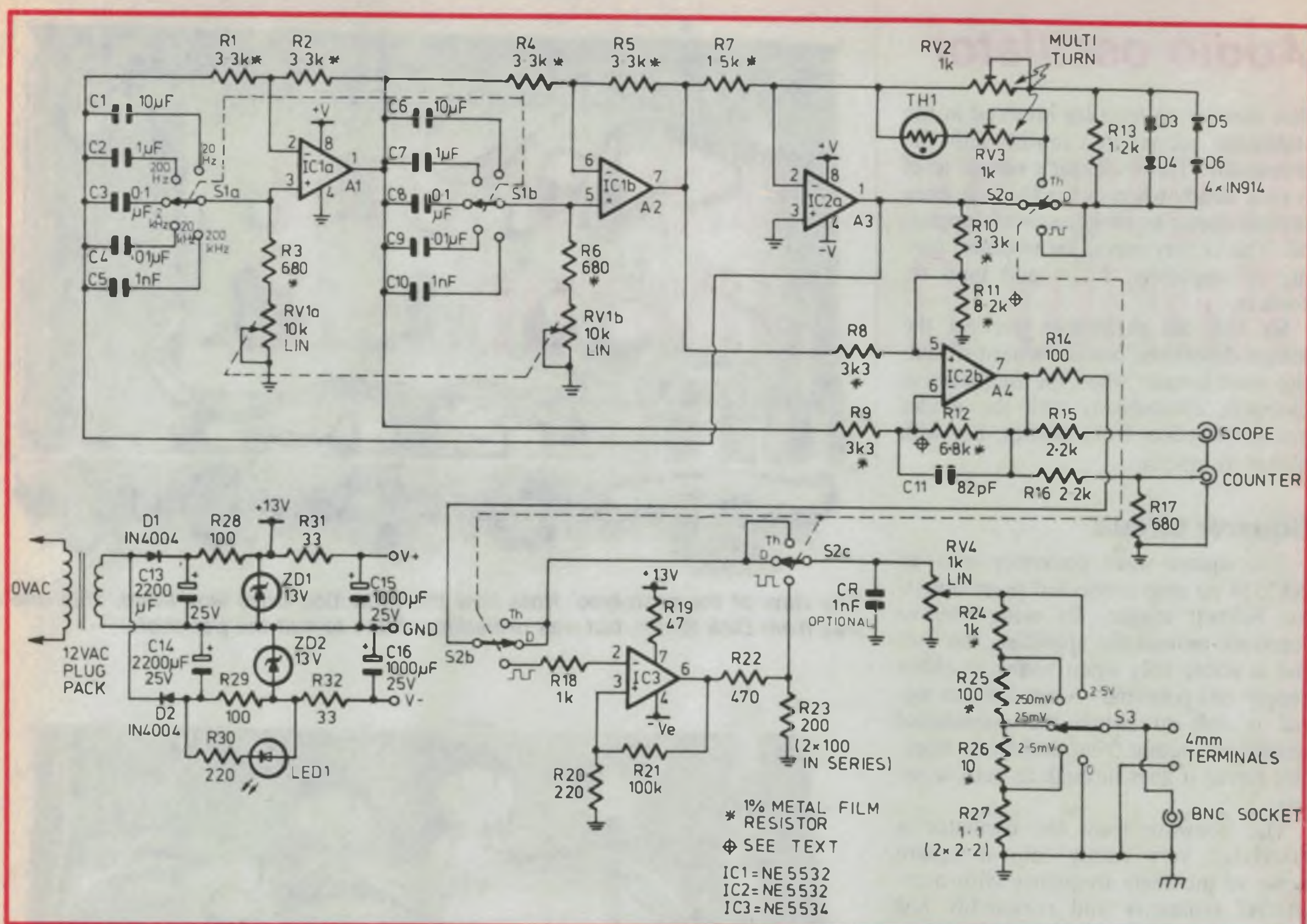
In this article we will describe how to build the basic oscillator, as well as the reasons for the various options that can be incorporated. The circuit in its basic form is a good quality general purpose audio oscillator, that uses 'garden variety' components. In this configuration, the stabilising element is a network of diodes, giving a stable output signal level, even when changing ranges. Despite the use of the diode network rather than a thermistor, the distortion level of around 0.2% will probably satisfy the majority of users.

If you want to obtain the lowest possible distortion, a thermistor is required, and distortion figures of 0.001% become possible. Naturally, some care is also required in the choice of the other components, as will be described. However, apart from the thermistor, all components should be fairly readily obtainable anyway. Like any high quality, low distortion instrument, the end result will depend on the quality of the components used.

So with this project a choice is possible. Spend the extra time and dollars to



The prototype was constructed in an Iskra case, although any suitable metal case could be used. The front panel artwork has a frequency scale (obscured by the dial) if you don't wish to use the vernier drive arrangement. Copies of this artwork are available through our Reader Services.



The circuit diagram. IC1a and b form the oscillator, in conjunction with IC2a which stabilises the sinewave output. The harmonic distortion is cancelled by IC2b and the squarer section is around IC3.

get the ultimate performance from this instrument, or use it in its basic form. Either way, this oscillator should prove to be one of our success stories.

Circuit description

The oscillator consists of two NE5532 (or TL072) dual operational amplifiers, in an unusual phase shifting configuration with a special combining and distortion reducing stage around A4. The 10k dual-gang potentiometer varies the frequency over a decade range, which when combined with the switched capacitors, provides a frequency coverage from 2Hz to 200kHz.

Mode switch S2 selects either the optional thermistor or the diode network to stabilise the output of the oscillator. The third position on S2 brings the square wave converter into operation. If you don't use the thermistor, S2 can be a two position switch, rather than the three position switch shown in the circuit.

The thermistor controls the oscillator's output voltage by virtue of its negative temperature-resistance characteristic. When cold, the thermistor has a high resistance (approximately 5k), so A3 has a high effective gain. At switch on, the oscillator will start and rapidly build up output until the power dissipated in the thermistor causes it to heat, making its resistance fall as a result. When the resistance of the thermistor plus that of RV3 totals 1500 ohms, (i.e., equal to R7), the gain of A3 falls to unity; just enough to maintain oscillation of the whole circuit.

Due to the thermal inertia of the thermistor, there is some overshoot and slow bouncing of the output level until this equilibrium condition is reached. The 1k trim potentiometer RV3 allows the output voltage to be set to the desired level. When the frequency is varied by moving the dual potentiometer RV1, slight bounce of the output will occur, depending on how rapidly the potentiometer is rotated. When a frequency range change is made via S1 the output level also bounces, in a way similar to that at first switch on.

If the bouncing phenomenon creates a problem, or just tries your patience, then switch to the diode mode. Here a network of diodes and resistors replaces the thermistor. The principle is much the same as with the thermistor, in that resistors R13 and RV2 are of such a value to allow oscillation to start. When a sufficient level is reached to forward bias the diodes, they will conduct, reducing their effective resistance and providing more negative feedback. A point of equilibrium will be reached so that the circuit just oscillates.

Trimmer RV2 again allows the output level to be set to match that when the thermistor is used. The conduction of the diodes is, fairly obviously, a non-linear process and this creates distortion in the output of the oscillator. However this distortion is symmetrical, that is, it is equal for positive and negative swings in the output signal, meaning it is predominantly third and higher-order odd harmonic in nature. The distortion cancelling network (A4) is able to substantially remove the distortion created by the diodes and provide a clean output signal.

The big plus of this arrangement is

Audio oscillator

that there is *no time lag* involved in the stabilising action, in contrast with the thermistor. The oscillator's output level is rock steady when either the frequency potentiometer or range switch is operated. This is very useful for response testing of amplifiers, filters and tape recorders.

So with the thermistor you get the lowest distortion, but at the cost of output level bounce when the frequency is changed; alternatively with the diodes you get freedom from bounce, but with higher distortion.

Squarer circuit

The square wave converter uses an NE5534 op amp connected as an inverting Schmitt trigger. By using positive feedback around the amplifier, the output is stable only when sitting at either supply rail potential. A small input signal is able to switch the operational amplifier's output from positive to negative rail as it goes through its zero crossing.

The sinewave from the oscillator is converted very neatly into a square wave of the same frequency with near-perfect symmetry and reasonably fast rise and fall times, thanks to the internal design of the NE5534. Resistors R22 and R23 scale the output to match the sinewave level. The square wave should have the same peak voltage as the RMS value of the sine wave, giving the same RMS value for both waveforms.

When S2 is not in the square wave position, no signal is fed to the NE5534 and the output latches up to the positive rail. This obviates the need to disable it by removing supply voltages, (as in some circuits), in order to prevent harmonics leaking into the sinewave output.

The rise and fall times are identical at around 1us, which is unfashionably slow these days. However, this order of performance is probably sufficient for normal audio work and the slew rate of most commercial amplifiers can be evaluated with a square wave of this speed. Some recently published square wave circuits are much faster, but also much more expensive and complex. In the interests of simplicity, we opted for the trade off between rise/fall times versus complexity.

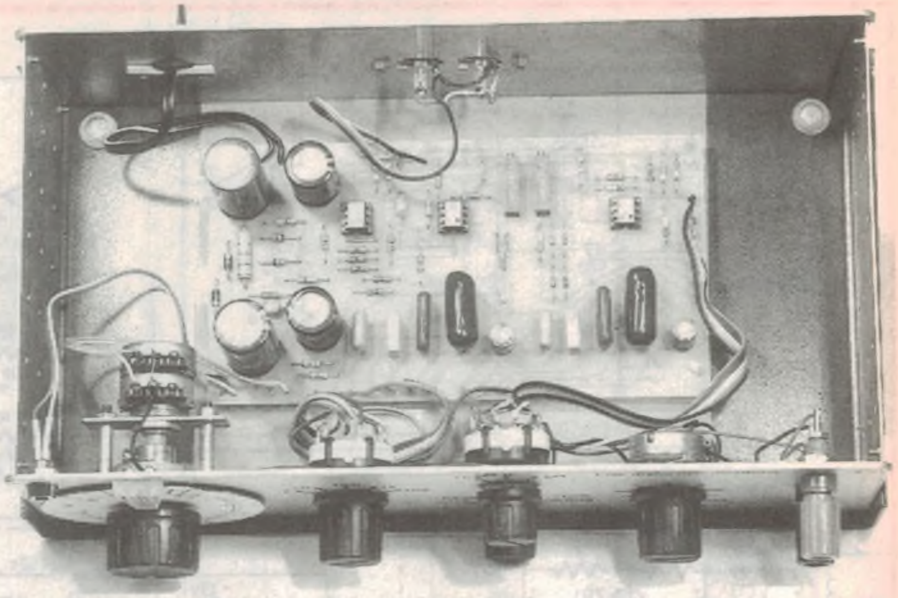
Output attenuator

This section could not be any simpler and is completely passive with a minimum of components (with no capacitors). The design philosophy is a low internal impedance rather than constant source resistance. The 20dB (10:1) step attenuator is as accurate as the dividing resistors R24 to R27, assuming the load impedance is relatively high.

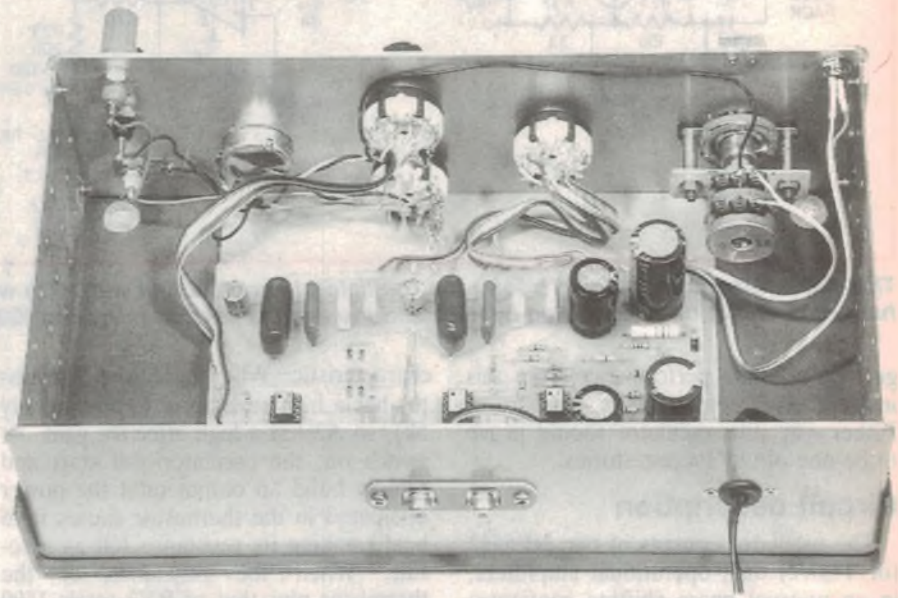
The source resistance is a maximum of 250 ohms for output signal levels of 0.5 to 2V (RMS). On the 250mV range the source resistance is almost constant at 102 ohms. On the 25 and 2.5mV ranges it is 11 ohms and 1 ohm respectively. Where the output level must be accurately set, use a measuring instrument such as a scope or a meter. Digital meters generally have poor high frequency response, although the *EA* True RMS adaptor (May 1985) used with a digital meter would be ideal for the job.

Power supply

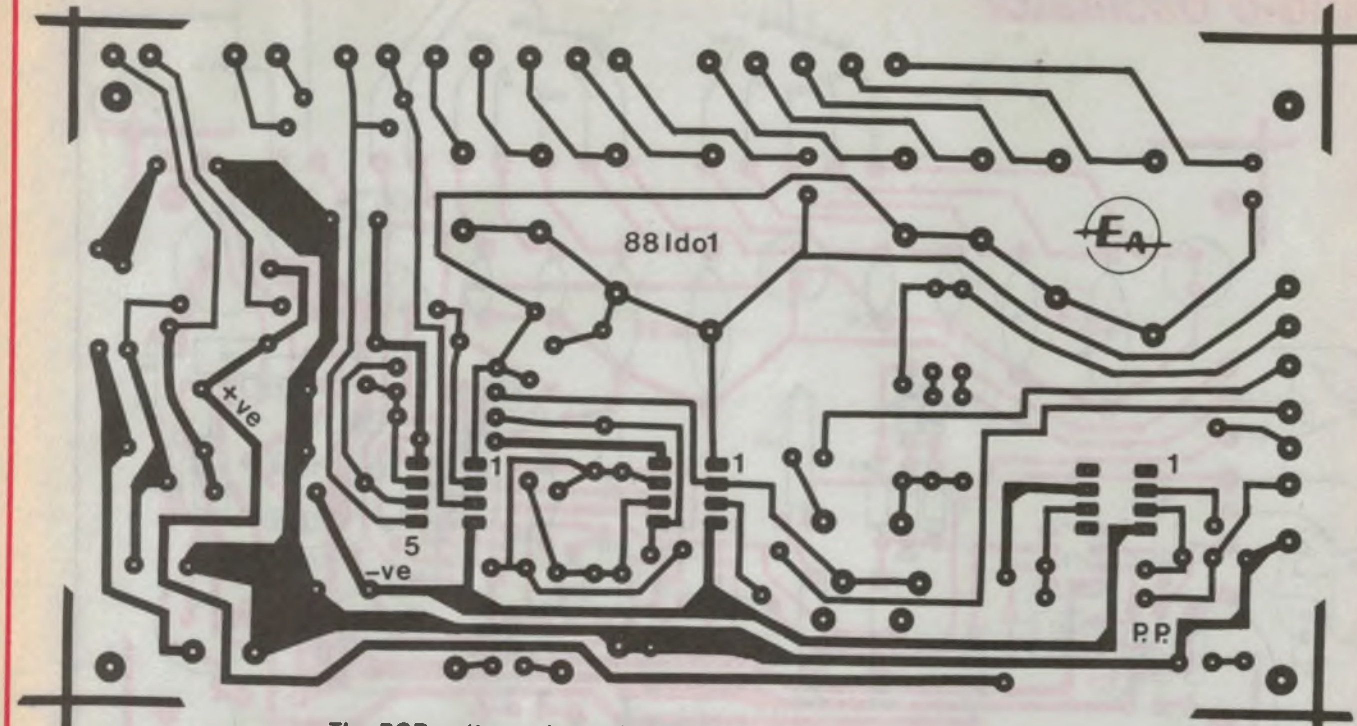
Power for the unit is derived from a 12V AC mains plug-pack transformer. These units are double insulated and are thus very safe. As well, the possibility of hum fields being injected into the circuit is eliminated, in contrast with an internal transformer. The metal case of the oscillator can therefore legally be



Top view of the prototype. Note how the reduction drive was fitted. This one was from Dick Smith, but was drilled in a lathe to suit the pot shaft.



Rear view of the prototype. Provide enough lead length to allow the PCB to be lifted out for servicing purposes. The lead from the power pack was clamped at its entry point.



The PCB pattern, shown full size.

earthed (see Forum, EA May 1988) to the mains, or left floating to avoid earth loop hum.

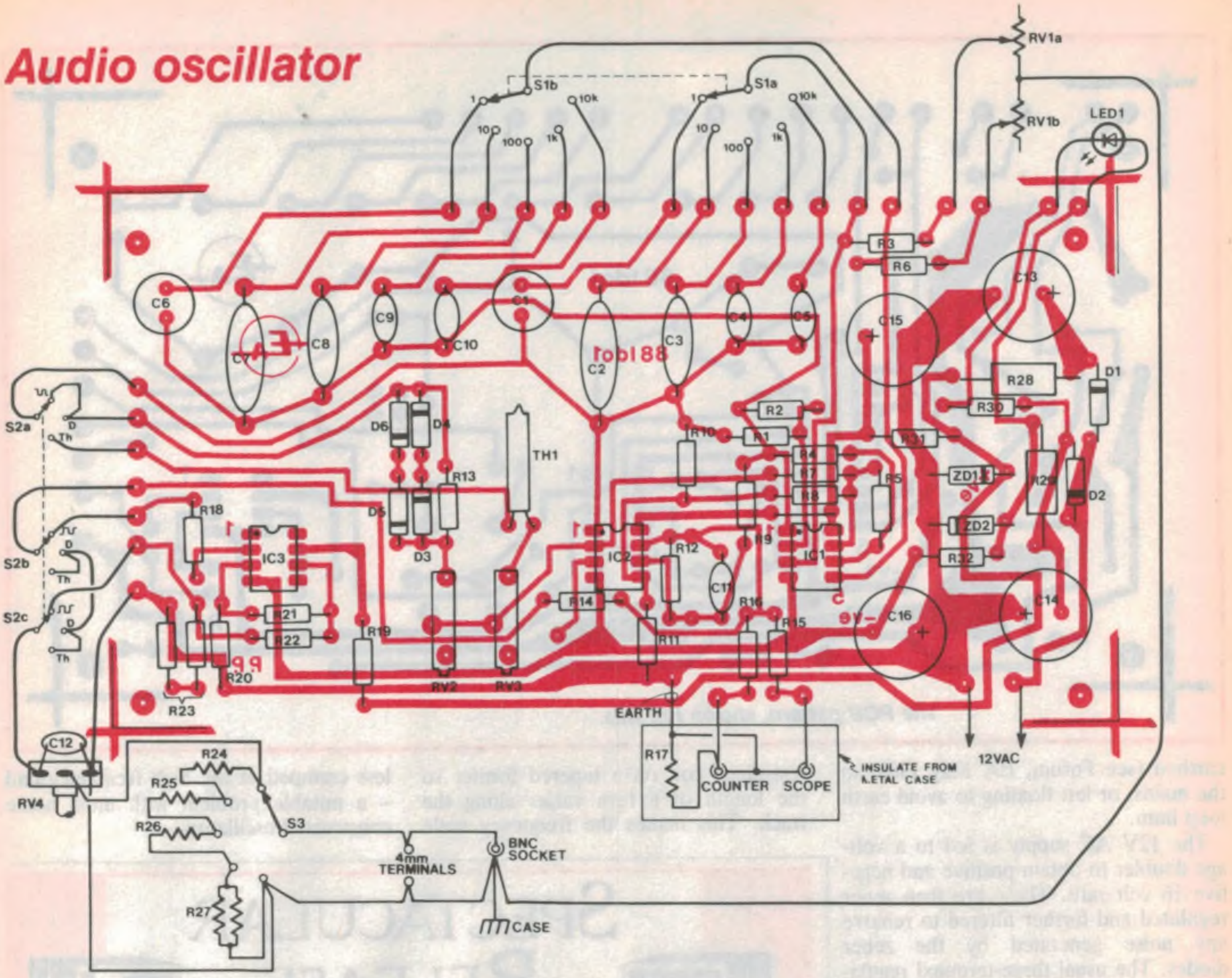
The 12V AC supply is fed to a voltage doubler to obtain positive and negative 16 volt rails. These are then zener regulated and further filtered to remove any noise generated by the zener diodes. The usual three-terminal regulators have been avoided, again in the interests of simplicity. Even so, the prototype oscillator was able to operate quite normally with the mains voltage as low as 140 volts!

Design options

Two basic options are a reduction drive unit for the frequency control, and a dual gang wirewound pot as the actual control.

Unfortunately, neither device is easily obtainable. DSE sells a reduction unit, but present stocks assume a 6mm (metric) shaft size for the pot being driven. A standard 6.3 mm (1/4 inch) potentiometer is just a bit too large, and a lathe is necessary to enlarge the hole, to avoid drilling off-centre. We believe DSE intends to rectify this situation eventually – meanwhile we suffer another manifestation of the metrication process.

The wirewound pot is also a problem. Most professional audio generators use non-linear wirewound potentiometers to select the frequency. Yes, non-linear wirewound, achieved by winding the resistance coil on a tapered former so the length of a turn varies along the track. This makes the frequency scale less cramped at the high frequency end – a notable problem with most home constructed oscillators.



The layout. Space has been allowed for various styles of capacitors such as polystyrene types. The earthing arrangement shown was that used on the prototype. To make construction easier, the counter and scope RCA sockets can be mounted directly on the case, and the earth wire from the PCB deleted. This way, the sockets are earthed by the case, which in turn is earthed at the BNC socket by the wire from the bottom left termination of the PCB.

Non-linear wirewound potentiometers are only available to special order and tend to be very expensive. Linear double-ganged wirewound potentiometers are presumably more readily available – except that at present we don't know exactly where. If you require the lowest possible total harmonic distortion (THD) from the generator, then the wirewound potentiometer is essential.

However, the prototype used a carbon track potentiometer, and the specifications still resulted in distortion levels around the 0.002% level. Just how consistent these would be is hard to judge, as contact noise within the pot would no doubt increase with use.

Circuit options

1. The operational amplifiers used in the oscillator can be of various types. However, the best is the NE5532; a dual, internally compensated version of the NE5534. The readily available TL072 also works, although it gives a small increase in noise and THD over the NE5532. Other types tried successfully include the LF353, RC4558, RC4560, TL082 and the LM1458. Note that the LM833 device is *not suitable* as it produces high frequency oscillation on the output signal.

One major difference between the various operational amplifiers is their slew rates. Low slew rate devices, like the LM1458, distort the sinewave output above 30kHz and are best used only if all else fails.

2. The thermistor is optional and is really only necessary if a THD figure of 0.2% is unacceptable. Thermistor type RA53 from Radiospares will cost around $12. Farnell Electronic Components also stock a thermistor, type RA54 at around $21.

This device is actually the preferred device, as it gives slightly quicker settling times. If you use it, the output voltage level will be 5V RMS (instead of the 2.5V rms for the RA53). To reduce this level to 2.5V, change R11 to 2k7 and R12 to 3k3.

3. The reduction drive unit is optional, as the printed front label has an approximate frequency scale for the basic version. Providing a genuine linear potentiometer is used the scale will be fairly close. The scale was actually derived using a wirewound potentiometer, selected for its linearity and matching characteristics.

4. The wirewound potentiometer option is recommended for long life, good frequency stability and low distortion applications. A drawback is that precise frequency setting is not possible with a wirewound potentiometer as the wiper tends to jump from wire to wire, making the frequency vary in a series of tiny

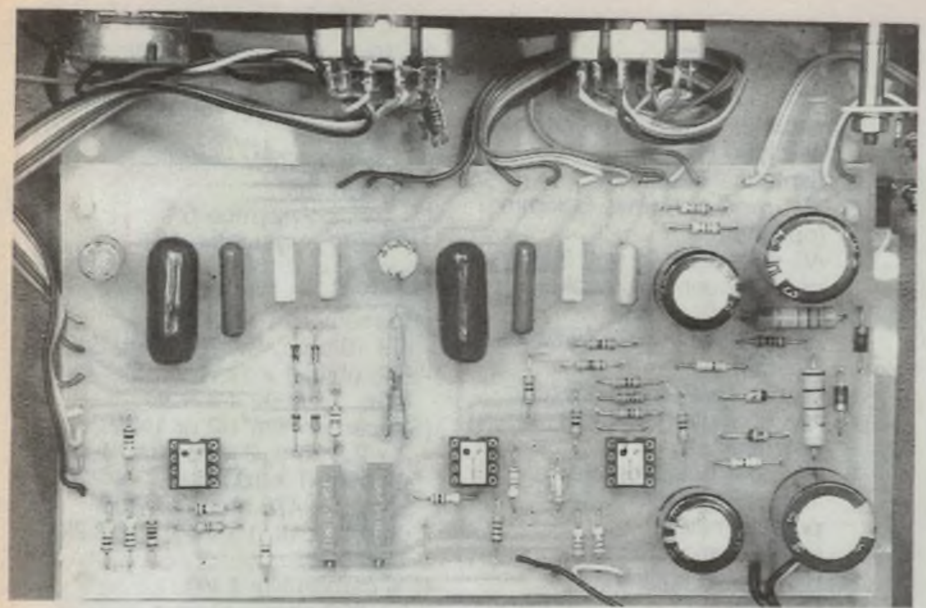


Photo showing the PCB installed in the case. The PCB is supported by four PCB standoffs. The lead from the plug pack should be passed through a grommeted hole in the rear of the case, and securely clamped.

steps. Intermediate frequencies are just not available unless a fine tune control is fitted.

Unfortunately, the potentiometer will probably be the most difficult component to source of the lot. For example, the 10k dual ganged linear pot which we purchased from Jaycar is in fact *logarithmic*; the 'A' curve rating is the Taiwanese method of specifying *audio* taper!

Similarly, a pot purchased from Dick Smith Electronics, while linear, has matching problems between sections. We found that if one half was set to 5k, the other would be around 4k in some cases. Matching of the pot sections is only necessary for low THD at low frequencies, and the DSE pot may be suitable for the basic oscillator.

Another problem we found was that some wirewound types (from the junk box) suffered considerably from mechanical hysteresis in that the wiper would lag the shaft rotation. This results in the scale only being correct for one direction of rotation.

We eventually used a potentiometer from the junk box, but can now report that Oatley Electronics has been able to obtain suitable carbon pots. We have not actually tried this pot, although ohmmeter checks suggest it will be suitable.

5. The perfectionist may like to install *polystyrene* range capacitors throughout, to achieve the ultimate in frequency stability. These are fairly readily available from capacitor wholesalers, but make sure you are seated when asking the prices!

Alternatively, use 630V DC (or 250V RMS) metallised-film polyester capacitors. Non-polarised 10uF electrolytic capacitors are required for C1 and C6. Ideally, the capacitors should be selected by measurement for relative accuracy, to maintain the correct frequency relationship between ranges.

The high voltage rating specified for the range capacitors is necessary, as low voltage metallised-film polyester capacitors can be 'noisy'. Higher voltage types seem to be free of the effect, possibly because the plastic film is thicker. If polystyrene types are fitted then there should be no problem as these are usually of the film/foil type.

6. The output signal level can be set to either 2.5V RMS (7V peak to peak) or, by altering several resistor values, to 5V RMS (14V peak to peak). This is achieved by removing R11 (8.2k resistor) and replacing R12 (6.8k) with a parallel combination of a 22k and a 33k resistor. Space has been provided on the PCB for this purpose. There is a small but insignificant increase in the THD figures at the higher output level.

7. The rotary switches should ideally have gold plated contacts, as poor connections can dramatically increase the THD of any oscillator. Miniature toggle switches have been avoided for just this reason – they are notorious for giving problems when used for 'dry' switching. Rotary and pushbutton types that wipe as they are operated are much better.

Dry switching refers to very low or no current flow in the circuit being switched. Under these conditions, the slightest corrosion of the contacts makes the switch unreliable and can dramatically increase the distortion of the output.

For a similar reason, multi-turn trim potentiometers have been specified. These are usually Cermet and have good stability and reliable contacts, unlike the cheaper carbon track variety.

8. The RCA sockets on the rear of the unit are for connecting a frequency counter and oscilloscope. They have a fixed output level and are sufficiently isolated from the main oscillator circuitry by resistors to eliminate any affect on THD figures caused by overloading within the oscilloscope or counter.

A counter is necessary for accurate frequency measurement and the oscilloscope output is intended for connection to the external sync (or trigger) input. When synchronised this way the trace is very stable – you never have to twiddle the trigger level no matter how distorted or noisy the pattern on the screen may become. Try it, you'll never go back to the old way!

Construction Details

The first decision to make is the choice of instrument case. The case used in the prototype is one available from Emona; an 'Iskra' case type HTF 3. This case features a professional style presentation with an adjustable handle that also acts as a tilt adjustment. Whatever your choice of case, we recommend an *all metal* type for best shielding.

Before commencing the electronics, prepare the case. Drill holes for the PCB supports using the PCB as a template, and drill out the rear of the case to accommodate the RCA sockets. In the prototype, these were insulated from the case, to eliminate any earth loops. Make sure the PCB is placed to allow room for the switches and any other hardware such as a reduction drive. Drill a hole for the AC supply, large enough for a suitable grommet: also provide clamping of the lead within the case.

Next drill the front panel – either using our artwork or according to your own design. If a reduction drive is being incorporated, fit it before applying the artwork. The frequency dial used on the prototype was made from an old pressure gauge dial, turned down on a lathe to the required size. The artwork was

Audio oscillator

applied by first spraying the dial white, then drawing the scale lines with a permanent ink felt-tip pen. A spray coat of plastic lacquer was then applied, followed by press-on lettering which was then protected with a final coat of plastic lacquer.

A metal bracket is needed to support the frequency pot if you are using the DSE reduction drive. It can be held to the front panel using spacers, fitted to the screws supporting the reduction drive unit. The dial is attached to the drive using 2mm countersunk screws (not supplied) which DSE sells in its assorted metric screw pack. Otherwise, these can be obtained from hobby shops.

Once the case is finished (the hard part), it remains to stock the PCB. This procedure is fairly straightforward, as the board has no special requirements as to the order of component mounting. As usual, mount the lower profile components first and the ICs last. Take care with the thermistor; it's fragile and expensive.

The point to point wiring should be straightforward if the diagrams are followed carefully. Note the earthing arrangement used, as this has been chosen to eliminate hum due to power supply charge currents. The case should be earthed, and this was done on the prototype by connecting the earth wire from the PCB to the panel mount BNC socket – which was directly connected to the front panel. Use only one earth wire from the PCB for this purpose, to prevent earth loops.

Connect the various switches to the PCB using multi-coloured ribbon wire where possible. Keep the wire length as short as is reasonable to still allow the PCB to be lifted free for fault finding and adjustments.

Commissioning

Once all wiring is complete and double (triple?) checked, but *before* the ICs are fitted, apply power to the circuit from the plug pack. Next confirm a few voltages. The main filter capacitors should have about 16 volts across each, and of the correct polarity; the zeners about 13 volts each. They, and the 100 ohm resistors, should not be hot. Confirm also that the IC sockets have the correct supply voltages of the correct polarity, i.e., pin 4 of each should be around −13V, while pin 8 (7 for IC3) should be approximately +13V.

If the voltages check out, turn off and plug in the ICs carefully. Then switch on again and confirm that the voltage at the output pins of IC1 and IC2 is within a few millivolts of zero volts DC. If all is A-OK, connect an oscilloscope and check for a sinewave oscillation at the output pins (1 and 7) of each of the dual operational amplifiers. If none is found, then adjust either RV2 or RV3 as appropriate and oscillations should soon appear.

Assuming everything is fine so far, the only things to set are the two trim potentiometers and the knob on the frequency scale. Connect a multimeter, preferably digital, to the output terminals. Set each trimpot to obtain exactly 2.5 volts AC (or 5V if the higher output level is being used by changing R12 and deleting R11), at about 200Hz and with the attenuator at maximum. The square wave output should read a little higher, say 2.8 volts on a typical meter. The square wave can be checked for shape and amplitude on the oscilloscope.

All the other functions can be checked out now, and any anomalies dealt with. For example, confirm that the output frequency changes by a factor of 10 between adjacent ranges and that a 20dB change (factor of 10) occurs for each adjacent attenuator setting.

If you are using the supplied artwork, be prepared for a mismatch of the frequency scale to the actual values indicated by a frequency counter. This is impossible to avoid, as the linearity of the potentiometers available is a variable we cannot do anything about. The alternative to using our scale is to do your own – necessary anyway if you are using a dial and a reduction drive.

Finally

As the specifications show, the generator has a constant output level from 2Hz to 20kHz. However, on the highest range, the output level will fall by approximately 0.6dB, a characteristic we could not avoid without greatly increasing the complexity of the circuit.

Also, when the thermistor stabilising mode is selected, it may be found that frequencies above 150kHz result in the output 'squegging'. This is a function of

PARTS LIST

- 1 PCB coded 88ldo1
- 1 Instrument case (Emona-Iskra case type HTF 3)
- 1 Scotchcal label
- 1 *6:1 reduction drive 6.35mm (optional)
- 1 AC plug-pack 12 volt 300mA
- 1 panel mount BNC socket
- 2 4mm binding posts
- 2 2-pole 5 way rotary switches (Jaycar)
- 1 4-pole 3 way rotary switch
- 1 10k dual ganged linear potentiometer
- 1 1k linear potentiometer
- 2 1k multi-turn trim potentiometers
- 5 knobs (various sizes)
- 2 RCA panel sockets
- 1 LED bezel
- 3 8 pin DIL sockets (machined pins)

Semiconductors

- 2 NE5532 (or TL072) dual op-amps
- 1 NE5534 op-amp
- 2 1N4004 diodes
- 4 1N4148 or 1N914 diodes
- 2 13 volt 400mW or 1W zeners
- 1 Thermistor (optional) (RA53 – Radiospares, RA54 – Farnell)

Capacitors

- 4 1000uF, 25VW PC electrolytic
- 2 10uF, bipolar electrolytic
- 2 1uF, metallised polyester
- 2 100nF, 630VW metallised polyester
- 2 10nF, 630VW metallised polyester
- 2 1nF, polystyrene 5%
- 1 82pF, polystyrene 5%

Resistors

(1% metal film 1/4W)
1 x 10 ohm, 1 x 100 ohm, 2 x 680 ohm, 1 x 1k, 1 x 1.5k, 7 x 3.3k, 1 x 6.8k, 1 x 8.2k
(5% carbon film 1/2 or 1/4W)
2 x 2.2 ohm, 2 x 33 ohm, 1 x 47 ohm, 1 x 100 ohm, 2 x 220 ohm, 1 x 470 ohm, 1 x 680 ohm, 1 x 1k, 1 x 1.2k, 2 x 2.2k, 1 x 100k.
(5% carbon film 1 W)
2 x 100 ohm

Miscellaneous

Aluminium disk and 2mm screws for reduction unit (if used), 4 PCB stand-offs, multi-coloured ribbon wire, hookup wire, small grommet.
Note: NE5532 and RA53 available from RS Components
NE5532 also available from David Reid.
* 6:1 reduction unit available from Phoenix Components
The DSE unit cat no H3901 is unfortunately 6mm

Specifications:

Frequency Range: 2Hz to 200kHz (5 ranges)
Output level: 4 decade ranges, maximum 2.5V RMS (or 5V RMS) with variable output level on all ranges. Unloaded output level within 0.6dB from 2Hz to 200kHz, (thermistor feedback). Within 2dB for diode feedback.
THD: 0.2% (with diode feedback – all frequencies); 0.002% or better at 1kHz, 0.005% – 20Hz to 20kHz (for thermistor feedback).
Square wave: 0.8us rise/fall times (equals 200kHz bandwidth), 1% symmetry or better, all frequencies.
Special features: Fixed level, isolated outputs for frequency counter and scope.
Options: Thermistor feedback for low THD, diode feedback for constant output level when changing frequency. NE5532 type op amps for best THD, TL072 otherwise. Wirewound potentiometer for best stability, long life and best THD – carbon track otherwise. Vernier drive for 6:1 reduction drive on frequency adjust, direct drive otherwise. Polystyrene capacitors for best stability.Note that the thermistor and the NE5532 op amps are essential to obtain our THD figures.

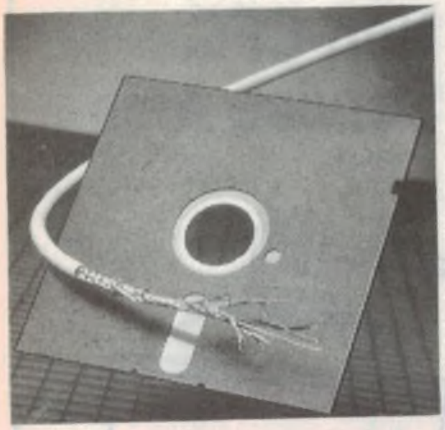
the thermistor, and we could find no cure that did not interfere with the distortion figures, or reduce the frequency range considerably. This problem does not occur for the diode feedback mode, or for the square wave. However, these two points are minor and should present few problems in normal use.

It is important to realise that the low distortion feature of this circuit assumes the use of suitable quality components. It would be dishonest to claim otherwise, and this fact applies to any low distortion oscillator design. Cheap components just cannot give quality performance. The more care you put into component selection the better will be the performance.

You can always decide to add the options later, and start out with the basic oscillator, which should make this project a viable and popular design well into the future.

By the way, it might be an idea to purchase the thermistor now, even if you don't immediately need it, as its long term availability is uncertain.

New Products



LAN cable

Belden's 9903 transceiver cable is now available to meet or exceed IEEE 802.3 requirements for compatible local area networks. This miniature version of standard UL Style 2919 cable is designed to run from a wall plate to a network's peripheral devices.

Three of 9903's tinned copper twisted pairs are data pairs, which are polypropylene insulated and feature 28 AWG stranded tinned copper conductors. The fourth pair is a PVC-insulated power pair with 24 AWG stranded tinned copper conductors. All pairs are individually shielded with Beldfoil aluminium-polyester material.

The overall Duofoil shield plus overall tinned copper braid shield provide 90 percent coverage to further ensure reduced EMI and RFI interference. These outer braid shields are electrically isolated from the inner shielded pairs. Fawn gray PVC forms the outer jacket, making 9903 especially suitable in office environments.

For more information, contact Belden Electronics, PO Box 322, Clayton 3168 or phone (03) 240 0448.

Frequency monitor

Captain Communications of Parramatta has released a miniature frequency monitor designed for displaying the frequency of both transmission and the frequency the receiver is tuned to. It is ideal for users of both transceivers and receivers who need accurate digital readout of frequency. Many older sets can be brought up to full 'digital' standard with this five digit frequency monitor. It is suitable for both HF and VHF operation, with coverage from 1kHz to 250MHz in two bands.

Unlike conventional frequency meters, the FC-200 can read both the frequency going out to the antenna and the frequency of the received signal. The latter is managed by a down system based on the receiver's local oscillator and by subtracting 455kHz.

The monitor comes complete with PL259 connectors for transceiver and antenna and with inputs for pickup of signal from the receiver's local oscillator. Its specififcations include a frequency range of 1kHz-54MHz (HF) and 50MHz-250MHz (UHF) and an input impedance of 1M ohm, 20pF. It operates from a 13.5V DC supply.

For further information call Captain Communications, 28 Parkes Street, Parramatta 2150 or phone (02) 633 4333.

Wireless intercom

The Mark 200 wireless intercom system from Swintek allows continuous, hands-free, simultaneous two-way communications (as opposed to the push-to-talk, walkie talkie type). This unique system has been used in many areas, from sports and entertainment to the NASA space shuttle.

Some of the applications include communications between director, talent and crew in broadcast/video/film/live entertainment productions; communications between co-workers in noisy work sites, or hands-free data entry in pathology, etc; two-way communications between police officers and other support personnel; and communication between firefighters where walkie-talkies are impractical.

For further information contact Trace Technology, Unit 26A, 1 Short Street, Chatswood 2067 or phone (02) 417 7922.

Video monitors for IBM

Computer peripherals distributor, IPL Datron has launched a new range of high resolution 35cm (14in.) monitors for the IBM PC and PS/2 compatible environments. The units include Dual Scan, CGA, EGA, VGA and Multiscan models and each carries a comprehensive two-year warranty.

The CC2411, 2422, 2431 and 3435 models offer a screen palette of 16 to 64 colours. With analog input the CC 3435 offers unlimited colour selection. The CM 2400 is a monochrome model offering screen colours of green, amber and paper white.

Prices of the monitors, ex-tax, are: CC 2411 (CGA) – $594, CC 2422 (EGA) – $844, CC 2431 (VGA) – $895, CC 3435 (Multiscan) – $1078 and CM 2400 (Dual Scan) – $247.

For further information contact IPL Datron, 19-25 Wyndham Street, Alexandria 2015 or phone (02) 698 8211.

20MHz AT

Electronic Solutions, has released a range of extremely fast AT motherboards using the latest Chips & Technology NEAT chipset. The boards come in a range of speeds from 12MHz 0-wait-state to a 20MHz model that clocks up 23.2 on Nortons SI program 23 times faster than the original IBM PC. All but the 12MHz board come standard with 1MB of RAM, expandable to 4MB on the motherboard.

All the boards are compatible with slower peripherals and memory, since the CPU and bus rate can be switched 8/10/12/16/20MHz (maximum speed depending on model). This means users can plug in slower memory, slower disk controllers etc., and then increase the clock speed later when faster peripherals and memory are fitted.

The motherboards are likely to be popular for some time, since most PC software currently on offer takes no advantage of the 80386 CPU. Electronic Solutions' tests indicate that, with rare exceptions, their 16MHz and 20MHz motherboards, when set up with suitable hard disks and controllers, can easily match and in some cases exceed the performance of expensive 80386 based PCs.

For further information contact Electronics Solutions, PO Box 426, Gladesville 2111 or phone (02) 427 4422.

FAX machine

Voca Communications has released a new base model facsimile machine – the Voca-fax M1200. The unit performs three functions in one compact unit. With its built-in handset, it needs only a telephone line to operate. It sends and receives documents, can be used as a normal telephone or can make clear copies of documents when a photocopier is unavailable.

This model weighs only 4.2 kilos, making it fully portable and provides a communication link in the office, home or wherever a telephone line is available. It can transmit documents up to 254mm (B4) wide and receive documents up to 216mm wide. Transmission time is just 18 seconds for an A4 page.

The M1200 is fully compatible with any Group 2 or Group 3 facsimile machine, and features comprehensive activity reports to monitor useage and a Transmit Terminal Identifier which automatically prints the user's name, phone number and date at the top of each transmitted page. The unit is priced at $1799.00

For further information contact Voca Communications, 11-29 Eastern Road, South Melbourne 3205 or phone (03) 697 7000.

Clamp-on meter

A new hand-held, clamp-on 'smart meter' has been introduced by F W Bell. This large aperture meter, Model UM-7900, handles all the measurement needs of the electrical or electronic technician.

It is designed for use with conductors up to 60mm in diameter. The UM-7900 reads nine parameters: DC current, AC current, AC voltage, frequency, power factor, phase angle, true power, apparent power and reactive power. It has a large illuminated 3-½ digit LCD, making it a stand alone unit, plus it is easily interfaced with other instrumentation via a RS-232 port.

For further information contact Elmeasco Instruments, 18 Hilly Street, Mortlake 2137 or phone (02) 736 2888.

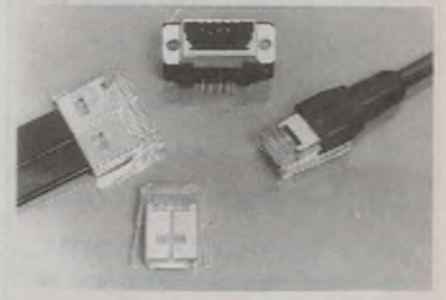
Anti-static wrist strap

The new Charge-Guard brand 2200 series adjustable static control wrist strap from 3M is designed to keep hands of all sizes static free. The adjustable construction of the strap ensures 360 degree skin contact and electrical conductivity for reliable static protection.

Soft, lightweight and non-allergenic, the band conforms gently and allows the skin to breathe, while the hinged closure secures the band in place with no danger of loosening. A silver-plated monofilament continuous thread throughout the band ensures conductivity.

To improve the functionality of the charge-guard adjustable wrist strap, 3M have also released the new charge-guard brand 2240 lightweight heavy-duty wrist strap ground cord. The cord is designed to work in conjunction with the wrist strap to take the worry out of jandling static sensitive devices and PC boards. Although the retracted length is only 380mm, the cord stretches to more than two metres when fully extended.

For further information contact 3M Australia, 950 Pacific Highway, Pymble 2073 or phone (02) 498 9333.



Shielded connector system

Utilux have introduced the Molex Semconn shielded electro magnetic-compatible plug and receptacle interconnection system for shielded round and flat cable.

The patented two piece Molex Semconn system is fully shielded against EMI/RFI for high speed data busing. This has become necessary because of the high data rates of information which the new programmable keyboards on PCs are capable of transmitting and receiving. These so called "enhanced" keyboards now appear in the IBM and Compaq ranges and the use of Semconn shielded connectors means that the end user has the ability to connect and disconnect the cable while maintaining the interconnection integrity. The connectors are designed to have a low insertion/extraction effort, and to maintain the interconnection integrity when used in low signal data lines, and are provided with 50 micro inches of selective gold plate in the contact area.

The Semconn shielded connector system is used on computers, point of sale equipment, instrumentation, business machines, keyboards, in medical electronics, in cellular and mobile radios, for commercial and home entertainment

New Products

and in security systems.

For more information contact Utilux, 14 Commercial Road, Kingsgrove 2208 or phone (02)50 0155.

Digital camera multiplexer

Tektronix has released a waveform and retrieval system that enables users to store up to 512 digitised waveforms from 256 digitised camera systems at once.

The MUX04 and MUX16 Multiplexing Systems, when used with Tektronix digitised camera systems, provide low-cost, multiple-channel storage, especially for users who already own analog oscilloscopes. These systems store high-speed, single-shot waveforms up to 1GHz, depending on the oscilloscope used. They can be used for testing in such applications as lasers, X-rays and high energy physics.

Most effective for storing fast signals, the MUX system is designed to provide easily configurable digital storage for analog oscilloscopes. It is most effective for storing signals that are too fast for digital oscilloscopes.

For further information contact Tektronix, 80 Waterloo Road, North Ryde 2113 or phone (02) 888 7066.

PCB exposure system

PCB prototyping and one offs can now be done quickly and economically in house, through use of the Kinsten pre-sensitised exposure system. The product range includes a UV exposure box, an etch tank, presensitised PCB and chemicals.

The UV exposure box model KVB 20 features high power double sided simultaneous exposure ensuring perfect line up of double sided boards and a typical exposure time of 60-70 seconds. A built in timer with expired time indicator and a re-exposure switch allowing fast and reliable multiple PCB exposure, the KVB 20 also comes complete with internal vacuum pump for maximum PCB/film contact, ensuring best possible track definition.

The etch tank of the kit called the ET10, is supplied complete with a thermostatically controlled heater and agitation system. Also available are presensitised fibre glass printed circuit boards in both single and double sided versions of various sizes and the appropriate chemicals to develop and etch.

A complete kit including all the above costs around $700.00

For further information contact Computronics, 31 Kensington Street, East Perth 6000 or phone (02) 221 2121.

High speed printers

IPL-Datron has released two new high quality, high speed dot matrix printers which it claims will out perform any competitive equipment in the same class. The 9-pin printers – OKI models 320 and 321 – can deliver a high speed 300 characters per second HSD, 200cps Utility or 62.5cps NLQ.

Additional features include three part forms handling, built in push tractor with parking, top, rear and bottom paper feeds, the ability to emulate Microline, Epson and IBM 9-pin models, and RS 232C interface.

Print features include the ability to generate typefaces which are: emphasised, enhanced, italics, double height, double width, continuous underlining, super/subscripts and, on the IBM model only, overscore.

Recommended retail prices are: ML320 – $799, ML321 – $999 plus sales tax.

For further information contact IPL-Datron, 19-25 Wyndham Street, Alexandria 2015 or phone (02) 698 4043.

Personal fax

Toshiba's new TF-111 'personal' fax manages to combine all the advantages of its big brothers in a very neat unit measuring only 377 x 318 x 125mm, including handset.

The TF-111 provides automatic dialling for up to 30 destinations, one-touch dialling for 10, plus delayed transmission which is especially handy for those overseas communications. It also has an automatic document feeder which will handle 5 sheets.

A crisp LCD display (with an adjustable contrast) shows stored names and numbers, provides the time, feature activation, as well as indicates problems, messages and call duration.

Naturally the TF-111 provides full activity reports, has a polling facility and is compatible with the standard G2 and G3 transmission modes.

Surge generator

Surge voltage generators are used in high resistance fault location in buried cables. Energy stored capacitively in the set is transferred to the cable under test. This burst of energy will cause an arc in the faulty area of the cable. The noise produced by the arc can be picked up by a sensitive ground microphone and the faulty part of the cable can be accurately located and repaired.

Baur makes a family of surge generators producing from 200 joules to 2000 joules at voltages up to 60KV. All sets can be made to operate as DC Hipots as well as burndown sets. In the latter a high power resistor is inserted in the output hence limiting the current into the cable.

For further information contact Macey's Electrical Accessories, Suite 8/9, Foamcrest Avenue, Newport 2106 or phone (02) 997 8544.

LED backlit LCD display

With the addition of five new models, LCD display supplier Optrex Corp has dramatically increased the range of sizes available in the DMC series of LCD character displays with built-in LED backlight. Models now range from 16 character x one line to 40 character x 4 lines.

Backlighting by LED is a more cost-effective technique than the alternative electro luminescence method, since an invertor is not required. The LCD incorporates a single +5V supply. This technique also provides a very bright and uniform display. However the power consumption is much higher than the electro luminescence backlit displays and is therefore not suitable for battery operated equipment.

DMC series displays, which can interface with 8 bit and 4 bit MPUs, have a maximum range of 0 to +50°C, with an extended temperature (from −20 to +70°C) option available.

For further information contact Amtex Electronics, 13 Avon Road, North Ryde 2133 or phone (02) 805 0844.

Digital Thermometer

Guildline have announced the availability of a new version of the very popular 9540 Digital Platinum Resistance Thermometer. This new instrument, the 9540B, is designed for temperature measurements over the range of −200°C to +600°C. The basic accuracy is better than 0.01°C and the resolution is 0.001°C at all temperatures with filtering applied. The 9540B has an IEEE 488 GP-IB Interface fitted as standard which provides full talker/listener protocol.

The Guildline 9540B is designed for accuracy and resolution and allows high accuracy fluid temperature measurement with automatic temperature monitoring, both digital and analog, making the 9540B ideally suited for systems users as well as for traditional laboratory applications.

For further information contact Parameters, Centrecourt, 25-27 Paul Street North, North Ryde 2113 or phone (02) 888 8777.

Basic Principles of VCRs – Part 4

Recording the picture

In part one of this series, we looked at the basic recording circuitry used in the VHS system. This month we discuss in greater detail how the luminance and colour signals are handled in the VHS and Betamax systems. We also consider a further aspect of the Video 8 system.

by DAVID BOTTO

Fig.1 is a simplified schematic of the luminance recording section of a typical VHS VCR machine. Compare this schematic with the block diagram of the luminance and chrominance section shown in part 1. If the input signal at point A is supplied by a standard colour bar generator, then the waveforms in the lettered points in the circuitry will be as shown in the diagrams.

To view these waveforms you would need an oscilloscope with at least a 5MHz response and a 10:1 isolating probe. In modern VCRs these separate sections are all contained within a few large integrated circuits, with the exception of a some individual transistors. However in Fig.1 the schematic is divided into smaller blocks, to make it easier to understand how the circuitry operates.

The complete video signal enters the circuitry at point A (Fig.2). This signal may be supplied via the TV tuner, IF amplifier and demodulator circuitry or by a colour TV camera. It's usually selected by a customer controlled front panel slider switch.

After passing through the slider switch the complete composite signal is fed to the luminance recording circuitry. It's also supplied to the colour recording circuitry, but more about this later.

The signal at A feeds through capacitor C1 to point B, where transistor Q1 acts as an electronic switch. In the playback mode a positive voltage is supplied to the base of this transistor (point X), turning it hard on and shorting the signal to chassis. This, of course, cuts off the signal input to the luminance recording circuitry. In the record mode Q1 is 'off' and has no effect on the circuitry.

The signal from the keyed AGC amplifier feeds into play/record function select switch SW1 (point C).

Play/record switches in early VCRs were mechanical, usually operated by magnetic relays. However in today's VCRs playback/record select switches (contained within integrated circuits, together with other semiconductor devices) operate electronically, responding to digitally coded pulses sent by a microcomputer IC (see part 3 of this series).

After passing through SW1, the signal is taken to the base of transistor Q2 which operates as an emitter follower. Capacitor C2 and coil L1 form an acceptor trap, tuned to 4.433619MHz. You'll remember that an acceptor trap is a tuned circuit which allows only signals of the frequency to which it is

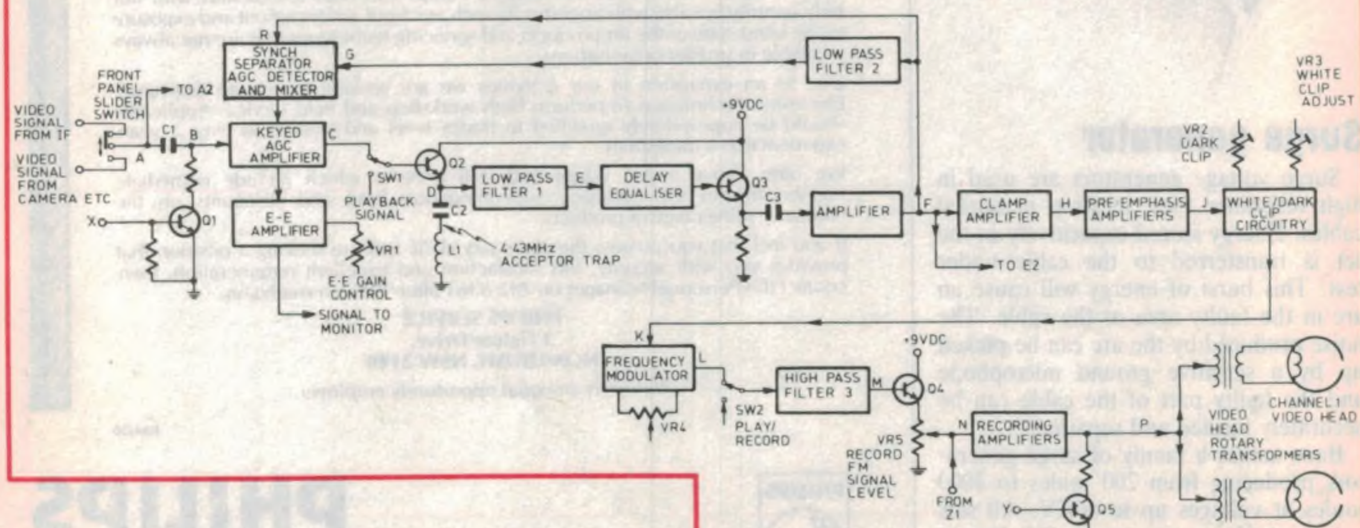


Fig.1: A simplified diagram of the luminance recording circuitry used in a typical VHS recorder.

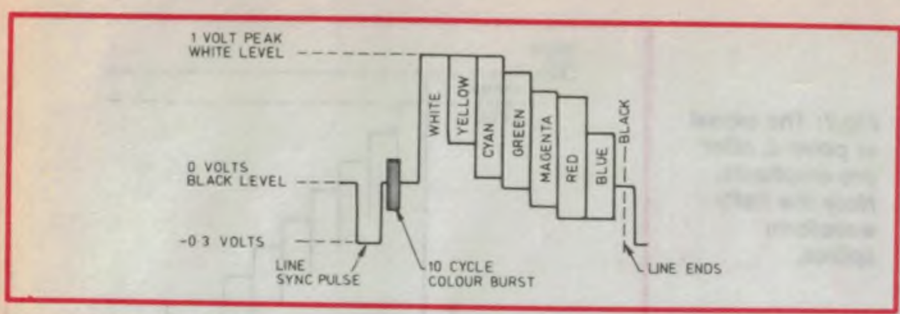


Fig.2: A 1-line section of an EBU colour bar video signal (75% amplitude, 100% colour saturation), as fed to the circuit discussed.

tuned to pass through it (point D). Thus the 4.433619MHz colour subcarrier is removed from the video signal (see Fig.3).

Next, low pass filter one removes any vestige of the chroma signal information that may have escaped the acceptor trap, leaving only the luminance signal at point E. Fig.4 shows the 'staircase' luminance or Y signal at point E, with the colour information removed. You'll notice that the circuitry has inverted the signal.

The luminance signal now enters an equaliser circuit, which delays the signal by about 600 nanoseconds. This is necessary because the colour signal will be slightly delayed by the chroma recording circuitry. The luminance signal must therefore be slowed down, so that both signals arrive together at the video heads to be impressed on the magnetic tape of the video cassette.

The signal then continues on its way to the base of emitter follower transistor Q3, to capacitor C3. Next the signal enters an amplifier. The waveform at the output of this amplifier (point F) is again inverted and looks like Fig.5(a), except for the two dotted pulses shown on the back porch of the synchronisation pulses.

Keyed AGC

The signal at point F returns through low pass filter two to point G, where it enters the keyed AGC sync separator

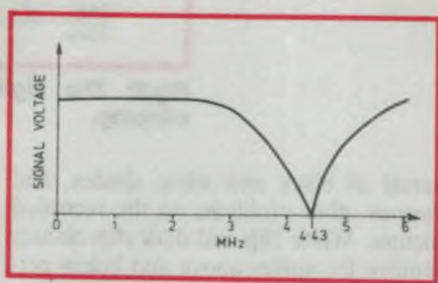


Fig.3: The action of the acceptor trap at point D in Fig.1, effectively removing the 4.43MHz chrominance signal.

circuitry. It also connects via point R to the keyed AGC clamp amplifier.

Since it's important to understand how the AGC (automatic gain control) circuitry works, it is shown in greater detail in Fig.6. The letter and block references are the same as in Fig.1, plus some additional ones.

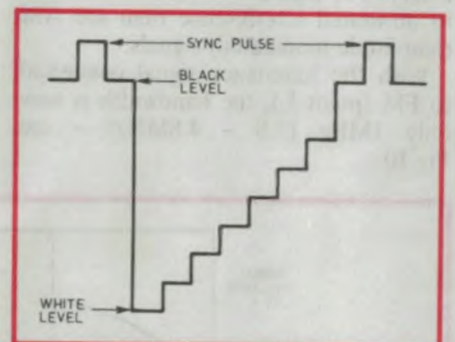


Fig.4: The luminance signal which remains at point E, after LP filtering.

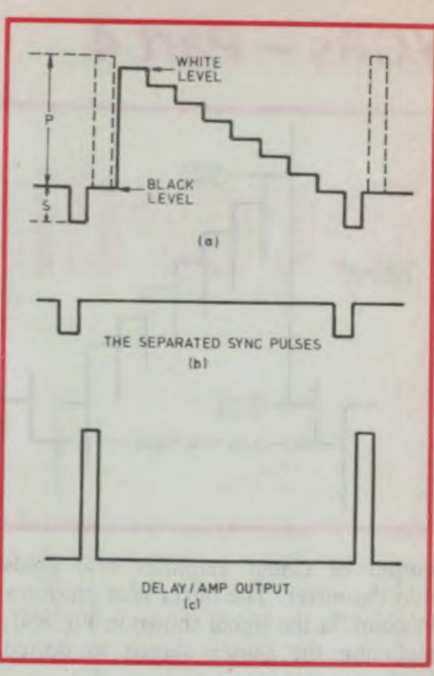


Fig.5: (a) Shows the 'staircase' signal at point F; (b) the separated line sync pulses, at point 5b (Fig.6); and (c) the delayed pulses at point 5c (Fig.6).

Because the picture brightness and content is continually varying, the AGC system does not control the total voltage of the signal. If it did, when recording a bright scene the gain of the luminance recording stages would drop, and on a dark scene increase – even if the input signal strength at point A (Fig.1) was unchanged.

The complete signal from point B feeds into resistor R1 (Fig.6). The signal from point F enters low pass filter 2 and then the sync separator, which allows only sync pulses to pass – Fig.5(b). Next the signal is amplified, delayed, and inverted – appearing as in Fig.5(c). It's then fed into the mixer.

The signal from point F also enters the clamp amplifier (point R), which changes the signal from an AC coupled signal into a DC coupled signal. The

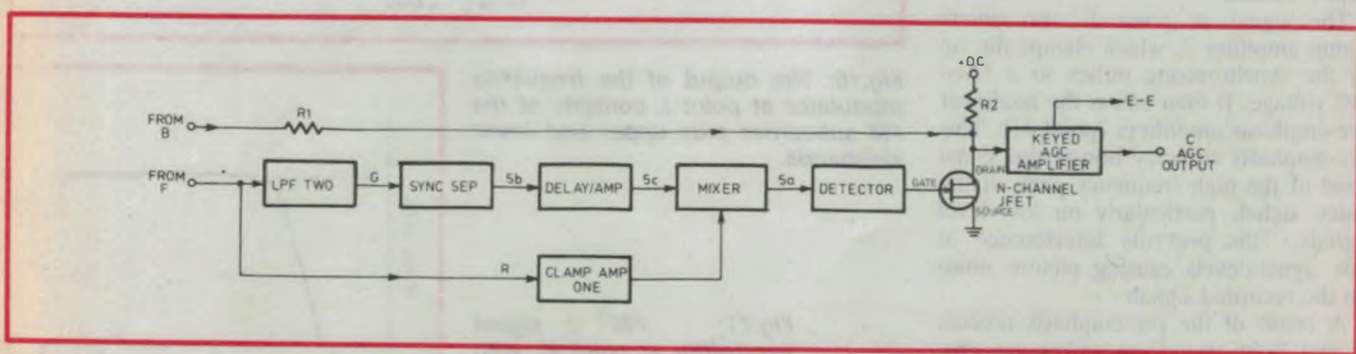


Fig.6: A simplified diagram of the keyed AGC section of Fig.1, used to explain how the AGC works. (See text)

VCRs – Part 4

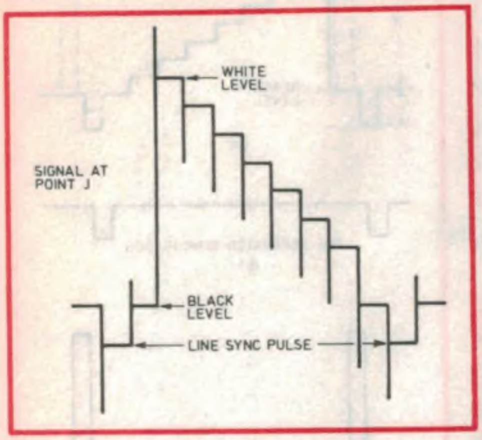


Fig.7: The signal at point J, after pre-emphasis. Note the hefty waveform spikes.

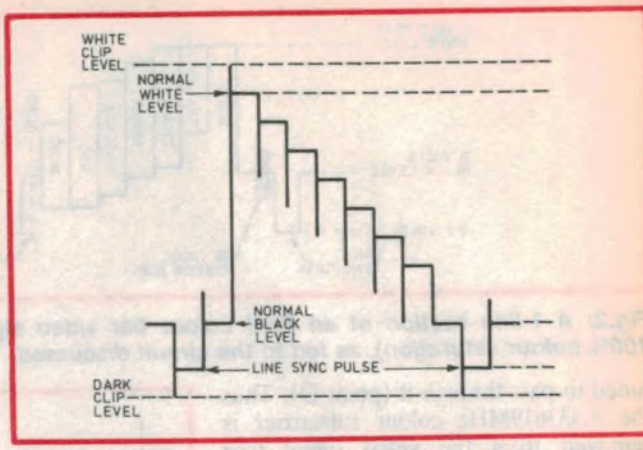


Fig.8: The signal at point K, after white and dark clipping.

output of clamp amplifier also feeds into the mixer. The mixer now produces at point 5a the signal shown in Fig.5(a), including the pulses shown in dotted lines.

Finally the signal is detected or rectified and supplied to the gate of the N-channel JFET (junction field effect transistor). With the gate disconnected, a JFET with a positive voltage connected to its drain acts like a fixed resistor, allowing current to flow though it. Thus the internal impedance of the JFET and resistor R1 act as a voltage divider, reducing the voltage of the incoming video signal from point B.

The positive-going rectified signal from the detector is fed to the gate of the JFET, causing its internal impedance to fall and thus reducing the input voltage of the signal entering the keyed AGC amplifier. The greater the signal at the gate of the JFET, the lower the input to the keyed AGC amplifier.

In this way the keyed AGC signal output at point C is controlled by the amplitude of the sync pulses, and not by the actual picture content. At point C the signal now appears as in Fig.5(a), but without the dotted line pulses and with the voltage of the sync pulse (S) kept constant.

The signal at point F also enters clamp amplifier 2, which clamps the tip of the synchronising pulses to a fixed DC voltage. It then enters the nonlinear pre-emphasis amplifiers (point H). This pre-emphasis circuitry boosts the signal level of the high frequency parts of the video signal, particularly on low level signals. This prevents interference at low signal levels causing picture noise on the recorded signal.

A result of the pre-emphasis process is that hefty waveform spikes are produced on the signal at point J – see Fig.7. Uncorrected, this could cause reversal of black and white shades, and various other problems on the recorded picture. White clip and dark clip circuits remove the spikes above and below certain fixed signal voltage levels (Fig.8).

The signal at point K is next frequency modulated. During this process the tip of the sync pulses produce a signal at 3.8MHz and the white peaks a signal at 4.8MHz (Fig.9).

The FM signal

You will remember from part one of this series that a frequency modulated signal is used to record the luminance signal, so that a bias oscillator is unnecessary. FM signals are far less sensitive to unwanted interference than are AM (amplitude modulated) signals.

With the luminance signal converted to FM (point L), the bandwidth is now only 1MHz (3.8 – 4.8MHz) – see Fig.10.

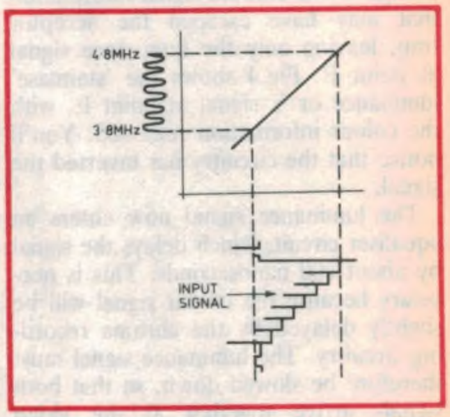


Fig.9: In the frequency modulation process, the luminance signal swings the carrier between 3.8 and 4.8MHz.

Next the FM signal passes through play/record switch SW2 and enters high pass filter 3, which attenuates the lower sideband (point M – Fig.11). This leaves

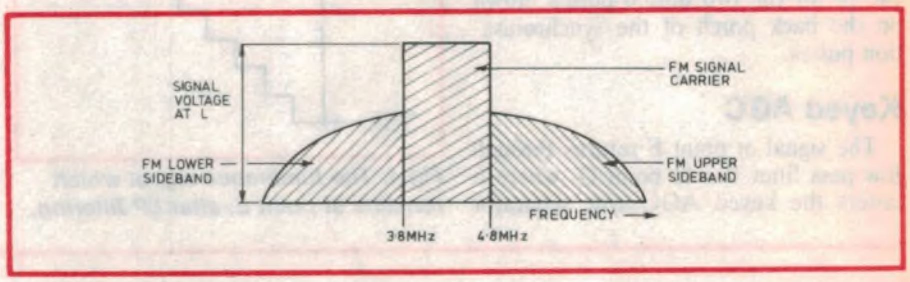


Fig.10: The output of the frequency modulator at point L consists of the FM subcarrier plus upper and lower sidebands.

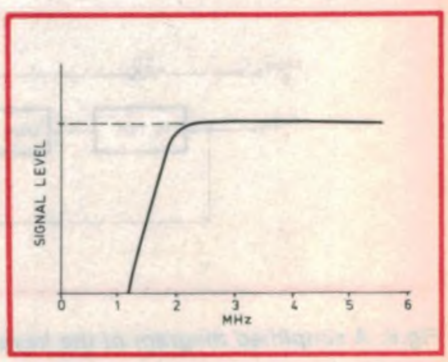


Fig.11: FM signal bandwidth at point M, with the lower sideband attenuated.

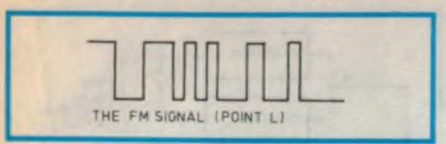


Fig.12: The actual waveform of the FM signal at point L, of constant amplitude.

room for the down-converted chrominance signal to be fitted in. Keep in mind that the amplitude of an FM carrier remains constant – only the frequency changes as it is modulated (Fig.12).

The FM signal now feeds into the base of emitter follower transistor Q4 (Fig.1). Preset resistor VR5 adjusts the record FM level. Finally the signal is supplied to the recording amplifiers. The output (point P) drives the primary windings of the rotary transformers, energising the two video heads set in the head drum.

The FM recording current signal is shown in Fig.13. The 'cotton reels' shown in the diagram are the down-converted AM (amplitude modulated) 627kHz colour signals, which use the FM envelope as a bias signal.

Transistor Q5 is cut off in the recording mode. In the playback mode 9V DC appears at point Y. Q5 then conducts, effectively shorting the signal to ground at point P.

Recording the colour

At first sight the colour circuitry looks rather complicated. However it is made up from a number of simple circuits. Old timers will recognise most, if not all of these as originating from the early days of radio and TV.

In order to understand the processing of the chroma signals, a basic knowledge of colour TV is helpful. See my

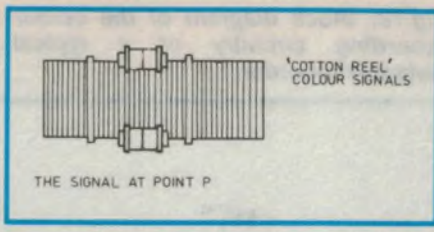


Fig.13: The 'cotton reel' chrominance components on the recording head signal at point P.

series "Understanding Colour Television", published in the January to March, and May to September 1987 issues of *Electronics Australia*.

Part one of the present series described the basic method of 'down-converting' the AM colour signal to 627kHz before recording it, together with a block schematic.

Fig.14 is a block diagram showing in greater detail (although still simplified) how the colour signal is recorded.

The complete video signal at point A in Fig.1 is taken to point A2 in Fig.14 and enters bandpass filter 4. The luminance information is removed, allowing only the 4.433619MHz colour subcarrier to pass and reach electronic play/record mode selection switch SW3 (point B2).

The 'cotton reel' chroma waveform is shown in Fig.15, and the bandwidth of the signal in Fig.16. The dotted line shows the luminance signal as it was before passing through filter 4.

Electronic play/record switch SW3 feeds the 4.433619MHz subcarrier signal into the ACC (automatic colour control) circuit. The colour signal from the ACC circuit (point C2) is fed through capacitor C4 and electronic play/record switch SW4 into the burst gate (point D2).

The luminance signal at point F in

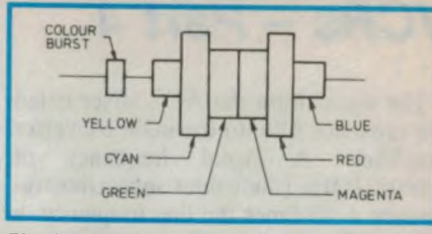


Fig.15: The 'cotton reel' colour bar signal at point B2 of Fig.14.

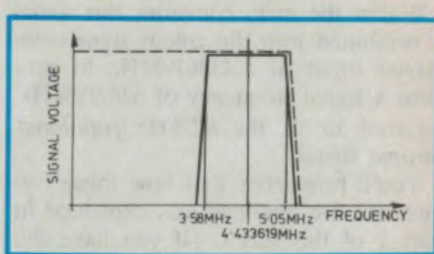


Fig.16: The bandwidth of the incoming colour signal at point B2.

Fig.1 is fed into the white clip circuit at point E2 in Fig.14, and then via capacitor C5 to the sync separator (point F2). This allows only the sync pulses to pass through, entering the monostable multivibrator at point G2.

Coil L2 and capacitor C5 alter the phase of the horizontal sync signal so that it is timed correctly with reference to the colour burst signal (point H1). This timed horizontal sync pulse is known as the *burst gate pulse*.

Point H1 goes direct to point J1 into the burst gate. It's then demodulated by the ACC detector, whose output is fed into the ACC mixer (point K1).

In this way the colour burst amplitude is kept at a constant voltage, controlled by the amplitude of the horizontal sync pulse input at point E2. In appearance it's the same as in Fig.15, but with the signal voltage of the colour burst kept at a constant level.

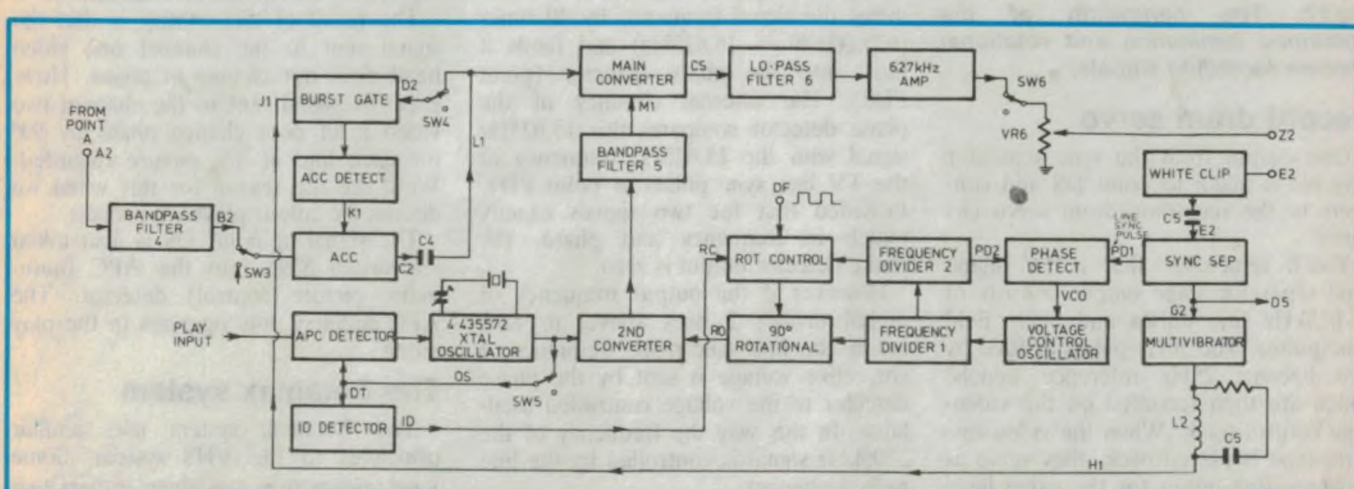


Fig.14: Block diagram of the colour recording circuitry of a typical VHS recorder.

VCRs – Part 4

The signal from the ACC mixer is fed via capacitor C4 into the main converter amplifier. A signal frequency of 5.060572MHz (the colour subcarrier frequency + 40 times the line frequency + 1/8 the line frequency) is also fed into the main converter via bandpass filter 5.

Within the main converter this signal is combined with the colour signal subcarrier input of 4.433619MHz to produce a signal frequency of 626.953kHz, referred to as the *627kHz rotational chroma* signal.

You'll remember that how these frequencies are obtained was explained in part 1 of this series. (If you have the April issue of *Electronics Australia* handy, it might be a good idea to refer back to it at this point).

The 627kHz rotational signal output from the main converter enters low pass filter 6 and then the 627kHz signal amplifier. The amplifier output passes through switch SW6 to preset pot VR6 (record colour level control). Point Z2 connects to point Z1 in Fig.1. The down-converted cotton reel colour signal then modulates the luminance FM signal as shown in Fig.13. Fig.17 shows the bandwidth of the combined signals.

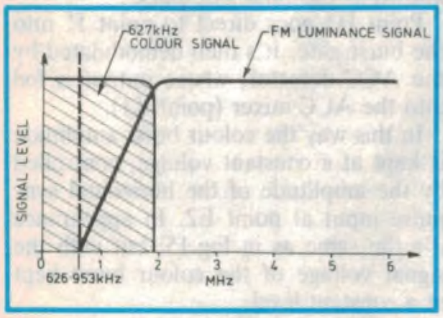


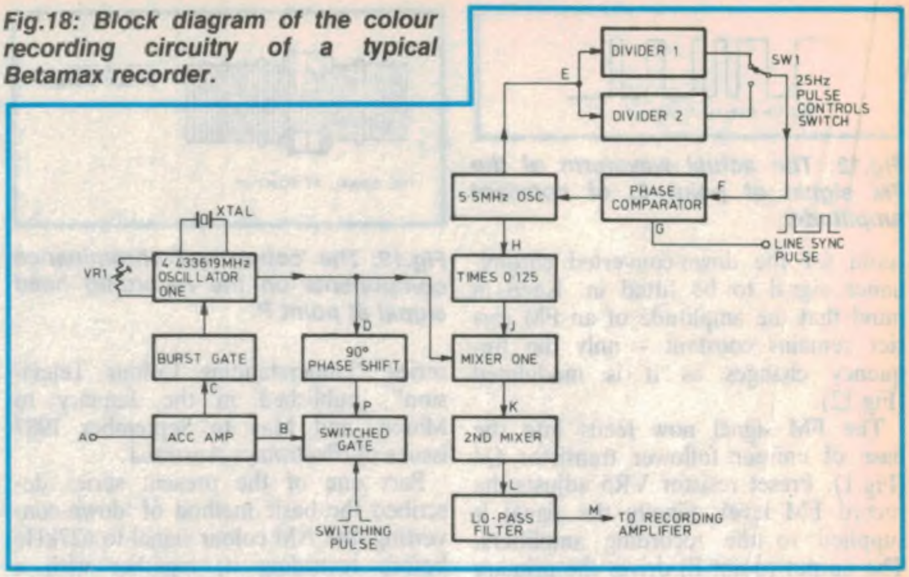
Fig.17: The bandwidth of the combined luminance and rotational chroma recording signals.

Record drum servo

One output from the sync separator (Fig.14) is taken to point DS and connects to the recording drum servo circuitry.

You'll remember that a TV signal sync separator stage output consists of 15.625kHz line pulses and 50Hz field sync pulses. The 50Hz pulses divided by two become 25Hz reference signals, which are then recorded on the videotape control track. When the video cassette tape is played back, they serve as synchronising pulses for the video head drum servo circuitry. (Refer to part 3 of this series).

Fig.18: Block diagram of the colour recording circuitry of a typical Betamax recorder.



The AFC loop

The 627kHz amplitude modulated colour signal is phase shifted in steps of 90°, through 360°. An AFC (automatic frequency control) loop is necessary in order that the various signal frequencies used to produce the 627kHz rotational signal are exactly correct and in phase.

The line sync pulses from the sync separator also feed to the input of the phase detector (point PD1), the output of which connects (point VCO) to a voltage controlled oscillator whose frequency is 160 times the line sync frequency (15.625 x 160 = 2500kHz, or 2.5MHz).

Digital frequency divider 1 accepts this signal and produces an output of 1/4 of 2500kHz, or 625kHz, which is forty times the line frequency. The 625kHz signal is supplied to digital frequency divider 2, and also to the 90° rotation circuit.

Digital frequency divider 2 now reduces the signal frequency by 40 times (625,000/40 = 15,625Hz) and feeds it back into the phase detector (point PD2). The internal circuitry of the phase detector compares this 15,625Hz signal with the 15,625Hz frequency of the TV line sync pulses at point PD1. Provided that the two signals exactly match in frequency and phase, the phase detector output is zero.

However if the output frequency of digital divider 2 rises above, or falls below the line sync pulse frequency, a corrective voltage is sent by the phase detector to the voltage controlled oscillator. In this way the frequency of the 2500kHz signal is controlled by the line pulse frequency.

Besides the 625kHz signal from digital divider 2 the rotational control circuitry receives (point DF) a 25Hz control signal from the servo circuits. The output of the 90° rotation control circuitry (point RO) is fed to the second converter. The output at point RO is phase shifted 90° with each succeeding line of the TV picture, and kept in step with the video head rotation by the 25Hz pulse from point DF.

The second converter down-converts the signal to 627kHz and feeds it via high-pass filter 5 into the main converter (point M1), where it combines with the colour subcarrier to form the 627kHz chroma signal at point CS. (How this is done was explained in part one of this series).

The 4.435572MHz signal at point OS via electronic play/record switch SW5 is supplied first to the ID (identification) pulse detector (point DT). The output at point ID feeds into the rotational control circuit at point RC, synchronising the 90° rotation control circuitry.

The result of this control is that the signal sent to the channel one video head does not change in phase. However the signal sent to the channel two video head does change phase by 90° for each line of TV picture recorded. We'll see the reason for this when we discuss the colour playback process.

The signal at point OS is also taken via switch SW5 into the APC (automatic picture control) detector. The APC circuitry only operates in the play mode.

The Betamax system

The Betamax system uses similar principles to the VHS system. Some basic information was given in part two of this series.

As in the VHS system the luminance

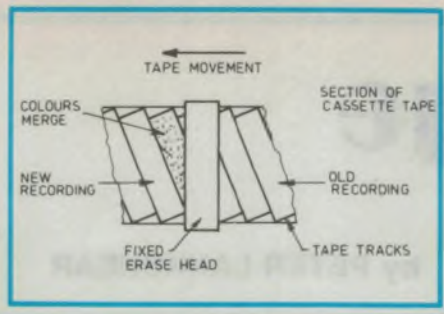


Fig.19(a): A fixed erase head causes overlapping of recordings.

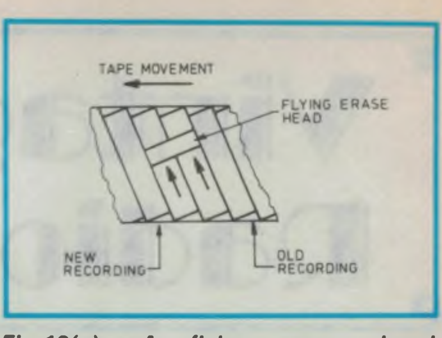


Fig.19(c): A flying erase head straddles both field tracks.

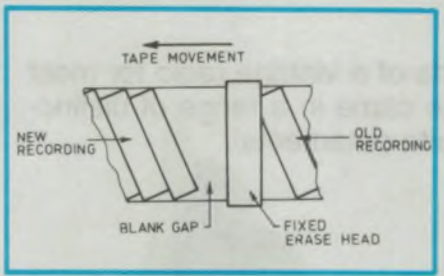


Fig.19(b): A fixed erase head also produces a gap at the end of a recording.

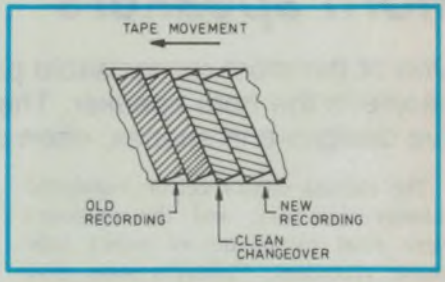


Fig.19(d): The flying erase head gives clean changeovers between recordings.

signal is FM modulated. However two frequency modulators may be used, with the signal fed to the second FM modulator delayed by one line. The frequency modulated signal is then passed through pre-emphasis amplifiers and black and white clip circuits just as in the VHS system.

The FM signal carrier frequency is 5.2MHz for a peak white signal, and 3.8MHz at black level. (Compare with Figs.9 and 10.)

Fig.18 shows the basic system used in the Betamax format colour recording circuitry. The colour signal with the luminance information removed enters at point A. The waveform is as Fig.15. It passes through the ACC circuit and into a gate circuit at point B. This gate alternately accepts the signals from points B and P, under the control of a pulse.

The signal from the ACC amplifier is also fed to a burst gate (point C) which keeps oscillator 1 (4.433619MHz) accurately locked to the colour burst frequency. The output from oscillator 1 enters a 90° phase shift circuit (point D), producing what is known as the *pilot tone* signal, which is recorded on the magnetic tape.

Oscillator 2's output (free running 5.5MHz) is supplied to digital dividers 1 and 2 (point E). SW1 is an electronic switch controlled by the 25Hz pulse from the video head drum.

You'll remember that each complete frame of a TV picture consists of two interlaced fields. As each field succeeds the previous one, SW1 is electronically switched between the outputs of the two digital divider circuits. These outputs are supplied to the phase comparator (point F) which also receives line sync pulses from the sync separator (point G). The phase comparator controls the frequency of oscillator 2.

In switch SW1's position 1 the signal from digital divider 1 causes the line frequency signal from the line sync pulse generator to be multiplied by 351 (351 x 15,625 = 5.484375MHz). In position 2 the line pulse frequency is multiplied by 353 (353 X 15,625 = 5.515625MHz). Thus oscillator two is alternately locked to one of these two frequencies as the picture fields change.

Oscillator 2's output (point H) now passes through a multiply by 0.125 (divide by 8) digital counter to point J, at one input of mixer 1. The output from oscillator 1 (4.433619MHz) is fed to the other input of this mixer, so that the output at point K is 5.1230721MHz (0.68945313MHz + 4.433619MHz) for one field and 5.1191659MHz (0.6855469MHz + 4.433619MHz) for the other.

In the second mixer the incoming colour subcarrier frequency is subtracted from these two frequencies, so that two different down-converted signals of 689.45313kHz and 685.5469kHz are fed (point L) through filter one into the recording amplifier (point M).

Channel 1 video head is supplied with the down-converted colour signal of 685.546kHz and channel 2 video head with the 689.453kHz colour signal. This two frequency signal system prevents colour crosstalk when the cassette tape is played back.

Erasing the picture

In both the VHS and Betamax systems, before the tape reaches the video head drum it first passes over the full erase head (see part 2). In the record mode a bias oscillator energises this head, wiping out all previous recordings.

Suppose we wish to make a new recording and insert it in the middle of an existing one? Using a fixed head erase system overlapping will occur – see Fig.19(a) – and the colours of the new recording at this point merge with the colours of the old recording. At the end of the new recording there will be a gap, as shown in Fig.19(b).

This problem is overcome in the Video 8 system by the use of a *flying erase head*, set at 90° to the video heads (see Fig.20). Since each video track records one field of the picture, two tracks make up one picture frame. The flying erase head covers two tracks (Fig.19(c)) and removes one complete frame of picture. When the new recording is made the change is noiseless and free from colour splash.

Next month we'll discuss how the recorded picture on the tape is played back. We'll also consider the vector relationships of the colour signals, and long play operation on the latest VCRs.

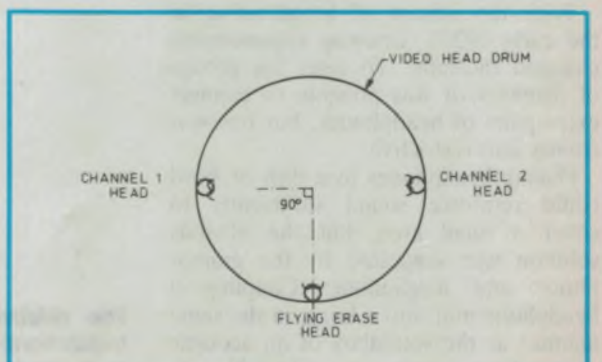


Fig.20: The flying erase head is mounted on the video head drum, at 90 degrees to the record/play heads.

Vintage Radio

by PETER LANKSHEAR

Horn speakers

One of the most recognisable parts of a vintage radio for most people is the horn speaker. These came in a range of distinctive designs and shapes, often quite ornamental.

The earliest radio receivers employed coherer detectors, and the messages were read by means of paper tape morse recorders. Coherers soon gave way to electrolytic and magnetic detectors which, whilst more reliable, produced insufficient energy to operate recorders.

The most sensitive and practical instrument in common use at that time was the telephone earpiece, which proved to be very suitable for these new receivers. Although messages now had to be transcribed, in all other aspects the telephone receiver was most satisfactory, and of course, has been in extensive use in radio reception to this day. Logical developments were to use a headband, as already used by telephone operators, and to fit two earpieces so that both ears could be used.

Headphones were hard to improve on for single operator communications work. They were efficient, gave some protection against outside distractions and kept the messages private. Had radio not evolved into public entertainment, it is likely that for direct audio communications, the headphone would have remained pre-eminent, just as it has in the telephone.

Headphones inadequate

With the advent of broadcasting in the early 1920's, listening requirements changed radically. To cater for groups of listeners, it was possible to connect extra pairs of headphones, but this was clumsy and restrictive.

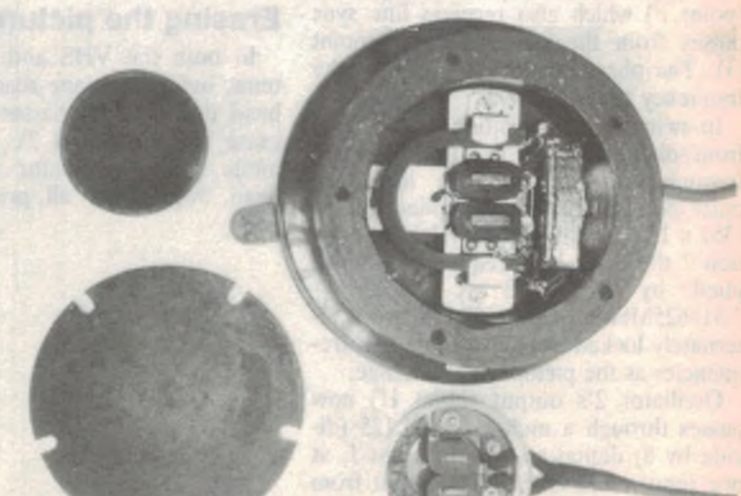
Placing headphones in a dish or bowl could reinforce sound sufficiently to cover a small area, but the obvious solution was suggested by the gramophone and megaphone. Coupling a headphone unit into a horn, in the same manner as the soundbox of an acoustic gramophone, gave a considerable increase in volume and quality.

A classic 'Morning Glory' horn speaker with mahogany petals. This one came from the British Amplion company, which specialised in this pattern.

Horns have never been bettered for efficient loudspeaker operation. By acting as a kind of acoustic coupling transformer, the horn matches the comparatively heavy diaphragm to the far less dense surrounding air, and, to this day, horns are commonly used where large volumes of sound are required. A factor in the practicality of talking pictures in the late 20's was the experience gained with radio horn speakers.

Although Western Electric had experimented with a horn loaded loud speaking telephone as early as 1907, the large scale manufacture of radio horn loudspeakers commenced in 1922. For the next five years, literally dozens of manufacturers flooded the market with all kinds of horn speakers of every conceivable shape, size and material.

Some of materials used were aluminium, steel, diecasting alloy, ebonite, wood, papier mache, plaster of paris and ceramic. Early horns had bells which varied from a few inches in diameter to more than 22" (560mm) across – but to perform satisfactorily by today's standards, a wide range horn needs a mouth of at least twice even this diameter. Only a dedicated enthusi-



The relative sizes and similarities of the magnets and diaphragms of a headphone and a 'Claritone' horn. The black object alongside the horn's magnets is a capacitor, used to improve tonal quality.

Not a piece of a vintage motor cycle, despite the name plate! The knurled knob is the diaphragm spacing control.

ast would accept such a monster (two for stereo) and this is one reason for the unpopularity of bass horns domestically.

Shape important

The exact shape of the flare is important. Although any horn will work, the most effective type follows what is known mathematically as an *exponential* curve. All this means is that along the length of the horn, for each unit increase in length, the cross sectional area of the horn doubles.

The early gramophone makers had discovered this characteristic, but whether the original concepts were scientific or aesthetic is debatable. They found that the classic 'morning glory' horn, named after a popular American flower which nature has evolved with an exponential flare, was superior both acoustically and visually to the straight sided cone. Some horns were made complete with petal-like segments, leaving no doubt about the floral origins.

An American Atwater Kent model L. It has a spacing adjustment collar under the base.

Incidentally it is not only flowers that have evolved the exponential curve. Many shells, including that of the snail follow the same law.

One very practical radio loudspeaker system used the horn of the family gramophone, which would have been gathering dust as interest centred on radio entertainment. The soundbox, or what we would now call the pickup head, was replaced by a horn driver unit. Not only was this recycling an attractive proposition to owners who were faced with an otherwise unused piece of equipment, but a cabinet gramophone would have produced results equal to those from a good sized radio horn.

A horn with a straight axis was clumsy, and various forms of folding were adopted. The traditional graceful curved neck and wide bell became the symbol of early radio, but there were many other forms.

Some British manufacturers disguised their speakers to look like ornaments, such as Dresden figures or Confucius. At least one American model used a bugle-like multi folding horn, inspired by a motor car bulb horn! As the ultimate concession to nature, a couple of American manufacturers incorporated large sea shells in their speakers. An idea borrowed from the gramophone industry was building horns into cabinets.

Horn construction was more metal fabrication than electronic engineering, so it is not surprising that some unlikely firms diversified into speaker manufacture. One such was the well known A.J.S. company of the UK, who took the opportunity to cover a recession in the motor cycle industry.

A German 'N&K' horn; the adjuster is at the end of the driver unit.

A British 'Claritone'; adjustment is by means of the lever projecting from the base.

Drivers

Initially, conventional headphones were used as horn drivers, but the need for increased power handling soon led to specialised driver units being produced. Generally, they were simply oversized headphones and standard practice was to provide adjustable diaphragm to magnet spacing. Operation was a compromise between sensitivity and power handling. Maximum sensitivity results from minimum spacing between the diaphragm and magnets, but volume is then limited by the diaphragm hitting the magnet pole pieces.

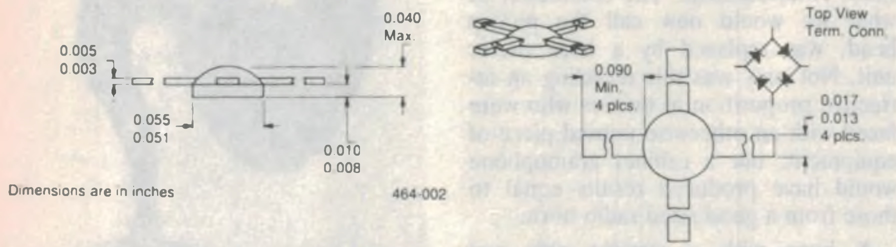
Specialist magnet materials were not available, and to improve on carbon steel magnets, some units used electromagnets energised from the radio's filament battery.

For maximum sensitivity the driver coils were usually connected directly into the anode (plate) circuit of the audio output stage. This meant that anode current flowed through the windings – potentially capable of causing demagnetisation with units having a permanent magnet. The polarity of terminals of horn speakers and headphones was therefore marked, to ensure that they were connected so this current would reinforce the field from the permanent magnet.

Later, when radios with built-in speakers arrived, horns were often used as extension speakers, giving them a reprieve. This has increased the chances of these very collectable items still being found today.

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY



Miniature Schottky diode quad rings

Alpha's new Schottky ring quad consists of four closely spaced Schottky barrier diodes monolithically connected in a planar beam-lead ring configuration for optimum diode matching. This new design reduces the diode junction spacing by nearly a third, thereby minimising the device parasitics caused by overlay capacitance and lead inductance. Both silicon and GaAs versions are available.

These diodes are mounted in Alpha's miniature epoxy covered 464-002 package, a new package with an extremely small base design which contributes further to a reduction in device parasitics.

Alpha's ring quads are designed primarily for use in double balanced mixers up to 26GHz. The small size and reduced parasitics of Alpha's 464-002 package makes these diodes ideally suited for high frequency broadband mixer applications requiring minimum conversion loss. Other applications where these ring quads can be used are phase detectors, modulators, and low power/high speed switches.

Silicon ring quads are available in low, medium, and high drive levels to suit local oscillator designs. A GaAs version is also available for narrowband operation up to 40GHz where minimum noise figure and conversion loss specifications are required.

Further information is available from Benmar International, Level 67, MLC Centre, Sydney 2001 or phone (02) 233 7566

Frequency synthesiser chip cuts radio costs

The National Semiconductor DS8911 phase-locked-loop (PLL) frequency synthesiser enables designers to significantly reduce the cost of electronically tuned radios (ETRs). The device is an up-conversion synthesiser that can digitally tune AM, FM, short wave, weather band and VHF frequencies. The up-conversion design means that fewer external discrete components are required for front-end alignment.

A single voltage controlled oscillator (VCO), operating between 98 and 120MHz, permits tuning of both the AM and FM bands. Cost reductions result from eliminating the AM-tuned circuits and associated matched-varactor diodes and costly labor-intensive adjustments.

The DS8911 also has an on-chip op amp and mixer. The on-chip op amp has an exceptional dynamic range and features a high level of spectral purity, attaining the low-phase noise levels required for AM stereo.

Other on-board components include a programmable divider, a reference chain divider, a phase comparator, a charge pump, a divider generating the AM low signal and the VCO.

The DS8911 is fabricated with a bipolar/CMOS technology, giving users both high-speed and low-power consumption advantages. It offers serial data-entry capabilities and is compatible with any bipolar or CMOS microprocessor. The device typically consumes only 25 milliamps of power during operation (0.5mA at standby).

Besides ETR applications, the DS8911 can be used in a wide variety of digital-synthesis operations, including cordless and cellular telephones.

For further information contact National Semiconductor (Aust), 1 Khartoum Road, North Ryde 2113 or phone (02) 887 4455.

PS/2 – compatible chip set

VLSI Technology, Inc. has introduced a chip set that allows manufacturers to emulate the IBM PS/2 Model 30. The three-chip set, which consists of the VL82C031 System Controller, VL82C032 I/O Controller, and the VL82C033 Disk Controller and Data Separator, significantly reduces the non-memory device count of a PS/2 Model 30-compatible system and improves the system speed by 25%.

In conjunction with the PS/2 Model 30-compatible chip set, VLSI Technology's Logic Products Division introduced a video graphic array (VGA) device that provides the type of high-resolution graphics normally available only in PS/2 Model 50 and higher systems. The VL82C037 Video Graphics Controller is also fully compatible with other models in the PS/2-compatible line, as well as with the IBM PC/AT and PC/XT.

The VL82C031 System Controller provides the dual-speed (8 or 10MHz) control necessary to operate the PS/2 Model 30 at peak performance. It also controls such functions as memory, I/O, parity, address paths, and data paths, as well as handling four channels of direct memory access (DMA).

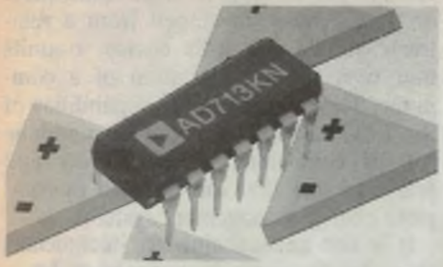
The VL82C032 I/O Controller provides system control of both the keyboard and pointing device ("mouse"), control of two serial communication channels, and control of both disk storage and display functions.

The VL82C033 Floppy Disk Controller and Data Separator contains an analog data separator, phase comparator, filters, and other elements necessary to perform a 765A-compatible floppy disk controller function at up to 500 kilobits per second.

The VL82C037 Video Graphics Controller provides high-resolution, 800 x 600-pixel displays having up to 16 displayed colours. If is fully compatible with the IBM VGA in all modes, and with Hercules graphics.

For further information contact Energy Control International, 26 Boron Street, Sumner Park 4074 or phone (07) 376 2955.

High speed quad BiFET op amp



Analog Devices has introduced the AD713, a new monolithic quad op amp which is claimed to feature the best combination of AC and DC performance available. In addition to settling to 0.01% in just 1μs (10V step) – twice as fast as comparably priced devices – the AD713 offers input offset voltage of 0.5mV and bias current of 40pA.

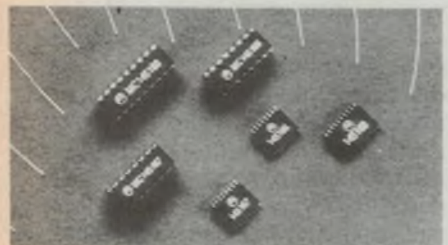
Providing closely matched AC and DC characteristics inherent to amplifiers sharing the same monolithic die, the AD713 saves space, reduces part count, and makes multiple-pole active filters and high-speed instrumentation amplifiers smaller, simpler, and more cost effective. Guaranteed matching characteristics include a maximum offset voltage of 0.8mV, maximum input offset voltage drift less than 25μV/°C (typically 6μV/°C), and input bias current of 35pA.

A low total harmonic distortion (THD) of 0.0003% at 3V RMS also makes the AD713 well suited for demanding multi-channel audio applications.

Other key specifications include a minimum unity-gain bandwidth of 3MHz, slew rate of 18V/μs, high open-loop gain of 400V/mV and minimum common-mode rejection of 84dB.

Further information is available from Parameters, 25-27 Paul Street North, North Ryde 2113 or phone (02) 888 8777.

Dual PLL for 46/49MHz cordless phones



Motorola's MOS Digital-Analog Integrated Circuits Division has introduced the MC14516/0/6/7 series of dual phase-locked loop frequency synthesisers based on silicon gate CMOS technology. The parts are primarily used for synthesis of 46/49MHz cordless phone frequencies, without the use of an external prescaler. Receive and transmit loops are run through two ROM programmable counters with two independent phase/frequency detect circuits. A common reference oscillator and reference divider are shared by the receive and transmit circuits.

The MC145160 series also offers a lock-detect circuit for the transmit loop, illegal code detect, and a buffered oscillator output for mixing. A 4kHz and 5kHz tone output is also included. The MC145160 and MC145166 accept channel programming through parallel BCD inputs. Channel programming through a clocked serial data input makes the MC145167 easy to interface with MPUs.

Key features of these new devices include an on-chip oscillator circuit to support an external crystal, and 3mA at 3V operating power consumption.

For further information contact Motorola Semiconductor Australia, 250 Pacific Highway, Crows Nest 2065 or phone (02) 438 1955.

Enhanced JFET op amps

Voltage drift is not the problem it used to be with TI's new Enhanced junction field effect transistor op amps. Developed by TI's Linear Op Amp Group, these new devices feature low initial offset voltage drift over time and temperature. Enhanced-JFET slew rates, low input bias and offset current.

Pin-compatible with industry-standard JFET op amps, TI's new family consists of two product series: the high speed TL05X and the low power TL03X. Both series offer two offset voltage grades in single, dual and quad units. Additionally, military, industrial and commercial versions exist for both product lines, as well as a number of packaging choices.

Among the packaging options available are small-outline (SO), dual-in-line packages (DIPs), ceramic DIPs and leadless chip carriers.

TI will continue to supply its three existing series of BIFET op amps: the low-power TL060s, low noise TL070s and the general-purpose TL080s.

For further information contact Texas Instruments Australia, 6-10 Talavera Road, North Ryde 2113.

Enhanced laser for FO use

Tektronix has released enhanced versions of its LDM 1550 and LDM 1551 high-output laser diode modules, offering the communications and instrument industries improved transmission efficiency and miniaturisation .

The enhancement is the use of a new fibre for pigtails, which allows low-loss applications at the long optical wavelengths favoured for multiplexed, multichannel applications.

The loss which is reduced is bend loss: signal absorption in fibre sidewalls when the fibre is curved beyond a critical radius. The new material, Corning CFM-28 single-mode glass fibre, sustains significantly tighter bends than earlier fibres without excessive loss.

The LDM 1550 and LDM 1551 are otherwise unchanged. They are laser/-thermistor/monitor-diode modules that offer guaranteed 1mW output power, 1550nm emission wavelength, hermetically sealed packages and low 10-40mA threshold current.

Further information is available from Tektronix Australia, 80 Waterloo Road, North Ryde 2113 or phone (02) 888 7066.

Books & Literature

Shortwave guide

ARTHUR CUSHEN'S RADIO LISTENERS GUIDE, by Arthur Cushen MBE. Published by Athur Cushen Publications, 1988. Soft covers, 300 x 210mm, 108 pages. ISBN 0 473 00560 3. Recommended retail price $22.

New Zealander Arthur Cushen is known to countless shortwave radio listeners around the world, having presented since 1966 a monthly report on Radio Nederland covering reception in the Pacific area. He wrote a column on shortwave listening in *EA* for over 30 years, beginning in 1953, and has also contributed to many other radio programs and magazines throughout the world. He has also represented the BBC as a Technical Monitor in the Pacific region, since 1942, and is National President of the NZ Radio DX Club. So there isn't much that he doesn't know about world shortwave broadcasting and DX listening!

Arthur's first book was an autobiography, entitled *The World In My Ears*, with a section at the rear introducing radio listening as a hobby. In this second book he has concentrated on radio listening almost completely, producing a volume designed not only to introduce the subject to newcomers, but also to provide useful information on various practical aspects.

There are seven major sections, of which the first six deal with radio listening itself while the last provides a profile of the author. The headings of the first six sections give a good idea of the material covered: Shortwave, Mediumwave, Equipment, The Radio Listening Hobby, Programme Listening, The DX Club and Conferences and Conventions. Each section includes a number of chapters.

The emphasis throughout is on a basic practical understanding, with only enough technical information to support this. This would make the book particularly suitable for people without any prior knowledge of radio or electronics, although there's still a lot of useful information for those who are more technically inclined. There's even a small item on active aerials, contributed by *EA*'s current vintage radio columnist Peter Lankshear.

Copies of the book are available in Australia from Technical Book and Magazine Company, in Melbourne, although Arthur Cushen can also supply them directly from New Zealand by mail, for $A22. His address is 212 Earn Street, Invercargill 9501. (J.R.)

Logic Controllers

PROGRAMMABLE CONTROLLERS: OPERATION AND APPLICATION, by Ian G. Warnock. Published by Prentice Hall, 1988. Soft covers, (student edition) 235 x 175mm, 447 pages. ISBN 0-13-730037-9. Price $39.95

Since their introduction in the early 1970's, programmable logic controllers or 'PLCs' have developed from a relatively simple, no frills device to units that rival the sophistication of a computer. The increase in the capabilities of the PLC has taken it from its mundane roll of controlling a few motors and relays to one that can be used in complete energy management systems.

It is not unusual now for technicians to write the controlling program for a PLC on a personal computer, typically an IBM, and to download this program to the PLC. As well, many PLCs now incorporate analog input and output functions, allowing the direct connection of transducers in the control system to the PLC. Throw in the capability of PID (proportional-integral-derivative) control, and the facility of communication via a serial port to other PLCs, and you have a very complex device.

So where do you start? Obviously, today's technicians need not only to understand control systems and computers, but they need to be able to program a PLC in one or another of the various languages typically used.

It seems that this book is a pretty good place to start. It is up to date, covers everything and does it in a reasonably accessible manner. Chapter 1 starts with a review of a control system, and also covers some basics such as a quick review of logic elements, relays and computers. Chapter 2 is where the PLC bit starts, and presents details on the structure and operation of typical PLCs. Various types are described, although the Mitsubishi types seem to feature somewhat.

Chapter 3 describes typical software facilities, and includes the principles of ladder programming and functions such as timers and data handling. Chapters 4 and 5 continue this theme but expand into flowcharts and sequential control tasks. The remainder of the book comprises four more chapters which examine analog I/O, PID control, serial communications, LAN networks, typical PLC applications and so on. There is even a section on robotics. The appendix contains selected manufacturers' data on various PLCs, including three from General Electric and two from Mitsubishi.

The book is aimed at those studying at post-trade or technician level, and would also be useful to undergraduates. It is practical, and contains numerous photos, diagrams and examples. And above all, it deals with current technology. The review copy was supplied by Prentice Hall Australia.(P.P.)

EA MINI ADS

Cap meter

continued from page 85

The zero adjust pot is fairly easy to use, being critical only when you're on the 200pF range and cancelling out the last 0.1 of a picofarad. The 20pF range of the control also makes the instrument quite suitable for measuring not only small fixed capacitors and trimmers, but PCB and wiring strays as well.

Mind you, we found that the two clipleads supplied with the instrument aren't really ideal for measuring strays – they're rather too long and floppy, making it difficult to zero out their own inherent self-capacitance. But it should be quite feasible to make up a custom probe, using a short length of low-capacitance co-axial cable, that would get around this problem. It should then be quite suitable for measuring strays down to the 1pF level.

In short then, we found the Q-1222 a nice little instrument, and one that should be quite an asset in any lab or workshop involved in either servicing or circuit development. Its measurement range is rather wider than the capacitance ranges provided on some DVMs, too, which should go at least a fair way towards justifying its cost as a separate and dedicated instrument.

The price quoted is $129, by the way, and the Q-1222 is available through all Dick Smith Electronics stores. (J.R.)

Remote control

continued from page 82

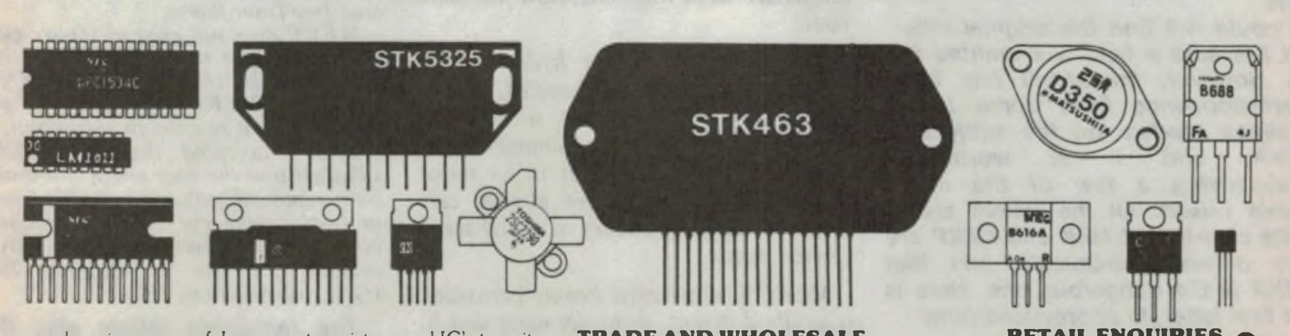
As already mentioned, the maximum load for each channel is 500VA. Although a heatsink would raise the load capability, it also increases the danger, as the metal tab of the Triac is connected to the active. If you decide to add a heatsink, insulate it from the Triac. However, 500VA should be adequate for most uses.

For test purposes, use a table lamp or similar, and run through the checks again, this time using the lamp to indicate correct operation. Check all channels, and confirm that the timer (if used) gives a delay of around 8 to 10 minutes.

The next and final stage is to hook up the receiver/decoder PCB to the power supply from the mains interface, and to also connect each channel to the decoder outputs. The whole thing can now be housed in a suitable enclosure, and the transmitter used to confirm that everything works properly. If so, great.

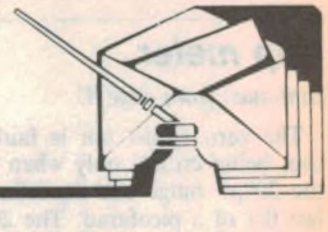
If not, Oatley Electronics will help you. This whole project is relatively complex, and despite the effort put into its design, may give problems to the less experienced constructor. We know it all works, and very well besides.

So if your project doesn't work, bring or send it to Oatley Electronics and they will fix it for you for a small fee (minimum of $15). Naturally, the firm reserves the right to refuse any kit sent back for repair, if it has poor construction or components damaged due to wrong insertion.



Information centre

Conducted by Peter Phillips



MEK, MIDI and requests

The hot topic this month is clearly the MEK versus MEKP controversy. We also review an IBM MIDI software package for our Universal MIDI interface and answer a few questions. But first a request...

It is always gratifying to get letters from readers, as it proves not only that *EA* is being read, but being read very carefully. Correspondence from readers takes many forms, but the most common type is that asking for technical advice. Hence this section of the magazine.

We try very hard to answer all letters as soon as possible, but there are a few reasons which can delay things. Like the letter recently which asked 'I've just completed the amplifier project in your magazine. Why doesn't it work?' Or the letter which starts by saying 'I realise this project was published a few years ago, but...' and ends by giving the date of the project as 1965.

We have problems answering letters like these, for obvious reasons. Most letters conform to the requirements listed in the Reader Services box (last page) and the *EA* staff all try to answer letters as quickly as possible. But remember that letters without the $5 fee are answered only in these columns, and then only if we think they are interesting to other readers.

But the letters that we really could do without, (fortunately the minority) are the rude ones. I don't mean letters with expletives, I mean those that are high handed and even abusive.

For example the phrases 'you are most dishonest in ...' or, 'I expect you to at least...' or 'I am only a dumb reader...' are mild compared to some we receive. The facts are, we try our best to produce an informative magazine each month. Sometimes we make a mistake, sometimes we make several mistakes. Fortunately few of our mistakes are life threatening, and we certainly try not to be dishonest. Correct us please, but we are only human and prefer the corrections to be polite.

And sometimes we are so busy getting the magazine to the presses, that letters take a bit longer to answer than we, or you, would like. All I can say here is that we will answer all letters (that are accompanied with the $5 charge), and the more help you can give us, the quicker will tend to be our reply.

So, having got that off my chest it's on with the show. First is the MEK/-MEKP conflict.

MEKP

We received five letters all commenting on a letter to the editor by Max Riley (VK2ARZ) in December '88 concerning the chemical MEKP. This letter included an extract from the Aviation Safety Digest, which went on to outline the dangers associated with MEKP. Unfortunately, the letter by Max Riley was printed as saying the chemical in question is MEK.

I could not find the original letter, but I'm sure a typo has omitted the 'P'. However, the result has been correspondence from some highly qualified readers on the subject of MEKP, and it is worthwhile summarising a few of the major points raised. All the letters stated quite clearly that MEK and MEKP are very different chemicals, and that MEKP is the dangerous one. Here is the first letter, in abbreviated form:

The dangers of an industrial chemist commenting on electronics are quite clearly shown in Forum (Dec '88) but similar dangers of radio types commenting on chemistry are not quite so apparent.

For example - Oct.'87: article titled 'Low cost techniques for making PCBs', where the author suggests the use of caustic soda and MEK. Dec.'87: letter 'concerned' at hobbyists using these chemicals, Mar.'88: author's defence of this. And then a letter in Dec.'88 warning users to avoid MEK, with an extract on MEKP as to why. OK, now for some facts:

Caustic soda (sodium hydroxide) is dangerous if incorrectly handled, but is safe enough for domestic use. MEK (methyl ethyl ketone) is a flammable solvent similar to acetone. It is no more dangerous than the petrol anyone can obtain in large quantities at a self-serve service station.

MEKP (methyl ethyl ketone peroxide) is totally different, decidedly nasty and is sold only for hardening polyester resins. It is not intended for use as a solvent. (R.V., Mt. Waverley, Vic.)

This letter continues with the comment that subjects outside the expertise of the writers should be verified by experts of the field, particularly where a danger could exist. The second letter is a bit more technical, and also picks up the mistake of associating MEK with MEKP.

MEK has the chemical composition of (C_4H_8O), has a flash point of 1.9°C, and must be used only in a well ventilated area free from flame.

MEKP does not exist as a pure chemical, but can be represented as a mixture of chemicals (H_2O_2) + ($C_4H_9O_4$) + ($C_8H_8O_6$). MEKP decomposes at about 60°C before it reaches its flashpoint. It is generally accepted that if MEKP is splashed into the eyes and if not immediately removed with an eyewash fountain or bottle – the eye will be permanently blind within 25 seconds. It is totally unsuitable for use in cleaning PCBs. (G.B., Greystaines, NSW)

The remaining letters also detail the dangers associated with MEKP, but agree that MEK is safe enough providing good ventilation is used,

and there are no flames in the vicinity. Here are some highlights from these letters:

The reactive nature of MEKP is due to the presence of the peroxide chemical bond which reacts violently with organic matter or metals. Another well known peroxide is hydrogen peroxide – often used in diluted form as a household bleach and disinfectant, but also used, in concentrated form, as a rocket fuel!

MEK will sting like hell if it gets in your eyes, but no permanent damage should result if it is washed out quickly with water. (R.H., Port Elliot, SA)

Another hazard of MEKP and other organic peroxides is that users are sometimes required to mix both peroxide catalyst and accelerator (e.g. cobalt octoate) to a styrene based polyester resin. If these are not sequentially diluted in the resin, but mixed together, an explosion and fire may result.

A totally different situation exists with MEK. This chemical is flammable, toxic and will cause eye damage, but not as acutely as MEKP. Three cautions in the use of MEK, MIBK and acetone (all commonly related ketones) are risk of dermatitis, narcosis and delayed explosion of improperly stored waste.

Most people will eventually suffer dermatitis after habitual skin contact. Inhalation of sufficient vapour will cause intoxication which could lead to fatal errors of judgment, violent behaviour and even unconsciousness.

The presence of alkali in a mixture of ketones and chlorinated hydrocarbons, such as could occur in a waste dump can cause delayed explosions. These wastes should never be mixed. (J.N., Curtin, ACT)

My experience with MEK over a period of twenty years was gained in its use as a solvent in making printing ink for PVC insulated electric cables. Subsequent to this, I have had a further six years experience with MEK being used as a cleaner for certain types of stains. MEK is also one of the ingredients in a proprietary paint stripper.

Providing adequate ventilation and precautions against flames are observed, I can see no reason against the use of MEK, if ordinary care is taken. (I.P., Mangawhai, NZ)

• From all this, readers should fairly quickly get the idea that MEKP is highly dangerous and should be avoided. MEK is not to be trifled with either, but the consensus of the writers seems to be 'OK if used with caution'.

The typographical error in our printing of Max Riley's letter may not have been such a bad thing after all – considering the learned responses we got. It's also rather surprising how many chemists read *EA*!

The next item is actually my review of an IBM MIDI software package for use with the *EA* (Feb.'88) Universal MIDI interface. The package has been developed by John Loftus, who has supplied us with a sample copy for review purposes. Here's what I found...

MIDI for the IBM

The *EA* MIDI interface (Feb. '88) was designed to be a cheap, universal MIDI out device, for use with any computer having a parallel output port. But the MIDI hardware is only part of the problem, and suitable software to go with such a project is usually the main limitation confronting enthusiasts.

The alternative for those wanting to get into MIDI is to purchase a commercial interface with commercial software, usually with an all-up price tag that is hard to justify except for professional use. So when a low cost software package supporting our low cost MIDI interface arrives, it is difficult not to get excited.

The package is called *Maestro*, and has been written for the IBM PC/XT, AT or compatibles. It requires 512K of RAM, a CGA colour screen and either one or two drives. The cost of the software is $35, which includes an excellent manual and some sample tunes.

I ran the package on my AT, connected via the MIDI interface to a Yamaha PF70 keyboard. Coming from the Apple stable, I immediately reached for a mouse when the menu screen appeared. It didn't take me long to realise that each selection is made by typing the first letter for that function, and before long *Fur Elise* was playing on the Yamaha.

OK, the MIDI out works, but what about some creativity? Because the interface doesn't have a MIDI in facility, any music from my hands would need to be written from the computer keyboard. And here Maestro is excellent.

I have worked with numerous music packages over the years, and often get frustrated when I find I cannot write what I really want. With Maestro, you can place a note anywhere within the bar, and give it a volume level independent of any other. This way, an accidental can be simply that, not some contrived variant of a triplet or whatever.

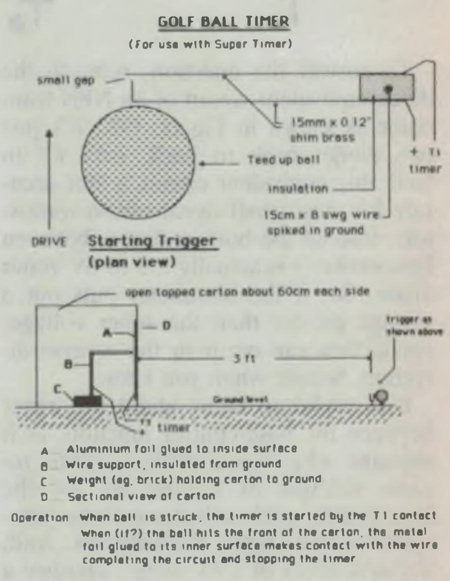
The music editor in Maestro is a form of text editor, in which each line of text details the note, its placement in the bar, duration, volume and so on. A three-note chord would take up three lines. A graphics display then allows the text to be shown as musical manuscript, which usually makes more sense to a musician.

We don't have the space to run through all the features of Maestro, but I am delighted with the package and can only recommend it in the most glowing way. It has a few minor quirks, and takes a bit of getting used to. However, the manual is well written, and it doesn't take long to be up and running with MIDI on the IBM.

Readers wanting to purchase the package should send $35, and state the size disk required (3.5" or 5.25") to John Loftus, 10 Lorient Court, Petrie, Queensland, 4502. This is probably the cheapest MIDI software around, and represents excellent value.

Super timer update

The next letter comes from Ian Page, designer of the Super Timer published in EA (Dec '88). Ian points out that the distance of 3" in the second last paragraph on page 74 should have read 3'. He has supplied also details of how to measure the speed of a golf ball, and the diagram of a suitable contact arrangement is shown in Fig.1. His letter, in part, is as follows:



As shown in the diagram, one set of contacts starts the timer (T1) and another stops the timer (T2). The T1 contacts get a caning each time the golf ball is hit, requiring them to be straightened out after each shot. The carton holding the T2 contacts is also only good for about four shots. However, this arrangement is simple, and may allow someone to practice their golf drives.

Information Centre

Why??

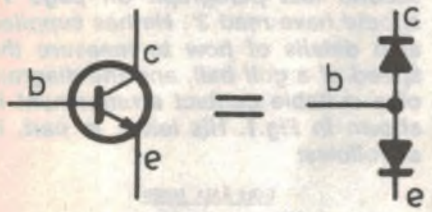
In an attempt to soothe my neighbours, I agree to turn down my hifi so that instead of it delivering 50W of audio power to the speakers, it will only deliver 25W.

Why are they still complaining? After all, the output power has been halved!

Answer to last month's Why??

Last month we asked why a known good small-signal silicon transistor shows conduction between its collector and emitter terminals, (collector negative) and conduction both ways across its base-emitter junction when tested with an AVO 8 ohmmeter.

The first point you need to know is that an AVO 8 ohmmeter, on its R x 100 setting, puts out approximately 9V across its test probes. Unusual perhaps in today's climate of DMMs, where 1V is considered high.



To answer the question, refer to the diode equivalent circuit of an NPN transistor as shown in Fig.xx. OK, it's just two diodes back to back, isn't it? In fact, this equivalent circuit is not accurate for most small signal silicon transistors, instead the bottom diode (between base-emitter) is actually a 5 to 6V zener diode. So, if the ohmmeter puts out a voltage greater than the zener voltage, conduction can occur in the reverse direction. Simple when you know.

It is useful to know about the zener between the base-emitter junction, as it explains why manufacturers quote reverse voltages of around 6V for the base-emitter and collector-emitter junctions for these types of transistors. And, if you're short of a 6V zener, sacrifice a transistor – they work well!

Vintage radio

The following letter concerns a battery operated vintage radio. My answer follows, which readers may note is somewhat cautious. I am not an expert in this field, and any comments from those who really know would be welcomed.

I have recently purchased, for restoration, a Kreisler Broadcast radio, Vibrator model, that requires a 6V 'A' battery. The radio is dated at around 1947.

Other people suggest the radio runs off a 6V car battery. Is this correct? Also, when I approached the task of changing all the capacitors in the set, I found that the originals were stamped as being 'non-inductive'. The capacitors were made by Chanex (Ducon), and I am wondering if these capacitors can be replaced with modern high voltage equivalents. (J.C., Bendigo, Vic.)

• In the very early days of radio, I seem to recall that batteries for radios were usually known as the A battery for the valve filaments, B for high voltage (B+) and the C battery for bias. It would seem to me, in the absence of a mention of either a B or C battery, that the radio in question is similar to a car radio from this period, in that the B+ voltage is derived from the same voltage supplying the filaments.

This was achieved with the 'vibrator', which was an electro-mechanical equivalent of a DC-DC converter. Here, the incoming DC is chopped by the vibrator, transformed up to a suitable voltage, then rectified usuallywith a diode valve. If this is the case, then you sure will need a car battery. I recall such a radio in my first car, which used to flatten the battery after about an hour of operation. The 12V versions were better, but the 6V types horrendous.

The 'non-inductive' capacitors refer to a type of construction which is normal practice today anyway. It means that the start and finish of the foil winding must not be the terminals of the capacitor, Instead, the foil windings are offset. Then one terminal can contact all layers of one foil at one edge, while the opposite edge of the other foil contacts the second terminal.

This means that you can use any conventional high voltage capacitor (400V) without problems. A polyester type is probably as good a choice as any. Please correct me if I'm wrong, all you radio restorers.

NOTES AND ERRATA

REAL WORLD INTERFACE

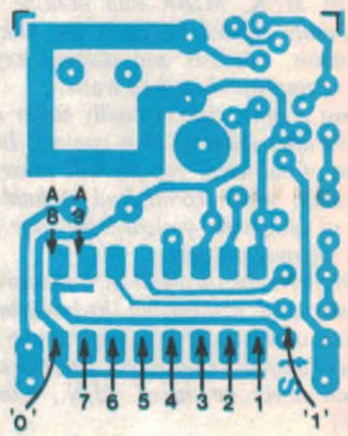
(December 1988): There are three minor errors in the PCB artwork as published on page 107 of the magazine. There is a small 'blob' between the pads for the two links connected to pins 10 and 11 of IC1, causing an unwanted bridge. Also, the pad on the upper side of C13 is very close to another track, and the magazine printing process has caused them to merge together. Finally, the track from pin 12 of IC3 which connects to a link should be connected to pin 11 of IC3, not pin 12. Corrected copies of the artwork are available from our Reader Services department for $4.50. (File 2/CC/101).

2 CHIP FM RADIO

(June 1988): There are two capacitors labelled as C6 on the overlay and circuit diagram. The 150pF one connected to pin 12 of IC1 should be labelled as C7 instead. Also the connections to the two ends of the volume pot have been transposed on the overlay diagram. (File 4/MC/7).

PCB SHORT TRACER

(February 1989): It has been drawn to our attention that the 50 ohm miniature trimpot specified for RV1 may be difficult to obtain. However, the circuit works quite well with the more readily available 100 ohm value. (File 7/MS/22).



SINGLE-CHANNEL UHF TRANSMITTER

(January 1989): The diagram of Fig.1 in EA January 1989, page 113 has the PCB artwork shown incorrectly. This diagram was intended to show how the coding is applied to the transmitter. The diagram should have appeared as shown.

The required code for the transmitter is applied by connecting the various pins to either a logic 1, a logic 0 or leaving that pin open-circuit. A logic 1 and a logic 0 are available on the PCB as indicated. (File 2/MC/29)

PC DRIVEN FUNCTION GENERATOR

(January 1989): In program listing 3, lines 200 and 210, variable 'PI' should be 'PI!'. (File 7/AO/40)

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.

RADIO, TELEVISION and HOBBIES

March 1964

Construction of the world's largest radio telescope: The world's largest radar-radio telescope is currently under construction in a partly natural, partly artifical spherical hollow, (approximately 1000 feet across), in the hills 12 miles south of Aricibo, Puerto Rico. This site was chosen for several reasons. It is within 18 degrees of the equator, which makes it possible to scan the ecliptic in which the sun and the planets move. The temperature varies very little, so structural materials would not be greatly affected by climatic changes. The sheltered area among higher hills is protected from heavy winds, and the location is relatively remote from sources of man-made interference.

Its chief purpose is to study the ionosphere. Professor William Gordon of Cornell University believes that the changes in the ionosphere can be studied by the back-scattering of free electrons from the various layers at UHF. This would make it possible to measure electron density and temperature, determine auroral ionisation and detect transient currents in the ionosphere.

Photoconductive cells: One of the most intriguing devices developed by solid state engineers is the photoconductive cell, based on Cadmium Sulfide and similar materials. In addition to simplifying conventional 'photo cell' applications, these cells have characteristics which make possible a whole new range of applications, from photography to space travel.

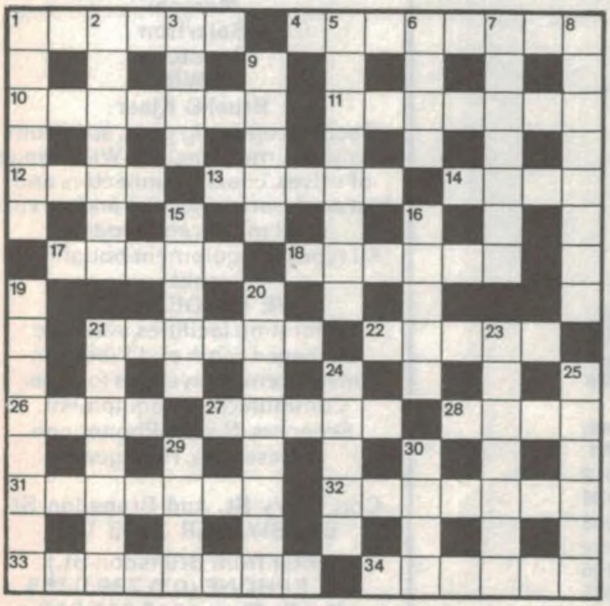
One of these applications is in the new Polaroid Land Model 100 Camera. For the first time, a truly electronic shutter has been designed for a camera, using a photoconductive cell to measure both normal light, and the brief light of a flash bulb, automatically. This makes the camera fully automatic under all conditions. Even a child can take perfectly exposed pictures every time.

Tunnel diode: One of the newest products of the electronics industry, the tunnel diode, is bringing about a revolution in computer design. With a switching time of one nano-second – one thousand-millionth part of a second – tunnel diodes look like dominating the design of third-generation computers, with speeds approximately ten times today's sophisticated designs.

MARCH CROSSWORD

ACROSS

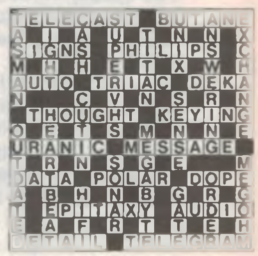
1. Name for electrical energy source. (6)
4. Enthusiastic constructor. (8)
10. Circuit pattern. (7)
11. Undesirable modulation of frequency. (7)
12. Prefix meaning "all", used in antenna terminology. (4)
13. Shocks. (5)
14. Kind of aerial. (4)
17. First name of pioneer of light dispersion. (5)
18. Units of energy. (6)
21. Type of computer. (3-3)
22. Name of an electromagnetic radiation. (5)
26. Prepare a PCB. (4)
27. Section of recording tape. (5)
28. Single time. (4)
31. Value of hecto factor. (7)
32. Set of instructions. (7)
33. Analogy of emf. (8)
34. Complement of 1 across. (6)



DOWN

1. Stationary winding. (6)
2. Inventors' rights. (7)
3. Word associated with hum. (4)
5. Frequency of tuning? (3,3,2)
6. Unit of data transmission rate. (4)
7. Places for info awaiting processing. (2-5)
8. Ring-shaped. (8)
9. Sliding contact on electric train. (5)
15. Light emitters. (5)
16. Reset calculator. (5)
19. Such is quality investment in microelectronics! (4-4)
20. Location for narrow-beam PIR sensor. (8)
21. Document for operator. (7)
23. Name of OTC's electronic mail system. (7)
24. Alternative abbreviation for a CRO. (5)
25. Transmitted a highly directional signal. (6)
29. Aperture control. (4)
30. Region of antenna radiation. (4)

SOLUTION FOR FEBRUARY



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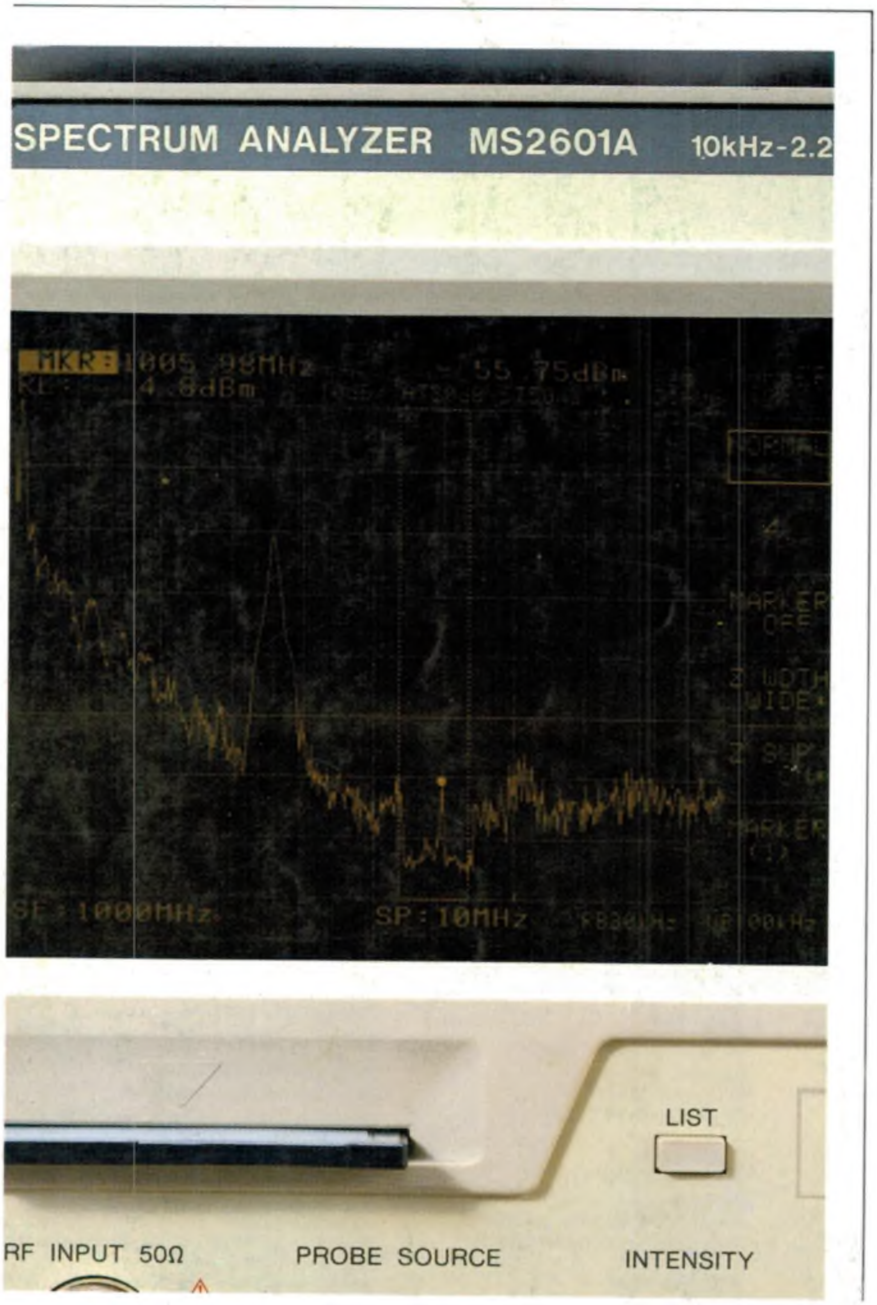

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