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June 1991

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

UNSW researchers develop 4.8kbps codec

Researchers at the University of NSW have developed what is believed to be the world's first single DSP full duplex codec, for sending speech on 4.8kbps data circuits. It's believed to have a great deal of potential, especially with the growth of ISDN — see page 101.

Marine radio changes: good or bad?

Next month, Australia's network of coastal base stations to support marine distress channels swings from the traditional MF to HF channels. Many boat owners are worried about the effect on communications reliability — see page 28.

On the cover

Our new Quad 'DI' Box is ideal for connecting a bank of electronic musical instruments to a standard mixing console, for recording or stage work. Low in cost, it's also easy to build. See our story, starting on page 64. (Picture by Greg McBean)

Video and Audio

Features

Projects and Technical

Professional Electronics

Columns and Comments

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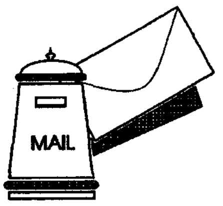
LETTERS TO THE EDITOR



Listening Post II

I read with interest your article on the Listening Post II, actually it seemed that you contributed to the development of the product through your 'Review'.

One point I would like to bring up is that the printout on page 83 has Australia completely coloured in, in black, and thus obscuring all details of weather information over the entire continent which is probably the primary reason for wanting the weather fax in the first place. I hope you can clarify if this is how all printouts will appear or is there an adjustment to alter the pattern or reception to eliminate this problem.

I live aboard and have an OCT 286-12 computer that I run off a 300W inverter. I have noticed that the power supplies for computers, and I suppose, printers as well, convert 240V AC to 12V DC.

Would it be possible to run my computer, screen and printer directly from 12V, thus saving me the added power drain of having to run the inverter.

Rogin Taylor,
Airlie Beach, Qld.

Comment: The LP II kit simply receives whatever images are being transmitted, Rogin. The image we reproduced just happened to be a 'windwave prognosis' — others have the country in outline for seeing clouds and isobar contours, etc. It is feasible to run computers, monitors and printers from 12V DC, but quite a lot of modification will be needed in most cases.

FM signal distribution

I refer to the Forum section (p48) in the March issue of *Electronics Australia* magazine, where you mention the means for distributing the ABC's FM programme material from the Adelaide studio to its other studios.

The actual method used up until the ABC changed over to using AUSSAT was by analog FDM (frequency division multiplex) transmission. This involved carrying the signal along with normal telephony and other traffic on Telecom's broadband microwave radio and coaxial cable systems.

Once it left the other studios, it was normally carried along with the regional TV video signal on a digitally modulated sub-carrier above the analog vide signal to their regional TV transmitter.

In most states, the ABC now distributes its regional TV signal via transponders on AUSSAT satellites. The FM sound signal is carried on supplementary channels provided as a part of the B-MAC encoding process.

Roger Woodward,
Sydney

Comment: Many thanks for the correction and further information, Roger.

Misleading graphs?

Thank you for publishing my letter in your February 1991 edition. Thank you also for the comment.

I must confess to error in respect to the second graph, that with the decibel scale. Please accept my apologies.

In relation to the first graph, you point out that it was supplied by Kodak. That is no more than I assumed to be the case. I would expect a commercial enterprise to endeavour to present its products in the best light, as indeed is its right.

For this reason I exercise caution with regard to claims published in advertisements or glossy handouts. I do not expect magazines, however, which perform a valuable advisory role for consumers (not that the particular production in question is actually a consumer item) to present products in their best light on behalf of manufacturers. I rely on publications such as yours to provide information about products in a clear and informative way.

The use of an 'offset zero' is not the ideal way to present graphs — not if you are trying to convey an accurate representation of fact at any rate. Graphs are useful for one specific purpose (otherwise tables of figures would suffice): they give the viewer a feel for figures, trends and relationships.

They do this by appealing to an 'older' part of humanity than our reasoning brains — they appeal to that part of us that allows us to judge spatial relationships, an ability much older in evolutionary terms than the ability to manipulate numbers.

This atavistic appeal breaks through the defences of even those who reject mathematics as 'too hard' while those who understand the subject are also grateful, for the supporting figures would in any case have to be converted into the psychological equivalent of a graph to be actually understood.

The graph you reproduced very effectively allows the reader to grasp a relationship: a wrong one! To notice the error the reader has to re-engage his or her cortex and discover, in perhaps five point print, the scaling problems I complained about.

In some cases the ideal graphing techniques have to be dispensed with for practical reasons. This is typically because the variation between the items being shown in the graphs is small compared to the magnitude of those items. In such cases it is wise to clearly mark the break in the scale, not only on the scaling line but also, in this case, on the bars of the graph itself.

This graph not only fails to show that, it actually uses equal physical intervals on the vertical scale along with a zero at its base in such a manner that it was either intended to deceive or was assembled by someone who has little knowledge of proper graphing techniques.

The combination of a linear scaling of the top part and the near infinite scaling of the bottom part means that one octave (and, being the highest frequency octave, arguably the least musically significant) is spread across five sixths of the vertical scale compared to the nine other audible octaves (along with an undefined number of infrasonic octaves) compressed into one sixth of the scale.

You point out that it is 'not unusual' to use such graphs. Indeed it isn't. That is one reason why Scientific American has in recent months in its 'Mathematical Recreations' column been conducting a compaign against all forms of misleading 'mathematics', including what it refers to as 'chart abuse.'

A truly informative graph by Kodak would have been to show three superimposed generalised frequency response graphs with a logarithmic horizontal frequency scale.

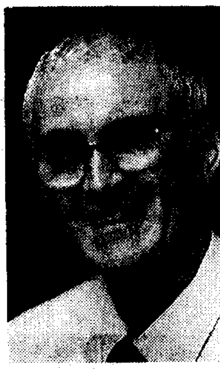
Of course, you could not publish a graph with which you had not been supplied. Perhaps then you should simply have refrained from publishing the graph that you were supplied with.

Stephen Dawson,
Duffy, ACT.

DROP US A LINE!

Feel free to send us a letter to the Editor. If it's clearly expressed and on a topic of interest, chances are we'll publish it. — but we reserve the right to edit those that are over long.

EDITORIAL VIEWPOINT



Pay TV — a good thing or not?

I must confess to having mixed feelings about both pay TV itself, and the Hawke Government's recent decision to defer indefinitely its introduction here. That's why I haven't commented on it until now.

On one hand, we have two of our three main commercial TV networks in serious financial difficulty (although due largely to foolish decisions by those who previously owned them), and the third having had to tighten its belt considerably in order to regain full viability. This perhaps suggests that the *last* thing Australia needs is further competition in terms of video programme delivery, at least for a while.

I for one also have doubts that those in charge of managing our broadcasting policy would be able to plan the introduction of pay TV in a way that wouldn't result in further damage to regional broadcasters, or result in an even further concentration of media ownership.

But on the other hand, we also have a situation where the traditional TV broadcasters seem in many ways to have become bogged down in a common mire of formula escapism, leavened only by a depressing stream of 'we'll all be runed' documentaries. There seems to be a surprising dearth of real programming diversity, and perhaps this results from what is essentially a 'provider driven' market rather than one like pay TV that is closer to being 'consumer driven'.

We also have an almost moribund local electronics industry, which might well be able to take advantage of the introduction of pay TV — not just by developing and building competitive consumer equipment for satellite TV reception, but also by supplying the studio and transmitter equipment to the new programme suppliers and stations that would spring up. In short, pay TV might just provide the 'shot in the arm' needed to revive the industry.

But it looks like we're not going to have the opportunity to find out, at least for a while. On the whole, I think that's a pity.

A few changes...

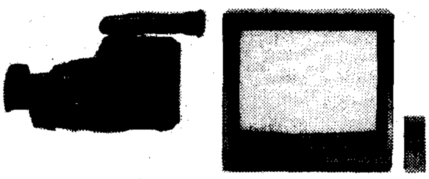
By the way, with this issue we've made a few changes to the internal order of things in the magazine. Nothing very major, I hasten to add. They're mainly re-arrangements, to provide a better 'focus' for the material published primarily for those readers who work in the industry, as well as having a general and/or hobby interest in electronics.

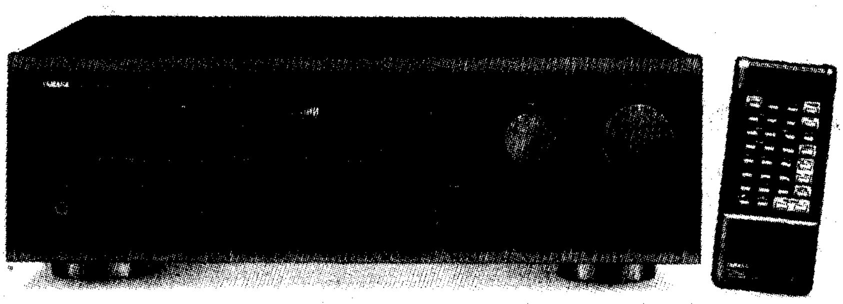
You'll find that our former 'Workstation' section has been renamed 'Professional Electronics', and enlarged to include not just computer-related material, but also News Highlights, Solid State, Silicon Valley Newsletter and other regular features directed largely to the professional reader.

I'm sure that a lot of this same material will remain of interest to the general reader, of course. But you'll now find it grouped together in the one area, rather than spread throughout the magazine.

Jim Rowe

What's New in VIDEO and AUDIO





New Yamaha amp features 'total purity'

Yamaha's new AX-550 integrated stereo amplifier is said to embody the firm's 'ToP-ART' (total purity audio reproduction technology) design policy, directed at providing the purest possible signal output. Features of the technology include a shorter and more direct signal path, a 'pure direct' switch which bypasses all internal filters and controls (apart from volume), a direct ground sensing circuit and all signal wiring in thick PCB tracks equivalent to 1.6mm diameter wire. Rated output power from the AX-550 is 85W RMS minimum per channel, with 135W peak into 8-ohm loads. Frequency response is 20Hz to 20kHz within 0.5dB, while the signal to noise ratio for CD and other high level inputs is 110dB in the 'pure direct' position.

The unit features a large power transformer, 12,000uF of reservoir capacitance for each channel and twin heavy duty heatsinks. It also comes with a wireless remote unit which operates not only the volume control, but the motorised input selector switch. The volume control is also motorised, this approach being used in preference to electronic switching because of the lower signal degradation.

The major functions of RS compatible CD players, cassette decks, tuners and turntables can also be controlled using the AX-550's remote unit.

The AX-550 is now available from Yamaha dealers.

Australian made light flasher/chaser

Victorian manufacturer Dynamite Marketing has released its latest product, the 'Lightning 64'. This audio chaser, with four outputs capable of handling 1000 watts per channel or a total of 2400 watts, has been designed to cater for resistive and inductive loads with zero switching. It will flash lights to the beat of the music, or by 'music modulation', or it will 'chase' from zero to 20 second intervals automatically through an array of 64 different patterns.

The 'speed' control adjusts the rate at which the lights flash, while the 'sound' control adjusts the level of music sensitivity. The 'All On' function gives the operator the opportunity to overide the controls and have the lights full on without flashing. The unit is user friendly and has many applications such as in hotels, restaurants, shop displays, party hire shops, school stage productions and for domestic purposes, to flash lights outdoors and indoors and even flash the lights inside swimming pools.

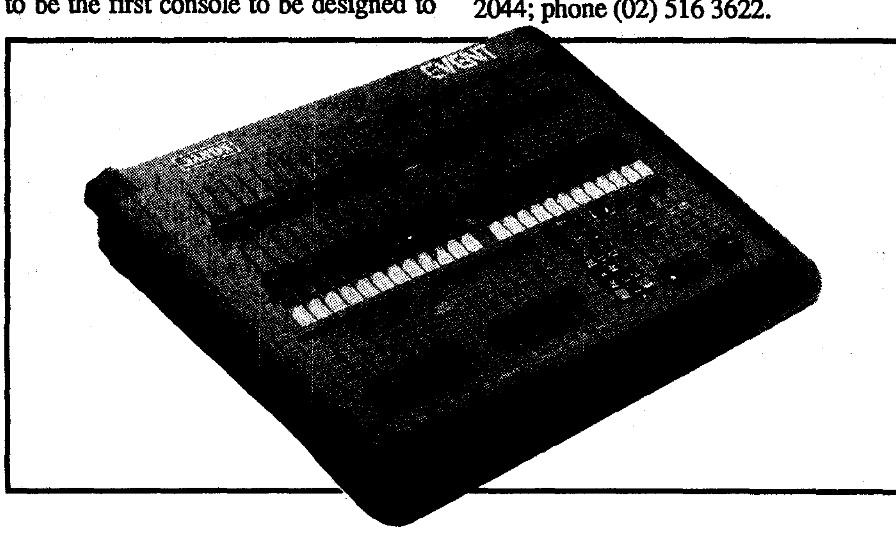
For more information circle 182 on the reader service coupon on contact Disco World, 300 Main Street, Lilydale 3140; phone (03) 735 0588.

Computerised lighting control console

Jands Electronics has released the EVENT, a computerised lighting control console available initially with 24 or 36 channels.

Based on a 68000 microprocessor (the same chip as used in a Mac Plus) running at 10MHz, the Event has a DMS-512 output, a midi input and a range of peripherals such as a VDU, a memory card, and analog outputs. But the Event offers much more than this; it is claimed to be the first console to be designed to work the way lighting operators work by providing a degree of flexibility. Major features include the ability to operate as a single preset console to provide double the number of channels; the ability to record up to 498 memories (a.k.a. scenes); and the ability to assign all memories, chases, pages and files with an eight character alpha/numeric label. Memory and chase labels display in the LCD window above the master faders.

For further information circle 181 on the reader service coupon or contract Jans, 578 Princes Highway, St Peters, 2044; phone (02) 516 3622.

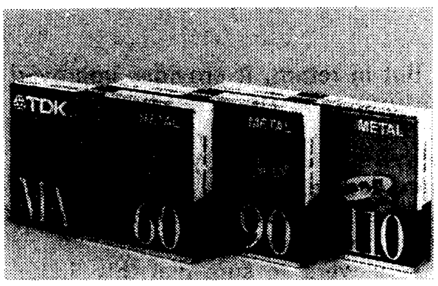


New metal tape from TDK

TDK has announced a new metal tape to supplement its metal position/type IV tape line up. The introduction of the new MA was brought about to meet the increasing demand for a greater choice of 'metal position' or type IV tapes.

Fitting in behind TDK's MA-X and its flagship MA-XG, the new MA is available in 60, 90 and 110 minute playing times with a starting price of $6.95 for the MA-60.

TDK engineers have managed to reduce particle size, obtain a more uniform particle dispersion and a higher packing density, all of which contribute toward the exceedingly high magnetic specifications for the new MA.



Coercivity, an important factor in determining a tape's high frequency output is 92kA/m (1160 Oe).

Both the low frequency MOL and bias noise have been improved, with the end result that the dynamic range over the entire frequency range is claimed to have been increased from between 0.5dB and 1.0dB over the previous MA.

To achieve precise phase accuracy, TDK has designed a unified two layer anti-resonant cassette mechanism.

Further, modulation noise due to vibration of the cassette mechanism is said to have been reduced by using specially selected anti-resonant materials in the cassette halves.

New series of loudspeakers from B&W

B&W Loudspeakers has introduced three new loudspeakers, which carry many features of the firm's 'Matrix' models but with wide appeal and at a lower cost.

The 600 series continues a recent B&W innovation, that of installing the drive units into a stylised 'high tech' polymer compound moulded front baffle. This is claimed to improve not only the appearance but also make for a more rigid cabinet.

All 600 series models use the latest metal dome tweeter, originally developed for the highly successful Matrix 801 Studio Monitor. The tweeter has been specially designed to permit higher power handling.

An integral feature is a newly developed magnetic cooling fluid, which combats compression by reducing the temperature of the delicate voice coil.

The 600 series additionally provides for bi-wiring and bi-amplifier operation.

Two sets of top quality gold plated terminals allows individual access to both the high and low frequency drive units.

The new DM620 has a 30 litre floorstanding cabinet, 200mm reinforced polypropylene bass unit and provides augmented bass response via a 200mm passive drive unit.

The DM630 is in a 62 litre floorstanding cabinet, and uses two active 200mm reinforced polypropylene bass/mid units, while the DM640 is in a 59 litre floorstanding cabinet and features a 160mm Kevlar midrange unit mounted in a separate acoustically isolated subenclosure from the two 200mm Cobex bass units. The DM640 also provides augmented bass response via rear facing variable tuning port. All B&W Loudspeakers are covered by a five year parts and labour warranty.

Additional information and specifications are available by circling 183 on the reader service coupon or from the Australian distributor Convoy International, 400 Botany Road, Alexandria 2015; phone (02) 698 7300.

BASF hops on DCC wagon

Philips Consumer Electronics and PD Magnetics have signed an agreement with BASF with respect to the new digitial compact cassette (DCC) system, as a result of which BASF will be given technical information about DCC and both parties will exchange information covering such matters as the development and manufacture of DCC tape and cassettes by BASF.

BASF, one of the world's largest manufacturers of magnetic media, will, as expected, become one of the first to hold a DCC licence. The agreement, as such, is claimed by Philips to offer important support for the DCC system.

New Onkyo tuner offers 'precision reception'

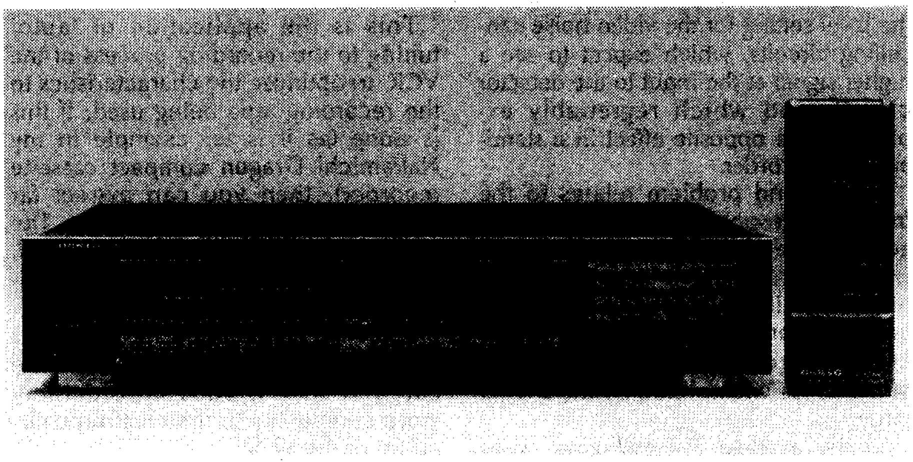
Following on from its successful T-9090 MkII tuner, Onkyo has introduced the Integra T-4700 quartz synthesised AM/FM stereo tuner.

Using a seven varactor, MOSFET front end plus IF strips that employ five ceramic filters, Onkyo claims the T-4700 offers sensitivity and selectivity specifications comparable to tuners at three times the price. It also uses a new power supply configuration that is claimed to provide greater interstage isolation and reduce residual noise, by providing single point grounding and parallel connections to all circuit blocks.

The T-4700 tuner incorporates a microprocessor controlled four mode Automatic Precision Reception (APR) system that constantly monitors signal quality and automatically chooses the best settings for stereo/mono, high blend on or off, wide or narrow IF response and local or distant reception sensitivity. The APR system can be overridden for manual selection of settings.

Dual antenna inputs, selectable both from the front panel and the infrared remote control offer the convenience of the best reception when a choice of antennas is available.

The T-4700 synthesised tuner has a recommended retail price of $799 and is covered by Onkyo's five year parts and labour warranty. It is available at selected Onkyo dealers.



'INTELLIGENT' HIFI VCR FROM AKAI

Tried using some of the new S-VHS video tapes in your standard VHS recorder, only to find that the results are no better than with a standard tape? Akai has just released a new range of VCR's which get around this problem, by automatically adjusting their equalisation and bias levels to suit the tape you're using. This month Louis Challis has been checking out the new model VS-A650EA, which must also qualify as one of the most complex VCR's ever...

In the short time since 'S-VHS' video cassette recorders (VCR's) were released, many people have purchased the special 'S-VHS' tapes in order to extract superior performance from their older VHS recorders. Much to their surprise, the results have proven to be futile, and have resulted in wide spread disappointment.

Now it stands to reason that if you use a better tape, then you should be able to get at least a smidgin of improvement in performance. So what are we doing wrong, when we taken an S-VHS tape, which have these wonderful finer particles and a higher particle density, and rather than showing an improvement in performance, seem to achieve the opposite effect?

Well, putting the technical issues as simply as possible, this anomalous behaviour is a direct result of two of the most critical design parameters in the S-VHS system being directly incompatible with those adopted as standards for ordinary VHS machines.

The first of those parameters relates to the level setting for the video noise cancelling circuits, which expect to see a higher signal at the input to the detector circuit, and which regrettably experience the opposite effect in a standard VHS recorder.

The second problem relates to the frequency response equalisation characteristic of the video signal (otherwise known as the 'Y' signal), whose playback circuit responds in a most unsatisfactory way to a tape with different frequency response characteristics, (as exemplified by the S-VHS tape).

To the average hifi enthusiast, who knows that using a better tape in a cassette recorder, or even in a video recorder, should result in some performance improvement, this constitutes a most galling situation. It's a clear sign that somebody has made what could best be described as a 'retrograde step'.

Akai's design team looked at this problem and realised that it was far from being an insurmountable problem. If one seriously addressed the core issues, and was prepared to stay within the clearly defined limits of the VHS recording standards, then the 'problems' associated with the superior S-VHS tapes could be turned into a positive advantage, in terms of a superior line resolution and most certainly in respect of better overall video quality.

Akai called their new system 'Intelligent HQ', and it works on a relatively simple and straightforward stratagem that was adopted by many audio compact cassette recorders more than five years ago.

This is the application of 'auto' tuning to the recording process of the VCR, to optimise the characteristics to the recording tape being used. If this is done (as it is for example in my Nakamichi Dragon compact cassette recorder), then you can extract far better performance out of a tape. The quality of video signal is enhanced, and almost approaches that of an S-VHS VCR.

It sounds simple, and in practice is nearly as simple as it sounds. The catch is that it adds considerably more complexity to the electronic circuitry of the VCR.

But in return, it provides improved performance on recording — and rather surprisingly, also during playback of both your own pre-recorded tapes, i.e., those recorded on the Intelligent HQ VCR, or even hired pre-recorded tapes.

Akai were so sure that this 'I-HQ' feature would be a winner, that they decided to introduce it into all new VCR's to be sold worldwide in 1991.

Deceptively simple

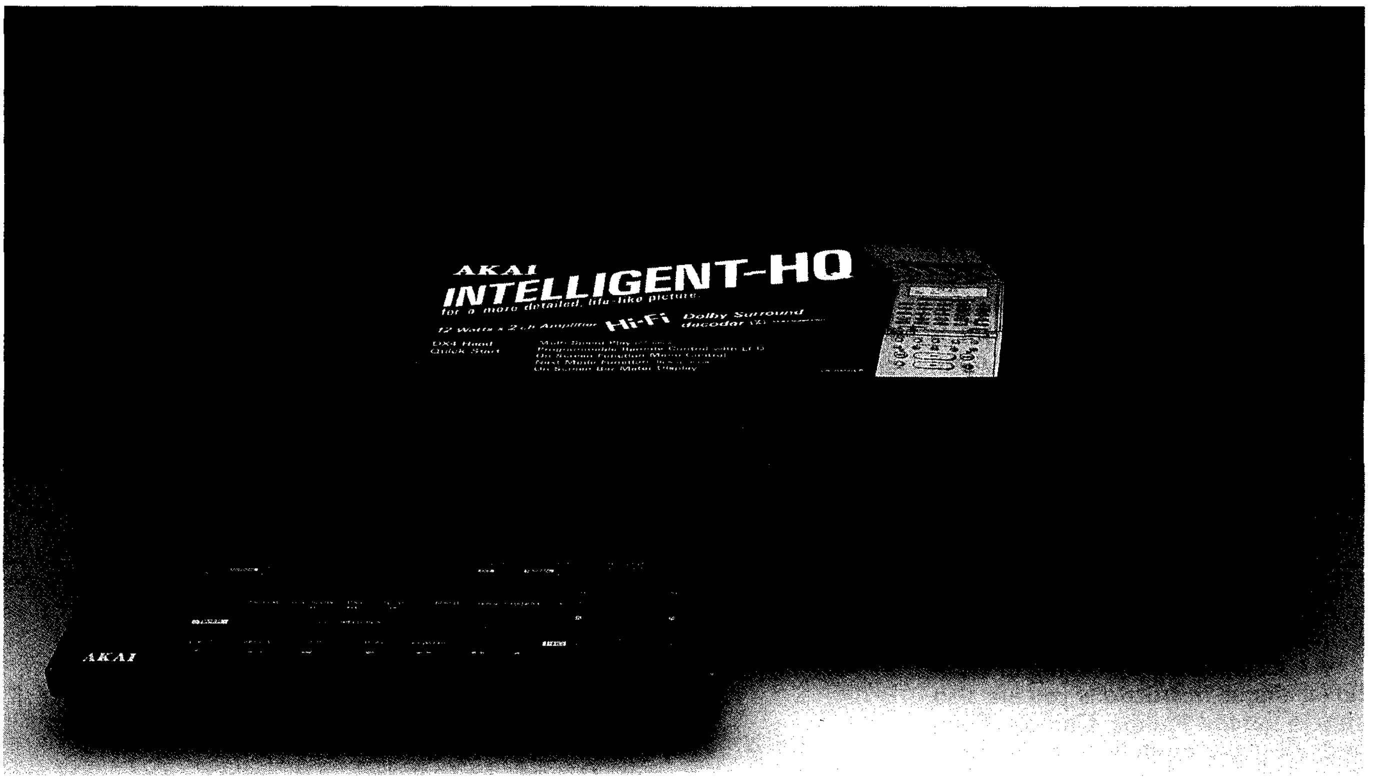
The frontal appearance of the VS-A650EA is deceiving, with a wide blank panel on one side, a single central pushbutton, large display module and (motorised) volume control knob.

Of course, when you push the single button on the front panel, the blank panel drops down to reveal the cassette loading slot and a 'sub panel door' (which is the back of the drop-down front panel) on which there are a myriad of controls.

These controls are with few exceptions basic functional controls, the first row of which includes 'EJECT', 'REWIND', 'STOP', 'PLAY', 'FAST FORWARD', 'PAUSE', 'RECORD', AND 'I-HQ' buttons.

Here I must voice my criticism of the colour of the lettering selected for 'pause' and 'record', together with the 'power' switch and 'quick tune' controls, which are far too hard to read. Akai would do well to enhance these as soon as possible.

The other primary controls provided on this panel include a rocking bar for 'Multiple Speed Play'; a series of buttons for 'slow motion' and 'reverse



slow motion', a 'still' button, a switch which allows you to switch to a different TV channel to the one you are recording; and channel selectors (up-down) and speed button for 'SP' (standard play) or 'LP' (long play), which effectively doubles the available recording time on a given tape.

Other controls include 'quick timer' buttons for 'hours' and 'minutes', and a 'stop time' button which allows you to select the time for a recording to stop.

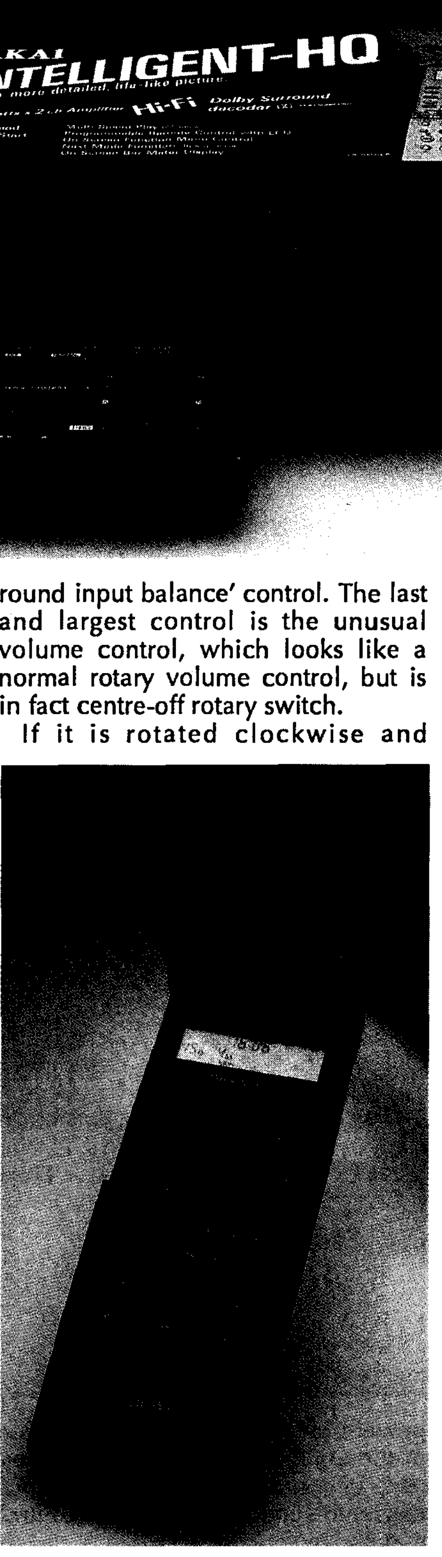
These controls are supplemented by an 'Edit' switch which facilitates the cancellation of the on-screen display when tape dubbing, and an 'audio select' switch to select the audio output after audio dubbing.

Apart from the two (left and right) channel recording level volume controls, the only other controls are the system reset button (which is only used in the event of a malfunction), and the 'E240/E210' tape select switch which is selected if a long play tape (which Akai does not recommend), is used — to adjust the 'remaining tape' time display.

Most of these controls and operating modes are confirmed on the excellent fluorescent display panel, whilst most but not all of these settings are also displayed on the screen of your TV set, if it is on.

Two further controls on the right hand side of the front panel are the 'Dolby Surround' button and the 'Surround input balance' control. The last and largest control is the unusual volume control, which looks like a normal rotary volume control, but is in fact centre-off rotary switch.

If it is rotated clockwise and counter-clockwise, it activates an electronic attenuator which in turn either decreases or increases the audio volume. It also confirms the activation by means of two flashing lights.



Louis Challis describes the unit's remote control as one of the most powerful he's ever seen...

"Sounds simple", you may say. Well yes, it is — except that the control panel I have just described and its multiple functions are really only meant to provide an alternative to the *real* heart of the control system, which is achieved using the separate infra red remote control.

RC-V655A remote control

This is one of the most powerful remote controls I have ever seen, and is a real credit to the ingenuity of the Akai design team.

At first sight it is just as deceiving as the (closed) front panel of the VCR itself.

The upper half of the remote control unit has an LCD display with programmable time in hours and minutes, plus the day of the month, the month and the day of the week.

The lower half has the normal functional controls of 'play', 'fast forward', 'rewind', 'pause-still', 'channel up and channel down', 'timer', 'TV-VCR' and 'Power on or standby'.

"Nice", you say. Well again, yes it is — because those controls are only the basic controls.

They are then supplemented by some 60-odd additional control functions, which the unit provides behind another of those ubiquitous hinged covers.

As I soon discovered, in the middle of the remote control there are two switches — a slide switch on one side, and an 'open' button on the other.

The slide switch has three positions, and depending on which of them is selected, the activation of the open button selects one of the three 'Teledex'-like keyboard overlays (actually two, plus one fixed), with legends for the 25 push buttons behind.

Thus with the 'TV' position selected, you have the standard numeric key pad controls, as well as brightness, colour balance, sound, mute and sound volume.

As I soon found, by keying in additional simple instructions you are also able to control Philips, Grundig, Sony and all Akai models manufactured since 1987 onwards, so your existing TV set will then be (nearly) completely compatible with your new VCR.

Admittedly, the remote control may not necessarily control all of their functions.

But it does control *all* of the critical ones, and that is important because it means you only need the one remote control to exercise control over the VCR and the TV. By closing the remote control's cover and then reselecting the program/clock switch position, the display overlay is changed — and with it the functions of 22 of the buttons on the keyboard.

These now give you complete control over the normal clock functions, as well as the ability to transmit all the encoded 'timer information' that you have just programmed (as well as future programming information) direct to the VCR, by just pointing the remote control at the face of the VCR and pressing the 'transmit' button, when you are ready.

The last position of the 'option' switch is 'video', and this provides 25 controls to select preset stations and a plethora of other controls, which are well labelled.

These provide control over tracking, display, Dolby surround, long play mode, the display module, the counter, muting, volume control, auto tracking, audio monitoring, blank searching and even the tape eject function.

All in all, this is an extremely powerful remote control and because of the multi-functional use of the key pad, undoubtedly the most powerful consumer equipment remote control that I have yet come across.

Having described the remote control, I had better not forget to mention that the VCR also contains a twin 12-watt amplifier. So that when coupled to your TV sets own stereo amplifier (presuming that it has one) and your home hifi system, you can use the full potential of the 'Dolby Surround' circuitry — provided also that your system offers that option. After examining all these goodies, I was a

Measured Performance of Akai VS-A650EA Video Cassette Recorder

Serial No: SI-C9065-00173

Horizontal Resolution	>280 lines	
Record to Replay Hi Fi	Video S/N ratio approximately 45dB	
Record to Replay Frequency Response	2Hz to 30kHz +0, -3dB	
Linearity	**Input Level dB**	**Output Level dB**
	0	0.0
	-10	-10.0
	-20	-19.9
	-30	-29.8
	-40	-39.5
	-50	-48.6
	-60	-57.5
	-70	-65.8
	-80	-74.8
	-90	-83.6
Erase Ratio	>80dB	

12W Power Amplifiers Frequency Response Driven from input signal
6Hz to 30kHz +0, -3dB

Clipping Level VRMS into 8 ohms load both channels driven

Left	12.2V
Right	12.1V

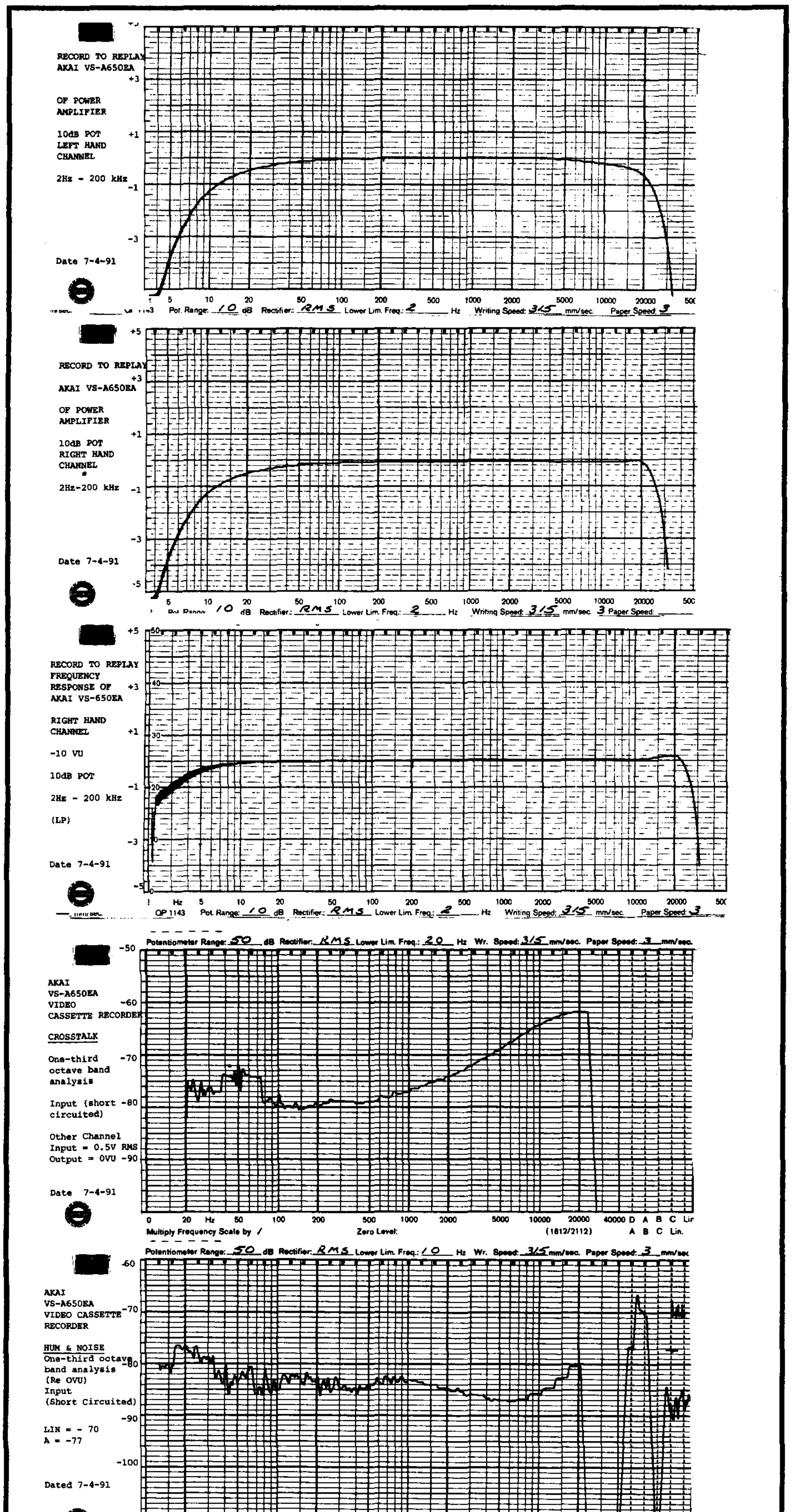
Signal to Noise Ratio Relative to 12 watt O/P = 70dB(A)

Distortion at 12W into 8 ohms both channels driven

Frequency	100Hz	1kHz	6.3kHz
2nd	67.3	67.0	67.7dB
3rd	76.6	73.7	76.5dB
4th	83.0	83.9	-
5th	-	-	-
THD	0.13%	0.13%	0.12%

Distortion at 1W into 8 ohms both channels driven

Frequency	100Hz	1kHz	6.3kHz
2nd	71.9	72.9	74.6dB
3rd	91.4	86.7	81.0dB
4th	85.6	81.5	-
5th	93.7	86.0	-
THD	0.076%	0.069%	0.087%



Here are the frequency response, channel crosstalk and signal to noise curves for the audio section of the Akai VS-A650EA VCR, as measured in Louis' lab.

trifle overawed — and decided that this VCR is most probably either TOO GOOD or TOO COMPLEX for at least 35% of the potential market. Of the intending purchasers, the 15 to 25 year olds will think it's absolutely wonderful. In many cases they may well prove to be the ones who have to teach their parents and/or grandparents how to use it — either to the best advantage, or possibly at all.

Lab tests

Before taking the VS-A650EA home, I put it through a gruelling series of tests in our laboratory to see how well it performs. With the I-HQ system activated, and with ordinary TDK-HDX PRO tape, the video performance proved to be excellent.

The VCR achieved a horizontal (line) resolution of 280 lines, which is impressive and considerably better than claimed. By contrast the video signal to noise bandwidth was precisely the 45dB claimed, and is certainly good.

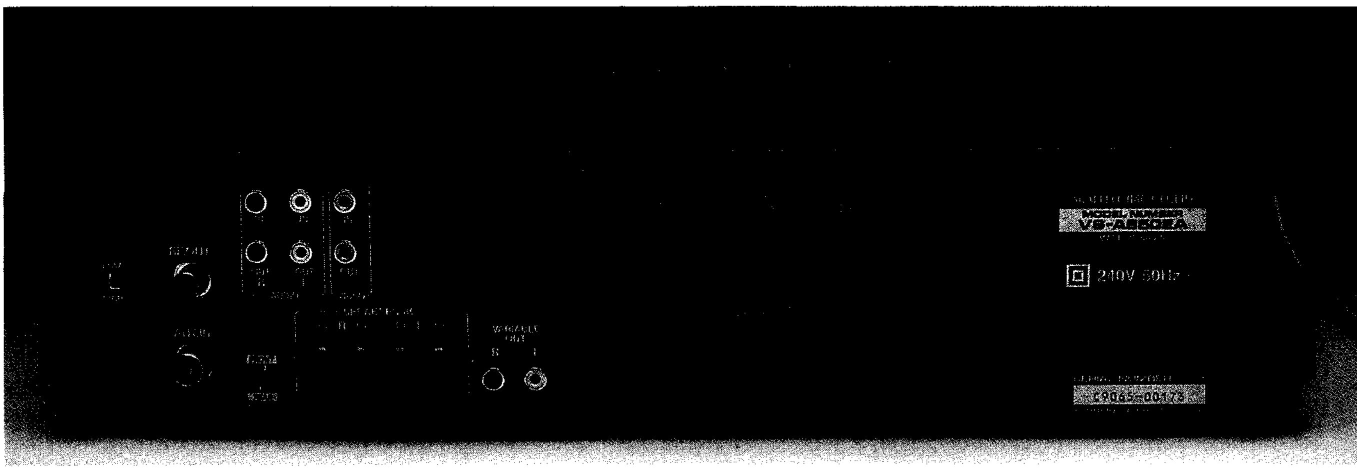
The hifi record to replay frequency response bandwidth is very wide and extends from 2Hz to 30kHz +/-3dB, which is better than most cassette decks and is even better than most DAT recorders. By contrast the signal to noise ratio is 70dB(A), which although good, when compared to a cassette recorder is not on a par with either the best of the competing hifi video recorders, nor with the latest DAT recorders.

Notwithstanding, the tape economy of this VCR would provide an exciting and extremely economical alternative to a DAT recorder. The record to replay linearity is also marginally inferior to DAT recorders, and the conversion non-linearity is readily detectable at levels below -40dB.

I experienced unusual difficulty in measuring the distortion, which was particularly well masked by the system's background noise. Although detectable, it was particularly low for high level signals and inconsequential (because of the noise spectrum) for low level signals.

The amplifier's performance was good, but not outstanding — with less than 0.13% total harmonic distortion at the three test frequencies with both channels driven to 12 watts into an 8-ohm load.

At the one watt level, the distortion was marginally lower, but not in direct proportion to the difference in output power level. Which was



Here's the rear view of the VCR. As you can see, there are rather more connectors than you'd expect to see at the rear of a conventional machine. In particular note the speaker outputs — the unit has two built in 12W amplifier channels.

surprising, as it goes against the trend which I have come to expect from modern amplifiers. The wow and flutter characteristics of the VCR were very good, and the audio signal wow and flutter was less than .005% weighted RMS — which is on par with most DAT recorders, and considerably better than I would expect any compact cassette recorder to achieve.

Overall, the objective performance of the VCR and its amplifier are good. But I would expect a hifi VCR to achieve a slightly better audio signal to noise ratio than the 70dB(A) which I measured.

Functional test

When it came to functional performance, the VS-A650EA is absolutely first class. It is easy to use, provided you follow the instructions carefully and aren't daunted by the large number of controls available. The on-screen display makes tuning a breeze, and the prompts which it provides are truly 'user friendly'.

Set up with a stereo TV, and with the VCR's amplifier feeding the rear speakers in a Dolby Surround stereo system, and with a pre-recorded 'Hi-Fi' stereo tape encoded for Dolby surround, the sound and presence is outstanding — and much better than offered by conventional stereo TV or stereo pre-recorded video tapes.

With the ability to achieve much better than 250-line horizontal resolution in the LP mode using the HQ feature, this VCR should pay for itself in tape purchases in the first couple of years, if you use or buy tapes at the rate my family does.

This VCR offers other unusual features, including the ability to disable the main keyboard so that children can't upset the controls, as well as a degree of functionality which is currently in a class of 'one'.

If you feel at home with computers or complex video equipment, then you'll revel in the flexibility that the Akai VS-A650EA offers.

But if you need somebody to interpret electronic equipment for you, then this is one VCR you should avoid.

It's designed for the modern generation, who are happy to punch knobs and twiddle controls, and revel in the advantages and attributes that superior technology has to offer.

Incidentally the VS-A650EA measures 425 x 365 x 100mm and weighs 7.5kg. It's recommended retail price is $1199. Further details are available from Akai dealers. ■

Icom IC-R100 Competition:

More 'runner up' entries

Here are some more of the entries for our very popular 'funny antenna story' competition — the ones that we judged to be *not quite* as funny as the winner of the Icom IC- R100, but funny enough to share with you. This way, they'll also bring their writers a small contribution fee...

Revolutionary work

By 1944, most RAN ships were equipped with Australian-built radar. The aircraft warning sets used a large VHF 'bedstead' antenna mounted above the main-mast. I was the radar mechanic on the newly commissioned *HMAS Hawkesbury*, en route to Milne Bay in Papua, when the antenna refused to rotate.

The skipper must have guessed my inherent fear of heights, and elected to restrict the ship's search for enemy aircraft to 'dead ahead' pending arrival in port.

With the ship safely tied up to the Navy wharf, I climbed hand over hand up the flimsy aft raking ladder and managed to seat myself comfortably atop the mast, with my legs securely wrapped around the base of the antenna.

The whole assembly was mounted on the fore side of the mast and was built of galvanized steel, with a motor housing about the size of a 10-gallon drum just below the bedstead array. This housing, pressing against my bare chest, did not make it any easier to remove the hatch cover to investigate the fault.

I cleaned the slip rings and called to my mate below to try it out. He disappeared into the radar cabin and immediately I could hear the motor start driving the gear train as the big antenna started to rotate. I shouted to him to stop and reverse rotation, but he was nowhere to be seen as the mass of steel pipe slowly came around and wiped me off my perch.

Somehow I managed to grab onto the underside of the antenna, about three feet from the centre, and thus suspended in space I was panning at a rate of one revolution per minute.

I was annoyed at my stupid mate and terrified, but my vocal cords were functioning well. After 15 seconds the thing stopped. It seemed like days, but I know that it had only rotated 90°, since I was hanging over the port beam. Far below, the ship's company had begun to gather on the upper deck to gaze in wonder.

As I hung there I did not know that I had repaired the rotation in the anticlockwise direction only, so my mate was forced to drive me around another 270°, by which time the entire fleet at anchor in Milne Bay was enjoying the show — along with numerous natives on shore. A cheer rang out as I finally alighted on my perch.

Somehow my trembling sweaty hands cleaned up the other slip ring, and it performed without further maintenance for the rest of the war. I have never climbed a mast since.

(George Holland, Forestville NSW.)

Close encounter

It was 1963. I was stationed in Malaya, living on Penang Island. In order to tune Radio Australia on my stereogram (valves in those days), I had erected a 60-foot bamboo pole at each end of the back fence, to support an aerial wire. This led down through a window into the lounge and connected to the radio.

Most RAAF houses, including mine, had security grilles fitted to windows and doors.

Another novelty was that the METAL outlet pipe from the toilet exited the wall about a foot above the ground, then turned a right angle to disappear into the ground. My scene is set.

One night there occured a thunderstorm such as can only be experienced in the tropics, with the usual accompanying awesome pyrotechnic display. I was out of bed because the kids were crying, and realised I needed to ease the bladder pressure.

There I was happily twinkling away, when a thunderous explosion shook the house. Simultaneously, the lights went out, the house filled with an overpowering ozone smell, and I hosed down the toilet wall.

Came morning, and I found that both the two poles and the aerial wire had disappeared, replaced by two piles of shredded bamboo. The stereo was full of shattered valve glass, and smelt terrible. The back wall of the house was cracked along the entire length, where the lightning strike had jumped from one security screen to the next.

The one saving grace to the whole experience was that I was still alive and in one piece, saved by those two bamboo poles. Had it not been for them, the lightning would probably have struck the metal toilet pipe to which I was 'electrically' connected.

Even now it hurts just to think what could have happened, and I still avoid using the toilet during a thunderstorm.

(B. Redshaw, Amberley Qld.)

Mysterious droplets

I had long entertained the idea that I would construct a vertical dipole, based on the capacity to vary the height of a column of colured brine (saltwater) enclosed in a clear plastic tube.

Opportunity came one hot but windy Christmas weekend, when I found all the necessary components immediately available around the household. A clear 10mm ID plastic tube was taped to a six-metre length of fluted wooden cornice moulding and erected — almost vertical, but canted slightly eastward outside the kitchen window.

The proposal was to pump brine (coloured with red food flavouring) into the tube, from a pressurised reservoir tank of a portable shower unit and observe the height of the fluid column against lineal-markings drawn on the wooden moulding — whilst simultaneously adjusting for best SWR on my rig.

Undeterred by the spectacle of a sunbathing couple next door, I pumped air into the reservoir tank and proceeded, cautiously, to open the stopcock. Unfortunately those plastic stopcocks are inclined to stick, so that when fluid failed to enter the column I pumped ever more pressure into the reservoir, and gingerly tried the stopcock again.

Oops — too far! The fluid sped up the tube like a rocket, the surplus ejaculating from the open end toward my neighbour's fence.

Fortunately only a few droplets were windborne over the fence toward the suntanning couple. I heard the female exclaim "Look at those little red drops on my legs! Where did they come from?"

I discreetly remained indoors, and found myself eavesdropping via the open kitchen window to the explanation given for such a phenomenon from her companion. Something about red 'bulldust' from the Nullabor Plains, being sucked high into the stratosphere by the jet stream, where it forms nuclei for ice crystals to form...

He went on to explain that the crystals can be carried thousands of kilometres and when they become too massive they begin to fall, melting on the way down. Hence the coloured liquid droplets from an otherwise seemingly cloudless sky.

Elementary, really!

(Fred Lehner, Launceston Tas.)

Difficult climb

This antenna (rigging) story relates to a colleague and I who were rigging a VHF antenna system. In short, my friend approached the top of the ladder and was about to hand me the antenna in question (I was on the building roof), when the base of the ladder began to slide away from the building it was leaning against.

He continued to climb the ladder, but gained no altitude — so he climbed faster. Still he made no progress and could not pass me the antenna.

At this point he gave up and became a crashed heap on the ground, fortunately uninjured and with no damage to anything. However while he was in a state of recovery and disentanglement, I was stranded on the roof and could do nothing.

(David Walker, Hastings NZ.)

Crucial component

Many moons ago I was doing TV servicing. It was the golden time when one could make a living repairing these 'brutes'.

I was called often to a customer at Deagon. I would be called three or four times annually, so a relationship with customers would be established easily. However after every repair I wanted to sell my customer a more perfect picture through the purchase of an outdoor antenna.

This customer's type was the most odd construction, of a piece of banana wire across a tall doorway with scissors, pliers, clothes hanger and many other items hanging in special configuration — and I must say, producing not too bad a picture.

My customer didn't mind me trying to sell her an antenna, because of my 'lovely accent'; but however 'lovely', no sale!

One day she called me due to snowy pictures on all stations. As soon as I arrived, trying all possibilities to rectify a snowy picture, I started with my now famous 'antenna sales pitch'. Beyond belief, she agreed to let me show her with a quickly erected antenna in the front-yard, how perfect her TV reception could be. After many tries, no luck. Snowy pictures drove us both insane.

The customer suddenly called out "What have you done with my pliers?" Before I could answer she said "That must be my beggar of a son who has pinched them".

She ran to the backyard and ordered him to return the tool immediately. After hanging them back on the banana wire — all stations were perfect again!

My antenna sale was cancelled on the spot. Arriving home, I discovered to my amazement that my new antenna lead was open circuit, a rare fault and the only time I have struck this in 35 years of TV.

You guessed it, I never tried to sell this family our fabulous outdoor antenna again. Would you?

(Chris Van Wyk, Redcliffe Qld.)

Execution at dawn

I was still at primary school in England. Pocket money for a month or so was sufficient for me to buy the components to build my first crystal set. The only control was the 'variable condenser', and the plans stipulated a good aerial. I decided to climb through the hatchway at the top of our stairs and put an aerial in the roof space. Walking between the floor joists, I secured the ends of my aerial and led the wire out under the eves to my bedroom window.

The result was very strong reception of several stations and all seemed fine — until my parents went to their bedroom later!

I had not paid much attention to the creaking, rather cracking sound beneath my feet, when I walked along the

Aerial CATastrophe

In the 1960's I worked as a TV serviceman. One day when I was leaving a house after making a service call, a neighbour asked if I would check his TV and tell him whether the snowy picture was an antenna or set fault.

The antenna was leaning over and obviously putting considerable strain on the ribbon. It had a folded dipole, which made cable continuity easy to check from the set end.

The TV was in a dark corner and as I bent down to put my hand on the floor behind it, I felt something cold, wet and gluggy ooze between my fingers. When I lifted my hand it was covered with some horribly foul-smelling technicoloured gunk.

Somewhat agitated, I asked the owner what it was and in a totally unworried fashion he replied that 'pusskins' (the family cat) must have been sick again.

At this point in time I was on the point of doing a 'Harpic' (ready to go around the bend). It was only after frantic application of fireplace ash, followed by soap and water, that I managed to calm down enough to pack my gear and with considerable restraint tell the owner to get someone else to solve his problems.

Now, 26 years down the track I still wonder if the antenna leans, the picture is still snowy, and last but not least — is 'Pusskins' still behind the telly, reverse cycling its food intake?

(David Allen, Findon SA.)

Icom 'Runner up' entries

plaster-bearing laths between the floor joists. However, my parents were well aware of my handywork from the cracks in their bedroom ceiling.

Breakfast the following morning was preceded by an execution. My crystal set was placed in the middle of the backyard and the blow from a sledge hammer reduced it to a pile of junk.

During the postmortem, I discovered that the crystal, though grazed, had survived with its two connecting wires intact. I still had the earphones and experimented with my antenna, crystal, and headphones. I could hear all the stations once more, but all together. Fortunately the Welsh service of the BBC was loudest of all!

(Barrie Egerton, Lidcombe NSW.)

Birthday offering

The house trembled with fear. She was furious; he had forgotten her birthday. He retreated from the war zone and drove off out of harm's way.

When he returned he was comforted to see her wired for sound, attempting to relax. A cup of coffee in hand, in-ear earphones attached to a walkman listening to music. Plus over-ear headphones plugged into the scanner, listening to the outside metropolis. Both at the same time!

She stared at him with an arctic gaze. He knew he was still deep in doggy doodles. He handed her a parcel. She icily stared at the package, thinking "Nothing will save him, no matter how extravagant".

The package was opened. He had given her a discone antenna for her birthday. He waited apprehensively for a reaction. She slowly smiled, then she could not hold back her enthusiasm as she thought of the new world of listening the discone would uncover.

The marriage was saved. Relieved he thinks to himself, "Now how do I get my shirts ironed?"

(Noela Hill (her), Bray Park Qld.)

Bright sparks

"Are you receiving?"

"Loud 'n clear."

"You beaut, it works!"

The time, midnight; the place, the football field at a country boarding school during World War 2. Another schoolboy and I had made two crude portable spark transmitters, very broad-band, with about 30 feet of antenna wire.

As members of the Cadet Corps, we were taught Morse code signalling, so what a way to practise! Of course, we knew such transmissions were illegal, but our concept of 'legality' extended little further than our experience of a very different type of 'antenna' used by the Headmaster to enforce school rules. We had set up our station on the football field with the antenna wire thrown over the goal posts. 'HQ' station was secreted in the dormitory with the antenna dropped out the window.

Suddenly, a powerful spotlight sliced through the darkness! It was a PMG truck, searching for — us?

We ripped down the antenna, dived for cover in the best Cadet Corps training style, and sneaked back to the dorm. Then we realised that illegal radio transmission of military style information during wartime could incur a much worse punishment than being at the receiving end of the headmaster's 'antenna'.

Next morning, inwardly quaking, we watched covertly for signs of the PMG officers, or the police. Nobody came. Then, at morning break, we heard the Science master comment,

"Seems the PMG crew was on the job last night, looking for that break in the overhead telephone wires".

Phew!

(H.L. Harvey, Edge Hill Qld.)

Tuning stubs

Himitangi Radio was an HF international transmitting station in New Zealand. I recall the day when I, along with several other TIT's (Technicians-in-Training), arrived at the station for an induction tour.

Significantly, we were first addressed by a station senior officer about the dangers of high RF voltages. Then we stood in wonderment as we were shown the huge transmitters and the forest of wooden telegraph poles supporting miles of open-wire feeders. We endured neckaches and wet feet as we trekked, eyes upward at the massive curtain arrays, across acres of paddocks.

On the way back to the transmitter building, our senior officer stopped us. With his face devoid of expression, he drew our attention to what appeared to be pairs of small black wires hanging, at varying intervals, from a feeder about 50 yards away. He asked whether any of the group would care to hazard a guess what they were?

There was much discussion. Perhaps they were matching sections? Lightning arrestors? Collectively, we hesitantly suggested tuning stubs. No, he replied. We gave up and awaited the highly technical explanation.

With long-suffering patience, our officer explained that the local seagull population, foolishly unaware of the differences between telephone lines and high power RF transmission lines, often alighted on the feeders.

When a transmitter was first 'fired up', any birds on the wire tended to explode in a puff of feathers. The pairs of 'tuning stubs' were the unfortunate creatures' legs, still grimly holding on.

(Norman Hughes, Rowville Vic.)

Powered descent

Last year I was asked by a close friend if I could help him install a CB antenna, on the roof of his house.

My friend, who shall remain nameless, was sort of scared of heights. To overcome part of his fear, he had rigged up a rope from himself, over the roof to the other side of the house, and fastened to the tow bar of the Commodore.

His girlfriend had come outside and said that he had to buy something at the milkbar. He started complaining, so she said "Stuff you!", and went inside.

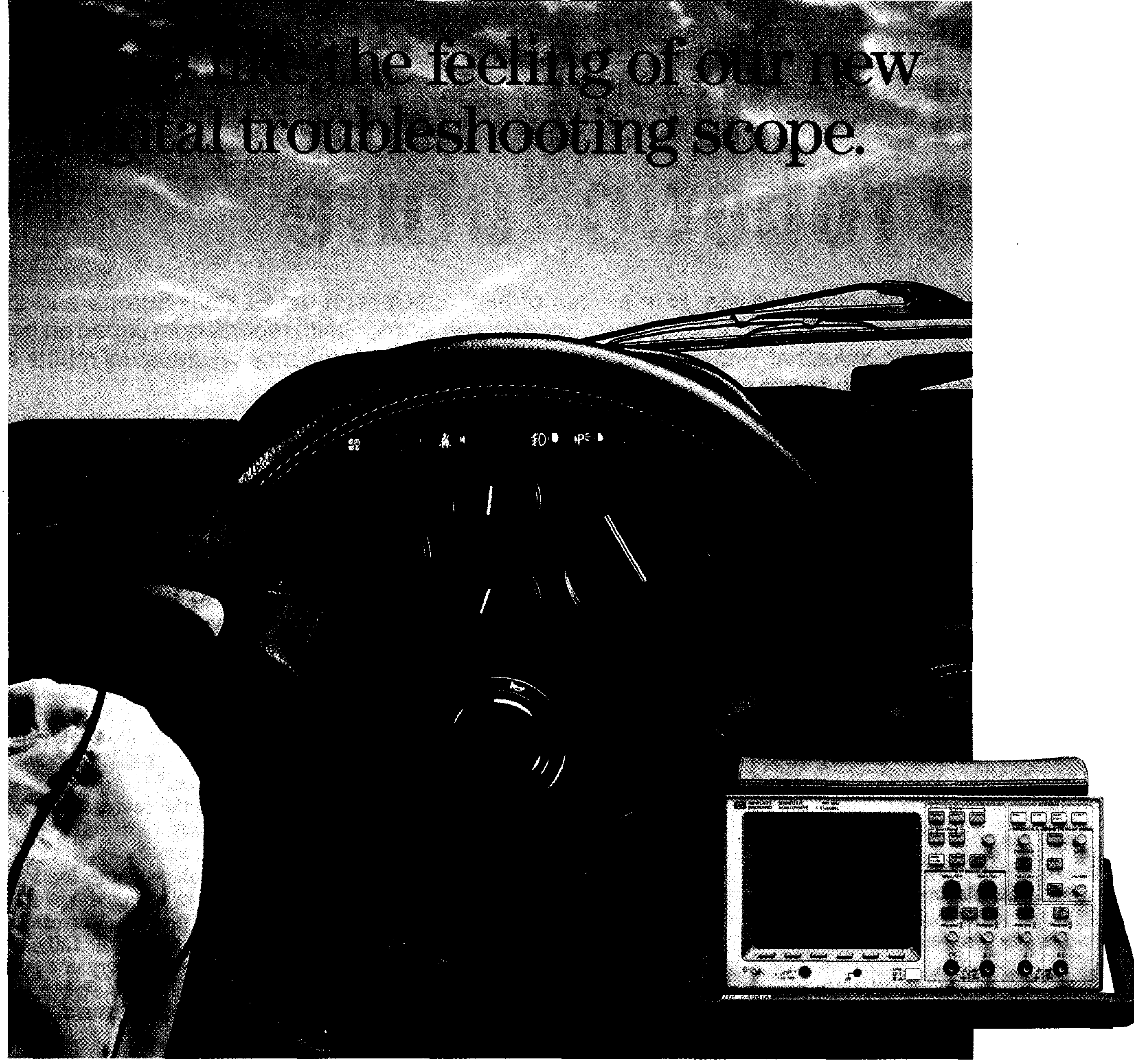
Next thing you know she went out the front, and started the car. Not knowing about her boyfriend being tied to the car, she took off for the milkbar.

My friend started to ski over the roof and down the street. His girlfriend had realised and hit the brakes, and he hit the back of the Commodore. Luckily, he had only a broken arm and needed a few stitches.

I had to finish off the job for him, and the CB works like a charm.

(Anthony Bearzi, Altona North, Vic.)

Continued on page 96



Now there's a 100 MHz digital scope that handles just like analog.

Digital oscilloscopes have certain advantages that are hard to overlook. But for troubleshooting, many engineers still prefer analog scopes. Simply because they like the way they handle.

The HP 54600 changes that. It *looks* like a 100 MHz analog scope. All primary functions are controlled directly with dedicated knobs. And it *feels* like one. The display responds instantly to the slightest control change.

But when it comes to troubleshooting, the HP 54600's digital performance leaves analog and hybrid scopes far behind. At millisecond sweep speeds, the display doesn't even flicker. Low-rep-rate signals are easy to see without a hood.

It has all the advantages that only a true digital scope can provide. Like storage, high accuracy, pretrigger viewing, hard copy output, and programming. And since it's one of HP's basic instruments the HP 54600 gives you all this performance at a very affordable price.

So if you like the feel of analog control, you'll like the way our new digital scope handles troubleshooting. To find out more call the Customer Information Centre on 008 033 821 or Melbourne 272 2555.

HEWLETT PACKARD

A Better Way.

JWT HTM125/A

Matsushita looking to a robotic future

The Japanese electronics industry is in a state of high anticipation, as Eastern Europe and the South Pacific region promise a cornucopia of opportunities. Barrie Smith reports from Japan on how Matsushita Electric Industrial, one of the largest players of all, sees reliance on industrial robots as the key to continuing success.

Konosuke Matsushita began in commerce by peddling double adaptor light plugs, designed and made with the help of his wife and brother-in-law. The place was Osaka; the year was 1918. His brother-in-law, a Mr Inoue, went on to found the Sanyo Corporation. But that's another story...

Matsushita-san had sunk every cent he could raise — ¥100 or US$50 (at the time) — into the venture. After an initial stumble, he realised he'd paid too much attention to the selling of his product, and too little to making a product that customers actually wanted to buy. But once on track, the trickle of orders became a flood.

Today, Matsushita — probably better known in its other guises of National, Panasonic, Technics and Quasar — operates in over 160 countries, employs more than 193,000 people and has a gross sales turnover of US$41.7 *billion*.

Osaka is its home, and when you're there it's difficult to avoid the company's corporate logos branded on the most amazing variety of consumer products wherever you turn: large screen TV sets at the airport, showing satellite broadcasts of Tokyo baseball on HDTV; corn plasters and face care products in the beauty stores; heated carpets, tables and toilets in furniture stores; irons, stoves, aircons, shavers, kettles, rice cookers and a silver ball twisted in the hand to activate a throbbing, soothing action; near ceiling-height audio flat panel speakers; the world's smallest and lightest DAT recorder; lighting on the world's longest bridge — all 37km of it; a dye-transfer colour printer; security systems accessible by phone from outside the home; and so on. The list goes on and on.

And that same list — 3000 or so separate items — is the very same, and an extremely comprehensive one, that is making company executives wake at night, rubbing their hands with glee as they survey the two markets that suddenly show promise of a bonanza that will last well into the 21st century.

Eastern Europe has opened up, with the countries in that region rapidly finding they need the trappings of the West to make their life even partially bearable — like toasters, food mixers, vacuums, CD players, VCRs, camcorders, laptop computers, hifi. The demand by the area's consumers, it is predicted, will be insatiable.

The South Pacific — which, by my definition includes SE Asia, Australia, New Zealand and the islands — the company views as the 'sleeping giant', and figures show this as the area with the highest growth rate of any part of the world.

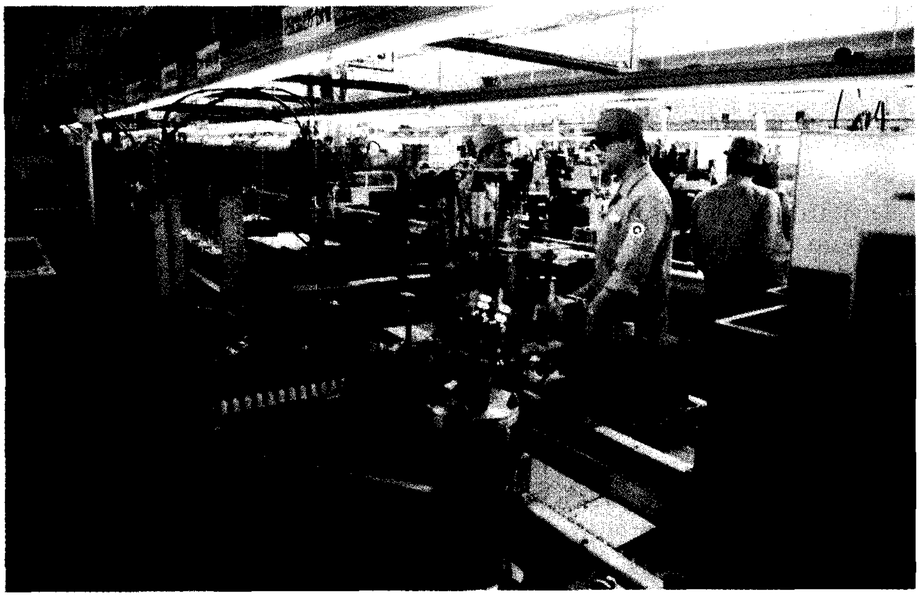
The company has already invested in manufacturing plant to meet this sales growth, not only across Japan, but in markets such as Malaysia, the Middle East and the Americas. These markets are 'attractive' in many cases because semi-skilled labour is plentiful — such as Malaysia. In Singapore the lure is a healthy supply of skilled personnel; and, in the USA, proximity to a huge buying population is the obvious draw.

Need for robots

But domestically the company faces major problems in establishing and running its manufacturing operations. Land is scarce and expensive, and labour — skilled or unskilled — is in drastically short supply. As one executive confessed to me: "The population is aging — we are short of young people. The total pie of labour is limited at this time."

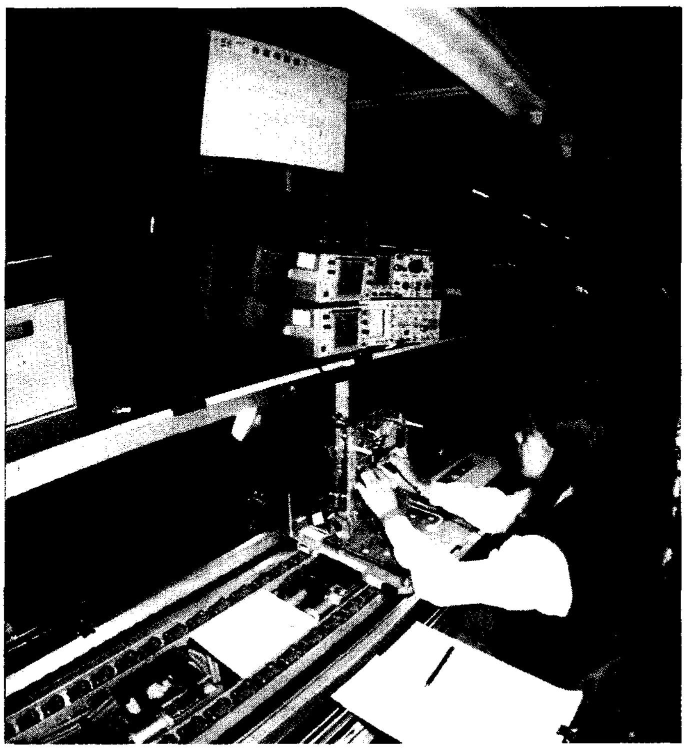
Which is why the company recently decided to initiate the manufacture of another product: robots.

Called Panarobots, these look like anything but the accepted vision as drawn by sci-fi artists. Matsushita's mechanised factory worker fall more into the descriptive category of a green box with lights, a video screen, and clusters of multi-jointed arms that look



The VCR production line at Kadoma-kita — robots are cared for and 'fed' components by personnel.

The video head production line at Matsushita's Okayama factory.



Checking and adjustment of all video products is done by humans.

as though they could accomplish every task required of them except the ability to pick the robot's — or your — nose!

Late in 1990 I spent over a week in the company's hospitable hands, along with 25 other journalists from our area. We saw everything, with the exception of the R&D departments — and sadly, nary a peek at the heated toilet seat production line.

We were allowed to photograph almost everything, with the exception of video head and IC manufacture. However, we were proudly shown everything connected with the company's robot implementation plan.

VCR assembly

We began the tour at the Osaka factory in the suburb of Kadoma-kita. The VCR assembly line gave us our first glimpse at how the company is rapidly moving towards its target of complete automation.

Each line runs 102 metres in length, using part manual and part robot assembly methods. Such is the mechanisation of the plant that, within 25 metres of the line's beginning, the VCR had reached an assembled state. No outer casing, but still complete.

At this point each VCR is lifted by hooks to an upper floor and given two hours of 'power on' operation, or aging, to settle the components down. Following this, the VCR descends back to the assembly floor for adjustment of the circuitry functions. The adjustment process has only one operator, the rest being controlled by robots.

This section of the line is about 50 metres long. Two years before, it had been completely man-driven.

We were told that one operator with a marital problem had been responsible for a number of sets being sent out with incorrect operating standards. But the company still places reliance on human eyes and ears to set and check the VCR's operating standards.

From the robot a probe bears down on a PCB, checks the figures, and then the testing machinery automatically adjusts the functions.

The adjustment operator checks resolution/grey scale chart and colour bars of each VCR on a monitor. Running beneath the solitary operator's arms a miniature conveyor belt takes test VHS tapes back and forth to each VCR. Just 70 metres from the start of the line the units are now adjusted to specs.

At this point the outer casing is attached. It took some considerable time to conceive, develop and teach a robot that could pick up and lower the top casing with the correct amount of splay applied. I watched as the robotic arms held the casing sides skewed out by suction pads, then released them so they could snap snugly around the chassis.

To further complicate matters for robots and humans alike, the factory does daily turn-arounds to handle SECAM, PAL and NTSC models for the varying market needs.

Again, the operator tests the assembled set with a test chart to CCIR standard, then the unit is loaded with a test tape for actual 'run' conditions.

Finally, test batches of five units are taken off the line for testing by personnel with no direct connection with the factory floor. 'Just to make sure'.

Upstairs is the head assembly line. 'No photos'.

The line of 204 metres folds into two. Robot population on this line is 945 — plus another 20 to check the former. After each nine robots, yet another supervising robot checks the others — if there's a reject, the item is sent back to the start of the line, and re-manufactured. One area that had been found very difficult was the task of building a robot capable of applying the elastic spring belts to pulleys.

The parts for this section are manufactured by outside suppliers, and arrive at the factory on preformed mini pallets. Components are selected directly from the mini pallets, and applied to the head assembly. It's been ascertained that trouble free, high standard production can only be assured in robot assembly by the highest possible standards in component supply. 'No wobbly widgets!'

Robotic Future

The plant operates on a 17-hour day — two shifts, 885 minutes of working time, 90% of which is under operation by the robots who produce 8000 units a day. The line is not working for only 10% of the time. Only 15 workers man each 204-metre production line on two shifts. They take take care only of the robots, not product assembly.

To give some idea of the tolerances with which the 'mechanical men' must comply, the height adjustment of the pins on the guide rollers and tape guides calls for an accuracy of 10 microns.

This precision would not be possible without the company's reliance on an aluminum die-cast chassis, which maintains its rigidity even under assembly line stresses.

Following manufacture, the head sub-assemblies are stored in plastic cases on revolving racks, and conveyed below when demanded by the lower assembly floor for certain model or country requirements.

Workers wear anti-static clothing, and are grounded to the floor so that no static charge goes through the ICs.

A total of 2750 robots work in this factory. All of these are maintained by machine keepers to keep them in top operating condition. If trouble arises in assembly it has been found to be almost exclusively caused by components being out of spec. The machine keepers are capable of correcting these assembly errors. Malfunction ratio is an impressive 0.1%.

Great emphasis is placed on education of workers. The factory has its own self-contained education organisation, and also training programmes prepared by the corporate training centre. Some 60% of male workers at this factory have qualifications approved by the Japanese Government. The floor was concrete, anti-static coated.

Okayama plant

Then, on to Okayama — an hour away by bullet train.

As we entered the building, employee name tags were hanging on an outside board — red ones indicating qualified workers.

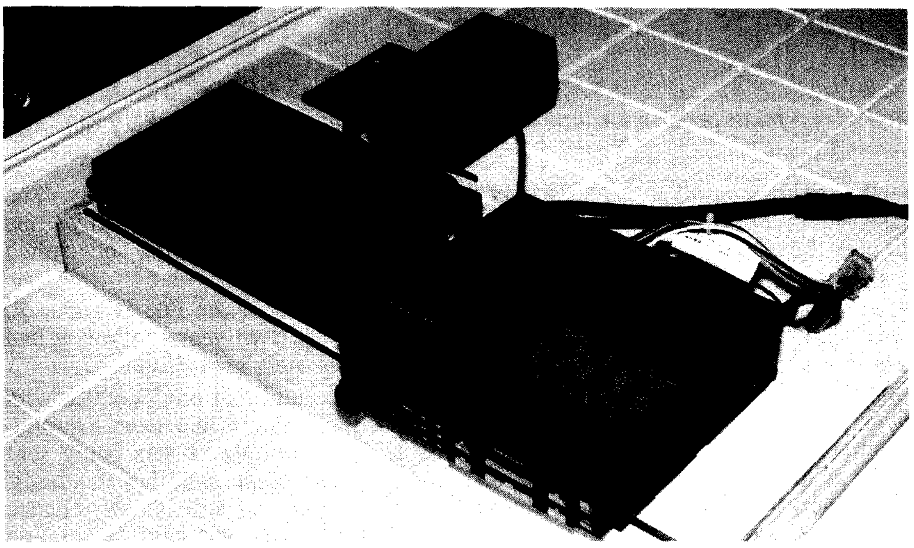
Here is the VCR direct drive and head cylinder assembly. The company places much stock in the technology and use of Direct Drive, which does not use bearings, relying on centrifugal force and abraded surfaces to coat working surfaces with a thin coat of oil.

The plant operates 24 hours a day — 16 with robots and eight with people. It's spotlessly clean; all machines are gloss enamel painted, with more than adequate fluorescent lighting illuminating light coloured walls and floors, so there are no dark areas.

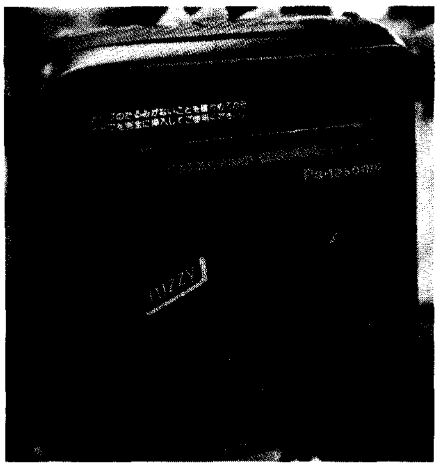
No mess, parts or tools on the floor. No wiring, no pipes on the floor, everything is plumbed and wired from the ceiling. Robot assembly had been introduced only six months earlier; prior to this assembly was manual.

The operators wear a bracelet, connected by alligator clip to an earthing wire running the length of the line. They wear factory-supplied rubber-soled shoes, resting on rubber foot pedals. Work clothing is a very nicely tailored jacket and pants.

Matsushita's sample of the automated home — with all functions, including the window blinds controllable by phone from outside the home.



World's smallest and lightest DAT recorder.



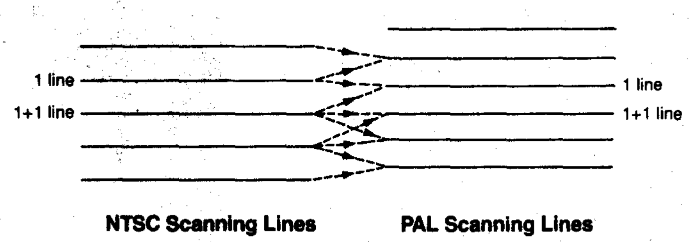
Panasonic's flagship camcorder — the NV-S1. This model is for the Japanese NTSC market. Note the use of 'fuzzy' on the side of the unit — a description not used in PAL markets.

Luminance Signal Conversion

■ Scanning Line Conversion

Information on every original scanning line is digitally analyzed and calculated to form a single line from two original lines.

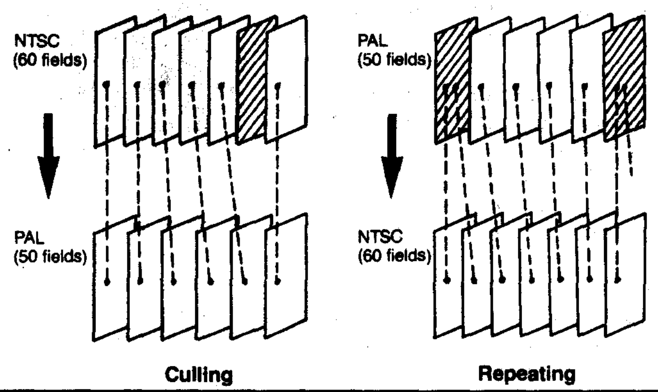
System	PAL/SECAM ◄─►	NTSC
Scanning line	625 lines ◄─►	525 lines



■ Field Frequency Conversion

The digitalized signals are sequentially stored field-by-field in the field memory and asynchronously read while specific fields are synchronized.

System	PAL/SECAM ◄─►	NTSC
Field	50 fields ◄─►	60 fields



In one section making laminated amorphous pro-heads, a robot not only set the head alignment but also the gap distance. It was a little unnerving to watch the check X-ray image come up on a monitor, and realise it was setting the gap to 26 microns. Automatically, by X-ray monitor, with no humans!

Next, the assembly of camcorder record/replay heads, which are smaller than a normal VCR's. A room little larger than a squash court housed possibly 30 robots — supervised by five people. Most of these loaded components into feed trays.

In another section the wiring for the head coils was done automatically by rows and rows of machines painted apple green — around 40 or 50 robots — and five people.

In the section making video camcorders I was surprised to see a lot of hand assembly. The circuitry and drive motors, etc., were fitted inside the outer casing of the camcorder.

Most of the girls were wearing white gloves, using a cradle to support the open casing. The camcorders being produced were the company's new S1 model, recently launched in Australia. The day we toured the line was the first run of a new model, including a colour viewfinder — for the Japanese market.

As we inspected each factory, an increasing feeling of anaesthesia overcame us — unless you looked across to the end of the line, the machines and sparse teams of people could have been making fishing reels, or rat-traps... and not machines that can demand a selling prices of two thousand or more dollars in their intended market.

But one factor that continued to amaze the Australians (if not the other nationals) in the group was the factory noise levels, with none of the staff wearing protective earwear.

Next year, beyond?

Speaking with one of the marketing men from the company, I found he had a continuing difficulty buying his own electronic hardware: "Each year I learn the secret plans of the company, and defer my purchases. Sometimes I get information three years ahead..."

On the question of Super-VHS and its future, I received this comment from Mikio Higashi, a Director of the company section responsible for audio and video: "We do not feel there is a demand for small screen TV sets with S-inputs, as the high quality picture is only appreciated on a large screen. But we know this is a stumbling block (in price), and so is the shortage of software in S-VHS.

At the moment 30% of VCRs are in S-VHS, but most TV sets available in Japan are S-compatible. It's the chicken and the egg. The change to S-VHS will not happen overnight, it will be gradual. But one thing that is for sure is that there is a trend to S-VHS, and we are supporting it."

The word 'software' bobbed up frequently in conversations, and appeared to be an important factor in the company's plans for S-VHS. Only the week before, the international press had carried a story of Matsushita's unsuccessful bid for MCA — the US TV and film production giant. Now that Sony (Video 8) owns Columbia Pictures and CBS, you can be assured it will not be the final bid by the Osaka company for the American 'software' producer — aka 'film studio'.

When discussing HDTV, I was told the company is not only heavily involved in the battle for the Japanese standard to be accepted world-wide, but its planners are looking to 1995 and 2000 for general acceptance of 'Super HDTV'.

At this stage the engineers are 'considering it', but conducting no practical research.

Multi-standard video

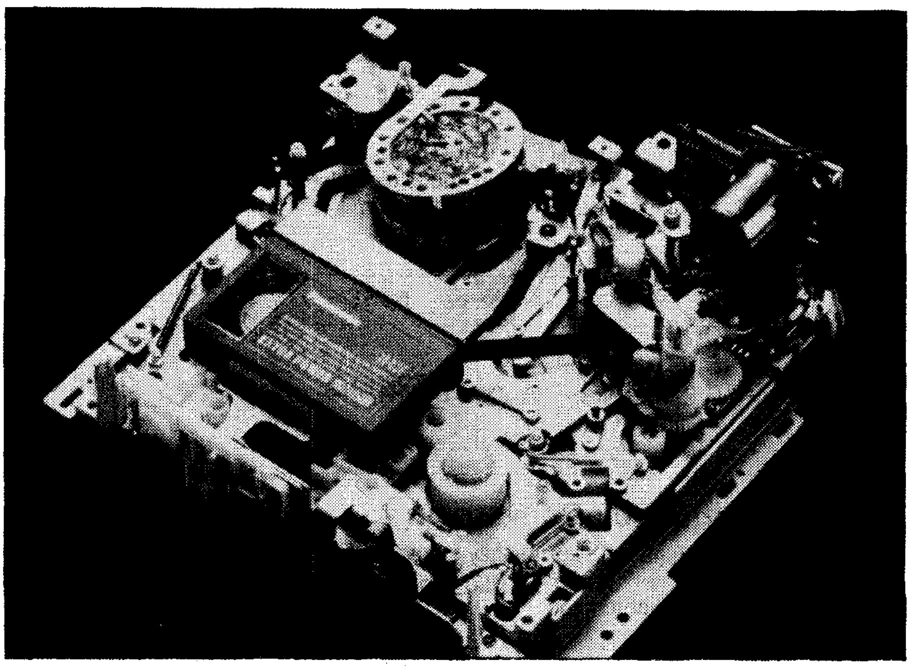
On another front, the company has surprised many in the industry by introducing a pair of 'table' VCRs with multi standard capability.

With the W1 model one can record and replay in any of the worlds' standards — PAL, PAL-M, SECAM, MESECAM, NTSC. Incoming video signals are broken into Y and C components, then each processed to match the desired system, after which luminance and chrominance are recombined and output as a video signal.

Information on every original scanning line is digitally analysed to form a single line from two original lines; the digitised signals are held in a field memory and read asynchronously while specific fields are synchronised; input chrominance signals are demodulated to colour difference signals, and converted to scanning lines and field frequency. The chrominance signals are then remodulated and output. The other VCR model, the J700, houses a world-wide tuner as well, allowing you to record a program anywhere in the world — in any standard. Yet another, a portable laptop VCR and tuner with a 5" LCD colour screen, can replay tapes in PAL and NTSC format.

Learning of these advances I then asked if there were any plans to manufacture a multi-standard video camcorder. Higashi's answer was this:

"To be very frank, I'm not sure there is a demand for it. The camera part of the unit would be the same, only the recording head and circuits would differ from system to system. Currently you can shoot on your own camcorder in whatever system it is, and replay on the multi standard VCR. So there would not appear to be any necessity to convert the camcorder. One problem is that we would need different imaging chips for each standard, and that would make such a machine difficult to manufacture."



Cutaway of Matsushita's VCR deck which is able to handle both VHS and VHS-C

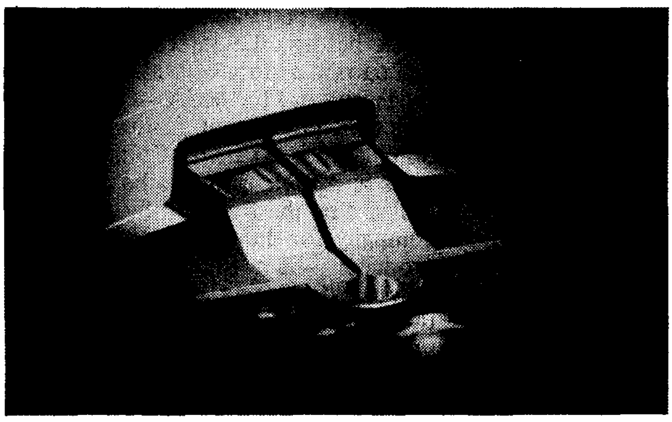
In VHS-C camcorders, the future lies in embracing digital picture processing after the professional world has proven it. Consumer acceptance for the company's anti-shake Digital Image Stabilisation feature will continue. Colour viewfinders will be the norm, as will hifi-stereo audio.

The size of these already minuscule picture makers will plummet — from a present 750gm to around 500gm 'very soon'. This will be accelerated by competitive pressure from the Sony camp and their Video 8 format.

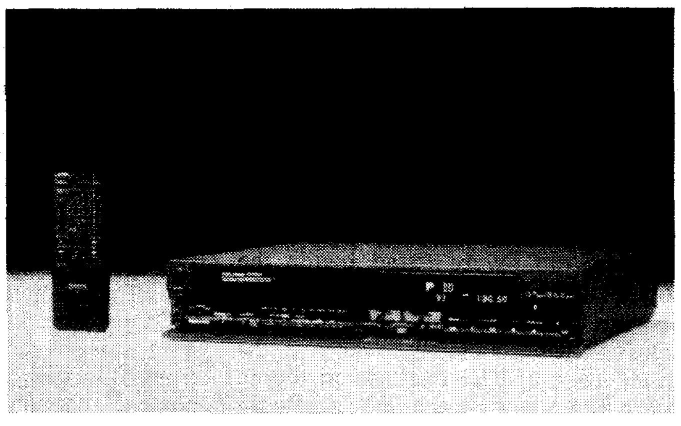
In manufacturing quality control, the future is in robots — but efforts must be strengthened in the area of control over component quality.

Video equipment for the consumer market will embrace — and absorb global design specifications. The demarcation lines between PAL, SECAM and NTSC will blur.

When asked who Matsushita's biggest competitors were, the answer was Malaysia and Korea. The former is proving to be increasingly attractive to Japanese companies as a manufacturing base, with its attractively plentiful and low-cost labour base. But Korea presents a threat of another kind — I was told how major companies in Seoul fly Japanese company engineers over for a weekend, and pick their

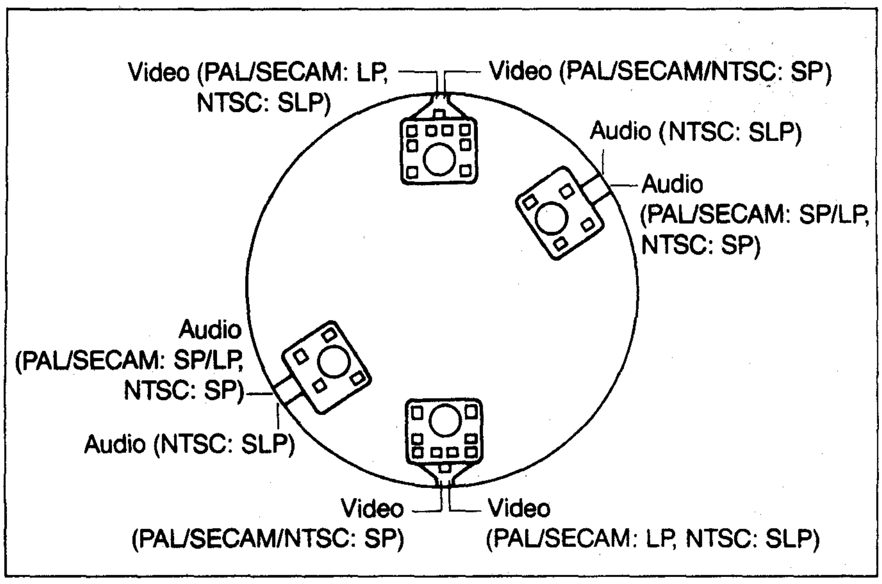


A laminated amorphous pro-head. The head's alignment and gap of 26 microns are set by robot operation.



The firm's NV-J700 VCR, with not only multi standard record/replay, but also a world tuner for global TV transmissions.

Head configuration in the NV-W1



		Conventional	NV-W1	
Audio Head-Width	NTSC	26μm (SP/SLP)	36μm (SP)	Clearer sound in any system.
			26μm (SLP)	
	PAL/SECAM	36μm (SP/LP)	36μm (SP/LP)	

brains on the more complex aspects of electronic manufacture.

Home movies

I spent some mind-blowing minutes in the Lucasfilm THX Sound Theatre for the home, and watched *Indiana Jones and the Last Crusade* thrown up by an LCD projector, plastered across a 100" projection screen and bolstered by hundreds of watts of surround sound.

Readers may be aware that we have George Lucas and his THX audio system to thank for not only the advent of the Star Wars generation of movies, but also radically different cinema sound installations that have blown away 50 years of audio cobwebs from many suburban theatres.

We were also the first non-Japanese to see the MP1 Movie Printer in operation. With it you can make full colour, dry, hard copy photographic prints in 80 seconds from any TV, VCR or camcorder picture source. 256 grey or colour tones produced very acceptable colour. The results were the best I've seen from this type of process. Print cost — around 70 cents each.

More new products

Among the new products we saw and heard demonstrated were:

- A 'fuzzy logic' vacuum cleaner that assesses the condition of the floor surface and dust therein, then produces the appropriate power of suction to clean with efficiency and efficacy. Fuzzy logic also rears its unfortunately-named head to find deployment in washing machines. Information such as the type of cloth being washed, type of detergent loaded, and degree of soiling are processed by a microprocessor and used to select any one of 600 different washing cycles.
- An Audio Flat Panel Speaker, only 6cm deep, that handles up to 350 watts RMS and produces an output sound pressure level of 88dB/W/1m — with a frequency response of 35Hz to 40kHz!
- A 'Speech Training System' that displays the user's speech on a monitor, and compares it to ideal displayed parameters, indicating whether the user's sound intensity, tongue and pitch configurations need re-shaping.
- I watched a demonstration kitchen being operated by phone from a distance — you could be next door, in the car, or across the world. With this Home Automation one could activate any appliance in the home — heater, oven, powered windows, even the front door security. Just ideal for putting the coffee on as you drive into the garage!

On the street...

Just before jetting back to that dear old, 19th century clockwork country we call 'Australia', I managed to get away from the company minders and lose myself in the city's electronics area.

The street level displays were always the same — row on row of huge TV sets, VCRs, and camcorders in brightly coloured cases, aglow with the unreality that is the ethereal promise of NTSC.

But upstairs was always the real, old-time Japanese electrical retailer — with their slightly 'cuckoo' range of product.

Like a solar-powered shaver shaped like a NASA shuttle; battery powered lint removers (for belly buttons?); a powered blade razor; and an odd device with stick-on tentacles that promised to deliver 'an effective low frequency treatment for stiff shoulders, fatigue, neuralgia and muscle pain: three types of massage — kneading, tending and vibration'.

One wonders whether Konosuke Matsushita would have much of a chance flogging his double adaptors door-to-door in the Osaka of 1991.

Maybe not on the ground floor, but he would probably find the upper floors much to his liking! ■

INDIA'S SURGE IN TECHNOLOGY - 2

In this second article looking at the current dramatic growth in India's hi-tech industry, the author describes what is happening in the area of satellite technology and communications.

by THOMAS E.KING, VK2ATJ

The number of India's scientists and technicians is great, but the tally of fanatic enthusiasts interested in experimenting with satellites is microscopic! An estimate by Bindu Padaki, an FM, TV and satellite TV DX hobbyist for 15 years, in India's most popular electronics magazine *Electronics for You* places the total at between 10 and 15.

One reason for this is the high cost of equipment; another is its unavailability.

Another is the general lack of knowledge (motivation?) about receiving signals from the sky. The miniscule number of home-brew hobbyists is not to be confused with a slowly growing number of home owners who invest in a commercial Sky TV package. While government officials have promised to examine policy, India does not yet have a set of comprehensive regulations to govern satellite TV.

Indians, in fact, can obtain a licence to install a dish from the Department of Telecommunications, but this only allows viewers to watch domestic TV programmes relayed by the country's own INSAT satellites.

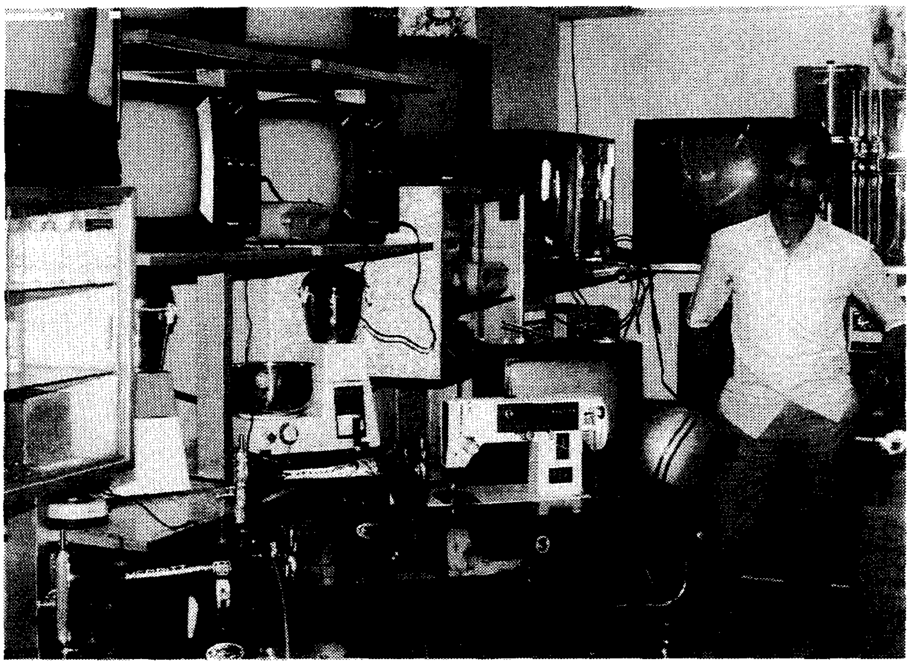
This proviso is universally ignored; Indian viewers watch whatever is available from international satellites.

While there's much foreign originated material beamed through Indian skies, let's look first at the signals from local birds.

On the domestic satellite scene, India's first INSAT (India National Satellite) preceeded AUSSAT by several years. Becoming operational in October 1983, the second satellite was designed and launched with the idea of increasing the number of TV viewers from less than 30% of the population to over 70% by the end of 1984.

This wasn't the first success with satellites, as India has been one of Asia's pioneers in satellite use for

INSAT's hi-tech wizardry has brought the electronic media to a remote mountain village in the beautiful Himalayan Mountain state of Himachal Pradesh.



As a larger middle class emerges in a prospering India, domestic manufacturers cater to their increased purchasing power with a wide range of indigenously produced goods.

television broadcasting. In the early 1970's a unique year long experiment with satellite TV was conducted by Doordarshan.

Using a loaned geostationary communications satellite, technicans from Doordarshan, in collaboration with those from the Indian Space Research Organisation, beamed special educational and farming programmes to farmers, their families and schoolchildren in some 2400 villages in six states. This triumph formed the basis for India's ongoing expansion of its extensive television network, much of which is now satellite based.

The Doordarshan network had around 500 land-based transmitters by the end of the Seventh Plan, which ended in March 1990. The start of the Eighth (five year economic) Plan on April 1, 1990 has heralded great advances in communications technology.

For example, INSAT-1D (the fourth and last in the '1' series) became operational in mid-July last year. Launched to replace the deteriorating INSAT-1B, this latest satellite is expected to serve the country for another five to six years.

Despite heavy transponder use for All-India television coverage, the major part of 1D's satellite capacity has come to the aid of the country's overburdened and archaic telephone service. Not only has the use of two-way satellite circuits resulted in a vast improvement in the quality and reliability of communications between major cities, it has allowed the widening of direct dial services within the country.

Beyond this are various commercial data link applications being employed across the country, thanks to 1D's design. For the benefit of Government departments, the National Informatics Centre's NICNET is a nationwide satellite-based two way data communications network that links district headquarters, state capitals and central Government departments in New Delhi. Each micro earth station is equipped with an 1.8-metre diameter parabolic antenna.

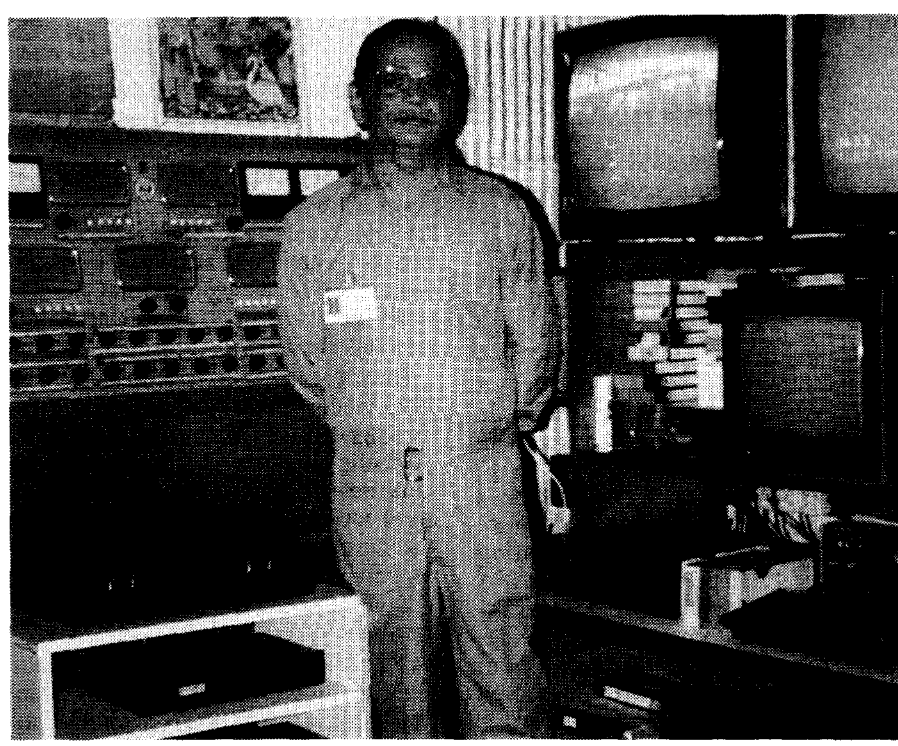
In addition, industrial units in rural areas where communications are limited can now make use of a satellite-based Remote Business Area Message Network, while staff in hi-tech-aware newspaper companies can compose pages and then transmit them by facsimile through 1D.

The 1D satellite (83° East) was launched aboard a US Delta rocket from the Kennedy Space Centre, and is also equipped with two national coverage (high power) TV transponders and one very high frequency radiometer for meteorological purposes.

Built by the Ford Aerospace Corporation, it is intended to be the last Indian satellite fabricated abroad. Indigenous technology has advanced to such a stage that the INSAT 'II' series will be an all-India project.

Before the first of the series II satellites is launched and becomes operational, however, it will be preceded by two test spacecraft in order to demonstrate and flight test the indigenous design and engineering.

The first test spacecraft is scheduled for launch in mid 1991 and the second in mid 1992, onboard the European



Deep inside Oberoi's marble-lined hotel is the heart of an elaborate audio visual satellite TV centre; overseen by Mr Wadhawan, it surpasses anything to be found in Australia.

launcher, Ariane. The second generation of satellites, like their predecessors, are to use 'S' band frequencies between 2.5 to 2.6GHz for transmission. While a *satellite* dish capable of receiving INSAT transmissions is still an uncommon sight, there are a number of Indian manufacturers who can supply S-band TVRO (television receive only equipment) systems for around $530.

The package is affordable by middle class families and consists of a 122cm dish antenna, a low noise converter and a receiver. It is most popular with viewers in remote and isolated areas, who wouldn't normally be able to receive a TV signal.

Signals from the sky

While television production (professionally designed sets), on-air time (weekday morning breakfast and afternoon TV for the elderly) and choice (two channels in Bombay, Calcutta, New Delhi and Madras and one channel elsewhere) has markedly improved and increased, the real thrill for the handful of dedicated hobbyists is DXing international satellites operating in the C band (3700 to 4200MHz) and Ku band (10.9 to 11.2GHz). There are nearly two dozen different C and Ku band satellites which can be viewed in all or parts of India.

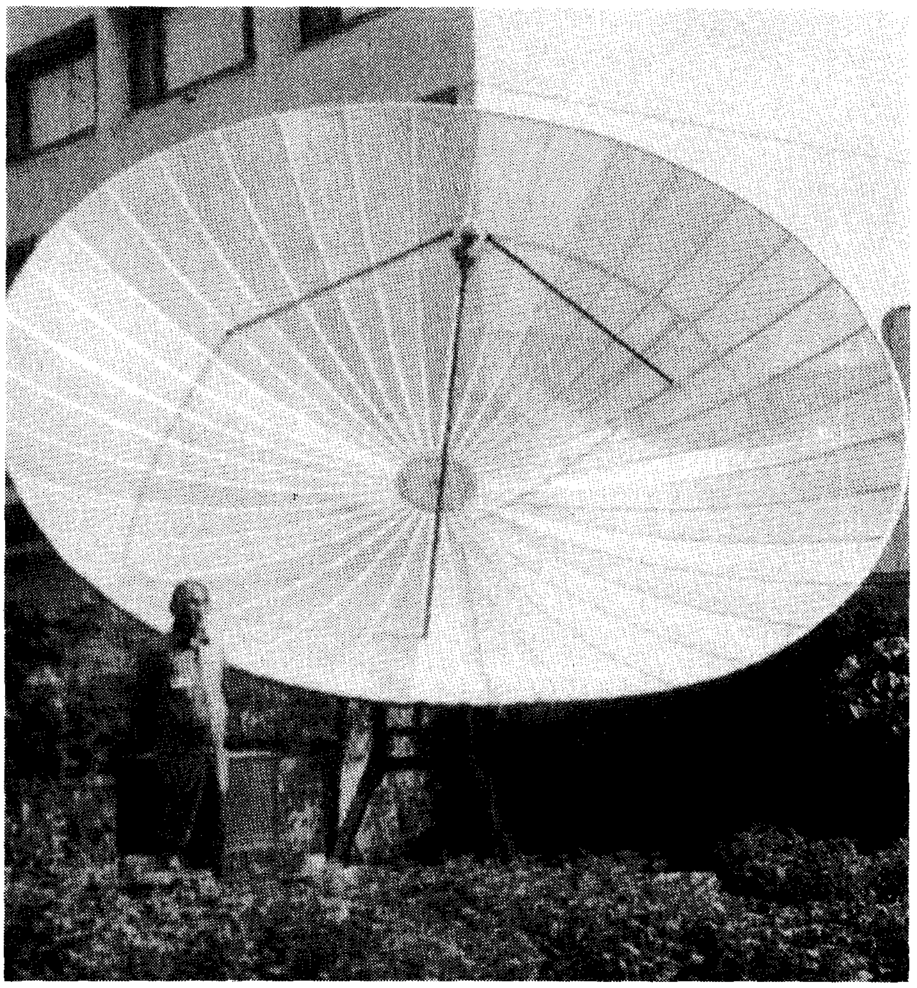
For instance, INTELSAT at 1°W can only be seen in Bombay and other west India centres, while the AUSSATs at 156° and 160°E can be watched in Madras, the closest Indian metropolis to Australia.

In between are satellite transponders relaying signals from such countries as Sweden (TELEX, 5°E), Oμαν (ΑραβΣΑΤ, 19° E), the USSR (Raduga, 35° E), Malaysia and Thailand (Palapa, 113° E) and Japan (Sakura, 130° E).

Even with receiving equipment capable of demodulating C-band signals, the few true satellite TV DXers in India could only expect to pick up a limited number of stations. The problem is the antenna size.

For noise-free pictures, the dish needs to be at least 762cm in diameter claims Mr Padaki. Hobbyists experimenting with C-band reception and using a 305 or 366 cm dish (with decreased performance) are able to receive enough signals from the sky to keep them thoroughly enthralled with space-age communications technology.

On a rather different scale and in a greatly different setting, the same technology has found its way into a few select hotels in India — including a number belonging to the country's leading hotel chain, Oberoi.



The luxurious Oberoi is only one of a few hotels in India to offer satellite TV to its hotel guests.

Operating a dozen or so top-of-the-range luxury hotels primarily located in key Indian business centres, the Oberoi Group is not only known for its up-market, stylish accommodation but also as an innovator in hotel standards, service and facilties.

The latter took a great leap forward in 1990 when selected hotels in the prestigious group 'sprouted' massive parabolic antennas and began pumping satellite television into their elegant guest rooms. The Oberoi in New Delhi was equipped with satellite TV in September 1990. A local company, CATVISION sold the hotel a TVRO package for about $8300.

Consisting of a 4.5 metre dish made in Delhi, an imported LNB receiver and line amp, CATVISION's charge included installation, according to Mr P.N. Wadhawan, Audio Video Engineer for the Oberoi. But on top of that a fee of 17 cents per day per room has to be paid to the company as a fee to view Cable News Network.

As we sat watching images that were coming from some 40,000km above India, the 26 year veteran employee said that when he began work in 1965 the Oberoi was the only deluxe hotel in the capital and that even B/W television was a long way from being introduced in India. As he continued to remark on the many advances that have occurred over the past few decades, I glanced out the window and across the centuries as my gaze scanned from the olympian-sized hotel pool and adjacent Delhi GolfCourse below to the nearby walls of an ancient medieval fort.

Sitting amid the ultimate comforts of the 20th century, but viewing the strong-hold where a long vanished dynasty once lived in opulent splendour, I was in two worlds at the same time.

But then this is part of the mystique that is India. ■

Marine radio changes: are they for the better?

Australia's marine radio users have been advised that in July this year, the existing network of coastal base stations providing support of 'distress' channels on the MF channels around 2MHz will be largely dismantled, and replaced with support on HF channels around 8 and 12MHz. As the new channels will be much more dependent on 'skip', many marine users are very unhappy about the effect of the changes on reliability of communications.

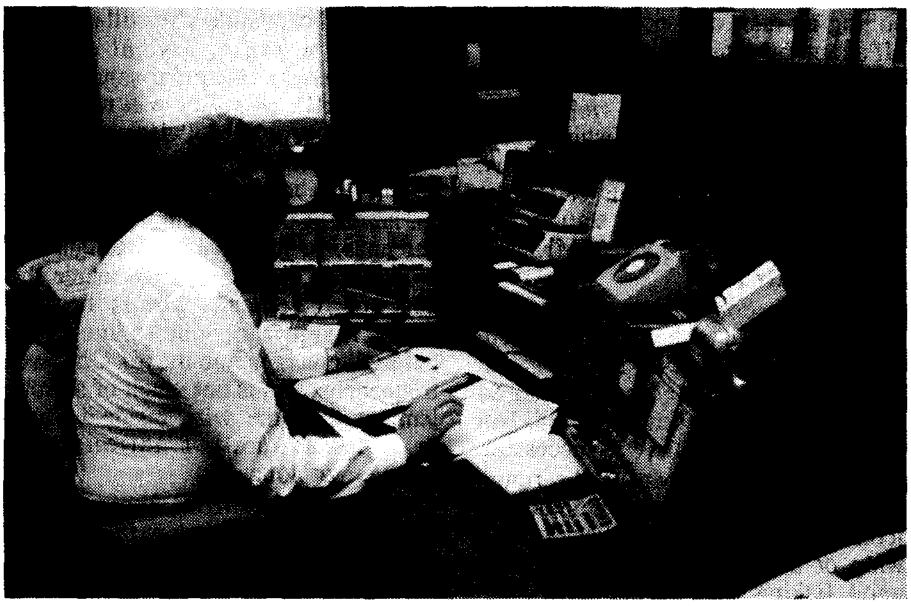
by TOM MOFFAT

Marine radio users in Australia are blessed with one of the world's best systems, run by the OTC. Small craft — yachts and fishing boats — are particularly fortunate, because with even simple radio equipment they're always in range of one of the many coastal radio stations that ring the continent. As they work off the coast or cruise from city to city, boats can receive the latest area weather forecasts from the coastal stations, and they can report their progress to the stations which then keep a running watch on their whereabouts and wellbeing.

The most important thing, of course, is being able to get on the radio and yell for help if you run into trouble. All boats with HF radio gear carry the international distress frequency 2182kHz, and most carry working frequencies of 2201 or 2524kHz. Within the HF spectrum these frequencies are quite low; in fact they properly belong in the medium frequency range, not HF.

Such low frequencies don't 'skip'

The Hobart Radio OTC station, facing the axe.



"Hello all ships! This is Hobart Radio 1". OTC operator John Brooksbank reading the weather sked.

well off the ionosphere, at least in the daytime, so they depend almost entirely on groundwave coverage. This gives a range of a couple of hundred nautical miles at most, but within this range the radio lays a thick blanket of RF and communication is very reliable. Performance is much what you'd expect from an AM broadcast station; the frequencies are similar.

As radio users well know, higher frequencies produce quite remarkable ranges, worldwide at times, but they depend on bouncing off the ionosphere to get there — groundwave coverage is virtually non-existent. The strength of the bounce or 'skip' varies with the time of day, the time of year, and the variation of the 11-year sunspot cycle. When a high frequency band is 'in', a 10-watt transmitter will get you across the world. But when the band is 'out', no amount of power will get you out of your own backyard if there's nothing for the signals to 'skip' from.

Changes planned

Australia's coastal radio network and its excellent lower frequency performance is about to be dismembered, starting from July 1 this year. It is intended to abolish all coastal stations except for Darwin, Perth, Sydney, and Townsville. Those facing the axe include cities like Adelaide, Melbourne, Hobart, and Brisbane, although it's reported that the government may relent on Melbourne Radio.

It is intended to designate new distress frequencies — 8291kHz and 12.290MHz — which would depend on skip for successful communication. The traditional 2182kHz would still be available, but with coastal station closures in many parts of Australia there would be no-one to listen for distress calls on 2182 except for other boats.

The idea is for Australia to conform with the new Global Marine Distress and Safety System (GMDSS). It's planned that with a network of high frequency stations and satellites, all internationally coordinated, vessels can have their distress calls heard and receive safety, navigation, and weather information anywhere in the world.

The system is aimed at the world's commercial fleets, with their elaborate radio installations and shipboard satellite terminals. But small craft operators in Australia, fishermen and yachties, feel they've been left to sink or swim on their own — literally.

The whole kerfuffle started early last year when the government released a little brochure called *Maritime Safety Communications — Changes Ahead.* Inside were maps showing the coverage expected from the four remaining coastal stations, for both day and night. Coverage was shown by contours of expected reliability, for 50%, 70%, and 90%. The night map showed Australia nicely blanketed by the 90% contour, which reached right to the edge of New Zealand.

But the daytime map had two serious 'holes', one over the entire northwest coast of Western Australia, and the other covering just about the entire coast of South Australia. These were shown as within the 70% reliability area, with possible improvement if boats employ 'Selective use of 12 or 16MHz frequencies by ship stations transmitting at 150 watts PEP'.

The proposal enraged small craft owners. The night coverage looked acceptable, but yachts and fishing boats are usually resting at anchor at night. It's the daytime when they're out and about...

According to the brochure, you're only going to get through from the two 'marginal' areas for 70% of the time, unless you pin your hopes on 12 and 16MHz frequencies. What happens if you're sinking in the middle of Spencer Gulf and the frequencies won't work? Gurgle-gurgle.

Computer predictions

Although Tasmania is shown as part of the 90% coverage area, the state's fishermen still had their doubts. As well, they were concerned about the expense and trouble of replacing their perfectly good marine radios and antennas with sets capable of handling the higher frequencies. So consulting engineer Andrew Boon was hired by a consortium headed by the Marine Board of Hobart, to make a study of the true radio situation.

Mr Boon used a computer to do a detailed prediction of the likelihood of successful communication from the fishing grounds in the southwest corner of Tasmania. Two runs were made, first simulating the existing system where boats communicate with Hobart and Melbourne Radios, and then for the proposed system with boats working Perth or Sydney.

The existing service produced a reliability figure of 92.2% for a 100-watt transmitter, and 94.1% for a 150-watt unit, averaged over the whole 11-year solar cycle. But the results for the proposed new system were in stark contrast to the government's version. Although the test area is allegedly in the 90% reliability contour, calculations showed a 70.4% figure for a 100-watt transmitter, and 85.4% for 150 watts. These figures are for a 13dB signal-to-noise ratio. With a signal quality reduction to 6dB S/N the computed reliability climbs to 98%, but this would be a truly borderline condition.

It's interesting to note that the computer predictions were made with the *Advanced Stand Alone Prediction System* (ASAPS) program, being sold commercially by the government's

Marine radio

own IPS and Radio Space Services. Did the government use its own program to come up with its 90% prediction? And if the Tasmanian figure is so far out of whack, what does it say for the 'marginal' areas of Western Australia and South Australia? Is their reliability really 70%, or is it worse?

Also worrying is the effect of falling transmitter power. With the present system, a power reduction from 150 to 100 watts causes a reliability decrease of less than 2%. But with the proposed system, the same power reduction reduces the reliability by 15%.

Many marine radios, particularly older ones, can produce 100 watts only when tuned to perfection and with the boat's motor running, to charge the battery. If the radio hasn't been tweaked up for awhile, and if the motor is off, the radio might be lucky to make 50 watts, or even 20.

At the 100 watt level reliability is already slipping away quickly, so an elderly radio might be quite useless when the chips are down. ('Mayday, Sydney radio, our motor's conked out and we're running up on the rocks!') One only has to listen to a fishing boat radio sked to hear many boats in the same area, all with '100 watt transmitters', whose signals vary from rock-crushing to inaudible.

Reception tests

Andrew Boon ran another series of tests on real radio circuits. These were radioteletype stations in Sydney, operating on marine frequencies between 4 and 17MHz. He set up a receiver in Hobart (actually an Icom 735 amateur transceiver), so its frequency could be set for different stations at different times under the control of a computer. He also digitized a sample of the AGC line so signal strength could be recorded automatically.

The results were tabulated as a chart of dates against time-of-day, with half-hour blocks during which communication quality was 'just usable' marked with an X. Overall reliability factors worked out somewhat better than those from the computer predictions, but the chart shows a worrying dearth of X's from 0400 to 0600 GMT every day, over a three week period of July and August, 1990.

This meant total radio failure every afternoon, just when boats would be pulling up their cray pots and heading off along the dangerous coastline.

Some 'real-world' tests came during actual cruises aboard the police boat *D'Entrecasteaux* and the fishing ketch *Stormalong*, in waters south of Hobart. At various times the boats called the Sydney and Perth coastal stations, on frequencies between 4 and 16MHz and logged the results.

The most common result was no reply at all from the station called. When Sydney could be raised, signal reports were generally in the S1 to S4 region; S4 was the best achieved. Not one call to Perth Radio was successful.

Both boats had top-of-the-range radio installations from Codan and Icom. The police boat used an untuned whip or a vertical wire, much like a good fishing boat installation. *Stormalong* had a loaded backstay arrangement, right to the top of the mast, considered the most efficient type of yacht antenna.

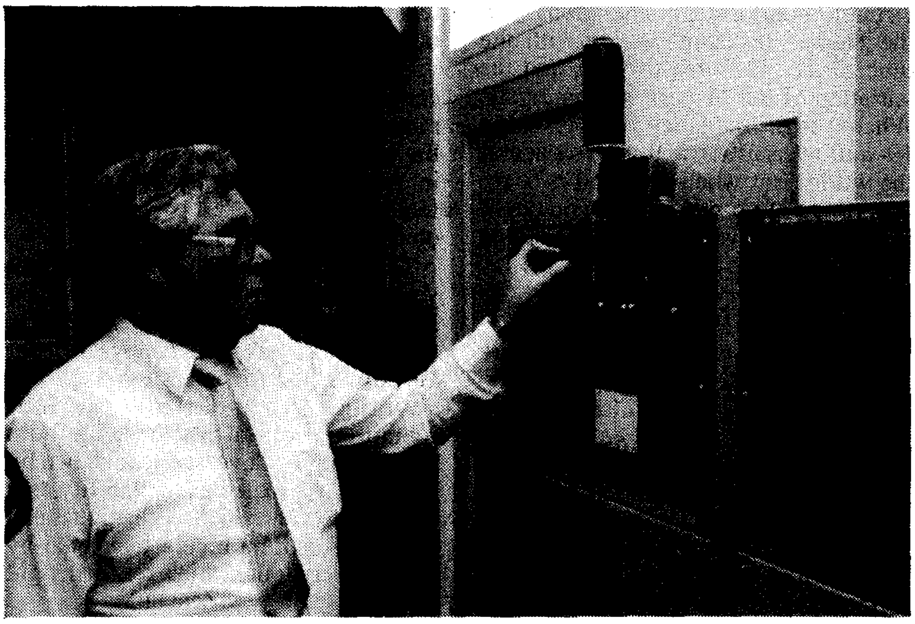
One interesting effect observed on both boats was that Sydney could hear them much better than they were hearing Sydney, even though Sydney Radio would have been using a much more powerful transmitter. So far nobody has come up with an explanation for why this occurred.

If the marine radio changes go ahead, many boat owners will have to shell out for new radios capable of working on the higher 12 and 16MHz bands at 150-watt power levels. Most current radios cannot do this. Maybe some boat owners won't have to change radios, but they're still going to cop extra expense. Several channel frequencies are changing, some as little as 0.5kHz, so radios will need new crystals at around $50-100 per channel. Fishermen see these small changes as a useless and expensive nuisance.

There's also a problem with existing antennas. In many older installations, the radio is mounted down inside the boat and the antenna wire is then run along inside the boat to the stern before it emerges into the air. On lower frequencies this is not much of a problem, because the wire inside the boat is only a small fraction of a wavelength long.

But on 12 or 16MHz, there might be an entire quarter wavelength of antenna — the most important radiating part — trapped inside the hull. This means many boat owners will be up for a remotely controlled antenna tuner installed at the stern, so the radiating part of the antenna can be outside.

The Boon report looks into the problems faced by fishermen and yachties who will be forced to upgrade radios or antennas or both. For a good quality installation with Codan or Icom gear, similar to the systems on *Stormalong* or *D'Entrecasteaux*, the boat owner will be up for well over $4000. Fishermen particularly are not impressed, especially in these depressed economic times. They feel their existing radio systems are quite adequate; they use them successfully every day. So why should they be forced to upgrade?



John Brooksbank with the Hobart Radio transmitter. The receiver is remoted from South Bruny Island, said to be one of the quietest receiving sites in the world.

It looks like the government may be getting part of the message, at least. As mentioned, Melbourne Radio will probably be saved from the axe. There is also a proposal floating around to keep a few of the critical 2MHz receiving sites going and remote-control them from the nearest (remaining) OTC coastal stations.

This would in theory allow reception of distress calls on 2182kHz. However I personally heard one session on a Sunday evening which makes one wonder how practical this is. Hobart Radio was being run remotely by Melbourne Radio. Melbourne broadcast the usual weather sked on 2201kHz, with the Tasmanian forecast included, and then asked for any position reports from boats.

I heard at least six boats calling from southern Tasmania, but after a short time Melbourne Radio came back with 'No calls heard, Melbourne Radio Clear'. The boat skippers then began talking among themselves in colourful 'fisherman's language', and their comments about the OTC's remotely-controlled Hobart Radio were not very complimentary.

Several alternative radio systems are available to soften any problems caused by the GMDSS changes. There are many non-government HF radio services that will continue to operate, regardless of what happens to the OTC services. Limited coastal stations are government licensed, but they're run by small groups of non-professional operators on a volunteer or semi-commercial basis.

These stations are usually of professional quality, sometimes with elaborate remote-control systems to mountaintop transmitter/receiver sites. They work on 2524kHz, sometimes a 4 or 6MHz frequency, the 27MHz marine band, and VHF. Any one station is usually equipped with the lot, and they transmit weather skeds and keep track of travelling yachts.

What limited coast stations DON'T do is monitor international distress frequencies, and they usually don't provide 24 hour-a-day coverage. Their use is generally limited to pleasure craft, but fishing co-operatives run similar services for their members.

VHF operation

The up and coming radio service for coastal navigation is VHF, on FM channels around 156MHz. A base station can generally be worked reliably out to 50 nautical miles, sometimes further. The OTC is slowly establishing a network of VHF stations right around Australia, but at the moment there are big holes in the coverage which will presumably be plugged sometime in the future.

An offshoot of VHF is the new Auto-Seaphone service; virtually a mobile telephone service for boats. Calls can be dialled directly from a keypad on the radio or the back of the microphone, and if the user enters '999' it sets off distress procedures ashore, automatically. The 999 number was probably chosen because it is the '000' telephone emergency number in the northern hemisphere.

(Sidelight: If you want to drive your yuppie friends mad with envy, just give them your Auto-Seaphone number as your alternative office telephone number during the summer. I can be be contacted on Seaphone 153280 aboard the yacht *Pinda*, where I sometimes write my magazine articles with a laptop computer. It's fun being a technological snob. Cellular car phones are definitely old hat now...)

VHF marine radios are cheap (around $500), reliable, and easy to install. The antenna is a simple whip, usually installed atop the mast. It's intended that VHF will virtually replace the HF service for all coastal operations, allowing limited HF stations to close down. But it will probably be many years before VHF is available around the wilds of the Western Australian coast, or the South Coast of Tasmania.

It has been shown that VHF marine radios sometimes have difficulty communicating when close to shore, where their signals may be blocked by nearby hills or cliffs. This is unfortunate, because boats are generally safest when they are well out to sea. Most boats run into trouble when they collide with land, where VHF performance would be worst.

Summary

The marine radio users' reaction to the GMDSS proposal may appear a bit negative, but it seems there are still a lot of questions to be answered about its effectiveness. Perhaps the government should be looking at the whole concept once again, before it reaches the point of no return. Once the coastal stations are closed, it's unlikely they could ever be resurrected.

There is one bright star that stands out in this whole GMDSS system: Emergency Position Indicating Radio Beacons, or EPIRBs.

These little portable transmitters are in limited use now; they transmit a distinctive tone on 121.5 and 243MHz, allowing searching aircraft to home in on another downed aircraft or a ship in distress.

Under GMDSS, satellites will be used to relay signals from the 121.5 and 243MHz units back to receiving stations on the ground, giving an indication that an emergency has occurred. For this to work, the satellite will have to be in range of the EPIRB and the ground station simultaneously. The satellite will also be able to pinpoint the EPIRB's position within 20km.

A further enhancement involves EPIRBs operating on 406MHz. Instead of just relaying signals, a satellite will be able to store a distress signal from one of these units and retransmit it later as it passes over a ground station, eliminating the need to be in view of both stations at once.

The satellite will be able to fix the EPRIB's location within 10km, and the EPIRB will be able to forward detailed information about the ship in distress. It's expected that it will be compulsory for commercial fishing vessels to carry 406MHz EPIRBs from 1995.

Eventually satellites will replace all land- and sea-borne marine communications. Already commercial ships can access satellites, and people aboard can talk to the world by simply picking up a handset. This is rapidly eliminating the need for the traditional 'radio room'.

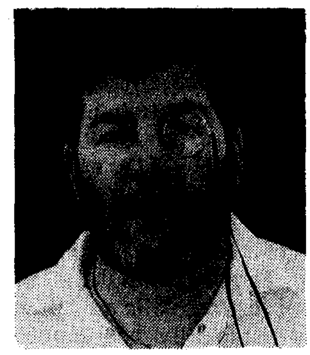
But shipboard satellite communications are still frightfully expensive, as are the 406MHz EPIRBs. Until then HF will remain a vital service, and it's certainly important to carefully assess the consequences before making any radical changes to it. ■

STOP PRESS: Melbourne reprieved!

The authorities have now announced that the Melbourne coastal radio station is to be retained, along with those in Darwin, Perth, Sydney and Townsville. However all other stations are still to be closed down at the end of June.

Moffat's Madhouse...

by TOM MOFFAT



The strange matter of 'Matter-mitters'

What this world really needs is a really good matter-mitter. A what? You know, a matter-mitter.

When I was just a kid, I remember going to one of those amateur stage reviews, put on by the army. I lived on a military base at the time, and the show was cooked up by young soldiers for the entertainment of the other troops.

The big production, on the stage of the base's cinema, had lots of singing and dancing acts with soldiers dressed as women when necessary. There were comedy sketches, like the old classic where they perform a surgical operation as shadows projected on a bedsheet, with lots of running commentary as various body parts are removed from the 'patient' with hammers and saws.

But the hit of the show as far as I was concerned was a sketch about a mad professor and his 'matter-mitter', a wild device that could transport matter from one place to another via radio waves. He'd put something in a box on one side of the stage and then turn on a 'machine' that flashed lights, wiggled meters, and made lots of convincing noises — and then the object would pop out of the box on the far side of the stage.

That sketch was pure stage magic, done for laughs, but it planted in my mind ideas that have stuck there to this very day. Why *can't* we have a matter-mitter, or a transporter, or whatever you want to call it? We can transmit sound or pictures over the radio, why not objects? I'm talking seriously now, and I've given the subject a lot of thought. I'll predict right here and now that before the end of my lifetime, *they* (the scientists) will come up with a real matter-mitter that works. That gives them about 30 years, at the outside.

Impossible? Well, 30 years before man walked on the moon, that was impossible too. Books were written, science fiction films were made, but they were all dreams. And then — whacko — Neil Armstrong says "One small step for man...".

There's been lots of fiction written about matter-mitters, just like about moon travel. Every space adventure worth its salt has some form of 'transporter' or 'tractor beam', a system to send people from an orbiting spaceship to the surface of a planet without the messy inconvenience of a lunar lander.

Remember *Star Trek*, made nearly 30 years ago. The Starship Enterprise had a whole room set aside for transporters. And there were three transporters, as I remember, that could work simultaneously.

Back down on the planet, time to come back to the ship: those immortal words from Captain Kirk as he flips open his communicator and says "Beam me up, Scotty!". Realists back then scoffed as us 'Trekkies' who believed that such things might one day come true, but what do they say now about the latest cellular telephones? The newest models, I notice, can be opened with a flip of the wrist, just like Captain Kirk did with his communicator. And they can talk to the world. So the Trekkies have got it half right so far; will the tractor beam be far behind?

If you sit down and mull over the problem of transmitting matter via radio, a few hitches become evident. The tractor 'beam' idea, for starters, looks to be out of the question, at least for early systems. What would its principle of operation be? You can't just squirt energy somewhere like a fire hose and expect it to stop at a particular spot and convert back to matter. And there's the line-of-sight problem: a beam would be fine for moving things from a spaceship to earth, but what about from Sydney to London? Perhaps there will be satellite matter repeaters, like today's satellite communication repeaters.

I think the first matter-mitter system will require a proper transmitting device on one end, and a dedicated receiving device on the other. I think the technology will involve scanning the source object, bit by bit, and sending it out serially, just like we do today with television and fax. The receiving end would have to be in sync with the transmitting end, and it would reassemble an object, bit by bit, just like a fax machine does to an image.

An imaginary system like I'm talking about was described in a story called 'The Fly', first as a short story in *Playboy* magazine back in the fifties, then as a chilling film starring the old master of horror Vincent Price, and finally as a more modern remake film that wasn't as good as the original.

This story described discrete transmitting and receiving units connected by a wire link, with a scanning system to break down the source object molecule-by-molecule, transmit it serially, and then reassemble the molecules on the other end. This worked fine with inanimate objects, and then with a live cat.

But when the experimenter climbed into the box himself, he unknowingly shared it with a fly. And when the molecules were recombined on the receiving end, some from the man ended up with the fly, and some from the fly ended up with the man. From then on we had a fine monster story, but the films would have given matter-mitters a bad name for awhile.

Bad name or not, matter-mitters will come, sooner or later. Looking at current scanning technology, we could probably build on what we already know from fax machines (slow scanning) and television (fast scanning). But we have to keep in mind the fact that these things don't actually send pictures or pieces of paper, what they send is IMAGES of the pictures or pieces of paper. The 'original' remains unchanged.

Perhaps we could send an image of an object. Why not scan each molecule and analyze its composition. Then we could send a *description* of each molecule — so many atoms of hydrogen, so many of oxygen, so many of carbon, and so on. At the receiving end there would be supplies of the necessary elements, and a means to combine the required number of atoms into molecules exactly matching the incoming specification. Finally the molecules could be reassembled into the complete object.

There's only one problem here: The received object would still be a *copy* of the sent object. Suppose I wanted to transmit myself to London. If I underwent the above process there would soon be myself in London, but there would still be my original self in Hobart. When it came time to return home, I could re-transmit myself from London to Hobart, but that would leave myself behind in London, and to make matters worse there would then be two of myself in Hobart. Golly — could the world take it?

It is obvious then, that the matter-mitter is going to need some way of ensuring that one object goes in and only one object comes back out. Perhaps there will be some gadget in the transmitter to release a poison gas and painlessly destroy the myself that went in. The remains could then be somehow reduced to their component elements (cremated?) which could then be added to the stockpile of elements needed for the receiver. How gruesome!

I'll bet you didn't know that a matter-mitter for small objects has been around since the 1920's, maybe even earlier. It was most recently demonstrated in a weird film called 'Brazil', a strange mix of Orwell's *1984*, *Alice in Wonderland*, Charlie Chaplin's *Modern Times*, Monty Python and Max Headroom. The film seemed to be obsessed with ducts and tubes; every set and piece of scenery seemed to include some kind of exposed tubing or ducting (a bit like the air-conditioning system at Hobart airport).

That film was so unusual it would take several viewings to make complete sense of it. One scene involving ducting gone wild depicted a building's central heating system, a behind-the-walls collection of ducts and pipes that moved and pulsated and made gurgling noises like a digestive system in the throes of intense stomach-rumble.

Then in one scene, a pneumatic tube! Remember them? I'll bet younger readers wouldn't — I'm sure they'd all but disappeared by the end of the 1950's. Pneumatic tubes allowed small items like documents and money to be sent from one place to another, automatically, with no human intervention once the items had been launched.

The pneumatic tube was a brass pipe about 50mm in diameter, hooked up to an air compressor or perhaps a suction device. There were openings into which you could insert small cylinders, with felt washers on them exactly matching the pneumatic tube's inside diameter. If you inserted one of these cylinders into the tube it was sucked or blown along at a frightening speed until it came out the other end. The cylinder was hollow, with a little door in it so you could insert money, documents, or anything else that would fit.

Networks of pneumatic tubes were installed in large department stores, banks, and other businesses of the era. These businesses usually had one central cashier's office; sales staff weren't allowed to handle cash or make change.

When you bought something (this was a long time ago, I remember my mother doing this) you gave your money to the sales assistant who then put it, along with the docket, into one of the cylinders. He or she then opened a little door on the end of the pneumatic tube and inserted the cylinder, and with a soft 'floop' sound it was gone.

A short time later there would be another 'floop' and a cylinder would pop out of the return pneumatic tube into a waiting wire basket. Inside the cylinder would be the change, and the docket marked 'paid'. In a large department store the cashier's office could have been a block away, even in another building, but things could be transmitted by pneumatic tube in a few short seconds.

If you looked at the ceiling in one of these stores, you'd see pneumatic tubes running everywhere. There had to be plenty of them since they were full duplex circuits, with one side for transmit and one for receive. Why aren't they still in use today? They were so quick and efficient! Perhaps they just priced themselves out of existence with all that brass tubing, to be replaced now with wires and 'electronic funds transfer'.

But the pneumatic tubes proved that the concept of a matter-mitter is more than just a pipe dream. There is at least one practical solution for moving things, quickly and unattended, from one place to another. Who's going to be the one to develop a modern electronic version? Such a thing would change the world forever, eliminating the need for transport and with it the problems of pollution and resource depletion. We could just step in, press a button, and 'be' somewhere else instantly.

Hey! Here comes another idea. As I was writing this, my daughters were cooking up some 'Alliance Freeze Dri Vegetarian Pilaf'. This stuff comes as a crumbly powder, and after adding water it reconstitutes back to a nice, moist, full, yummy meal.

Why can't we freeze-dry people? The human body is supposed to be 90% water, so if you remove the water a 100kg man becomes a 10kg parcel that can be easily sent by ship or air from place A to place B. The freeze-dried person would notice no passage of time on the journey since he would not exist as a person until re-constituted at the destination.

No, that's too messy for routine use. Let's save it for times when it's necessary to send people on space journeys lasting several years. For day-to-day travel, give me the good old matter-mitter any time!

(Jim Rowe comments: Presumably YOU will be volunteering for the first test of the prototype, Tom. I don't think too many people will be fighting you for the privilege! The matter-mitter sounds risky enough, but the freeze-dry system sounds positively ghastly...) ■

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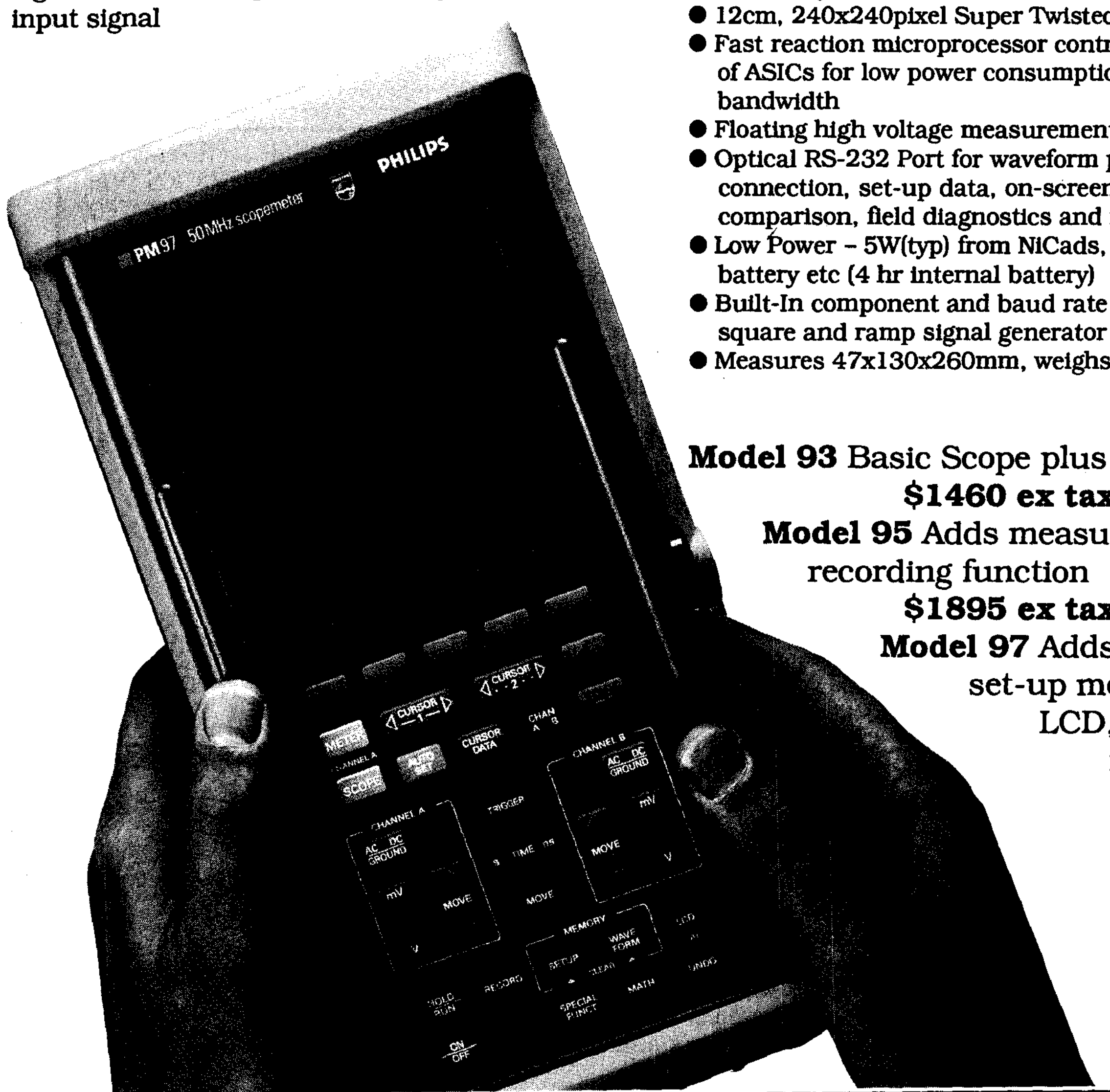

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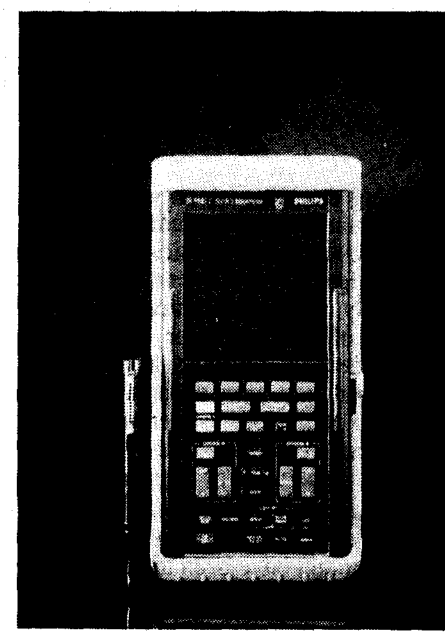

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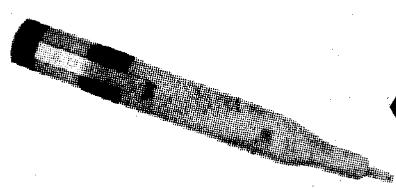

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When I Think Back...

by Neville Williams

Vintage Radio Receiver Design — 1
The 1920's: a decade of 'give-it-a-go'!

Looking back over the years, vintage radio enthusiasts may well gain the impression that receiver design has been subjected to a bewildering sequence of technical fads and fashions. Perhaps it has but, as this and succeeding articles will show, there have been sober, practical reasons for most of the on-going mutations in components and circuit techniques.

During the '20s, which witnessed the inauguration of public radio broadcasting in Australia, the physical and electrical design of receivers underwent especially rapid and radical deviations — and of little wonder. Within that single decade, wireless broadcasting progressed from pure speculation in the media to an established service, subject to urgent, outspoken demands by the first ever generation of listeners.

Temperamental equipment that could be coaxed to perform for enthusiastic novices might have been tolerated in the early '20s but, by 1930, listeners were demanding receivers and programs that were routinely accessable to every member of the household — not just to the technically inclined.

In urban areas, they reasoned, receivers should logically operate from the power mains and be switched on and off as casually as any other electrical appliance. In the country, listeners had developed their own high expectations — reliable service and upgraded receivers, consistent with manageable battery drain.

Within that same time scale, commercial wireless suppliers had to come up with totally new products to satisfy a totally new domestic entertainment market, with no precedent beyond the humble mechanical phonograph. The guidelines for domestic wireless sets had largely to be worked out by trial and error, 'on the run'!

Not surprisingly, progress in the design of wireless/radio receivers, in the '20s, didn't follow any uniform timetable. While the demands for improved technology and styling were ongoing, some suppliers took longer than others to react — as evidenced by articles and advertisements in the wireless press of the era.

By way of example, I would refer readers to that most informative *EA* reprint: *The Best of Australia's Wireless Weekly — 1927*, available from most newsagents for about $4.

All shapes, sizes

In that reprint, conservative crystal, regenerative and reflex receivers appear cheek-by-jowl with superheterodynes and neutrodynes. Models with old-time bakelite panels and multiple tuning knobs contrast with trendy single-dial designs. Table models compete with futuristic self-contained consoles and, in a predominantly battery set environment, Colville Moore offer a lone 8-valve 'all-electric' model. All this, extracted from a few weekly issues from a single year.

Behind such product diversity was the fact that receivers on the Australian market in the '20s were a near-random mix of British, European and American imports, plus local designs assembled by everyone from purposeful manufacturers to 'back-yarders' and hobbyists. Suppliers all tended to 'do their own thing' for as long as they could attract sufficient customers.

In this situation, with mostly limited and scattered sales of any one model, documentation in the way of type designation, specifications and circuit details came a bad last. Nowadays, as a result, information about receivers from the '20s usually has to be picked up in any way it can — a fact well known to vintage receiver enthusiasts.

The situation changed abruptly in the early '30s when a new tariff barrier favouring locally-made components and equipment set the scene for large-scale production and promotion of uniquely Australian receivers, along with circuit diagrams and/or service manuals from specialist publishers.

Indigenous industry

This, as it happened, coincided with the emergence of much improved technology for AC mains-powered receivers and with a drive by the electricity supply authorities to extend the mains into rural areas. That, along with progressively expanding broadcast services, triggered a huge demand for the new-look models, effectively ushering in the so-called 'golden age' of Australian radio — cut short only by the intervention of television in 1957.

Responding to engineering guidance from suppliers of local valves and other components, designers of the new Australian receivers tended to adopt a more uniform response to market needs so that, behind the differing cosmetic exteriors, circuit practice from the '30s onwards evolved on a much more structured basis than had previously been the case.

It is appropriate to observe here that the rush by Australian listeners to equip or re-equip in the early '30s largely wiped out the motley array of receivers from the preceding decade. Of little practical or sentimental value at the time, they were either dumped in toto or dismantled by experimenters seeking re-useable components.

Or, again, dealers accepted them as 'trade-ins' for a suitably tempting figure, dumping them thereafter by the proverbial truckload.

At the original Reliance Radio factory/showroom in York St, Sydney — my first ever job — I remember a stack of old-time battery and semi-electric sets in the musty basement, which ultimately met just such a fate. They cost less to dump than to service and re-sell!

Later, during a brief stint at the E.F. Wilkes factory in Redfern, Sydney — my second job — I was confronted by a pile of one-time 'up market' American made Gulbransen receivers. Boasting type 50 output valves and the chunkiest dynamic loudspeaker I had ever seen, they were so cumbersome that the staff couldn't even be induced to carry them away gratis!

Now quite rare

In short, with virtually no resale value, comparatively little of that early gear survived intact, with the result that genuine examples of '20s technology are now few and far between. Most of those that do remain are in town museums across the country, in the hands of private collectors, or in antique shops at prices mostly well above what they originally commanded.

One vendor I came across recently was offering a 6-valve AWA receiver 'circa 1925' in ostensibly pristine condition. It carried a price tag — hopefully or otherwise — of $525.

(Perhaps I should mention here that an enthusiast group dedicated to old-time radio and allied interests is the Historical Radio Society of Australia. Our immediate contact in Sydney is Mr Garfield Wells, NSW State Secretary, PO Box 428, North Sydney 2059).

But I have got ahead of myself. Interwoven in time as they certainly were, it may nevertheless be helpful to take a brief look at major technical trends in the '20s, as a broad background to a more detailed examination of indigenous Australian receiver design in the following decade.

Amateurs, experimenters

In the pre-broadcasting era, most receivers held by members of the public were of simple design, often home constructed: 'catswhisker' crystal sets, or 1-, 2- and 3-valve 'reaction' sets — most commonly a regenerative detector followed by one or two audio stages.

Operated by enthusiastic 'experimenters', they were used to monitor coastal wireless 'traffic', Morse code, speech and music transmissions from amateur radio stations, and the occasional demonstration concert — in short, whatever transmissions the owner might happen upon by interchanging coils and twiddling knobs.

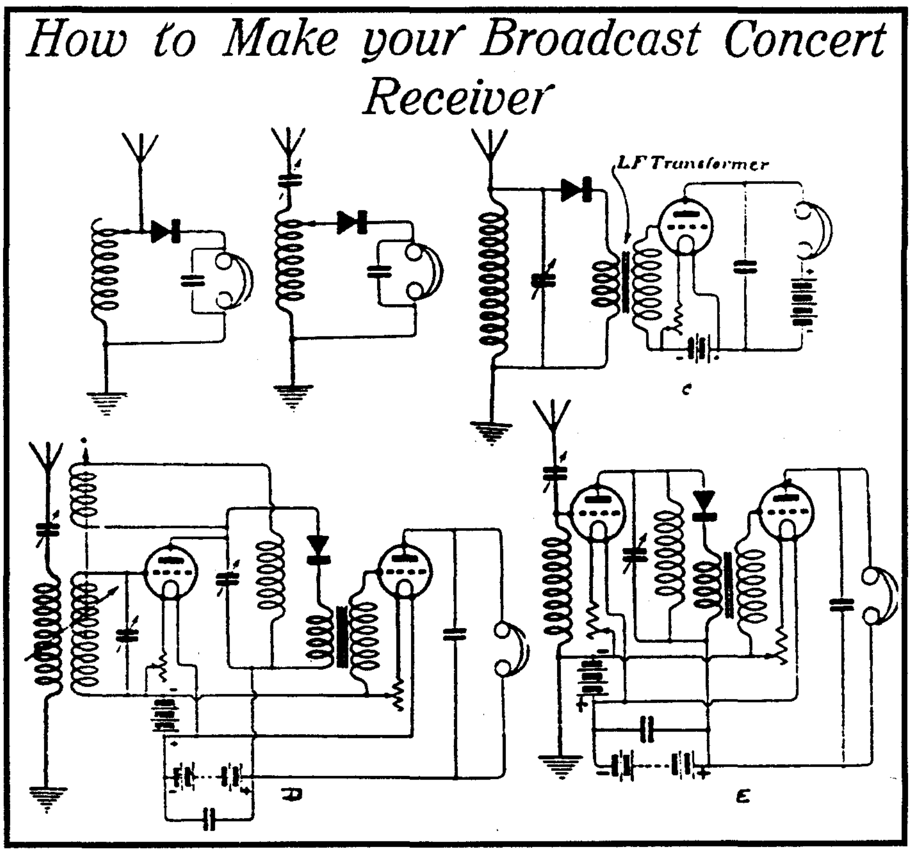


Fig.1: Circuits for 'sealed' receivers for Sydney's pioneer high-power station 2FC, as suggested in the October 1923 issue of The Australasian Wireless Review. Circuit 'D' uses a regenerative RF amplifier ahead of a crystal detector, followed by one audio stage.

(A sound documentary of this era is available on the audio cassette 'Loud speakers', from the ABC radio series *Bright Sparks*. It is available for $15, or $45 for the complete 8- session series, from ABC Radio Tapes, GPO Box 9994, GPO Sydney 2001. For phone inquiries or credit card orders, ring (02) 339 1034.)

That some professional valve-based receivers were available at the time is evident from the memoirs of Sydney Newman (*EA*, January '91, p.46) where he mentions a batch of Marconi 'Seven' long-wave receivers imported by AWA, around 1921. While appropriate for official communication services, however, they would have been beyond the means of most amateur enthusiasts.

Doubtless anticipating the commencement of formal public broadcasting by the end of 1923, Electricity House in George St, Sydney, advertised a range of typical components and basic receivers in *Wireless Weekly* for March 9 of that year. Their crystal sets ranged in price from £3/10/0 to £7/10/0 ($7 — $15) with one- to three-valve sets priced from £9/0/0 to £35/0/0 ($18 — $70).

In practice, the crystal sets would have been of little use more than a few miles from a transmitter, being therefore limited mainly to urban areas.

Under favourable reception conditions, small regenerative valve sets could pick up transmitting stations hundreds of miles away — provided they were used with an efficient outdoor aerial and earth and were critically adjusted, with the detector on the threshold of oscillation.

In the longer term, small regenerative receivers won only limited acceptance by would-be listeners to public broadcasting stations. The reason was simple enough: as distinct from 'experimenters', broadcast listeners were less inclined to persist with weak signals and more likely to expect loudspeaker reception, to be shared by the whole family. In terms of circuitry, this translated into at least a 4-valve receiver, typically comprising a tuned RF amplifier stage ahead of a regenerative receiver, and followed by two audio stages. But more about that later.

'Sealed set' fiasco

As it happened, the Federal Parliament caused a major 'hiccup' in receiver design concepts in August, 1923 by deciding that the proposed public broadcast stations in Australia should be supported by direct subscription. The idea was that listeners would nominate their preferred licenced broadcaster, pay the specified fee direct to the particular company and instal a receiver capable of receiving that station only.

Said to be the brainchild of AWA's manager Ernest Fisk, the sealed-set legislation cut right across the prevailing concept of sensitive, broadly tuneable receivers, with legitimate access to all available transmissions.

In a rare example of sealed-set mentality, *The Australasian Wireless Review* featured a story on '2FC The First Big Broadcasting Station in Australia' in its September, 1923 issue. The annual subscription fee for the new Farmer & Co (Sydney) station was to be 3 guineas (£3.3.0).

Transmitting on 1100 metres (272kHz), its powerful 5000-watt signal would hopefully dwarf existing amateur transmitters and would not call for anything like the same order of receiver gain or selectivity. By implication, the owner of a sealed set would not want to, nor need to, nor be eligible to tune into other less pretentious stations.

In the next monthly issue, with the opening of 2FC only weeks away, the magazine published a group of suggested circuits for suitable receivers (Fig.1) — the only ones I have ever seen intended specifically for Australian sealed receivers.

Unpretentious crystal sets or amplified crystal sets, the magazine suggested that they should be constructed around a coil/capacitor combination which could be pre-adjusted to limit the coverage to within +/-10% of the allotted wavelength, (I quote) 'allowable under the regulations'.

Presumably, the completed receiver had to be set up in such a way that, to the satisfaction of itinerant radio inspectors, the available tuning range would be no greater than necessary to cope with the combined frequency drift of the receiver and the designated station. This was before the routine use of crystal- locked transmitters.

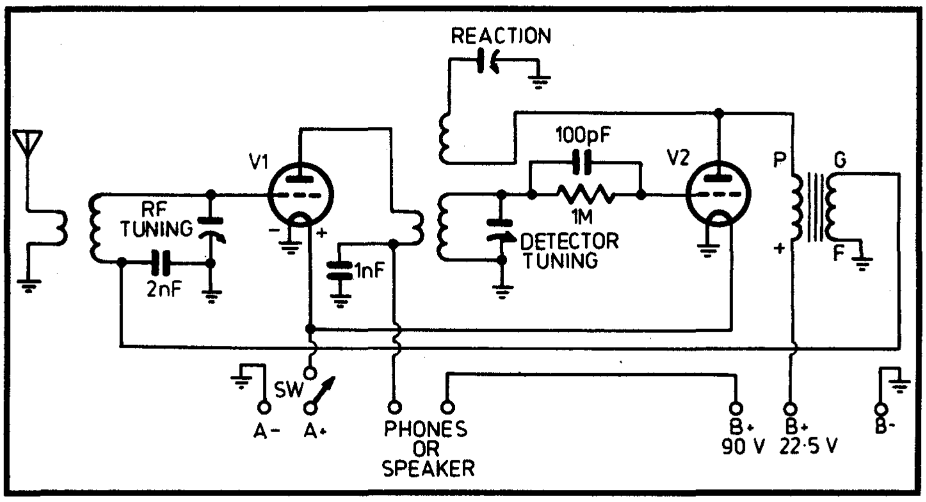


Fig.2: In this simple reflex circuit, the incoming signal is amplified by V1 before being passed on to the regenerative detector V2. The detected audio passes through the transformer back to the grid of V1, where it is again amplified before being applied to the phones or speaker.

Rejected *en masse* by prospective listeners and a potential financial disaster, the sealed set concept lasted less than a year. As from July 17, 1924, public broadcasters like 2FC were re-licensed either as A-class stations, financed by a collective licence fee payable to the Government, or as B-class stations supported by advertising revenue.

From that date, having taken out an annual, comprehensive 'wireless licence', listeners were once again free to use general-coverage receivers, listening to whatever signals came their way.

As before, the more eleborate the receiver, the more stations they were likely to hear, hopefully on a loudspeaker.

Speaking personally, I have never encountered an identifiable sealed set and I can only assume that most of those which were sold during the 6-odd month currency of the scheme were smartly updated for general coverage of the medium- and/or long-wave broadcast bands.

Early broadcast sets

Typical of the early, small general-coverage broadcast receivers was a Colmovox 3-valve 'Junior' model, marketed both as a do- it-yourself kit or built up, by Colville-Moore Wireless Supplies Ltd, of Rowe St, Sydney. It comprised a regenerative detector using panel mounted plug-in coils, followed by two audio stages.

As advertised in *Wireless Weekly* for August 13, 1926, the cost of the basic kit, with a polished maple cabinet, pre-assembled and engraved bakelite panel, and wiring diagram was £6/5/-. Valves, plug-in coils, batteries. headphones and other 'extras' necessary to make it go added up to another £5/6/10.

In today's currency, just under $24, that doesn't sound like a lot of money. But at the time, it would have represented a typical month's wages, or as much as we'd now pay for a large colour television receiver! Such prices provided a powerful incentive to cut costs by any available means.

Reflex principle

In an effort to secure a more comprehensive receiver for reduced outlay, some designers resorted to the so-called *reflex principle. It involved using one of the valves for two distinct functions, thereby saving a valve and its attendant current drain.*

For example, in a simple non-reflexed vintage receiver, the incoming signal might be fed via a tuned aerial coil to the grid of a triode RF amplifier stage. From the anode, after amplification, it would pass through a tuned RF coil to a detector and thence through an audio transformer to a single audio stage — a configuration sufficient for reception of distant stations on headphones, or possibly strong locals on a loudspeaker.

In a reflexed version of the above (Fig.2) the 'grid' connection of the audio transformer would typically be wired back to the bottom of the aerial coil, the junction being bypassed to earth with a capacitor of around 2nF — sufficient to allow the tuning circuit to behave normally, but not so large as to prevent the much lower frequency audio signal from reaching the grid.

In short, the audio signal would be fed up through the tuning coil to the RF amplifier grid so that this would be subject to two quite distinct input signals, one superimposed on the other.

As a result, there would be two different signal components in the plate current — one at the original signal frequency feeding the detector, the other at the superimposed audio frequency. By inserting a pair of headphones between the primary of the RF coil and B-plus, the audio component would be heard as before, having been separately amplified as it passed through the reflexed valve.

Ostensibly, the receiver would equivalent to the original three-valve design (RF amplifier — detector — AF amplifier) but using only two valves — one doing two jobs. In all fairness, however, this last statement needs to be qualified.

The actual saving in a typical reflexed receiver was limited mainly to a valve and socket and the attendant current drain; the other peripheral components and wiring were still required. Besides that, reflexed receivers generally have tended to be somewhat temperamental for the following reasons:

- Having to handle two signals at once, reflexed stages could be more subject to overload on strong signals, leading to increased distortion in some situations.
- By reason of inherent non-linearity, an RF amplifier stage may partially rectify an incoming RF signal and generate a residual detected resultant across the audio load in its anode circuit. This may interact unfavourably with the formally detected signal which it is supposed also to be amplifying.
- The deliberate re-routing of signal back through a receiver circuit could aggravate stability problems arising from other sources — e.g., inherent RF stage instability, detector regeneration and HT supply feedback.

While the above-mentioned considerations have limited the appeal of the reflex principle, the fact is that reflex receivers have featured from time to time in do-it-yourself articles and in the inventory of receiver manufacturers. Collectors of vintage receivers can at least be forewarned if they come across one in which a single valve appears to be doing two jobs.

(The 'Vintage Radio' feature in the December, 1990 issue of *EA* deals with a mid-'30s model AWA Radiolette using an IF amplifier reflexed to function also as an audio stage. Because of detection effects in the stage, as noted above, the audio volume control could not completely silence the receiver — a well known flaw in this particular configuration).

Typical family set

Price and running costs notwithstanding, the Colmovox 4-valve receiver mentioned in the March, 1989 instalment of this series, was more typical of the average family receiver of the mid '20s. (See Fig.3). While physically similar to the 'Junior' model mentioned earlier, it included a separate tuned RF stage ahead of the detector, to ensure improved range and selectivity, and to minimise the risk of detector radiation.

Tuning involved separate dials for the RF and detector stages but, by careful selection and/or trimming of the plug-in coils, the dials could be made to 'track' reasonably well, each needing to be set to about the same reading for particular stations. With two audio stages, the set could be used with a loudspeaker or, for personal listening, with headphones and with the audio section partially disabled to conserve battery life.

A comparable 4-valve set advertised in *Wireless Weekly* for August 13, 1926 was the 'Selectrodyne', from the Radio-W'less Mfg. Co, of 317 George St, Sydney (Fig.4). Depending on the cabinet and extras, it cost between £26/10/0 and £36/10/0. Arguably, perhaps, it was advertised at the time as 'the only 4- valve set that will bring in 3LO (Melbourne, 800kHz) without interference from 2BL (Sydney, 855kHz)' — already much less than the 10% separation envisaged in the sealed set era.

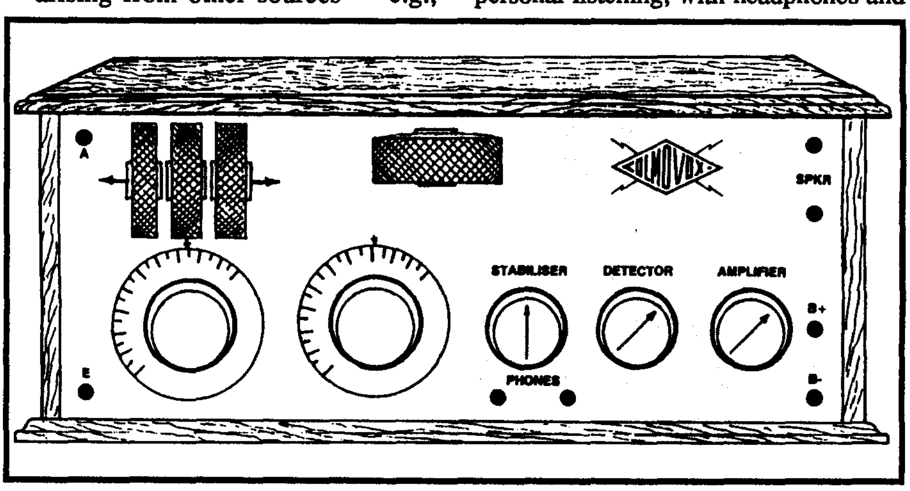


Fig.3: The panel layout of a typical 4-valve battery wireless set from the mid '20s. It represented a manageable compromise for many listeners between inter-station performance and purchase/running costs.

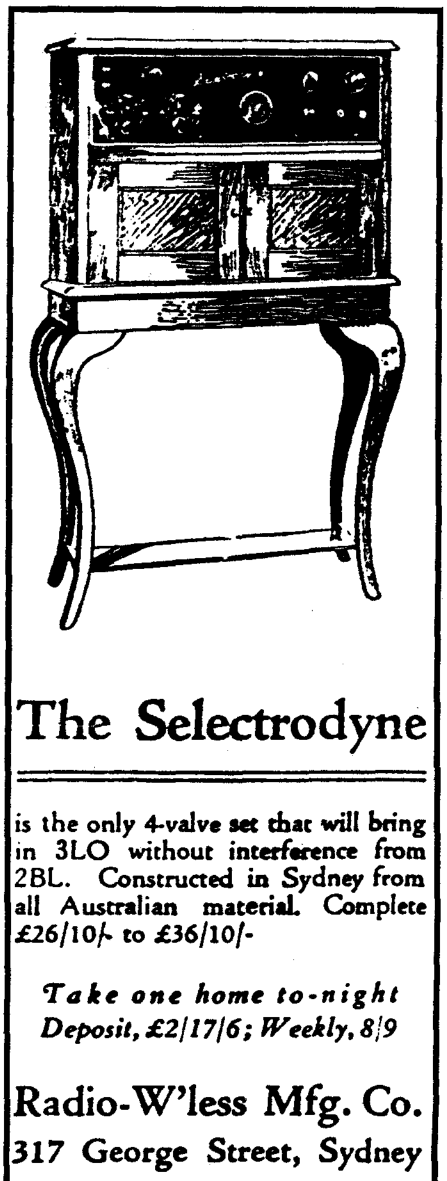


Fig.4: The Australian-made 4-valve 'Selectrodyne' advertised in 1925 for up to £36/10/0. The cupboard section would normally accommodate the batteries, with the loudspeaker standing on top.

The circuit diagram of yet another 4-valve receiver in this general class appears on page 94 of *The Best of Australia's Wireless Weekly* mentioned earlier. Known as the 'Marco 4', it, along with others like the 'Browning Drake' often featured, in the old days, in arguments between between enthusiasts who favoured this receiver or that!

While some such receivers may have been marginally easier to set up and use than others, the chances are that, when optimally adjusted, there would have been very little difference between the performance of contemporary 4-valve 'TRF' receivers — so described because they used a tuned RF stage ahead of the detector.

With hindsight, looking back at some of the circuits, there is good reason to speculate whether the regeneration — or 'reaction' — actually operated around the detector, or the RF amplifier, or both. By offsetting the losses in the associated tuned circuit(s), the end result may have been much the same: boosting the gain and sharpening the selectivity, to a limit set by the onset of active oscillation.

Even without visible feedback circuitry, triode RF amplifier stages, with grid and anode circuits tuned to the same frequency, were prone to oscillation by reason of the valve's own anode/grid capacitance.

Oscillation could be suppressed by using a lower gain valve or reducing the filament voltage with a rheostat; alternatively, the associated coils could be rendered 'lossy' by design or resistive loading — measures which prejudiced gain and possibly selectivity. The answer in many cases, including Fig.3, was to fit a so-called 'Stabiliser' control (see separate panel).

More elaborate TRF designs will be discussed in the next article. In the meantime, AWA (Amalgamated Wireless A'Asia) threw out a major challenge to local manufacturers with a completely different kind of receiver.

The superheterodyne

Conscious of the growing listener demand for improved gain and selectivity, and taking their cue from RCA (Radio Corporation of America), AWA released a range of Australian-made 'Radiola' superheterodyne receivers (see *EA* for July 1990, pages 45-47). As most readers will now know, 'superhets' operated on a quite different principle to conventional receivers using RF amplifiers and detectors tuned to the signal frequency.

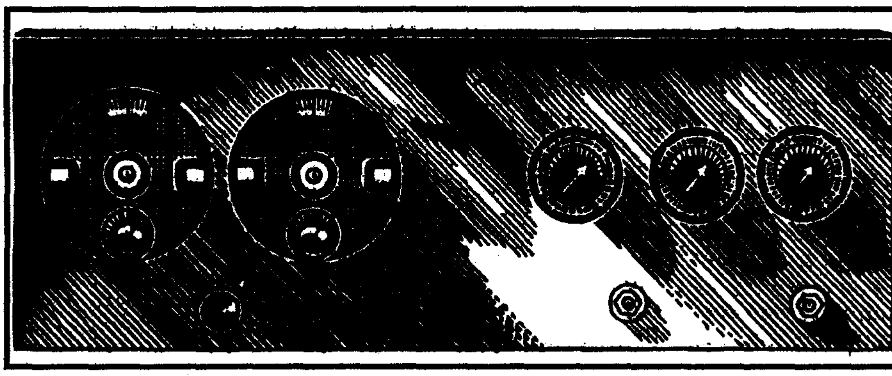


Fig.5: The front panel of an 8-vale battery superhet, described for home construction in Wireless Weekly for July 29, 1927. The dial on the left is for oscillator tuning; the one to its right tunes the loop, which connects to three terminals at the rear of the receiver.

Briefly, incoming signals were/are 'heterodyned' by an inbuilt tunable oscillator, effectively shifting them down to a much lower, so-called *intermediate* frequency. In the mid 1920's this was typically in the range 50-60kHz. At this reduced frequency, they were passed through a pre-tuned IF (intermediate frequency) amplifier, which could provide much higher gain and better selectivity than was then practicable at the original signal frequency.

The process did not prejudice the original modulation so that, when subsequently fed to a detector, the audio content was recovered in the usual way, hopefully free of interference from other stations. For the user, however, those early superhets had certain 'off-putting' peculiarities which set them apart from other receivers of the day. (See Fig.5)

First off, the local oscillator, being tuned within 50-60kHz of the incoming signal, could all too easily radiate a spurious signal within the broadcast band, creating interference in nearby receivers. To minimise the problem, superhets were not normally connected to large outdoor aerials, being used instead with frame aerials sitting atop the receiver and tuned by the receiver's own aerial tuning dial — controlling what came to be known as the 'loop condenser'.

In practice, the signal pickup by a large resonant frame aerial, similar in frontal dimensions to the receiver itself, compared favourably with that of a routine outdoor aerial/earth combination. It offered the further advantage of being directional, such that it could be orientated edge-on to favour a wanted station, and/or broadside-on to reject an interfering signal or even a distant source of static.

Double-spot tuning

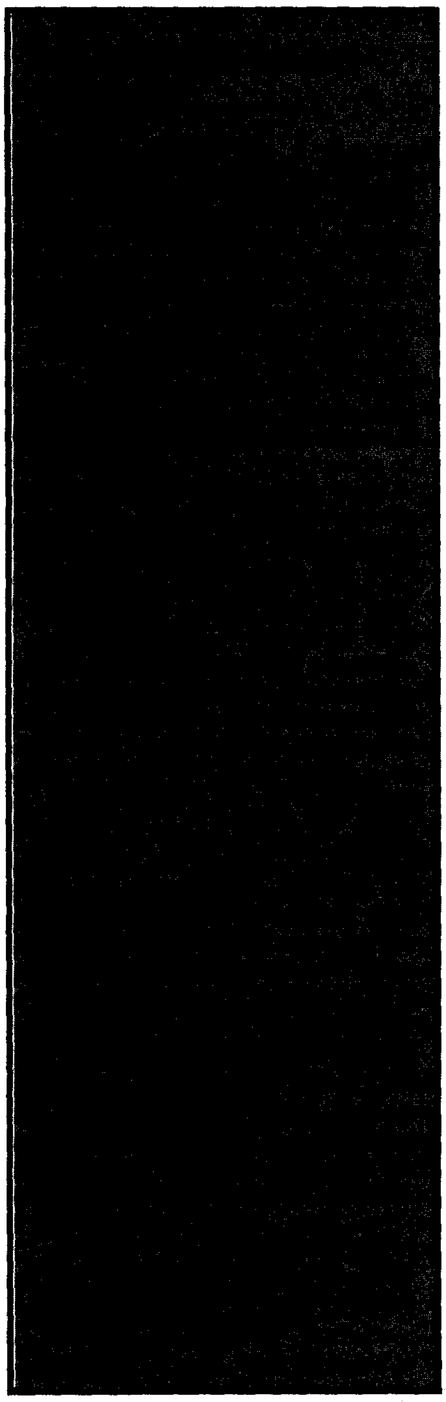
A further peculiarity of early superhets was that a wanted station could be received with the local oscillator tuned

Fig.6: A coil and IF transformer kit advertised for the 8-valve superhet receiver, as illustrated. The IF transformers are wired into circuit much the same as audio transformers. No mention is made of their resonant frequency.

below the station frequency. Always a potential source of confusion, this was commonly referred to as 'double-spot' tuning.

As a corollary of the above, any one setting of the oscillator dial could conceivably bring in two entirely different stations, one above and the other below the oscillator frequency and separated from it by the IF. This came to be known as 'image reception'.

In *Wireless Weekly* for July 29, 1927 (p.36 in the reprint *The Best of Australia's Wireless Weekly — 1927*) readers setting up a home-built 8-valve superhet were encouraged to experiment with the controls, writing down the best setting for the loop dial for each station and the two possible settings for the oscillator dial. This done, they could double-check their figures and list the best combination for each individual station.



Interestingly enough, in this and similar articles of the period, I found no mention of the actual IF used, nor any reference to pre- or post-IF alignment.

Home hobbyists were simply warned to use only matched sets of IF transformers, connecting them into circuit as per the markings (see Fig.6).

While none of the above peculiarities was likely to deter a technically informed listener, they did set the superheterodyne apart as 'peculiar' and perhaps not the wisest choice for the average family, reliant for technical guidance on the average local supplier.

If, as a collector, you come across one of these early superhets, don't be surprised by the lack of any information about the intermediate frequency.

As noted earlier, it will probably lie in the region 50-60kHz and therefore well below the range of any ordinary modulated test oscillator or signal generator.

In such a case, the intermediate frequency could most easily be deduced by pre-setting the receiver oscillator in about mid-range and tuning the signal generator across the broadcast band to identify the two frequencies at which the test signal is heard. The intermediate frequency will be half the difference between them.

For example, with the receiver oscillator at about mid range, signals may be heard from the signal generator when its dial reads either 960 or 1080kHz.

The difference between the two is 120kHz, indicating an IF amplifier pretuned to 60kHz. It follows that the receiver oscillator must have been set to 1020kHz — 60kHz above 960kHz and 60kHz below 1080kHz.

Ironically, most modern Wien-bridge audio signal generators cover the frequency range up to at least 100kHz, but the signal would not be modulated. It would have to be observed with a CRO, or as a DC voltage across the detector grid resistor using an electronic voltmeter.

In the second of these articles we shall be looking more closely at the superhet configuration in the context of the '30s, when it re-emerged to dominate receiver design for domestic and most other applications — this, for what we described earlier as 'sober, practical reasons'. ■

(To be continued)

NEW BOOKS

Antenna matching

REFLECTIONS: Transmission Lines and Antennas, by M. Walter Maxwell, W2DU. Published the American Radio Relay League, 1990. Hard covers, 237 x 160 x 30mm. ISBN 0-87259-299-5. Recommended retail price $40.

Transmission line operation, matching and the effects of standing waves are probably the topics most discussed among people who work with RF transmitters and receivers. Yet at the same time, they're also the ones that seem to be associated with the most myths, confusion and half-truths, especially among radio amateurs. This book has been written to clear up a lot of the misunderstandings and myths about the subject.

Author Walt Maxwell W2DU is well qualified to write it. Before he retired, he spend over 20 years at RCA Laboratories as a noted antenna designer. Over a long and distinguished career he also designed and built AM broadcasting stations, and designed antennas for satellites and other spacecraft. The present book is in fact a revised, updated and expanded version of a very popular series of articles he wrote for *QST* magazine from 1973 to 1976.

There are 21 chapters in all, most with titles that convey the author's down to earth approach and his intention to debunk popular myths. Here are a few examples: '1 - Too Low an SWR Can Kill You'; '3 - Going Around in Circles to Get to the Point'; '5 - Low SWR for the Wrong Reasons'; '7 - My Transmatch really Does Tune My Antenna'; '8 - The Reality of Reflected Power'; '17 - How Does a Transmatch Work?'; and '21 - Some Aspects of the Balun Problem'.

The text is written in clear, easy to follow language, and is well supported by illustrations. There's a good introduction to the use of the Smith Chart, and also a chapter giving listings and instructions for using some nine different BASIC programs to assist with impedance matching calculations. In short, it's a very helpful book, and one which should be of value not just to radio amateurs wanting to 'get things straight', but also to engineers and technicians working with RF — and very likely engineering students as well. I only wish I'd had a book like this when I first had to wade through the subject!

The review copy came from Stewart Electronic Components, of 44 Stafford Street, Huntingdale 3166 (PO Box 281, Oakleigh 3166), which can supply copies by mail for the price shown. (J.R.)

SMT design reference

SURFACE MOUNT & MIXED TECHNOLOGY PCB DESIGN GUIDELINES, by David Boswell. Published by Technical Reference Publications, 1990. Spiral bound, 298 x 210mm, 98 pages. Price US$150.00 plus US$12.00. ISBN 872422 01 2.

The subtitle on this book describes it as a handbook for professional engineers, designing PCBs for SMT and mixed conventional/SMT applications. The author points out in his introduction that along with the development of SMT and the continued miniaturisation of complex components with lead spacings of less than 0.635mm has come the potential for severe production problems, if design excellence is not achieved.

There are 17 chapters and six data appendices, and many different aspects of PCB design are covered in considerable detail. These includes physical structure and strength, designing to facilitate mechanised production, designing for specific soldering processes, layout for surface mount components, track widths and clearances, solder resists and solder pastes, design aspects for facilitating visual inspection, in-circuit testing and rework/servicing, thermal considerations and so on. In short, the coverage is quite comprehensive.

I should perhaps point out that the book consists mainly of concise reference data, rather than explanatory text. In that sense it is indeed a reference handbook, and mainly for the guidance of professional designers. However judged in that context, it seems likely to be of considerable value.

The review copy came direct from the publisher, which is at Asahi House, Church Road, Port Erin, Isle of Man UK. It is available from them direct via mail order, at the price shown. (J.R.) ■

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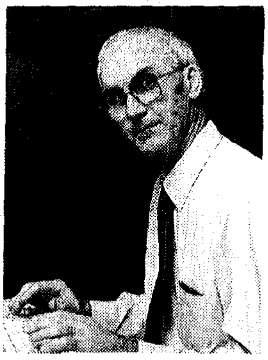


Magic and mystery in stereo decoders — and how DO you gauge user friendliness?

I have an interesting pair of letters for you this month, both of them with comments in response to things that have been discussed either here in Forum, or elsewhere in the magazine. One draws our attention to the operation of switching-type decoders for FM stereo signals, while the other tackles the question of what constitutes true 'user friendliness' in computers and other electronic equipment...

At the end of last month's column, you may recall, I noted that there had been a further letter in response to my January piece on AM, but that I'd leave it until this month because unlike the others it didn't deal specifically with amplitude modulation. In fact it deals with FM stereo — a rather more complicated kettle of fish, to garble a metaphor.

It seems only fair to start this month's column with the letter concerned, which came from a familiar correspondent: Phil Allison, a technician based at Summer Hill in Sydney. So without further ado, here's what Mr Allison wrote, prompted by the January discussion:

Further to your Forum on AM sidebands, it may be of interest to readers to consider the case of FM stereo. Those familiar with FM stereo would know that a 19kHz pilot tone and 38kHz modulated subcarrier difference signals characterise the encoding system (see attached frequency domain diagram).

The interesting thing is how this signal is converted to separate left and right channels in modern receivers using an IC decoder (e.g., LM1310). In the IC, the pilot tone is used to synchronise an electronic switch which simply directs the FM composite signal alternately to left and right outputs and associated low-pass filters. The result is near perfect separation of the left and right channel information, and very low distortion.

How the composite signal shown in the diagram is precisely decoded by simple time division boggles the imagination!

This apparent contradiction between the time and frequency domain pictures of FM stereo is sobering for those electronic snobs who think spectrum analysers show the 'real' picture, and deride the humble CRO.

Thanks for those comments, Phil. As you can see, I have reproduced your frequency domain diagram here as Fig.1. It's certainly true that the composite stereo signal emerging from the main FM detector is rather more complex than our original amplitude modulated carrier, with its 'baseband' *sum* or 'mono' (L + R) signal, its double sideband suppressed-carrier *difference* or 'stereo' (L - R) signal sidebands extending above and below 38kHz, and its *pilot tone* signal at 19kHz.

I certainly agree that the method used in modern stereo receivers and tuners to 'decode' this signal *does* seem too simple to be true. The traditional approach — and the one used in the first generation of FM stereo receivers, if I recall correctly — was to split all three components apart by filtering. Then the pilot tone was either frequency doubled or otherwise used to produce a replica of the original 38kHz subcarrier, which was then fed into a product detector (synchronous demodulator) along with the DSB difference signal sidebands, to recreate the original baseband (L - R) difference signal. This in turn was then added to and subtracted from the (L + R) mono signal, to produce the original L and R stereo signals. It was a fairly involved process.

As Phil Allison comments, it's not at all easy to visualise how the newer generation of FM stereo decoder chips is seemingly able to circumvent this process, by apparently just switching the complete composite signal rapidly between the right and left output channels via low-pass filters. I freely admit that I for one have never been able to visualise exactly what goes on inside these chips, despite having tried to follow the explanations given in various manufacturers' data sheets and application notes.

The explanations always seem to have a 'take our word for it, the chip works' air about them, in some cases even noting that a precise analysis of the chip's operation becomes quite involved. And of course the chips *do* work extremely well, as Phil Allison points out, producing stereo signals with near perfect separation and very low distortion.

I remember that back in the April 1975 issue of *EA*, David Edwards and I de-

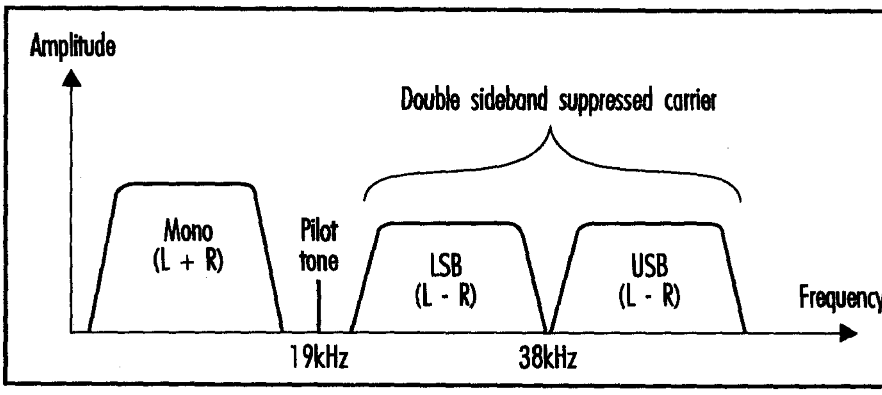
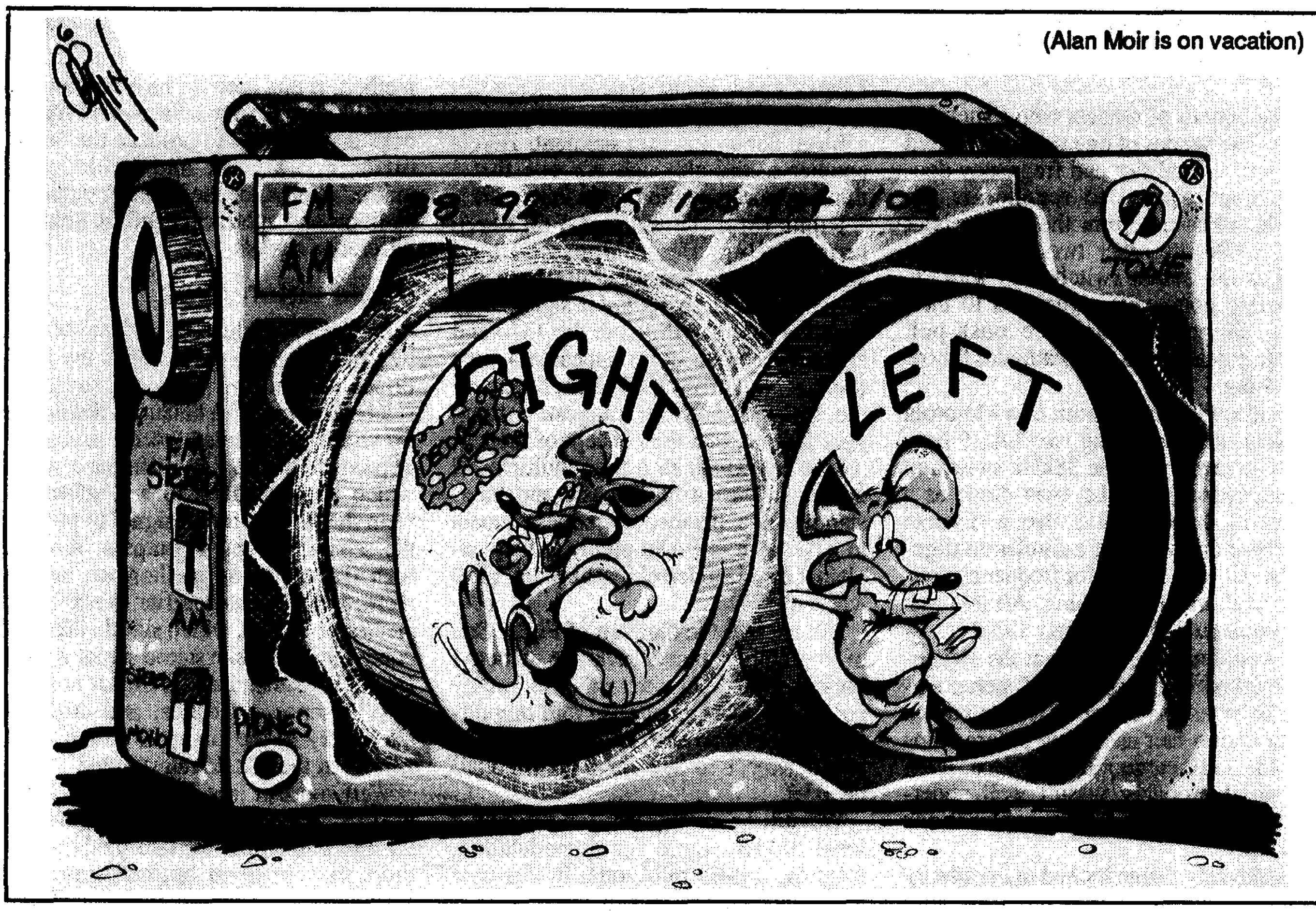


Fig.1: The frequency-domain representation of a composite stereo signal as transmitted by an FM station, and to which Phil Allison refers in his letter.



(Alan Moir is on vacation)

scribed the magazine's first stereo decoder project (which used a 1310 chip). Looking back at the article, I see that we got around this difficulty of understanding how the chip performed demodulation by using this fairly glib explanation:

The alternative technique is based on the fact that together, the M and S signal components of the multiplex signal are equivalent to the main components of a signal produced by alternately sampling the original L and R stereo signals, each at a rate of 38kHz. Because of this equivalence, it becomes possible to decode the original L and R signals in virtually a single operation, by performing a time demultiplexing operation.

Simple, isn't it? Well, it mightn't be too convincing, but it got us out of trouble at the time. And it really isn't that much worse than the kind of explanation you get in many books on the subject. For example in Gordon King's book *FM Radio Servicing*, published by Newnes-Butterworth in 1970, the explanation given is along these lines:

One way to look upon the stereo system is as a scheme which alternately switches the A and B channels simultaneously at the transmitter and receiver. The switching rate is based on the 38kHz subcarrier frequency, with synchronism effected by the pilot tone. Thus at one instant in time the A channel at the transmitter is switched on, as also is the A channel at the receiver, thereby allowing the A channel only to be reproduced in the left-hand loudspeaker. One thirty-eight-thousandth of a second later, the A channel closes down and the B channel opens, again at the transmitter and set in synchronism. This brings in the right-hand loudspeaker. The switching rate is so rapid that one gets the impression that the signals in the two channels are perfectly constant and isolated. The switching frequency is well above hearing, of course.

I might add that this quite clear and easy to follow description of time-division multiplexing occurs only when Mr King is just about to describe a switching-type decoder.

He makes no reference to it earlier, in describing the FM stereo system in general, nor when he is explaining the generation of the composite 'multiplex' signal at the transmitter. There he describes only the traditional process of matrixing the two audio signals, generating the 38kHz subcarrier signal, using a balanced modulator to produce a DSB signal from the stereo difference signal, filtering out the subcarrier itself, producing the pilot tone and combining all of these components to produce the composite signal which is fed to the FM transmitter.

Similarly in Edward M. Noll's book *Servicing FM-Stereo Receivers* (Howard Sams, 1963), we find the even more vague explanation:

The second demodulation process is really a time-division technique. In this process the composite signal is passed directly to the demodulator or time-division sampler. The responsibility of the inserted carrier, in this method, is to sample the composite signal at the subcarrier rate.

Since there is a definite time relation among subcarrier, subcarrier envelope cycles and the L + R signal (according to the information to be conveyed), samples of L and R data can be delivered to the output in the form of pulses. These are filtered to reconstruct the original L and R channel information.

So we were obviously not the only authors who couldn't really explain how the switching-type decoder actually worked!

Incidentally Edward Noll goes on to show the circuit of a Philco switching-type decoder of the day, using *valves* — a couple of 12AX7 twin triodes in fact,

FORUM

for the benefit of readers who remember them. The triodes of one valve were used as a tuned amplifier and frequency doubler respectively, to regenerate the 38kHz subcarrier from the 19kHz pilot tone, while the other two triodes were used as the output switches — with the incoming composite signal fed to their grids, in parallel, and the push-pull 38kHz signal fed to their cathodes for the switching.

He also gives the circuit of a Motorola 'add-on' decoder using two 6AU6 pentodes to regenerate the 38kHz switching signal, driving a 6AL5 twin diode as a switched detector, and also a discrete transistor circuit using a similar configuration but with diodes for frequency doubling and output switching. All this was in a book published in early 1963!

It would appear, then, that the switching method of decoding FM stereo signals is by no means new. It was known about and in fact used long before chips like the 1310 came into existence. Even though it probably wasn't well understood, judging from the explanations given.

By the way I have looked in our library for other books on FM stereo, especially ones which might give a more detailed and mathematical analysis of the processes of stereo encoding and decoding. Surprising though it may seem, I couldn't find any. They must exist, I'm sure, but they do seem to be a little thin on the ground.

You may be interested in the diagram we gave in our April 1975 article to show the internal operation of the then fairly new 1310 chip, which is reproduced here as Fig.2. As you can see, it gives a somewhat different picture to that of the chip as a 'simple' time-demultiplexer switch. I don't know about you, but it doesn't look all that simple to me!

More about this in a moment. Here's another aside, although it's one that I think is worth mentioning at this point:

Right from the start of FM stereo broadcasting, the composite signal shown in Fig.1 has generally been described as a stereo *multiplex* signal. This term was used well before the 1310 and similar decoding chips appeared — it's used by Noll in his 1963 book, for example. Which tends to suggest, I think you'll agree, that the concept of the signal as *equivalent* to a time-multiplexed one is at least a fairly basic and longstanding one. In any case, it doesn't seem to have been invented purely to help explain how decoder chips like the 1310 worked!

But back to the diagram of Fig.2. One of the things that struck me, when I looked at it again myself after many years, was that it really isn't all *that* different from the kind of block diagram you'd expect to see for a 'traditional' decoder.

We still have a system for deriving a local 38kHz signal for demodulation, from the 19kHz pilot tone. In this case it's a PLL (phase-locked loop), with a VCO (voltage-controlled oscillator) running at 76kHz, and then divided down and locked to the incoming pilot tone via the upper phase comparator. (The other phase comparator is used essentially to detect the presence of the pilot tone, to switch the chip between stereo and mono modes of operation.)

Apart from filtering the various signal components, which is in this case done *after* the chip rather than during the processing, the main difference between the 'switching' method as implemented inside the 1310 and the 'traditional' method, is that here we have a 'decoding switch' — instead of a balanced synchronous demodulator to produce the (L - R) difference signal, and a 'decoding matrix' to produce the L and R signals by addition and subtraction of the sum and difference signals.

Basic differences

So the basic differences between the two methods are these. With the traditional method we pass the subcarrier sidebands through a balanced demodulator with the recreated 38kHz subcarrier, to produce the (L - R) difference signal, which is then added to and subtracted from the (L + R) mono signal to produce the separate L and R outputs. Whereas with the switching method we use the recreated 38kHz subcarrier to operate an electronic switch, which simply takes the complete composite stereo signal with its (L + R) baseband mono signal and (L - R) difference sidebands, and directs it alternately to the L and R output channels — at the 38kHz rate. Right?

Well, more or less. The problem is that the more you look into the exact circuitry used to implement the two methods, the more they seem to become similar — variations on a common theme, rather than two totally different approaches.

To illustrate this, I found a circuit in one of National Semiconductor's Linear Application Notes (AN81), showing the decoder and output section within the LM1310 chip and its later derivative the LM1800. This is shown in Fig.3. Here the composite stereo signal is applied to the base of Q44, and a matching DC bias level to the base of Q43. The recreated 38kHz subcarrier is applied as a bipolar signal to the bases of Q39, Q40, Q41 and

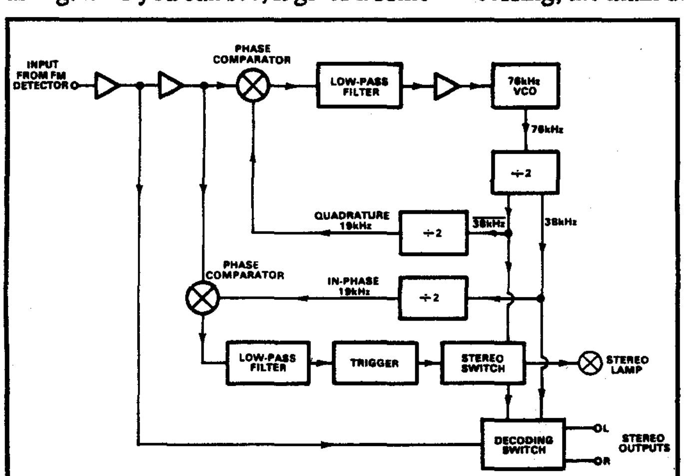


Fig.2: A block diagram for the internal 'works' of the 1310 stereo decoder chip, as given in our April 1975 article describing a stereo decoder.

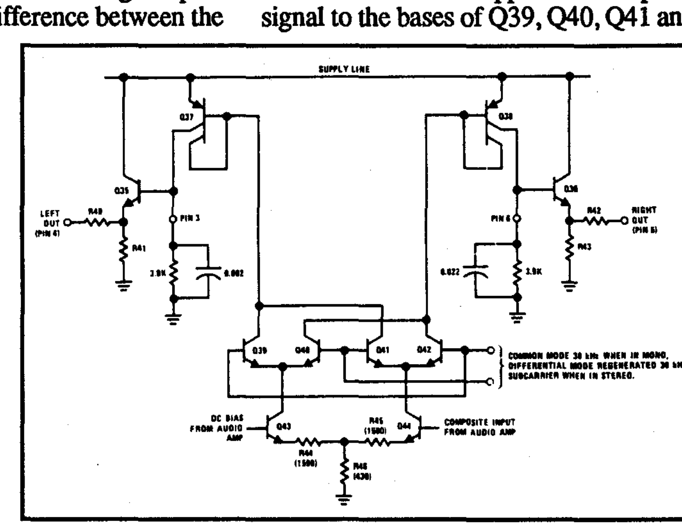


Fig.3: Taken from National Semiconductor's Linear Application Note AN81, this is the schematic for the decoder and output section of the LM1310 and LM1800 chips.

Q42, so that when the first and last of these are switched on, the centre two are switched off and vice-versa. The collectors of Q40 and Q42 are connected to Q38 and Q36, whose emitter effectively becomes the demultiplexed 'R' output, while the collectors of Q39 and Q41 are connected to Q37 and Q35, whose output becomes the demultiplexed 'L' output. The R-C circuits connected to ground from the collectors of Q37 and Q38 provide the low-pass filtering, to remove all of the high order sideband components and switching transients.

So at first sight, Q41-42 form our electronic switch, taking our composite stereo signal from Q44 and simply switching it back and forth between Q37 and Q38. But what about Q39 and Q40? Again at first sight, these seem to be purely for switching in an equivalent DC level, to 'fill in the gaps' for each output channel when it is not receiving the switched composite signal, and avoid introducing a DC switching component.

But in reality, it isn't that simple. In the National application note, the text explains that a key role is played by those three resistors R44, R45 and R46 in the emitter circuits of Q43 and Q44. In fact these resistors are carefully chosen, to provide a critical degree of AC coupling between the two emitters while still providing a balanced situation for DC.

It turns out that the resistors are chosen so that of the composite signal voltage present at the emitter of Q44, just over one fifth (0.22 to be precise) is coupled through to the emitter of Q43. Where it will of course produce a corresponding variation in Q43's collector current, and 180° out of phase with the full signal appearing at Q44's collector (since it's here applied to the emitter, rather than the base).

The application note text explains that only when this is done, do the outputs of Q35 and Q36 contain purely the L channel audio and R channel audio respectively. So that far from simply being used to 'fill in the switching gaps' to prevent the appearance of a thumping great 38kHz switching component in each output, Q39 and Q40 play a vital role in the decoding, by switching 'just the right amount' of opposite polarity composite signal to the two outputs in between the pulses of full composite signal.

The text even refers to the three emitter resistors R44-46 as the 'decoder matrix', emphasising its key role in the decoding.

So in our switching-type decoder, we in fact have a 'matrix' of resistors whose ratios are critical to the decoder's operation, because they adjust the ratio between in-phase and out-of-phase stereo components. Doesn't that sound a bit familiar? That's right, it's not much different from the addition/subtraction function performed by the 'decoding matrix' section of a traditional stereo decoder. Although in that case, the 'decoding matrix' *follows* the balanced modulator rather than coming before it.

Perhaps all we're really doing here is adjusting the addition/subtraction ratios, so that we can do the matrixing before rather than after. Come to think of it, that coupling ratio of 0.22 sounds suspiciously close to the amplitude of the difference signal sideband components, as a proportion of the overall composite stereo signal amplitude — they're held at 22.5%, if I remember correctly...

And then there's that electronic switch, formed by Q39-42. Doesn't that look rather familiar too? Yes, it's almost exactly the kind of configuration used to produce analog multiplier or (wait for it) *balanced modulator/demodulator* stages. In fact if you wanted to produce a balanced demodulator to reproduce the (L - R) component in a traditional decoder, you'd go for almost exactly the same configuration.

The only real difference here is that we're driving it with a pair of 38kHz square waves, so that it works in switching mode instead of linear mode. But then we're heavily filtering the outputs, to filter out the high-order harmonics and mixing components...

Much the same

See what I'm driving at? The more you look into it, the smaller the differences between the two types of decoder become. In a sense, you get the impression that they're really performing much the same operations, only in a different order — so that superficially things look rather different. It looks as if the switching decoder essentially does its matrixing *first*, just before demodulation, which allows the demodulator to produce the L and R signals directly. And although it uses a balanced demodulator driven by 38kHz square waves, the additional high-order components generated by this are immediately filtered out again.

So although the switching type of stereo decoder looks rather 'magical' and mysterious if you look at it as a 'simple' demultiplexer switch, the mystery seems to evaporate quite a bit if you look into it more closely. Don't you think?

Mind you, if you ask me to explain *exactly* how it all works in detail, I admit that I'd still have some difficulty. My Fourier analysis theory is getting a bit rusty, nowadays...

Perhaps one of our younger and/or more erudite readers will oblige us all, by sending in a clear and detailed analysis. I'm sure we'd all be grateful — including Phil Allison, I imagine.

User friendliness

The other letter that I'd like to present this month came from another familiar name: John Day, of Oakleigh in Melbourne. And Mr Day is responding not to anything we've covered in Forum, but to comments Tom Moffat made in his December 1990 'Madhouse' column, about user friendliness in appliances and other electronic equipment.

His letter is actually quite long, so I won't be able to reproduce it here in its entirety. But here are some of the more salient sections, to give you a good idea of the points he makes:

I was particularly interested by Tom's ideas on user friendliness. I would have to agree that many of the most common items we use, such as washing machines, coffee makers and motor cars would all equally qualify as some of the most hostile pieces of equipment known to man. Many modern, as well as most not so modern, items of entertainment electronics also qualify in that respect. But how do we judge user friendliness?

Tom likes the IC-2SA transceiver, but I rate it as a bit unfriendly, because I can't just pick the thing up and use it without consulting the manual. Nice gadget, lots of nice tricks, just the thing for a techno-freak; but for somebody who wants to use the thing occasionally it is a bit of a trap. I would suggest that whilst the IC-24AT has lots more buttons, because of the legends on the keypad you can pick it up and do pretty well anything, without having to look at the manual.

My idea of user friendliness is based on how effectively I can utilise something without having to remember anything. In my car I have an Icom IC-2400A transceiver. I can do anything I want without having to use the manual. In fact I glanced through the manual the day I put the radio in the car, and haven't looked at it since. Therefore the IC-2400A must be user friendly!

Now to the computers. Like Tom, I was also a bit wary of the Mac back in 1984 when I saw one for the first time in the USA. But I must admit that I said then, that if they got this thing right, it would be a world beater.

Recently we have acquired several Macs, basically for use in desktop publishing. Trouble is now that I have spent some time on the thing, I don't want to use anything else.

Using the same criteria as before,

FORUM

'how much do I have to remember', let's look at why people say the Mac is more friendly. When I first started using Microsoft 'Word' on the PC, it took several weeks of consistent use to get things down to the point where I could say I was proficient — and I have used computers, and some pretty sophisticated software, all my working life. On the keyboard of the PC I have a 'cheat strip' above the function keys, and on the top of the monitor I have a larger cheat strip with more detail — all provided by courtesy of Microsoft, fortunately. It is just as well that they do supply them, because otherwise I would be referring to the manual many times each day.

Back in August, when I got the first of our Macs, I installed a copy of Microsoft 'Word' for the Mac. The guy I bought the system from said that I only needed to remember one thing: "point and click to do something, click and drag to select something". "That's all?" I queried. "Yes, that's all", he replied. Well, he was right. The first page of the quick reference booklet in the box told me how to install the product, which was pretty damned simple anyway — especially when compared to the trauma of installing the MS-DOS version.

It was when I ran the programme and started writing a letter that I found my friendly equipment vendor had misled me. I actually had to remember THREE things! What he forgot to tell me was how to undo what you have just done (command-Z keys). Apart from that, I have opened the manual only on rare occasions — and I don't need a cheat sheet, either.

That was my first experience of Macintosh, and even as an experienced computer user I was impressed. This was something radical, a user interface which did not require me to remember more than a few simple things. Like selecting multiple files to erase, move or copy — this means only having to hold down the shift key while you click on them, rather than having to start another application such as X-Tree or what-have-you, on the MS-DOS machine, unless you use DOS 4.

Having warm and pleasant thoughts about this new machine, I proceeded to install some pretty complex, sophisticated and expensive software. All of which turned out to be just as easy to install, just as easy to use and on the whole just as friendly as the first package. [That's because] in the Mac environment the user interface is inherent in the system itself [not provided by the individual applications].

I suppose my final word to Tom is that when you look at products which are different, we need to put away our preconceptions. I was brought up on, and even wrote, operating systems like MS-DOS, so I have no inherent aversion to them. The difference in this day and age is that facilities like those found in Apple's 'Finder' (the operating system interface), and the user interface in the toolbox, are necessary to support neophyte users — and even experienced ones who don't want to rely on memory any more.

Why should I need to remember the DIR command is for looking at a directory, that I need to use the /w ending if I want to see more things on the screen, and that I need to use a filter to alphabetise the list if I want it that way? Least of all, why should I need to use the MORE filter to get the thing to list in pages, and even then only in one direction? Surely clicking on a folder and selecting VIEW by NAME or KIND is one hell of a lot easier — particularly when the scroll bars in the window allow you to move around so easily.

Whatever products we are looking at, I think the user friendliness can only be gauged by two basic factors: does it do what I want, and does it allow me to use it intuitively and with a minimum of reliance on memory.

Well — thanks indeed for those comments, John. I'm sure when Tom Moffat reads them he'll find them just as interesting and thought-provoking as I have. I suspect quite a few other people will find them interesting too.

I guess I find myself in pretty broad agreement with you, too. When I think about it, my own evaluation of whether something is 'user friendly' or not also depends fairly strongly on how intuitive I find its operation to be, and how little I need to consult the manual. So I can't think of any serious argument against your criteria. But what do other readers think?

When it comes to comparing the Apple Mac system and its user environment with that of MS-DOS machines, I can't really offer much more than general comments because I have almost no experience in using a Mac. In any case, I don't want Forum to get embroiled in an argument about which of the two environments is 'best', because *my* intuition tells me that this kind of argument is a bit like trying to decide which is the 'best' religion.

From the little I know of the Mac, it certainly seems to be a very 'user friendly' machine. I suspect that John Day is quite right in suggesting that it's rather better in this respect than the MS-DOS machines that I've been using so heavily for the last few years.

Of course a lot of progress has been made lately towards making the MS-DOS environment more friendly and intuitive, with the growth of Microsoft's *Windows* and similar mouse-driven graphical interfaces. As John Day says elsewhere in his letter, these still have a way to go before they reach the level of the Mac. But let's face it: they're already a big step forward from the crude early operating systems and software that some of us 'cut our teeth on' in the computing sense.

And of course there are other factors *besides* user friendliness which influence most of us to prefer one type of computer over another, just as one's religious conviction or political allegiance is decided by a lot more than a simple rational choice.

For example one of the things I personally prefer about the IBM- clone MS-DOS computing environment is its 'open' nature, giving you the freedom to choose both hardware and software from a wide choice of vendors. I believe this results in healthy competition, as well as freedom of choice, whereas with the relatively closed Mac environment you seem to be generally locked into whatever Apple chooses to offer you — and at whatever prices they nominate.

I also have an aversion to the kind of 'knocking' advertising that Apple indulges in to promote the Mac, with its ridiculous suggestions and/or implications that hardly anyone actually *uses* MS-DOS machines, and that none of the MS-DOS based software is provided with a graphical interface or will work with a mouse.

But this is all beside the point. We were talking about user friendliness, and surely we're all in favour of that — not just in personal computers (of either camp) but in equipment of all kinds.

Tom and John have offered some valuable comments in this regard, I believe. Hopefully others may care to offer their thoughts on the subject as well.

How about writing in to draw our attention to equipment or software that you've found to be either particularly friendly or *unfriendly*, for example. That ought to get things going, and the publicity might just pressure the people concerned to lift their game.

That's about all for this month, though. Hopefully you'll join me next time, when we look at a couple of letters discussing project problems. ■

THE SERVICEMAN

The VCR with a problem that was much harder to explain than to fix!

This month we have a mixed bag of items, covering all kinds of service problems. We'll start with the story of an inexplicable fault I had with a video recorder. Then there'll be a couple of items from contributors, one of them nostalgic and the other right up-to-the-minute. I hope you'll find them as interesting as I did. Firstly, my own problem...

When you hear the end of this story, I believe you'll agree with me that it's one of the strangest tales ever told on these pages. It concerns a Sharp video recorder, a model VC381X.

This particular machine had given considerable trouble in the past and the last repair (by somebody else) had cost the owner 'over $200', so he didn't want to spend too much on it this time.

It all began when the customer asked me to come and repair his old Philips colour TV. That was no problem, and half an hour later I was packing up to leave when he dropped his *real* troubles on me. He asked if I would set up the video properly. His daughters had not been able to record off-air recently, because all the channels seemed to be 'off tune'.

It only took me a few seconds to confirm that the video was properly tuned, but that there was indeed a problem. The off-air signals were so weak as to be totally unusable.

Signals were visible in all three bands, but they were so far down into snow as to appear like far-fringe reception. Yet this was in a good signal area, and the TV was working perfectly when fed with signals direct off the antenna. So it had to be a problem with the video's antenna booster.

I packed up the video and loaded it into the van. Apart from the fact that I didn't have a replacement booster in my kit, I didn't welcome the prospect of dis-embowelling the machine with the customer standing over me watching my every move. I mean, if I am going to make a mistake, I would rather do it in private!

Back at the ranch, I lost no time in opening everything up to gain access to the relevant circuit boards. In fact, the one I wanted most was the antenna socket-booster-RF modulator board, which was mounted along with the power transformer and DC power supply boards at the back of the chassis.

The first time you encounter one of these panels you wonder if you will ever dismantle it, let alone get it all back together again. But after three or four dismantle-reassemble circuits it becomes a lot easier — although I don't think anyone would ever consider the process to be 'simple!'.

It was only after I had it all stripped down that I realised that I had omitted a test that might have saved me so much angst (Murphy at work again!).

That test was to bypass the booster, and to feed the antenna directly into the tuner. The booster amplifier is only necessary when the antenna signal is being split between the VCR tuner and the RF output socket. It compensates for the signal loss in the splitter.

For test purposes the splitter can be bypassed and the signal fed directly into the tuner. If the VCR then responds as though there was no problem, it's safe to assume that the booster is unserviceable.

In the case of the VCR under discussion, the result of this test was ambiguous. The off-air 'EE' picture was a bit better, but was still too snowy and not at all what I would have expected.

Because I had attacked the problem from the wrong end, I already had the booster board dis-assembled; so it was no trouble to replace the booster assembly. If I had analysed the problem more carefully this is the last thing I would have done!

However, the new booster produced not the slightest improvement. I spent some time checking voltages around the new unit, but all was in order and it was working quite as well as could be expected.

This left me feeling rather miserable because the fault now seemed to be in the tuner, and replacement tuners are quite expensive components. I didn't relish having to go back to the customer and tell him that the job was going to cost an arm and a leg.

But I wasn't going to condemn the tuner just yet. I had one other trick up my sleeve, before that decision had to be made.

I have often referred to my modified portable TV, which I use for all kinds of test procedures. This time I wanted to check the output of the video's tuner, and this was easy to do after I had removed the link between the portable TV's tuner and IF strip.

A moment later I was relieved to see

that the video tuner was absolved of all blame. The picture on the screen of the small TV was perfectly clear and sharp. It also responded normally to fine tuning adjustments made on the VCR tuning panel.

Having proved that the VCR booster and tuner were working properly, it remained for me to find out where the signal *was* being lost. The monitor screen was still showing a weak and snowy picture.

Here my small TV has another useful purpose. I can take the output of its own tuner and inject the known good signal into a suspect IF strip. I unsoldered the IF output on the VCR's tuner and injected the test IF into the copper pad surrounding the tuner pin. The result was no better than the recorder's own tuner could produce.

Next, I tried injecting IF directly into the base of the first IF amplifier transistor. This produced an immediate response — a perfect picture on the monitor. So the trouble lay between the output of the tuner and the input to the IF strip. This comprised a capacitor, a resistor, and an 8mm strip of copper track. It didn't seem possible that there could be much wrong with that little lot, but it was enough to stop the signal...

Working backwards from the base of

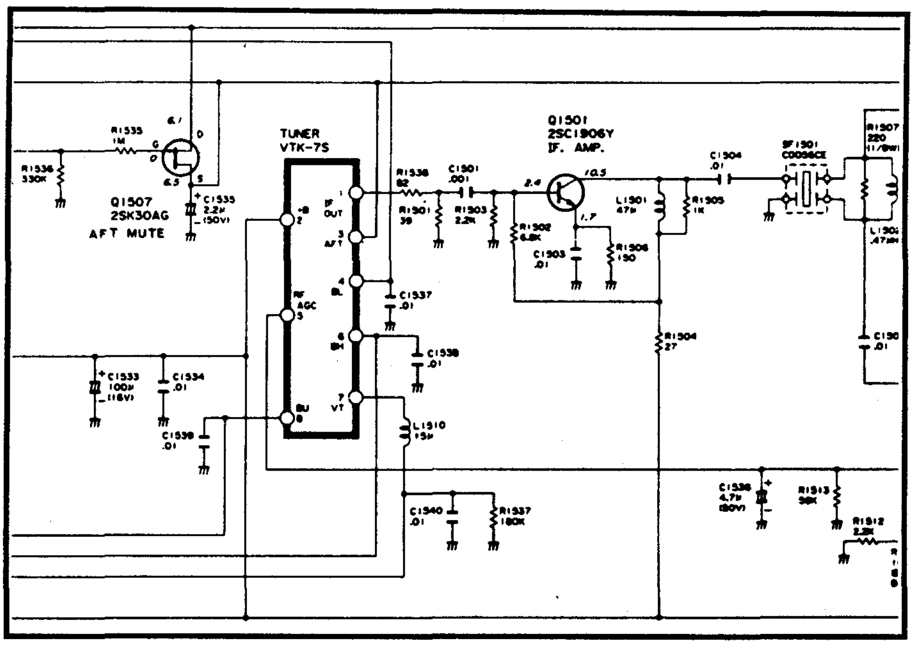


Fig.1: The Serviceman tracked down the fault in the Sharp VC-381X video recorder to this section of the schematic, where the IF signals come from the output of the tuner module to the IF amp input.

the IF amplifier transistor, I could inject signals into the coupling capacitor and get a first class picture. Then into the series resistor, and still get a good picture. But injecting the signal into the front end of the copper strip produced a rotten picture! This didn't make sense.

An 8mm strip of copper couldn't attenuate the IF signal by 40-odd dB, surely? Especially when my multimeter told me that the strip measured less than 0.1 ohms from end to end! I had at first thought that the strip was cracked, hence the ohmmeter measurement. But it wasn't cracked, yet still offered several hundred ohms of impedance at the IF frequency.

I scraped off the varnish that overlay the copper, and ran my meter probe along the track. Over it's whole length, the DC resistance was so low as to show no difference to the lowest range on my meter. Yet when I ran the IF probe along the same track, it acted like a perfect slider potentiometer.

About two millimetres from the tuner end of the track, the level of snow in the picture began to diminish. Half way along the track the snow was so little that the picture was almost acceptable. And one millimetre from the IF input end of the track the picture was perfect.

Once before I found a short length of PCB track that acted like a resistor. That was in a Sharp television, and in one of the power supply rails. But that track *did* look 'funny', like a whole lot of tiny copper dots so close together as to almost touch.

This one looked like perfectly good copper, and reacted like perfectly good copper to DC. It was only at the IF frequency that it played up. I bridged the track with a short length of wire and cured all the problems. Then just to be sure that I wasn't being made a fool of

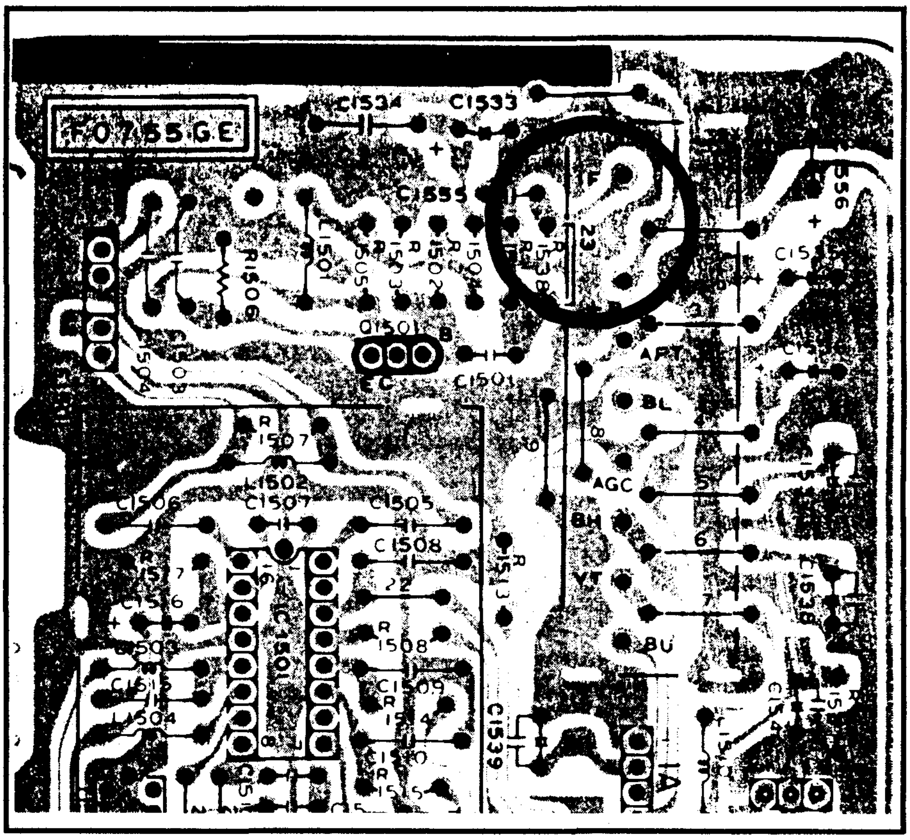


Fig.2: And here's the relevant section of the VCR's main PC board. The fault turned out to be something quite unexpected — and still very hard to explain.

by an obscure dry joint, I went over the whole assembly with a hot iron and fresh solder.

But there was no argument. With the bridging wire removed, the set would not work. With the wire in place, it worked perfectly. I can't offer a reason. Only a description of what I found, and how I cured it.

Referring back to the second paragraph of this story, I now suspect that the previous repairs might have involved the replacement of either the tuner or the booster. These are both expensive items and could have resulted in charges of 'over $200'.

If that was the case, it doesn't reflect too well on the previous technician. The set must have gone back to the owner at that stage with the fault still apparent.

I hope you'll never get caught by one of these problems, but at least you'll know how to fix it if you do.

Joke became fact!

The next story comes from contributor K.W., of Hawthorn in Victoria. The story was originally submitted as an entry in the recent EA/Icom 'Funny Antenna Story' competition and was unsuccessful at that time. However, *EA*'s Editor Jim Rowe considered it worthy of further consideration and asked me if it could be used as a Serviceman item.

I'm afraid that I'm crazy about nostalgia and the way things used to be, so K.W.'s story struck an immediate chord with me. As well as the 'memory lane' bit, the story has a lesson for current practice, so I had no hesitation in selecting it for this month's page.

K.W. began his career in television servicing in West Germany, as he says 'back in the days when TV was only just starting'.

The story he tells here begins with a couple of anecdotes from the period, then goes right in to the story proper. Here's how he tells his tale:

It was in the early days of television in Europe, with just one station on air, and that showing test pattern all day with program material only in the late afternoon and evening.

An elderly couple came into my shop, hoping to buy a television set. They were very impressed with the various demonstration models on show, but were reluctant to buy the particular set they seemed to like best.

In the end, after a whispered conversation, they confessed that they would prefer to buy a television set that had a program on all day long, even if it would be more expensive!

But elderly couples were not the only ones to exhibit a lack of contact with what was the then 'reality'. One day a Lieutenant from the US Air Force came into my shop and tried to explain that his radio needed a new 'toob' (valve!) I said "Yes — OK. But what type do you need?" He replied "Well, it's round and about two inches high!"

As you might imagine, those days provided plenty of material for amusement, from the very unsophisticated audience of the time. The following story came also came from the same city but a little later, in 1964 when colour television was just being introduced.

A common joke in the trade — when going on a housecall to repair a colour set — was that the first thing you should do was to wipe your hands under the front of the set and then explain to the stunned customer that there is no sign of 'colour dripping out', so the fault can't be too bad after all.

Some customers did not take it too well, especially when then told that the picture tube in the new set needs a refill of colour, mainly red, every four to five months. They were usually a little happier after being told that very little colour was necessary, 'just half a cup approximately'.

I won't admit that I indulged in such practical jokes, as I sold quite a number of colour television sets at that time and tried to do the right thing by my customers. I usually rang them after a few months, in the interests of closer customer relationship.

On one occasion a dear old lady answered the phone and told me that the set was working very well and she was quite satisfied with the picture. Except for one thing: "The colour is dripping out sometimes and it is very hard to get it off the carpet!"

As you can imagine, my mind did a few sommersaults and she must have sensed my thoughts, when she continued "I know you think I am just a silly old Moo who must be seeing things, or imagining them. But I assure you it is true!" She went on to tell me that she had cleaned up the most recent mess — but promised that when it happened again she would give me a call so I could see for myself.

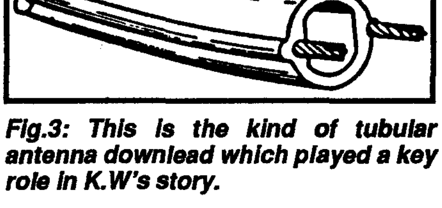


Fig.3: This is the kind of tubular antenna downlead which played a key role in K.W's story.

It was weeks later and I had already forgotten the whole thing when the lady rang to tell me that the colour was dripping out again(!) and if I wished to see for myself, I should come and have a look at it.

I have seen overwatered flower pots, steaming and dripping coffee machines, and even worse things on top of television sets and was prepared to find something similar. Something easy to explain. But it was to be nothing of the kind!

The set was a console type television on two-foot long legs, freestanding, with nothing on top of the spotless, mirror-like polished cabinet. Under the set, on the otherwise immaculate carpet, I found two dark spots. One was a dark brown, a rusty brown colour and about 3 to 4 square inches in area. The other was an intense light green colour — about 1 square inch — right next to it and directly under the picture tube.

My first impression was that it had come from a leaking electrolytic capacitor, but I have never seen any green liquid coming from electrolytics. The spots seemed to be a bit moist and I was able to identify the brown one as rust. But rust in an almost new set? Not very likely! All of this went through my mind as I moved the set forward to remove the rear cover.

The whole mystery became very clear when I removed the antenna cable. The antenna was about 15 years old and was mounted on the chimney of the three storey building. It consisted of AM, FM and VHF antennas connected via a splitter from where the 300-ohm cable ran straight down to the set, entering the house right under the window. Then there was a slight bend upward to the back of the set, where it was supported by a piece of string and then a slight downward bend, ending in two banana plugs to the set's antenna input.

The antenna lead was a type of round, hollow cable, similar to a thin garden hose. This type of twin wire 300-ohm antenna lead-in-cable was used quite often at that time in Germany.

The rest is easy. The completely corroded splitter box, under the antenna, consisted of nothing but lumps of rust and oxidised copper. That mixture had been washed down through the hollow antenna cable during a thunderstorm the night before.

Through the antenna plugs, it found its way to some vent holes in front of the *set. The water then dispersed in the carpet, leaving only the rust particles and the intense green verdigris on top, giving the impression of colour dripping out.*

The cure was easy. I fitted newer, more modern cable and the trouble never recurred. But I wonder if my colleagues ever knew just how nearly their practical jokes were to coming true!

Well, don't you agree that that story was brilliant? I've heard some waggish yarns about the servicing industry in my time, but never has anyone suggested that colour tubes needed to have their colour 'topped up' occasionally.

As far as I know, that tubular 300 ohm cable has not been used here in Australia. I have only ever seen flat ribbon cable. But the tubular type was also common in the UK and the USA, back in the early 50's. I found the accompanying illustration in a 1959 edition of a book on black and white TV servicing from that era.

The tubular cable was claimed to be more weather resistant, with lower losses than flat ribbon. Yet as K.W.'s story shows, it was quite capable of bringing the weather inside along with the signals, if not properly mounted.

Just in case you think that this story has no relevance to the present day, just bear in mind what might happen when water gets into low loss air spaced coax.

Thanks, K.W. I'm sure we all enjoyed that little bit of nostalgia.

Obscure, yet familiar

Now we come to a more up-to-date story, from P.M., of Hagley, in Tasmania. P.M. services industrial electronic equipment, and his story offers an insight into the problems associated with that type of gear. He writes thus:

I am an avid reader of your column and often identify with the antics of your contributors. I offer the following example of a recent battle I had with an almost perfect printer, in reply to your request for input on a wider range of equipment. I hope you will find it interesting enough to include in the Serviceman pages.

Unfortunately, due to the nature of industrial service work I have to be a bit vague in places. But then I am often accused of being that, so I will carry on anyway.

The printer in question was delivered to my service centre as a collection of circuit boards in a cardboard box, with a note attached reading simply 'No Display'.

This type of printer is used for printing labels for packaging and consists of several boards for memory and control, with a main power board and separate alphanumeric display board, all connected together by a 60-way ribbon cable.

I checked all the boards carefully for any sign of physical damage before I assembled them. (I once received a power board from the same place with the note 'blown fuse'. On examination, I found that 90% of the tracks on the board had been vaporised!) This time the boards were OK, so I put it all together and the battle was joined.

The printer performed a perfect startup sequence and when tested, operated perfectly. A quick check of the power board showed all to be well there, so, convinced that the fault had to be on the display board, I fitted a known good board and fired up. Still no display!

At this stage I became slightly perturbed, but when I changed the cable and came up with the same result I began to wish I had never opened the box.

I should point out that this repair was carried out in the absence of any circuit diagrams or manual. My only guide was a hand-drawn wiring diagram, with test readings from an operating machine pencilled in. (Repair work of this type takes skill, concentration, and an IQ of not more than 50!) At this point, and mainly because it was the simplest thing to try, I replaced the power board — with immediate success!

The display was perfect, and so was everything else. Except for the fact that I now had an apparently perfectly good power board that wouldn't drive a display! The only things the display board requires from the power board are an unregulated 30V rail and a 5V logic supply. These were both present, and my confusion was rapidly becoming panic. I think we all know the feeling, when you start checking your meter and wondering if you have any holidays owing!

In desperation, I started doing continuity and earth checks. The earth returns from the display were routed back to the power board on two *separate pins, one on the front of the board and one on the back, from where they both ran to a common point — where the heatsink was bolted to the chassis.*

At a point midway down the board, the return line on the front went through the board and linked with the one on the back. I checked from the connector to earth on the back, fine. On the front — nothing. There was simply no connection through the board, even though the hole was nicely full of solder and the machine had been in service for years.

A probe on either side of the board at the pin-through showed absolutely no connection, no matter how hard I pressed and twisted them.

The old solder was removed with solder wick and the joint redone. Lo and behold, a display! To be on the safe side, a piece of 15A fuse wire was inserted into the hole and was soldered to the tracks on either side. I don't think that board will ever come back — at least not with that particular fault, anyway.

Thanks, P.M. Your story shows that even industrial equipment suffers from common types of faults. Which isn't all that surprising, I suppose, since it often uses much the same components and construction as domestic equipment.

A similar lack of continuity between the two sides of a double-sided board was common with an early model Toshiba colour TV. In those sets the fault was bad solder joints, even though the tracks were linked by 1mm square pin-throughs! Perhaps P.M.'s 15A fuse wire would have been a better product to use.

Well, that seems to be all the space I'm allowed for this month. There are some more contributions to come, and other stories from my own bench. See you next month? ■

Fault of the Month

SANYO VTC5300 video recorder

SYMPTOM: Noisy lines across the screen. The lines are bad until the colour is turned off, then they become far less noticeable. In monochrome, they look vaguely like hum bars, and they do move on the screen like hum bars. However, there is no trace of ripple on any of the DC rails.

CURE: C5007, a 470uF 16VW electro on the main regulated 12V rail, had gone open circuit. The cap is at the output of the filter, hence the lack of ripple. However, without its bypassing effect it obviously allowed hum to enter the rail from elsewhere.

This information is supplied by courtesy of the Tasmanian Branch of The Electronic Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

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* Kits may be returned if inner components bags are unopened and packaging is in its original condition

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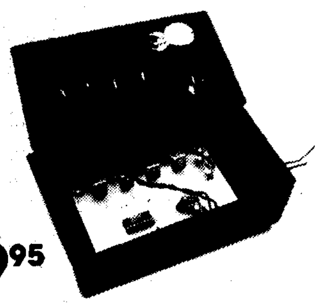

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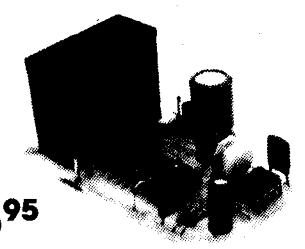

EA March '91

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- Includes deluxe probe case, all components, test lead with clips, PCB and pre-punched front panel label

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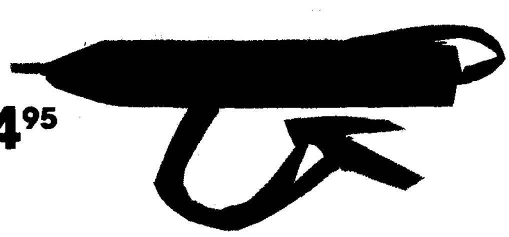

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Cat K-5220

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SILICON CHIP Feb '91

NEW '91

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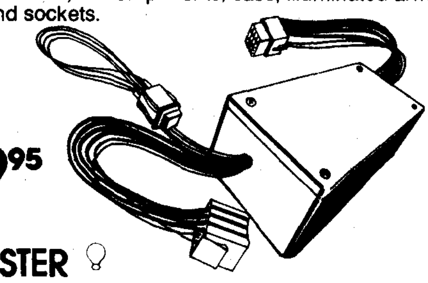

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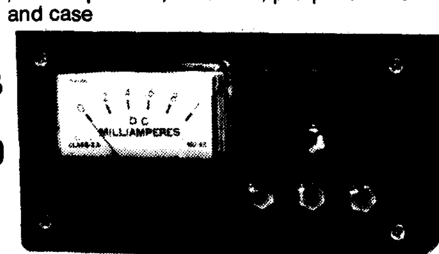
EA July '78



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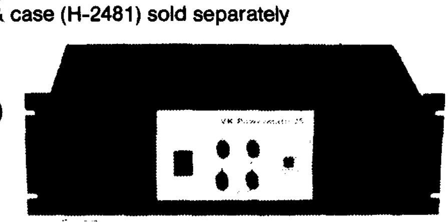

EA Jan '90

Mains — Kits marked with this symbol involve mains power wiring. Take extreme care when working with this equipment.

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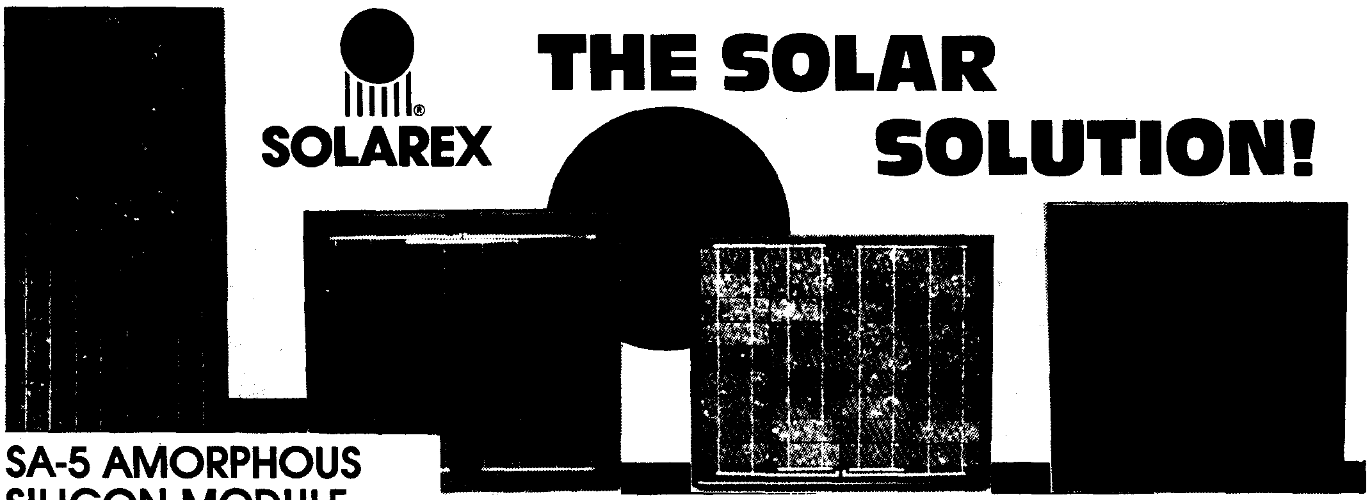

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Specifications (@ 25 °C) -

Size:	306mm x 346mm x 21mm
Peak Watts:	5 watts
Current @ Nom. Volt.:	0.33 amps
Volts (open circuit):	23 volts
Amp Hrs/week: (42hrs peak sun)	13.86
Watt Hrs/week: (42 hrs peak sun)	194.04

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Specifications (all @ 25 °C)

Size:	444mm x 267mm
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Current @ Nom. Volt.:	0.59A
Volts (open circuit):	21V
Amp Hrs/week: (42hrs peak sun)	24.78A
Watt Hrs/week: (42 hrs peak sun)	346.92W

Cat O-1010

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MSX-18L

Specifications (all @ 25 °C)

Size:	444mm x 459mm
Peak Watts:	18.5 watts
Current @ Nom. Volt.:	1.13A
Volts (open circuit):	21V
Amp Hrs/week: (42hrs peak sun)	47.46A
Watt Hrs/week: (42 hrs peak sun)	664.44W

Cat O-1018

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Current @ Nom. Volt.:	1.13A
Volts (open circuit):	21V
Amp Hrs/week: (42hrs peak sun)	47.46A
Watt Hrs/week: (42 hrs peak sun)	664.44W

5 year limited warranty

Cat O-1019

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MSX-40 FRAMED

Specifications (all @ 25 °C)

Size:	764mm x 502mm x 54mm
Peak Watts:	40 watts
Current @ Nom. Volt.:	2.51A
Volts (open circuit):	21.1V
Amp Hrs/week: (42hrs peak sun)	105.4A
Watt Hrs/week: (42 hrs peak sun)	1475.9W

10 year limited warranty

Cat O-1040

$399

MSX-60 FRAMED

Specifications (all @ 25 °C)

Size:	1109mm x 502mm x 54mm
Peak Watts:	60 watts
Current @ Nom. Volt.:	3.76A
Volts (open circuit):	21.1V
Amp Hrs/week: (42hrs peak sun)	157.9A
Watt Hrs/week: (42 hrs peak sun)	221.9W

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Cat O-1060

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* Amp Hour ratings are based on a daily average insolation of 600mW hr/cm²
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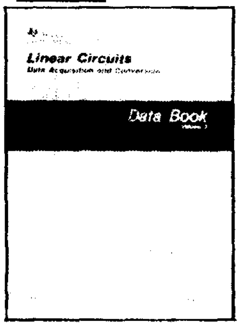

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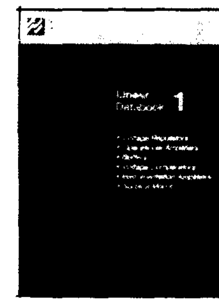

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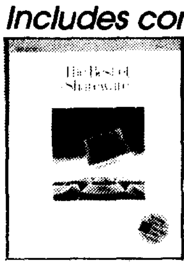

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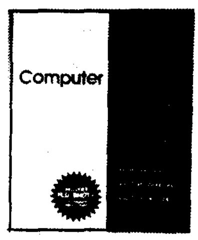

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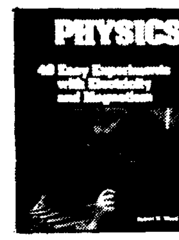

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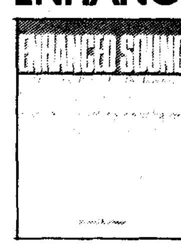

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1.2m x 4.8mm	W-4108	Black	3.50	2.80
1.2m x 4.8mm	W-4110	Colours	3.50	2.80
1.2m x 6.4mm	W-4112	Black	3.95	3.15
1.2m x 6.4mm	W-4114	Colours	3.95	3.15
1.2m x 9.5mm	W-4116	Black	4.50	3.60
1.2m x 9.5mm	W-4118	Colours	4.50	3.60
1.2m x 12.7mm	W-4120	Black	4.95	3.95
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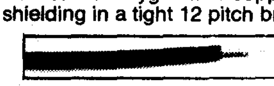

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FIG. 8 SHIELDED CABLE

Same specs. as our single core cable moulded in a figure 8 configuration.

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DICK SMITH ELECTRONICS

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

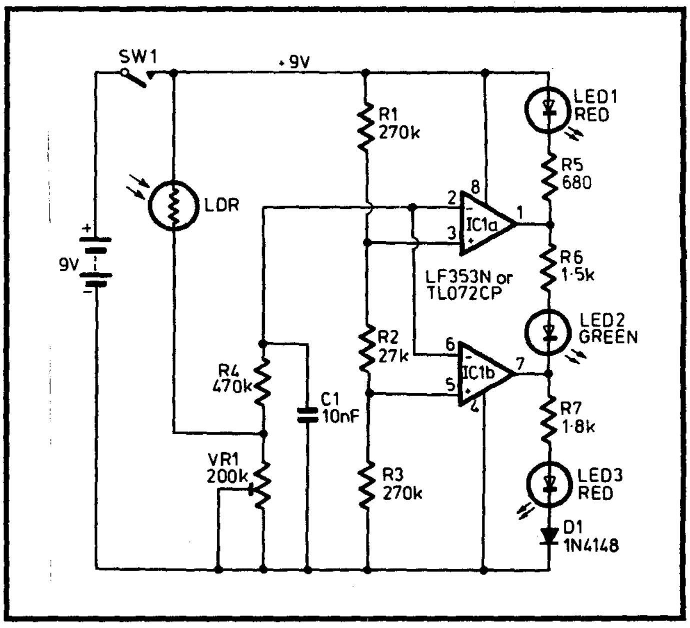
Darkroom exposure meter

This exposure meter is very easy to use because its display is one of three LEDs. One red LED indicates 'overexposure', another 'underexposure', while a green LED shows when the light intensity is correct.

Since this is a comparison-type meter, you must first determine the correct light exposure by making a test print. Then you adjust the light meter (trimpot VR1) until only the green LED comes on. Future exposures can then easily be determined. With the new negative in the enlarger, place the light dependent resistor (LDR) on the print masking board. Alter the aperture of the enlarger until only the green LED glows — this is the correct setting for that negative.

The string of resistors R1, R2, R3 provides positive voltage references for the positive inputs (pins 3 and 5) of both opamps. The voltage applied to the inverting inputs (pins 2 and 6) is determined by R4, VR1 and the LDR. When light shines on the LDR, its resistance is decreased and this applies a positive potential at the inverting inputs. At the correct exposure, IC1A's pin 1 is positive (high) and IC1B's pin 7 is negative (low), so the green LED2 is lit. LED1 does not conduct as it is reversed biased, nor does LED3 as the output of IC1B is low.

If the light measured is 'too bright', then the resistance of the LDR falls even further. The higher potential on pins 2 and 6 means both opamps now will be switched low. LED1 will conduct from the positive supply rail, while the low outputs of both opamps mean neither LED2 or LED3 will light. When the light is 'too dark', both pins 2 and 6 will fall beneath their reference voltages, and so both opamps will go high. Only LED3 will now conduct, as both LED1 and LED2 will be reversed biased.



The value of VR1 determines the useful range of the light meter, and the values given suit my black and white printing. To respond to brighter light sources, the value of VR1 should be reduced.

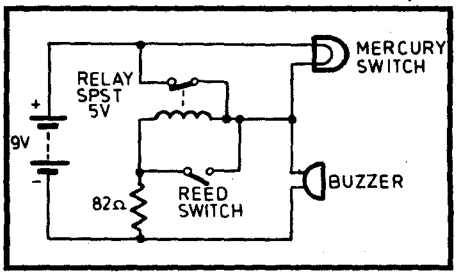
Peter Boyle,
Edithvale,Vic. **$40**

Inbuilt VCR alarm

Vexed by vicious villains who ruthlessly ran away with my valuable VCR, I decided to design this delightfully simple setup to thwart the thieves. Because it takes so little time for the thief to snatch and run, this alarm is built into the VCR to continue to attract attention as the thief runs down the street.

The circuit is simple. Disturbing the VCR shorts the mercury tilt switch. This operates the relay which then holds through its own contact and which also provides nine volts to the piezo/buzzer. The buzzer operates until either the battery voltage drops below the release voltage of the relay (about two hours with an alkaline), or the relay is disabled by operating the reed switch to short the coil. A 5V SPST miniature relay was used with an 82 ohm resistor providing a suitable drop. Installation was achieved using double-sided tape and fine hookup wire. Most of the components were placed on the relay itself, the buzzer is near a vent, and the battery is located in an empty recess of the plastic chassis. The reed switch was mounted inside the back wall of the VCR to allow easy access with a magnet. With the cover replaced, nothing is obviously visible. It is worth bringing a nine volt battery with you when shopping for your buzzer in order to find the loudest one. There are differences even within the same model.

Robert Marazzato
Reservoir Vic. **$35**



Headphone amplifier

Headphones do not need to be driven from a low impedance source, as do loudspeakers, since they are predominantly mechanically rather than electrically damped. This circuit amplifies a line-level source signal to drive a typical low-cost mylar diaphragmed moving-coil headphones. Its measured impedance from 20Hz - 20kHz was almost constant at around 32 ohms.

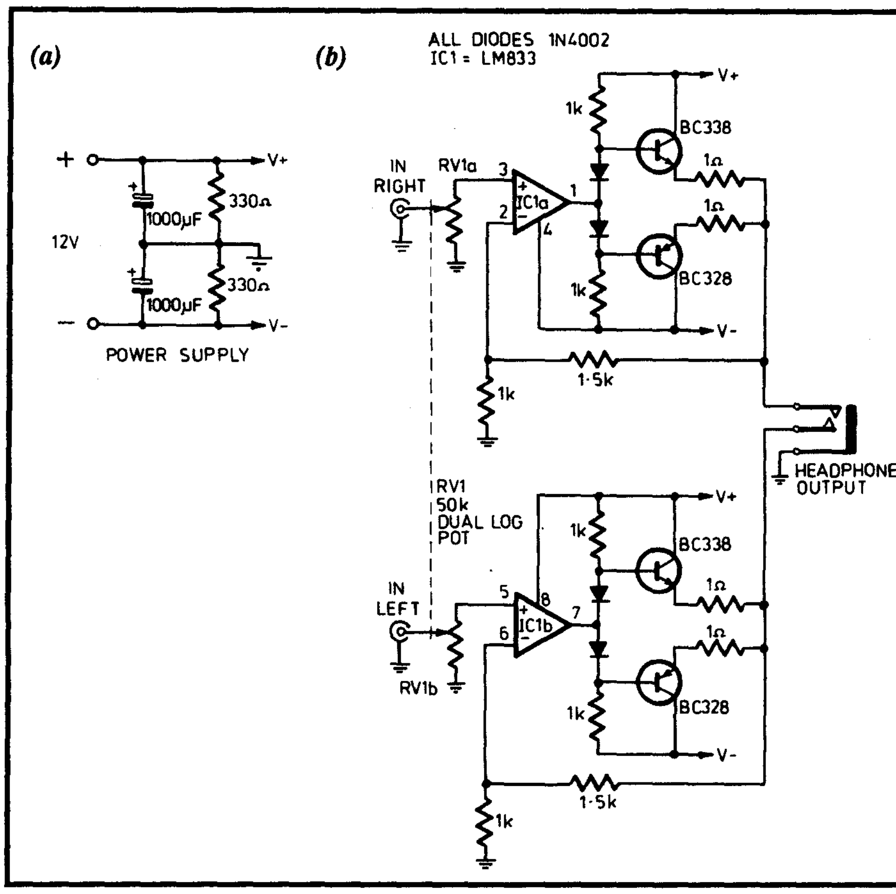
Unlike most headphone amplifiers, this one runs off a 9-15V single supply, giving a power output of around 100mW into 32 ohms. Total harmonic distortion is only 0.003% at 1kHz, rising to 0.02% at 20kHz. There is no audible noise or hum, even when running off an unregulated plugpack.

To allow operation off a single supply while still giving good ripple rejection, a somewhat unusual power supply is used.

Two 330 ohm resistors bias the input and output to half supply voltage, and are bypassed by 1000uF capacitors. The 1000uF capacitors provide a low impedance at audio frequencies, as the resistors are far higher than the 32 ohm impedance of most headphones. Unfortunately this means DC offsets change the bias, so if these are present the amplifier should have its inputs capacitively coupled.

Otherwise this power supply is perfectly satisfactory, giving 70dB of ripple rejection. 70dB attenuation of interchannel crosstalk at 1kHz and 55dB crosstalk at 10kHz. This supply also prevents switch-on thump.

The amplifier circuit itself is fairly standard, consisting of an op-amp driving a class-B emitter follower to increase the current to the level required for driving headphones. The op-amp used is an LM833 which has two advantages — it was designed for audio use and thus gives wide bandwidth and low distortion; and it is a dual op-amp, so only one IC is required. Both the op-amp and the output stage areincluded in the negative feedback loop, which is set for a gain of 2.5. The dual 50k log pot at the 'input functions as a volume control.



The op-amp drives a class AB output stage consisting of a complementary pair of BC338/328 transistors. The transistors are biased by the 1k resistors and 1N4002 diodes to a quiescent current of about 20mA. This value is not critical — 5 to 50mA is acceptable, and in fact, varies considerably, depending upon the Vbe of the transistors and diodes.

Diodes give much lower crossover distortion than the resistors sometimes used in the same position, and make the bias largely independent of supply voltage. With diodes, distortion is barely audible with the output stage operated open loop! The 1 ohm emitter resistors prevent thermal runaway.

Jeffrey Harrison,
Mount Waverley, Vic. **$45**

LED torch

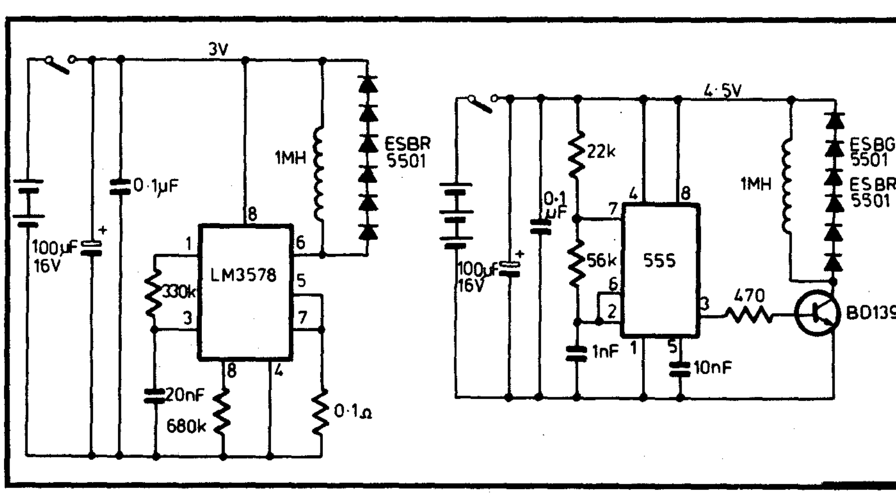
This project was designed to get as much apparent brightness as possible from high efficiency superbright LEDs, while running from torch batteries. The LEDs are pulsed at short duty cycles, at higher than their rated currents, in order to get more brightness with less heat. The eye responds to the peaks of intensity of the pulsed waveform.

A switching step-up inverter is used to drive the string of diodes. This eliminates the need for a limiting resistor and also provides a higher voltage to drive more LEDs. The 1mH inductor, or peaking choke, can be bought across the counter but it must have a DC resistance of less than 0.5 ohms.

Two versions of the circuit are given: the first runs off 4.5V and uses common components (555 and BD139), while thesecond uses 3V and a low power LM3758 switching regulator. With careful adjustment, high brightness can be generated. The inductor is the best thing to change, as the smaller it is, the more light is produced. But the switching frequency can also be altered by reducing the timing capacitor to produce more current. Water clear high efficiency LEDs were used like ESBR5501 and ESBG5501, but 3000mcd types are preferred if not too costly. When choosing your diodes, try a sample of various types to see which ones light up a piece of paper the best, as data sheets sometimes do not give a good indication of light output because of beam shape.

If you use green LEDs, fewer are needed as they have a larger voltage drop. They would be running a little too hot if their colour changes to amber.

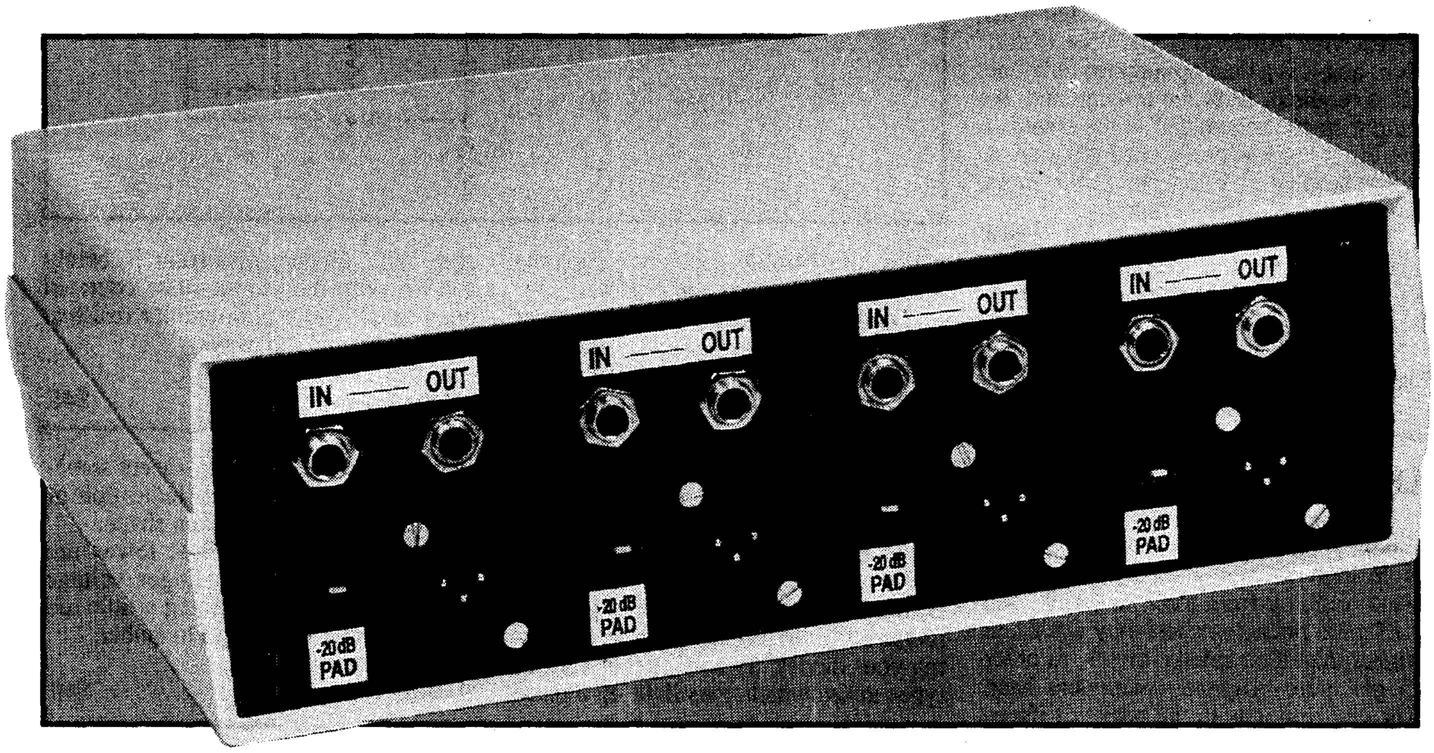
L.W. Brown,
Burwood,Vic. **$40**



QUAD 'DI' BOX FOR STAGE AND STUDIO

This simple unit will replace four separate direct injection (DI) boxes, but at a fraction of their total cost. It offers excellent performance, and is ideal for connecting a bank of electronic musical instruments to a standard mixing desk.

by ROB EVANS



In the October 1987 issue of *Electronics Australia*, we described an active DI box which offered features normally found in the best, and most expensive commercial units. Not surprisingly, this has proven to be an extremely popular project with countless units being built over the past few years.

However, there are a number of circumstances where *several* DIs are required, and the battery powered, portable nature of the original design is not really needed...

With electronic instruments playing a larger part in contemporary music, it's not uncommon to find a keyboard player (for example) equipped with several devices to be connected to the mixing desk — these might be a couple of keyboards, a sampler and a drum machine. In this case four DIs are needed, and all in the one location. So we have a situation where mains power is close at hand (powering the various instruments), and the DIs tend to be grouped in a cluster on top of the performer's monitoring amplifier — where they invariably roll off, causing a tangle of cables.

As a further complication, each DI is generally turned off (by unplugging the input jack) until a performance or recording is under way, so as to preserve the unit's internal battery life. It's under these conditions that our new DI design is ideal. By grouping a number of DI stages in one box, and powering the unit from the 240V supply, the above problems are all solved in one stroke.

There are fringe benefits of this arrangement, too. While the normal battery powered DI has a restricted headroom due to its 9V supply rail, a mains powered unit can easily have a much higher voltage source, and a corresponding increase in signal overload margin. In practice, battery powered DIs rarely exhibit this problem — nevertheless, with certain instruments such as drum machines it can occur due to their high signal output levels.

Also, we are obviously not concerned with battery life in a mains powered DI box, so the actual current consumption of the circuit is not a primary consideration. This in turn allows us to use higher performance op-amps — which generally consume more power — and improve the DI's overall noise and distortion figures.

As you can see from the specifications panel, the performance of this new design is more than adequate for stage *and* studio applications.

Another clear advantage of this arrangement is cost. Depending upon the type of box that you use, our 'quad' DI box can be built for less than half of the total price of four battery powered DIs — and it's much simpler to build.

Some constructors may wish to house the circuit in a standard 19" rack-mount case, which will obviously increase the cost by a substantial degree. However, this approach allows a number of 'quad' DIs to be installed in the one box — depending upon the front panel space, an eight- or even 16- channel DI box could be built at quite a reasonable price.

By the way, while the main application for our new DI is with electronic keyboards and drum machines, the circuit works equally as well with bass guitars and acoustic instrument 'bugs'.

In fact, it's not uncommon for a musician to use a number of different acoustic instruments through a performance, with each instrument connected to the mixing desk via its own 'bug' and DI box — another ideal situation for a mains-powered multiple DI box.

If you're not familiar with DI boxes, balanced lines, phantom power and so on, you might like to refer to the October '87 article for more information on these terms, and the principles involved.

Design considerations

As you can see from the shots of the prototype, each DI stage offers the usual unbalanced input and output sockets, a XLR-type balanced output and a 20dB 'pad' switch. These function in the same manner as with our past battery powered design, with the exception of the unbalanced output.

Usually, this socket has a direct electrical connection to the input connector, so the instrument's signal (at the DI input) is simply linked through to the monitoring amplifier without electronic intervention. This is quite a logical arrangement, since if the DI's battery expires during a performance, the instrument can still be heard from the stage amplifier — which is better than no sound at all!

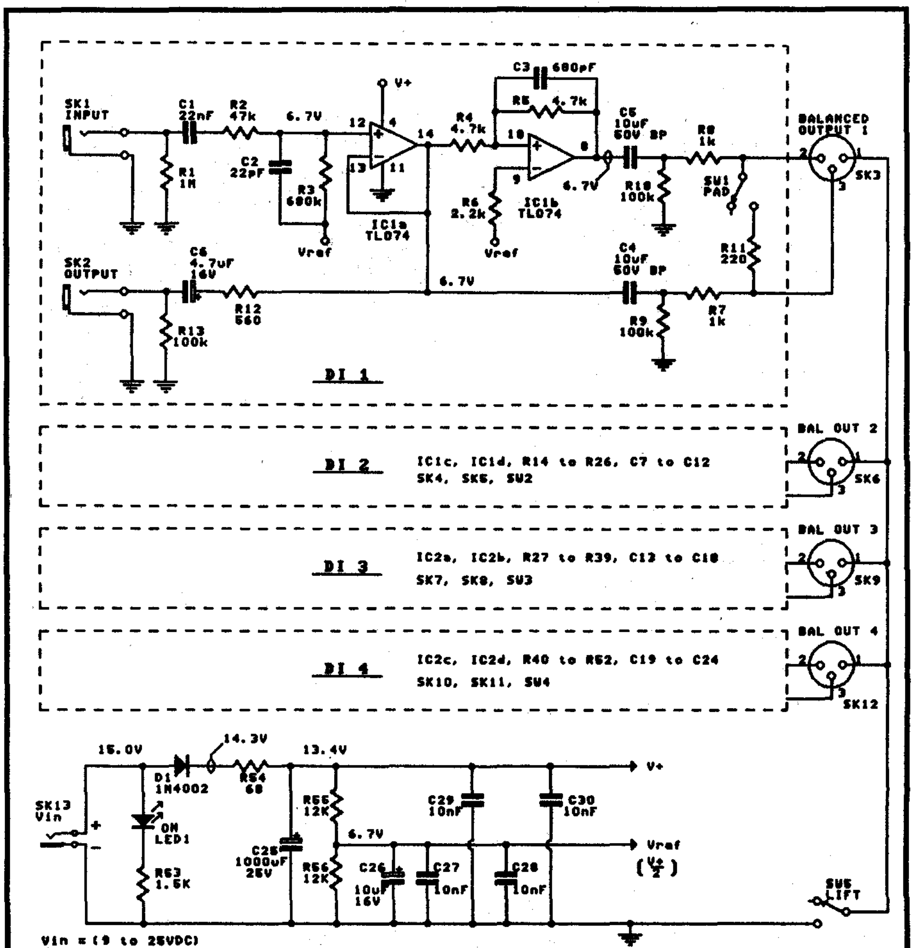
Of course in our new design there's no risk of battery failure, so we have elected to pass the input signal through an active buffer stage before appearing at the unbalanced output. With this arrangement the instrument's output is only loaded by the high impedance input of the DI (around 420k), while any following device (monitoring amp etc.) is now driven by the DI's unbalanced output, which has a source impedance of about 600 ohms.

The advantage here is that instrument's performance cannot be compromised by an unfavorably low impedance load at the monitoring amp's input — which in some cases is less than 50k. A bass guitar pickup for example, has an output impedance in the order of a few thousand ohms, and will produce a reduced and dull signal when connected to this type of amplifier. In this case, the DI's in-line buffer will restore the signal quality at both the monitoring amplifier, and the mixing desk.

Other than this change, the design of

SPECIFICATIONS

Signal to noise ratio:	better than -100dB (unweighted, 20kHz bandwidth, ref. 0dB input)
Frequency response:	15Hz to 600kHz (-3dB rolloff points)
Distortion:	Less than 0.01% (ref. 0dB input)
Overload level:	+14dBm (15V DC supply)
Input impedance:	approx 420k
Unbalanced output impedance:	less than 600 ohms
Current consumption:	approx 20mA (15V DC supply)
Supply voltage range:	9V to 25V



The complete circuit of the DI box, with only one of the four stages shown in detail. The input at SK1 is buffered by IC1a, then inverted by IC1b — the outputs of both op-amps drive SK3.

each stage is quite similar to the original battery powered circuit, as presented in the October '87 issue.

The 'pad' switch and its associated attenuator has been retained, so that the balanced output will be at a reasonable level for a wide range of input signal strengths. In this case however, the attenuation factor has been increased to 20dB rather than 15dB, due to the likelihood of large input signals from keyboards and the like.

After performing noise calculations and a series of practical tests, it soon became clear that the TL07X series op-amps were best suited to the job. In fact, for an input signal with a *high* source impedance, these FET-input devices will produce a better noise figure than the common high-performance bipolar op-amps.

In our final circuit, two TL074 quad op-amps have been used to produce the four DI stages. Four TL072 dual op-amps would accomplish the same result, but the larger IC allows a slightly neater PCB layout.

Circuit description

To avoid cluttering the schematic diagram, the circuitry of only one DI stage (DI1) is shown in detail, while the the other three stages (DI2 to DI4) are represented by function blocks — all four stages have identical circuitry, as you would expect. The remaining section at the bottom of the schematic shows the power supply, which converts the raw DC voltage from the plugpack into appropriate supply rails for the op-amps.

The DC input voltage at SK13 is applied directly to the power indicator LED1 via current limiting resistor R53, then to the remaining power supply circuitry via protection diode D1 — this prevents any current flow (and damage to components) if the plugpack is connected with a reversed polarity.

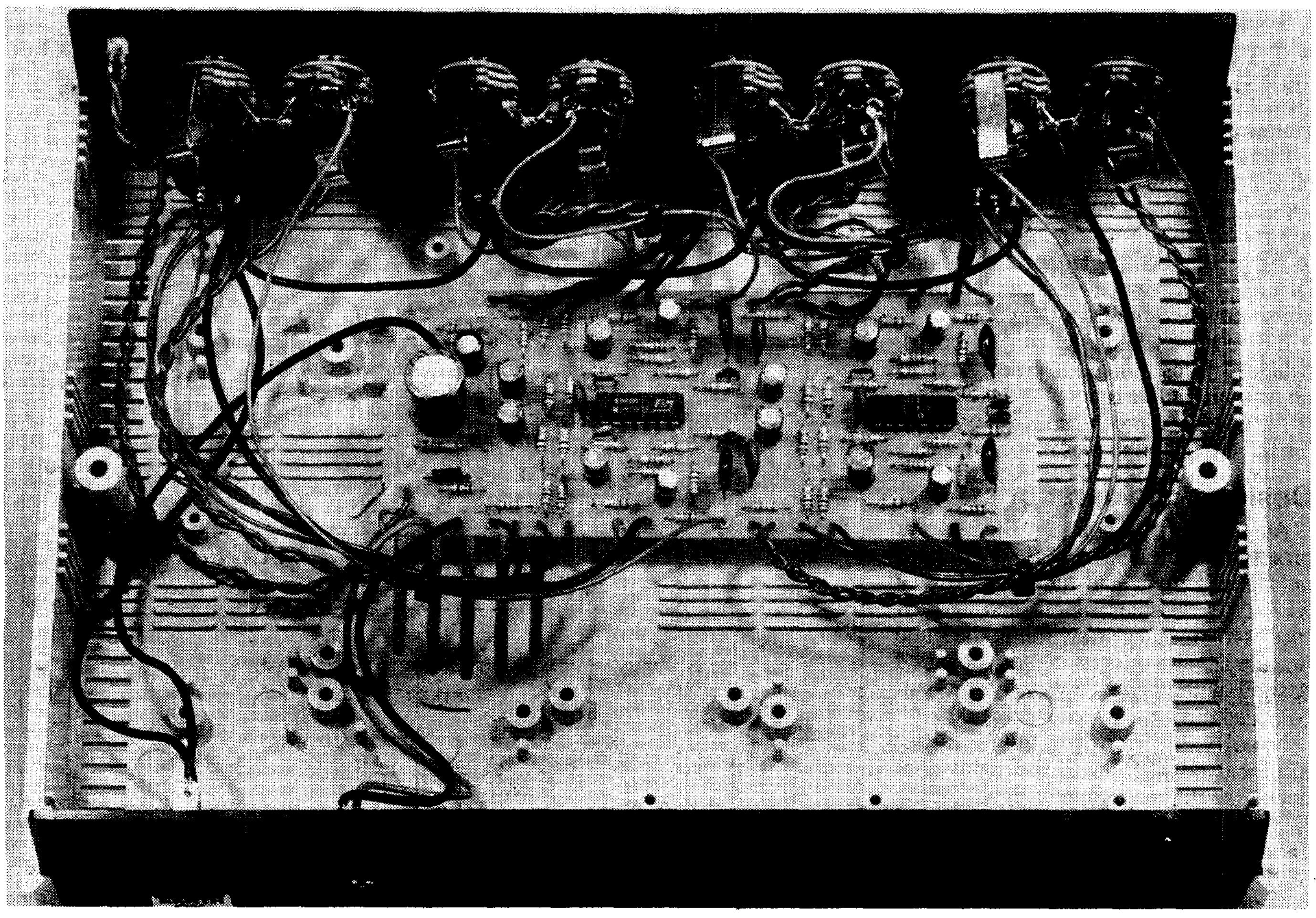
The resulting voltage is then filtered by R54 and C25, and passed to the voltage divider formed by R55 and R56. This generates an additional supply rail (Vref) of half the incoming voltage level, which is filtered by C26 and bypassed at higher frequencies by C27 and C28. The main supply rail (V+) is similarly bypassed by C29 and C30.

The DI's signal circuitry is also quite straightforward. The input signal at SK1 is applied to IC1a via coupling capacitor C1 and the low-pass filter formed by R2 and C2, which attenuates unwanted high frequency signals such as stray RF interference. The low-frequency cutoff point of the input stage is set to around 10Hz by the high-pass action of C1, R2 and R3.

IC1a is arranged as a non-inverting buffer stage (a gain of one) and offers an extremely high input resistance at pin 11, which allows the DI's input impedance to be set to about 420k by the combination of R3, R2 and R1. To bias the circuit at half of the supply rail (V+), R3 also couples Vref to the op-amp's non- inverting input (pin 12).

The output of the buffer stage is then sent to the unbalanced output (SK2), the in-phase connection of the balanced output (pin 3 of SK3), and a following inverting stage based around IC1b.

In this case, the inverter is set to unity gain by R4 and R5, biased to Vref again via R6, and has its upper frequency



An inside view of the completed unit. While the box may look too large for the circuit board, all of its front panel space is needed for the DI's various connectors and switches.

response limited to around 50kHz by C3.

The resulting signal is applied to the out-of-phase connection of the balanced output (pin 2 of SK3) via C5 and R8 — the output signal from IC1a is similarly passed to pin 3 of SK3 via C4 and R7.

Both C5 and C4 are bipolar electrolytics, since if phantom power is applied to the DI's balanced output (this would originate from the mixing desk), the capacitors will have a more positive potential on the leg facing SK3.

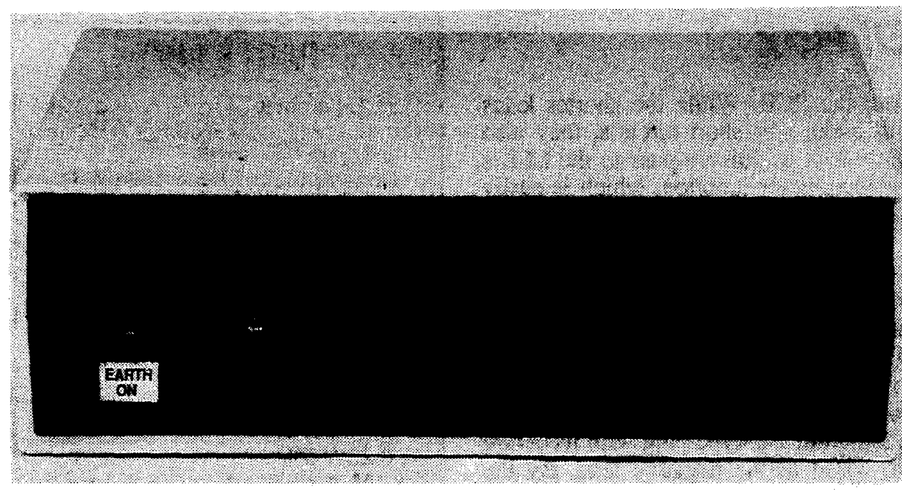
When phantom power is not present however, the op-amp side of the capacitors is more positive.

R7 and R8 serve to both limit the op-amp current in the event of a short circuit at SK3, and to provide output attenuation in conjunction with R11 via the 'pad' switch SW1. When this switch is closed, the balanced output is reduced by a factor of 10 (20dB) by the resulting voltage divider action.

As mentioned, the output from IC1a is also passed to the unbalanced output at SK2, providing a buffered version of the input signal with an output impedance set to around 600 ohms by R12. Again, C6 isolates the DC voltage present at the op-amp's output.

The input, output and two balanced outputs are referenced to 0V via R1, R13, R9 and R10 respectively.

If these resistors were not included, the various input/output capacitors (C1, C6, C4 and C5) would remain discharged until a device was plugged into the DI, where the charging action (via the device) would produce a sharp transient signal through the circuit — in short, the speakers would go 'bang'!



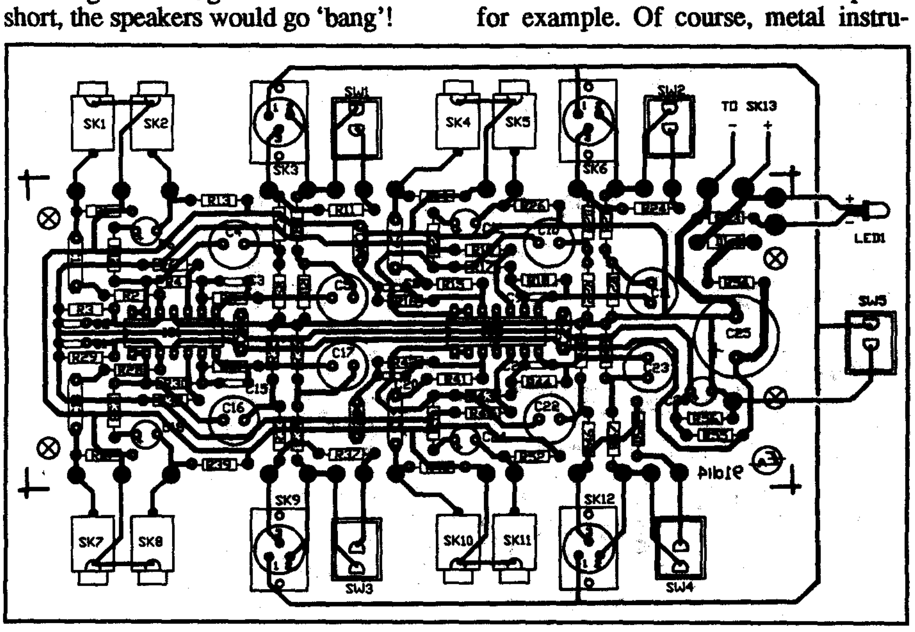
The rear panel holds the plugpack power connector, and an earth lifting switch for all four DI outputs.

The remaining circuit component SW5 acts as an output earth lift for all four DIs, by disconnecting pin 1 of SK3, SK6, SK9 and SK12 from the circuit's 0V common line.

As it happens, there is little point in disconnecting pin 1 of each DI output individually (by four separate switches), since all four channels will normally be interconnected at the mixing desk anyway — so lifting just one earth would have no effect.

Construction

While the plastic instrument case used in our prototype was quite suitable for the job, the box size and material is really not critical in this project. Some constructors may wish to save a few dollars by using a smaller case, and mounting the XLR connectors on the back panel for example. Of course, metal instrument and rack-mounting cases are ideal, but at a cost penalty — also, the metal panels are more difficult to work.



The component overlay: Carefully follow this diagram during construction, paying particular attention to the orientation of any polarised components.

Most of the DI's components fit onto one compact printed circuit board (PCB) coded 91di4 and measuring 58mm x 141mm. Before commencing construction, thoroughly check the PCB for any etching anomalies such as broken or shorted tracks, and ensure that all holes are drilled.

Then mount all of the lower profile components on the board, working through to the electrolytic capacitors. Pay special attention to the orientation of any polarised components, and refer to the overlay diagram at all times.

Next, attach appropriate lengths of hookup wire to each PCB pad for later connection to the various plugs, sockets and switches. If the PCB is to be mounted into a plastic box, the signal input/output leads should ideally be formed with shielded cable. In practice however, standard hookup wire is quite adequate since the DI outputs offer a low impedance, and most common input sources have a similarly low driving impedance (keyboards, drum machines, etc).

Then mount the connectors and switches into the front and rear panels, and secure the circuit board to the bottom of the case with PCB standoffs. Next, trim each connecting wire and solder the free end to its matching plug/socket/switch as shown in the overlay. When soldering wires to the XLR connector, tin each pin before making the connections — these solid pins tend to draw heat away from the soldering iron, and can easily lead to dry joints if they're not tinned in advance.

Also, if you trim the leads of the power LED, take care not to apply too much heat when attaching the wires from the PCB. While the shorter leads will avoid any short circuits, they also allow heat to quickly pass to the LED's semiconductor junction, which is easily damaged by excess heat.

The polarity of the DC input socket connections (SK13) will depend upon how the plugpack itself is wired. The most common type used in music applications (to power effects pedals and so on) has a nominal voltage of 9V (around 12V off-load), and is terminated in a 2.1mm DC-type plug with its centre pin wired to the negative lead. By the way, we found that the matching 2.1mm chassis-mount connector is best attached to the case with a little silicon sealant/adhesive.

While this type of plugpack and connector (2.1mm) is quite common, some constructors may have a particular plugpack in mind for use with the DI box — say, a 12V-rated unit with a 3.5mm plug wired centre-positive.

In this case, the matching 3.5mm socket can be installed in the rear panel and the power wiring changed to suit. However, it may pay to leave the 2.1mm connector (and wiring) in place for emergencies — plugpacks *have* been known to fail.

Also, for those that are really keen to save a few dollars, each 'pad' switch could be left out and its associated attenuator (that is, R11) wired permanently in-circuit. If the DI is to be used exclusively with high signal level devices (keyboards etc), this is quite an acceptable compromise.

That's about it for the construction procedure. But before using the DI box in a practical situation, it may pay to complete a couple of simple tests to confirm that the unit is functioning.

PARTS LIST

1 PCB 58mm x 141mm, coded 91di4
1 Instrument case, 280mm x 190mm x 80mm (see text)
4 Chassis-mount, male 3-pin XLR-type (Cannon) connectors, plastic or metal
8 6.5mm mono chassis-mount sockets
1 2.1mm enclosed chassis-mount DC jack (see text)
5 SPST miniature rocker switches, with indicator dot

Resistors

All 0.25W 5%:
4 x 1M, 4 x 680k, 12 x 100k, 4 x 47k, 2 x 12k, 8 x 4.7k, 4 x 2.2k, 1 x 1.5k, 8 x 1k, 4 x 560 ohms, 4 x 220 ohms, 1 x 68 ohms

Capacitors

4 22pF ceramics
4 680pF ceramics
4 10nF metallised polyester
4 22nF metallised polyester
4 4.7uF 16V PCB-mount electrolytics
1 10uF 16V PCB-mount electrolytic
8 10uF 50V PCB-mount bipolar electrolytics
1 1000uF 25V PCB-mount electrolytic

Semiconductors

2 TL074 quad op-amps
1 5mm LED
1 1N4002 diode

Miscellaneous

PCB standoffs, hookup wire, solder etc.

Testing, testing

Only a few basic checks are really necessary to establish that the circuit is ready for a trial run. First, connect the plugpack to the DI and apply power — the 'power on' LED should immediately illuminate. If not, check that the correct voltage polarity is being applied to the PCB, and that the LED itself is functional.

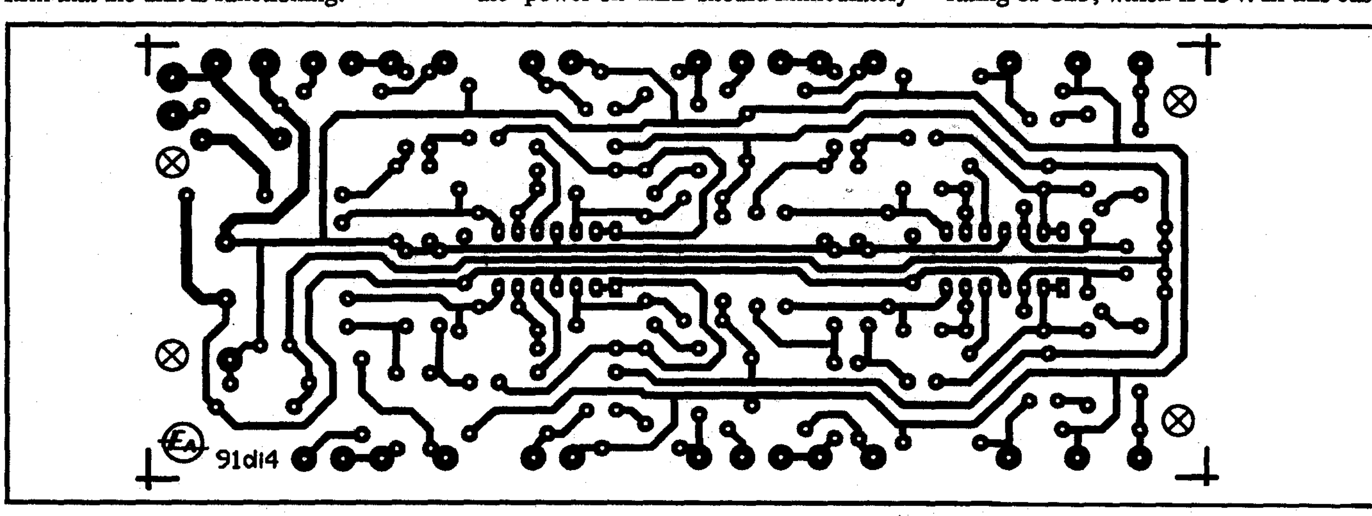
Next, check that the voltage level at the output of each op-amp is at half the voltage level of V+, or in fact measures the same as Vref. When reading this voltage, take particular care if you place the multimeter probes directly on the IC pins, since the tip can easily slip and short-out adjacent legs — this could electrically damage the IC. The best method is to apply the probe to the leg of a passive component that is connected to the op-amp output in question.

By the way, the voltage levels shown on the schematic diagram are for an input voltage of exactly 15V, and are only intended as a faultfinding guide. However, it's quite easy to calculate what these levels should be for your particular DC source — the important thing is that Vref (and the op-amp outputs) must measure close to half of the voltage at V+.

As also indicated in the schematic, an input voltage between 9 and 25 volts is acceptable to the DI's circuit. These two extremes are governed by the signal headroom and the power supply components respectively.

With a 9 volt supply, the op-amps will overload (reach output clipping) if the input signal rises to around 2V RMS or +8dBm, which is above the maximum output of virtually any musical instrument. However, supply voltages below this level should be avoided, since the risk of signal overload becomes appreciable — this type of overload sounds very unpleasant, and *may* cause loudspeaker damage.

At the other end of the scale, the maximum supply limit is set by the voltage rating of C25, which is 25V. In this case



An actual size copy of the PCB pattern.

the circuit can accept an input signal of at least +20dBm without overload, which as you would expect is more than adequate. While there is little point in increasing the source voltage beyond this point, the TL074 can in fact cope with a 36 volt supply rail (+/-18V). If circumstances dictate that such a high source voltage is used, C25 and C26 should be replaced by capacitors with suitable voltage ratings.

When it comes to testing the unit in a practical situation, first try connecting one of the DI stages in series with the signal path from the instrument to its associated amplifier/speaker system. That is, the instrument connects to the DI input, while the monitoring amplifier is driven by the DI's buffered output. If all is well, there will be no appreciable increase in distortion or background noise from the amplifier's speaker, indicating that the first stage of the DI is performing correctly.

Next, connect the balanced input of a mixing desk's channel to the DI's balanced output with standard microphone cable, and monitor the result. The signal at the desk end should also be clear and noise-free, while the DI's 'pad' switch should substantially reduce the received signal level.

If a significant hum is heard at this point, try disconnecting the common ground link between the instrument and the desk with the DI's 'earth lift' switch. If the hum persists, the plugpack may have a high level of mains ripple superimposed on its DC output; however in this case, the hum will also be present at the buffered output, and should be evident in the first (instrument to amplifier) test.

When the above tests have been completed on all four DI stages, the unit is ready for use. If your construction technique has been thorough, the project will provide years of high-quality and trouble-free service — without replacing any batteries... ■

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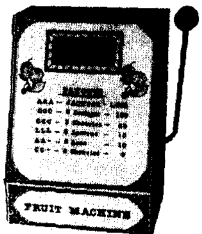

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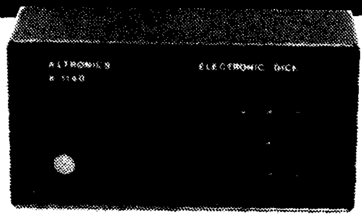

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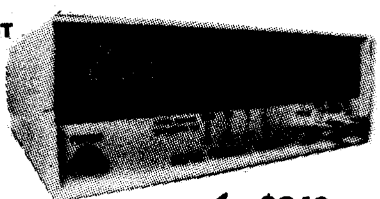

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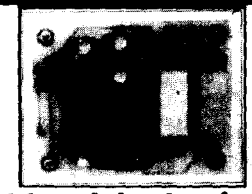

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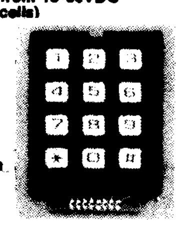
Four Digit Combination Lock

Operates from 10-30VDC (or 8xAA cells)



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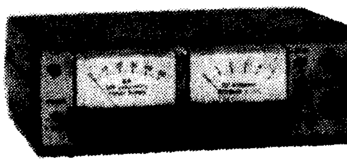

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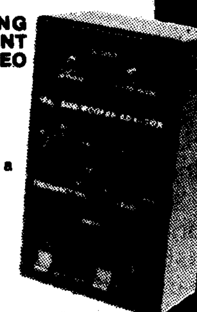

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Construction Project:

NEW CRO ADAPTOR FOR MONITORS - 3

We conclude the construction of our new video digital CRO adaptor by describing the final board and how everything connects together to give a complete unit.

by PETER PHILLIPS

The final stage of the project involves constructing the third printed circuit board, referred to as PCB3 (91TV3c), and then hooking everything together.

This board is the most complex of the lot, although its construction and adjustment are relatively straightforward. Naturally, the other two boards should be operational before building PCB3 as it relies on signals from the other boards.

The basic function of PCB3 is to convert the analog signal from the amplifier section of PCB2 to a digital signal, then store it in a 2K byte static RAM. The contents of the RAM are then read out and the digital signal is applied to PCB1 for subsequent display by the TV monitor.

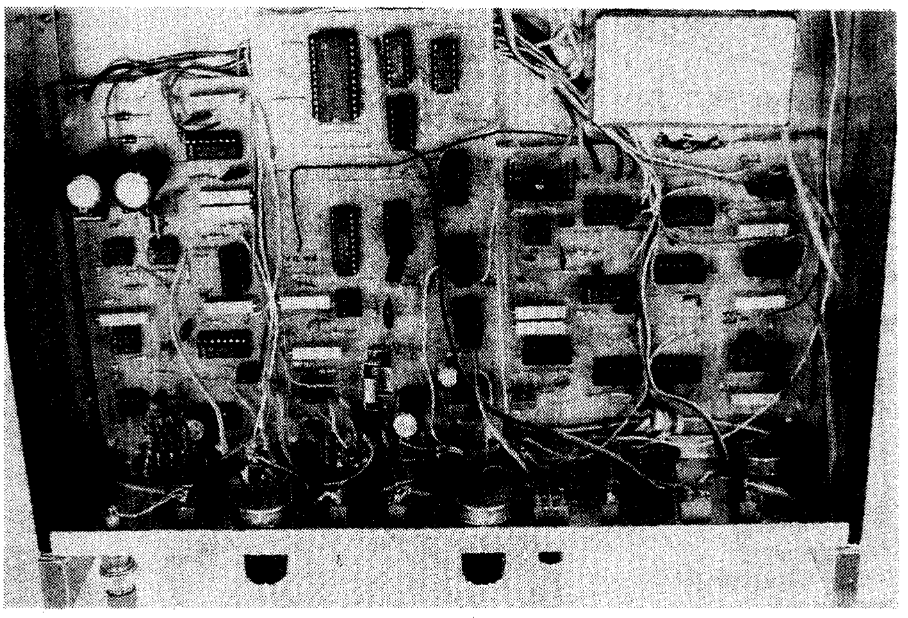
There are two basic cycles involved, called the *store* and *read* cycles. The unit can be set to 'auto' mode, in which the store cycle and read cycle continually repeat at a rate determined by a front panel control called 'update speed'.

The 'manual' mode causes one store cycle followed by continual read cycles. The store cycle is initiated with a pushbutton and the resultant display will remain unchanged until the next press of the button.

The board therefore contains an analog to digital converter and the circuitry to implement the store-read cycles.

As well, there is yet another section of the power supply contained on the board, including the rectifier that supplies 10V DC to PCB1.

To explain the operation of the board, we'll break it down into sections, starting with the method used to create the display.



The output signal

Starting with the output signal may seem an odd way to begin, but knowing how the display on the TV screen is produced is essential in understanding how the whole thing works.

As most readers will be aware, a monochrome TV display operates with three signals: those that produce the horizontal and vertical scan of the electron beam and a brightness signal (video) that intensifies the beam to produce illumination of the tube phosphor. To produce a shape on a TV screen requires all three signals to be synchronised, as they need to be repetitive for the display to remain stationary. To show a sinewave on the screen, a series of small dots (or pixels) have to be sequentially displayed on the screen, arranged over a number of horizontal scan lines. If only one cycle is being shown, the first horizontal scan line will have a single dot (top of the waveform) and subsequent lines will have two dots.

The centre scan line will have four dots and the last line a single dot. This is probably very obvious, but it leads into the explanation of how the A to D converter works and how the data output from the memory is used to create a display.

The memory IC used is an 8-bit x 2K static RAM arranged in a 128 by 128 matrix. That is, 128 pixels across by 128 lines vertically, giving a total of 16384 possible pixels (or 16K). This is achieved by reading 16 memory locations during each scan line. Because the system requires one bit (or pixel) at a time, the 8-bit byte read from the RAM needs to be converted into a serial form to allow each bit to be used

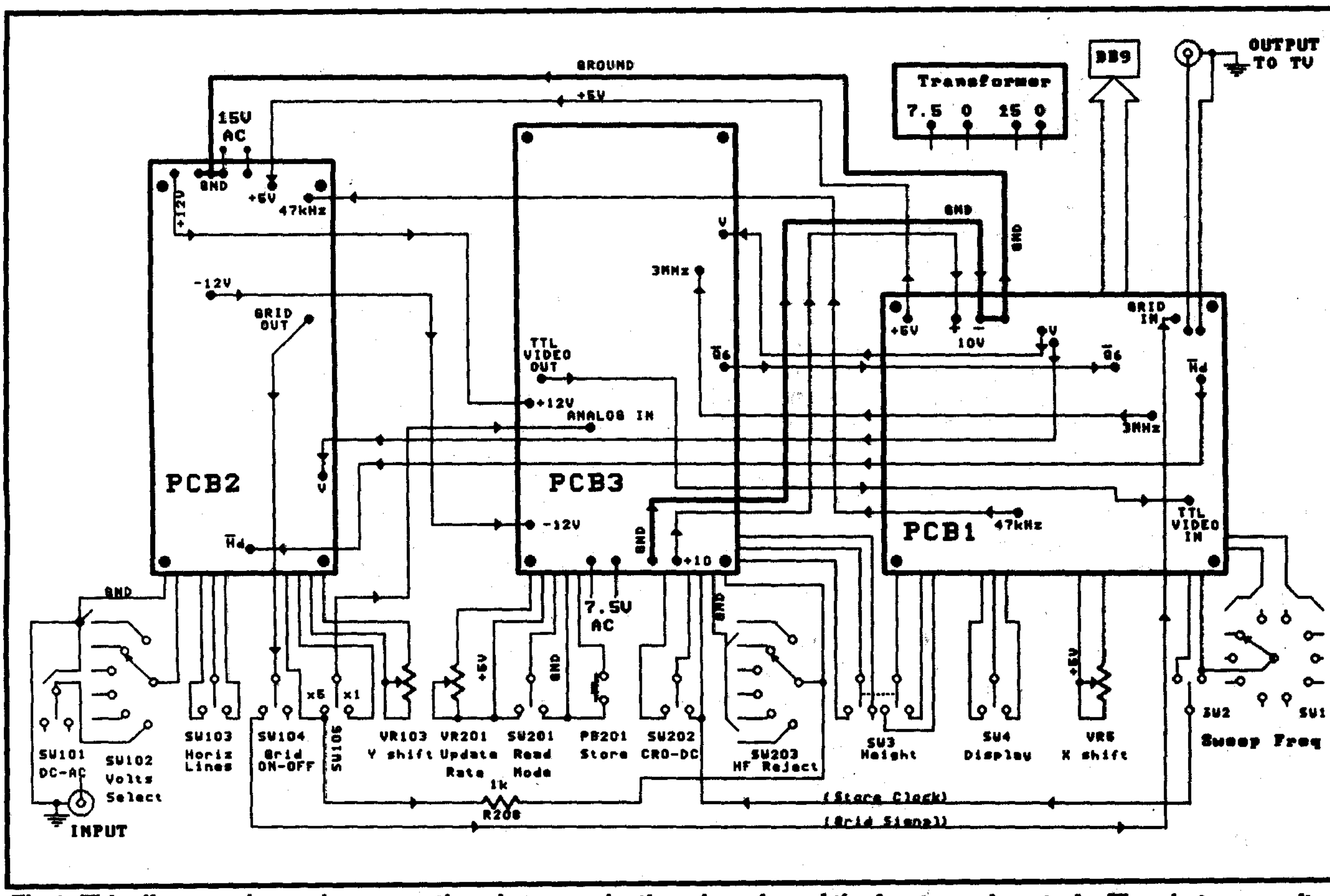


Fig.1: This diagram shows the connections between the three boards and the front panel controls. The photo opposite is a shot inside the case to help you sort everything out.

separately from the others. Thus, the first memory location contains a binary number that can produce up to eight dots (or pixels) at the left of the screen on the first scan line used by the display. As the beam moves across the screen, the next 15 locations are read, and the binary number converted to pixels for that line only.

The read frequency is 3MHz and to ensure the display is central to the screen and positioned to prevent horizontal overscan, the 3MHz signal is applied 64 lines after vertical retrace and then after a preset time following each horizontal retrace. Because there are 128 pixels across, the width of the display is 42.67us (reciprocal of 3MHz x 128). A pixel is therefore a dot having a duration of 42.67us/128, or around 0.7us. A scan line lasts for 64us, with

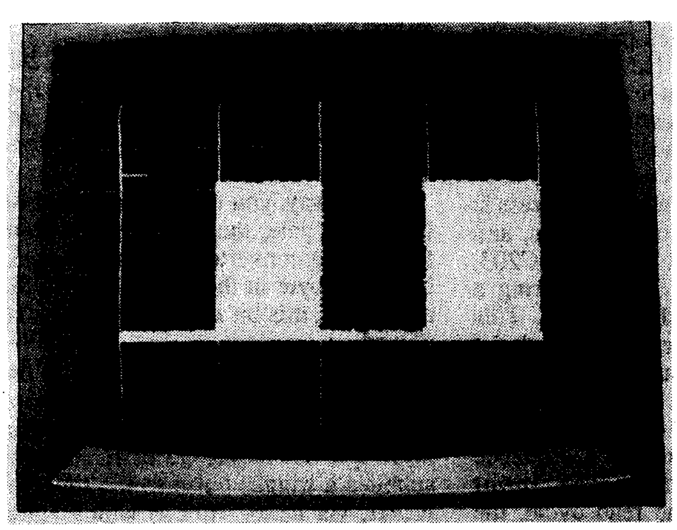


Fig.3: This shot shows a square wave being displayed in block mode.

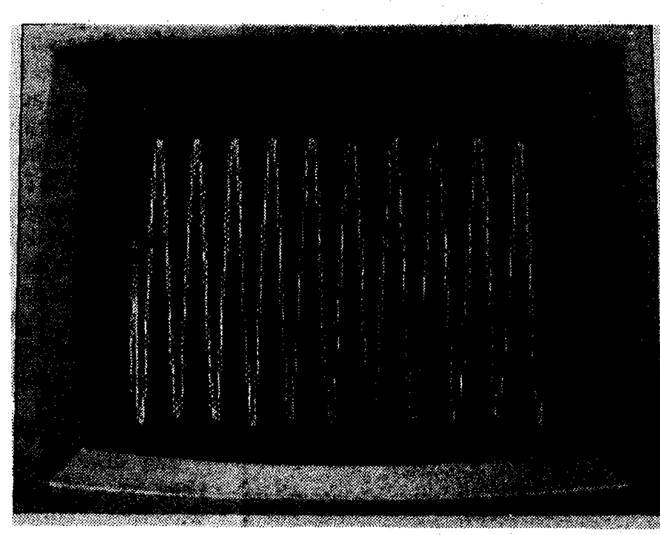


Fig.4: Here's proof the unit can show a 1MHz waveform. The ragged edges are a function of the resolution and digitising process.

CRO Adaptor

10 seconds (or so) for horizontal retrace leaving around 54us for the scan time. This leaves a gap of some 6us either side of the display, and a gap of 64 lines from the top of the screen and a further 60 or so at the bottom. Remember that this system uses 256 lines per frame and a frame rate of around 60Hz.

The important point to make is that a dot on the screen is positioned by two factors: the memory location containing the information, (gives vertical and horizontal positioning) and the bit within the location (gives horizontal positioning only).

PARTS LIST

Resistors

All 1/4W, 5% unless otherwise stated:

R201,202	4.7k
R203,207,208	1k
R204,206	2.2k
R205	12k
R209	10k
R210	2.7k
R211	1.5k

Variable resistors

VR201	47k linear, panel mount pot
VR202,203	10k 10-turn PCB mount trimpot

Capacitors

C201	100uF electrolytic
C202,217	100pF ceramic
C203	10nF polyester
C204,209,210,211,212,213	0.1uF monolithic
C205	0.1uF polyester
C206,207	10uF 25V tantalum
C208	1000uF 25V electrolytic
C214	0.1uF ceramic
C215	10nF ceramic
C216	1nF ceramic

Semiconductors

D201	1N4148 signal diode
BR201	WO-4 1A bridge
IC201	74LS123 dual timer
IC202	74LS257 quad multiplexer
IC203	74LS299 shift register
IC204	6116 2K static RAM
IC205	74LS27 triple NOR
IC206,207	74LS393 dual counter
IC208	74LS74 dual D flipflop
IC209	74LS00 quad NAND
IC210	DAC0800 8-bit DAC
IC211,213	[illegible] comparator
IC212	7805 5V voltage regulator

Switches

SW201,202	SPDT miniature toggle
SW203	6 pos, 2 pole rotary
PB201	pushbutton, N/O

Miscellaneous

PCB 90mm x 170mm coded [illegible]; two x 8 pin DIL IC sockets; five x 14 pin DIL IC sockets; three x 16 pin DIL IC sockets; 20 pin DIL IC socket; 24 pin DIL IC socket; 4 x nylon PCB supports; hook up wire.

The read circuit

The gated 3MHz signal from PCB1 is used to sequence the read cycle and is applied to pin 13 of IC202 on PCB3. This IC is a quad two-input multiplexer, which can be regarded as a 4-pole, 2-way switch. During a read cycle, IC202 connects the 3MHz signal to the clock inputs of IC203 and IC206. This latter IC is an 8- bit counter and in conjunction with IC207 is used to sequentially address the RAM (IC204).

You will notice that the first three bits of IC206 are connected to a 3-input NOR gate (IC205a), which in turn supplies a signal to IC203 via the multiplexer IC202. IC203 is an 8-bit universal shift register, controlled by pins 1 and 19. The sequence of events goes like this:

At the start of the first clock pulse, memory location 0 in the RAM is accessed and the 8-bit data byte from this location is stored in IC203. This occurs because all outputs from the counters are a logic 0, producing a logic 1 at the output of IC205a and therefore at pin 19 of IC203 (via IC202) giving the condition of parallel load for IC203. When the 3MHz signal produces a negative going transition, IC206 (counter) increments by one, setting pin 19 of IC203 to a logic 0.

On the next positive transition of the clock pulse, the data in IC203 is shifted right — appearing at output pin 17. This data is fed to PCB1 and subsequently to the TV monitor. The electron beam will now be at horizontal scan line 65, and a dot will result if the data is a logic 1.

After the eighth clock pulse, when all eight bits have been fed to PCB1, the next memory address is accessed and the data from this location is stored in IC203. Again the data is shifted out and applied to PCB1.

In summary, each memory address is accessed after eight clock pulses, and the 8-bit data is first stored in IC203, then read out in serial form during a cycle lasting eight clock cycles. This cycle will continue indefinitely if manual mode is selected by SW201.

The store cycle

The store cycle requires a sequence that is controlled by the input waveform. Unlike the read cycle, the clock signal for the store cycle has a frequency determined by the user, selected to give the required display. It is this feature that allows the converter to effectively display a wide range of frequencies, as the store frequency is set to suit the waveform and the 3MHz read frequency is correct for the TV display.

The sequence is started by a reset pulse from IC201, a dual timer that also sets the sequencing rate when SW201 is set to auto mode. This pulse resets IC208a, a flipflop with its Q output connected to the write input of the RAM and the select line of the multiplexer IC202.

As a result, the clock signal is now switched to the sweep frequency selected on the front panel and the RAM is set to WRITE mode.

The analog input signal is applied to the comparator of IC213, which produces the trigger signal, connected via SW202 to IC209d. This signal will set the gating circuit of IC208a and IC209 and allow the store frequency (via IC209c) to be applied to counter IC206 and the shift register IC203.

The sequence of events is similar to the read cycle, in which the serial data from the A to D converter is applied to the serial input of the shift register IC203.

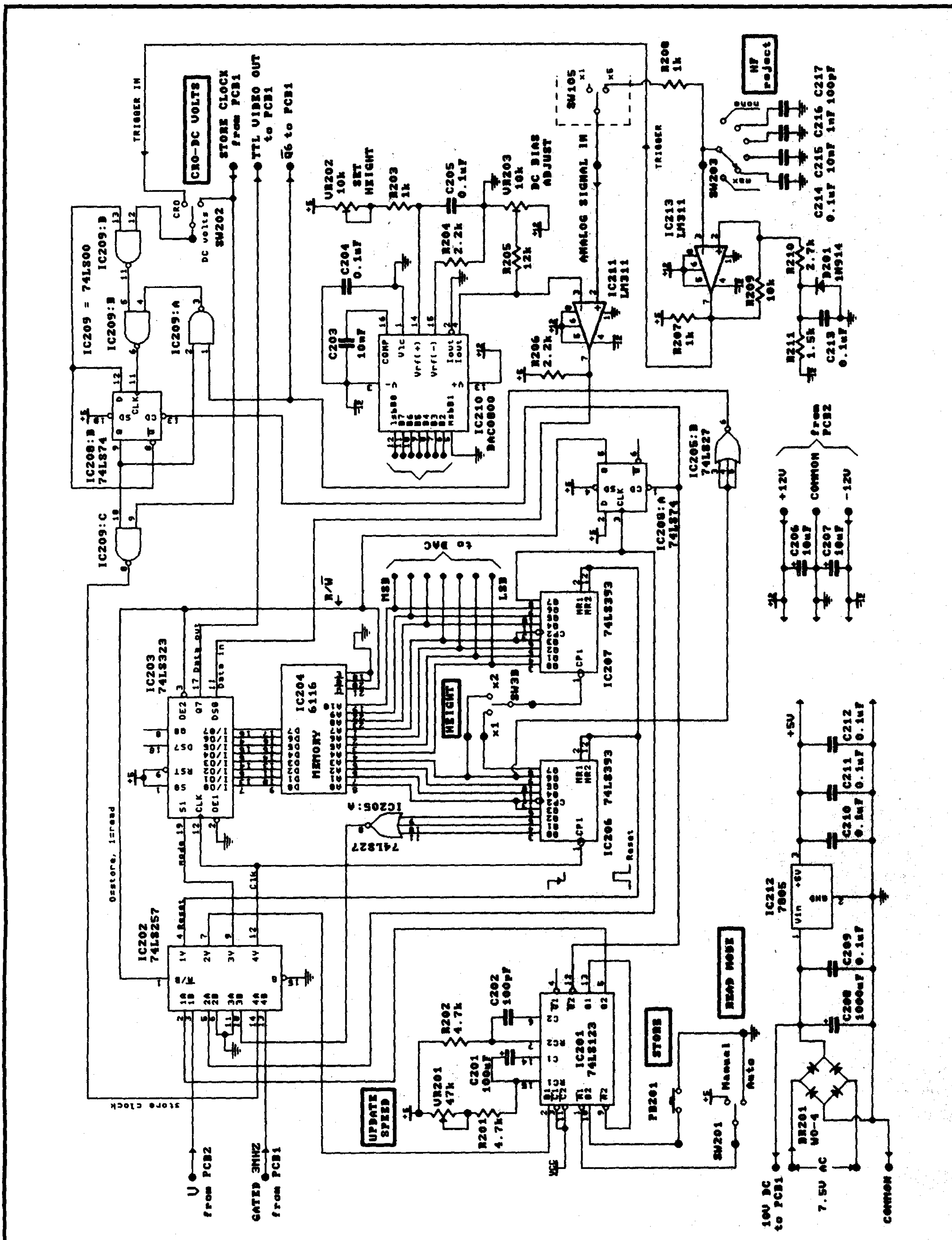
On the eighth clock cycle, the data in the shift register is stored in the selected RAM location. The next eight clock cycles store the serial data in IC203 for subsequent storage in the next RAM location. This continues until 16 locations in the RAM have been accessed, requiring 128 cycles of the store signal.

The cycle is then interrupted by output Q6 of IC206 (pin 9), which is inverted by IC205b then connected to the clock input of IC208b via gates IC209a and b.

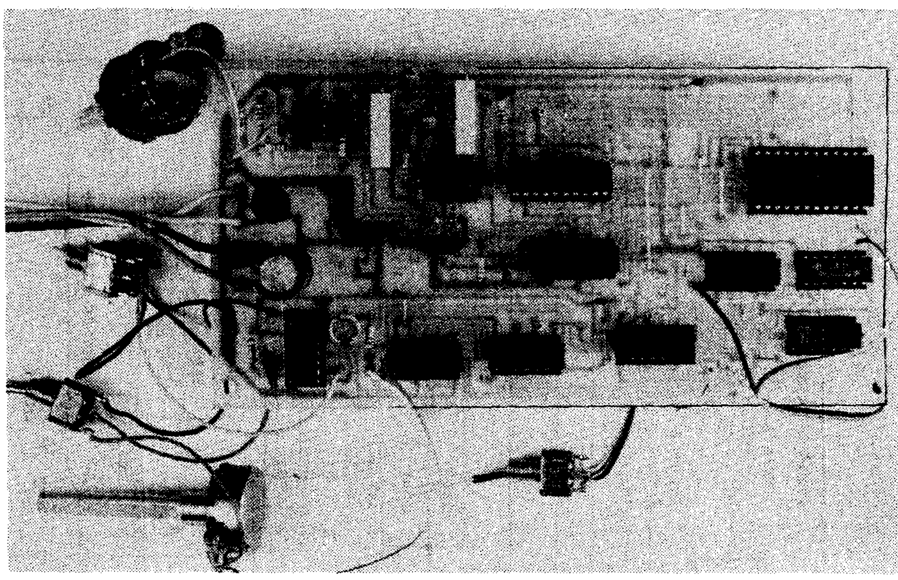
Another trigger pulse from IC213 will cause the cycle to resume, in which the next 16 addresses are sequentially accessed and a data byte written to each one.

By the way, you might notice that on the store cycle, the first data bit from the A to D converter becomes the last bit of the byte in the RAM, and on the read cycle, this bit is the first to be displayed.

There are therefore 128 'scans' of the waveform, and the store sequence stops when Q7 of IC207 sets pin 5 of IC208a to a logic 1. Output Q7 of IC207 also supplies a trigger pulse to the timer of IC201, via IC202 (pin 7) which starts the read cycle. If auto mode is selected by SW201, the store sequence will be entered after the timer has elapsed as a



The circuit of PCB3 includes an A to D converter and the logic to operate the 2K static RAM. There are two cycles: 'read' in which the waveform is read out and displayed and 'store' when the waveform is stored in memory.



result of the feedback between pins 13 and 9 of IC201.

The A to D converter

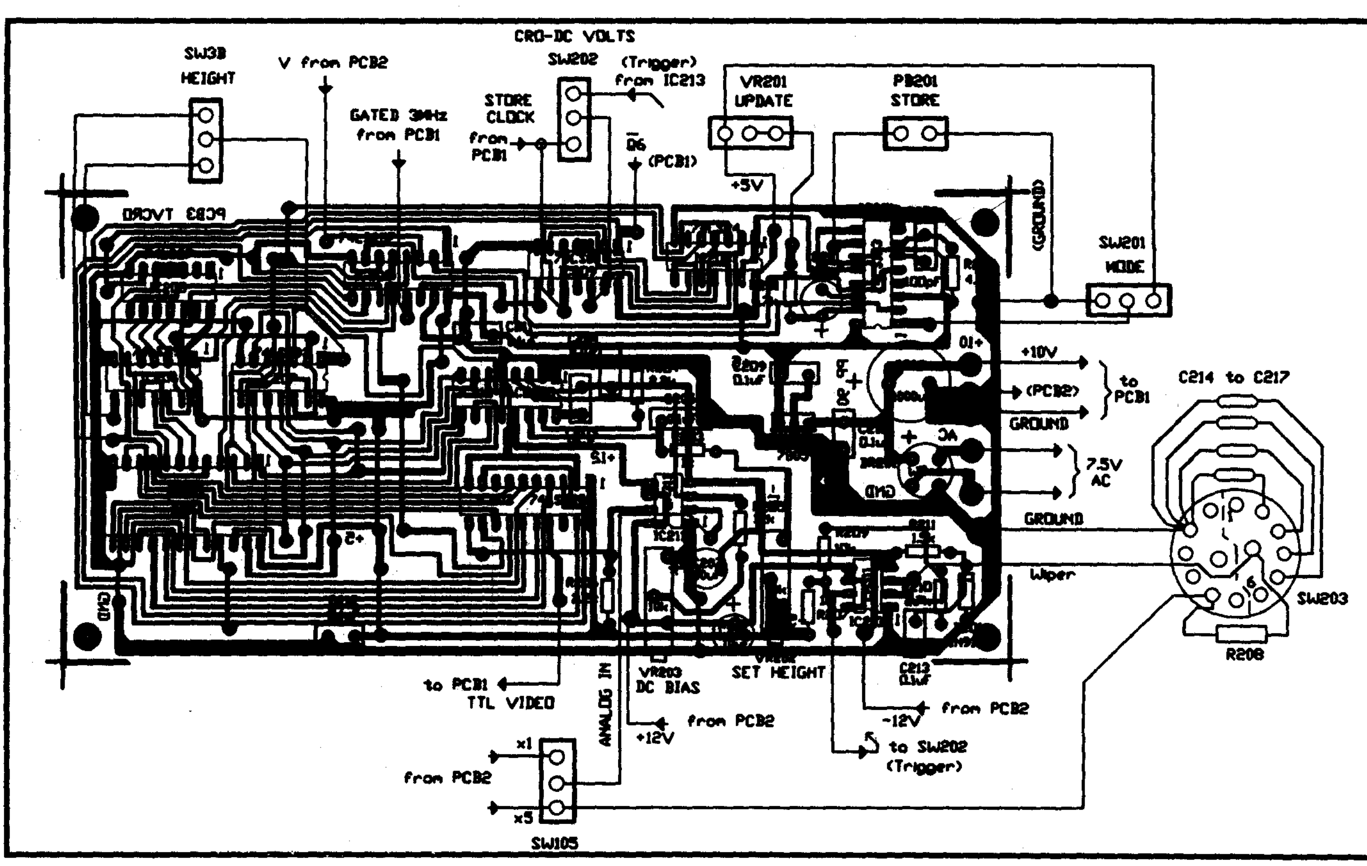
By now you can see that there are 128 *discrete* levels available. The A to D converter is a model of simplicity, consisting of the comparator formed by IC211 and the DAC0800 of IC210, driven by the counter of IC207. The DAC has the task of providing 128 different levels of voltage to one input of the comparator, while the analog signal is applied to the other input.

When the store cycle is started, the output of the DAC will be a maximum (around +2.5V), as all binary inputs are a logic 0 and the output of the comparator will be a logic 1 for signal levels greater than the output of the DAC.

In most cases, the output of the comparator will be a zero, as the first part of the read cycle represents a scan of the top of the waveform. The output of the comparator connects to the serial input of shift register IC203, for storage as already described.

After the first line (16 memory locations), and after the next trigger pulse, the counter of IC207 increments by one. This sets the output of the DAC to its next level down, and now all analog input voltages higher than this new level are stored as a logic 1.

This sequence continues for a total of 128 times, and on the last line, the output of the comparator will nearly always be a logic 1 as this represents the bottom of the waveform. The result is that the RAM contains a logic 1 for all analog inputs greater than the reference from the DAC. Otherwise a logic 0 is stored. If this data was supplied directly to the video display, the result would be a waveform with its enclosed area filled in. However, as already explained in Part 1, an outline of the



There are quite a few links in the layout, and these are best fitted after the IC sockets have been mounted. This helps locate each link. Take care when soldering as some of the tracks and solder points are quite small. The photo above shows how PCB3 looks after assembly, although the resistor next to IC211 has now been moved off the board (R208).

waveform is produced by timers on PCB1.

Some details

The comparator used to produce the trigger pulse during the store sequence performs a very important task. Because the input waveform is scanned 128 times, it is essential that the scanning commence at exactly the same time relative to the waveform. Otherwise the waveform will appear jagged or even totally lost.

To minimise false triggering, a Schmitt action is produced by the network comprising R209, 10 and 11, diode D201 and capacitor C213. This gives around 0.5V of hysteresis to the comparator. Incidentally, this circuit was posed as the November 1990 What?? question (Information Centre) and a description given in *EA* for December 1990.

To allow the unit to display a DC value, SW202 is used to connect to either the output of IC213 (for AC signals) or to the sweep frequency.

This is necessary as a DC signal cannot produce a trigger output from IC213 and the circuit needs some form of triggering to operate. The sweep signal frequency is unimportant, although very low frequency signals will cause a longer store cycle.

A feature that has not been described is the facility provided by SW3. This switch connects to both PCB1 and PCB3, and selects a display that occupies either 128 scan lines (as already described) or all 256 lines.

When set to the x2 position, the data output from the RAM is read twice. That is, each two adjacent scanning lines have the same information, giving a display exactly twice the height compared to the x1 setting. There is a possibility of overscan, as some of the horizontal scan lines are lost during vertical retrace.

This works by selecting, via SW3B, the output from the first address counter (IC206) that clocks the second (IC207). The gating of the 3MHz clock signal needs to be altered as well, which is achieved by SW3 on PCB1.

The only adjustments on this PCB are those for the DAC0800, in which VR202 sets the maximum level of the DAC output and VR203 adjusts its output relative to zero. These adjustments are described later on.

I've purposely refrained from giving detailed descriptions of all the gating circuits and all the components, as this would lengthen the article into tome-like proportions and probably confuse everyone anyway.

Unless something goes drastically wrong, the board will operate correctly and an intimate knowledge of the innermost workings is therefore unnecessary. Also, a bit of analysis will quickly show what is happening now that the main sequence has been described.

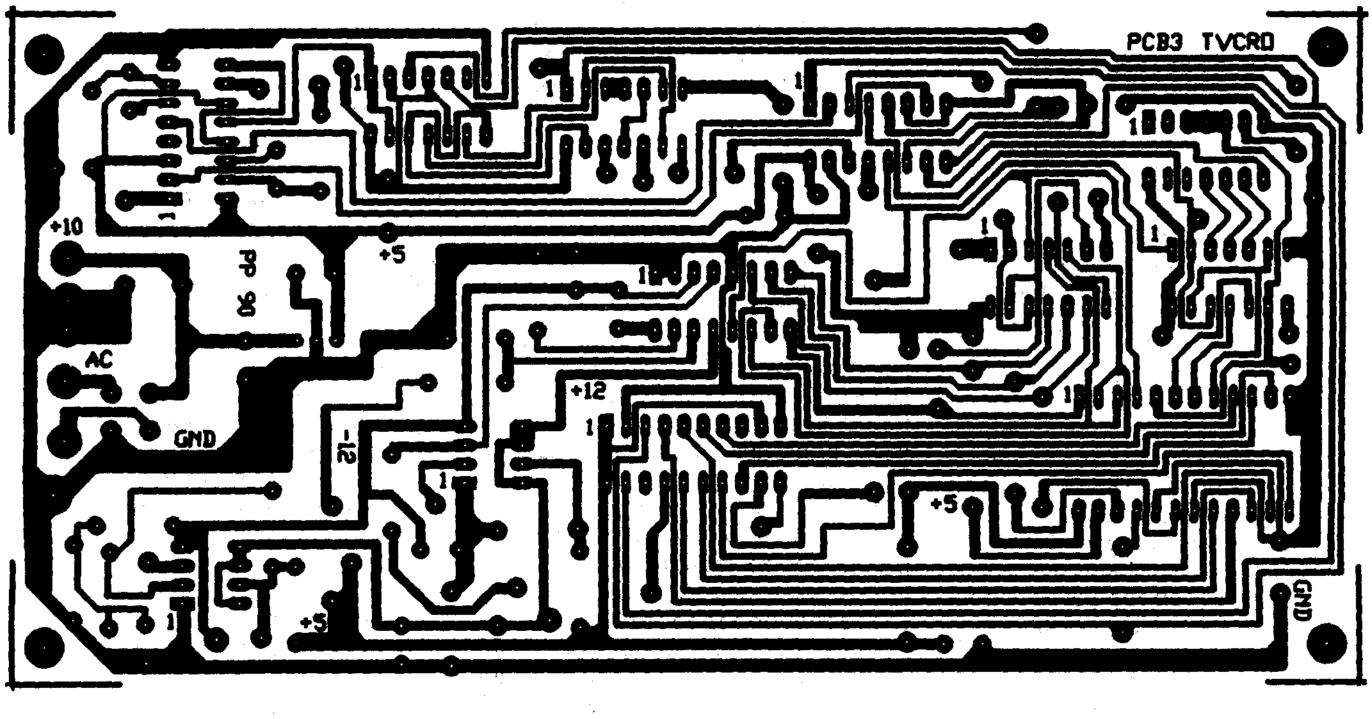
Construction

Construction of PCB3 requires more care than the previous two, due to the increased complexity of the board. Because I've opted for single sided boards, there are quite a few links due to the largely digital content of PCB3. Also many of the tracks pass between IC pins, and most of the tracks are relatively thin. For this reason, you will need a fine-tipped soldering iron and thin solder to avoid accidental solder bridges between tracks. A magnifying glass will be useful, such as those supported with a head band. This way things appear large enough to make mistakes very obvious. So with care, construction should not be a problem.

The order of construction is not important, but it may be easiest to fit the IC sockets first. If you are game enough to solder the ICs directly, then fit some of these first. Fitting the sockets (or ICs) first will make it more obvious where the links go.

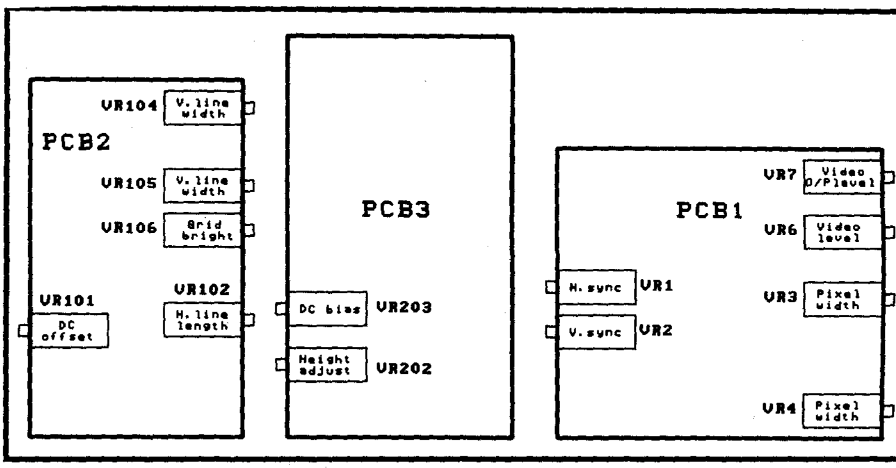
The links can be made from tinned copper wire, but where several links are placed close together, use insulated wire to prevent the links from shorting to each other.

When all the links are in place, continue with the remaining components. Note the polarity of the electrolytics,



The PCB pattern of PCB3. Like all circuit diagrams and PCB designs in this project, this pattern was developed using Protel (Autotrax for boards — Schematic for circuits.)

CRO Adaptor



The function and component number of each potentiometer are shown in this diagram to help when you are finalising all the adjustments.

the diode and WO-4 bridge rectifier. Also make sure you fit the regulator IC correctly. A small heatsink is required for the regulator.

There are four switches, a pushbutton and one variable resistor connected to the board, and the wire lengths should be sufficient so these components can mount on the front panel with the PCB located some 10mm from the panel. Capacitors C214 to C217 mount on the wafer switch (SW203), and to conform with the front panel design, the first and last switch positions are open circuit.

Use a spare lug on the switch as the ground point. Resistor R208 also mounts on this switch, from the common of the switch to a spare lug, then via wiring to SW105 from PCB2.

The power leads for the 7.5V AC input from the transformer and the 10V output to PCB1 can run under the PCB when it is mounted in the case, and 1 amp hookup wire should be used.

At this stage it may be useful to lay all three boards on the workbench as shown in Fig.1. This diagram shows all the interconnections that are required and when the boards are laid together you can judge the lengths of the power wiring. However don't start the interconnecting until PCB3 has at least been powered up and the 5V regulator section checked.

Getting it all going

To test the board, connect the 7.5V AC supply from the transformer. If you are using the recommended transformer (type 6672 - configured as described in Part 2), obtain the 7.5V from the 20V and 27.5V tappings.

When power is applied, 5V should be present at the power terminals of the ICs and around 10V DC should be measured at the leads that power the 5V regulator on PCB1. If all is well, plug in the ICs and commence wiring all the boards together.

The diagram of Fig.1 should help in the wiring, although the exact location of each point on the three boards will have to be obtained from the layout diagrams. It will help to label the various points on the boards with a felt-tip pen. Connect all the power wiring first: that is the wiring to the transformer and the various supply lines between the three boards. PCB1 has its own 5V regulator and requires 10V DC from PCB3. The 5V supply for PCB2 comes from PCB1, and 15V AC is required by PCB2 for the +/-12V regulators.

PCB3 also has a 5V regulator and requires 7.5V AC from the transformer. The +/-12V rails for PCB3 are supplied by PCB2. All wiring should be with 1 amp hookup wire, except the +/-12V supply to PCB3, which can be with leftover wire from the ribbon cable. The next stage is to tidy up the wiring between PCB1 and PCB2 and to perform any minor readjustments that may be necessary.

The procedure for testing and adjusting these boards was described in parts 1 and 2, and it is essential that these be operational before trying out PCB3. Confirm that the calibrated grid can be displayed, and trim the various adjustments for the grid. The diagram of Fig.2 will help identify each adjustment. Also check that a rectangular block is shown on the screen when there is no connection to the point marked 'TTL video in' (PCB1), when the display is set to 'block'.

From here on, it's relatively simple (hopefully). Although VR202 and 203 need to be set, the whole unit should now be operational.

Apply a 1kHz sinewave, with an amplitude of 0.8V to the input of the adapter. Set the V/DIV switch to 0.2V, (on x1 magnification) select AC input, RUN mode and the trigger input to SIGNAL.

Also select 0 on the HF REJECT switch and set the TIME/DIV switch to 0.34ms (on x1 mode). Check that the grid is positioned as far up the screen as possible (Y SHIFT control) and see what happens. If all is well, you should see a sinewave on the screen, although it may be clipped due to VR202 or 203 being out of adjustment.

If nothing happens, even though PCB1 and 2 check out as already described, then obviously PCB3 has a problem. As a first check, use a conventional 'scope to examine the signals at pins 2 and 3 of IC211. For the signal input given, there should be a 5V p-p sinewave at pin 2 and a negative going ramp (from the DAC) at pin 3. This latter signal, after adjustment will also be 5V p-p, centrally disposed around 0V. Faultfinding this board is largely a matter of checking connections and ICs, as despite its complexity, there is not a lot to go wrong if the board is wired correctly.

The adjustments

To set VR202 and VR203, switch the grid signal to display HALF grid (three horizontal lines) and apply the signal as previously described (0.8V p-p). The two adjustments interact, and the correct setting will give a sinewave that reaches the top and bottom lines of the grid. These two adjustments effectively calibrate the vertical amplifier.

From now on, it's a matter of testing all the functions and getting used to using the adapter. For example, a square wave is probably best seen in BLOCK mode as shown in Fig.3 as the top and bottom lines of the waveform will be invisible in trace mode. A 1MHz sinewave is shown in the photo of Fig.4, captured using SINGLE mode. The outline of the waveform may be slightly jagged (as in Fig.4) due to a +/- 1-bit error in the digitising process. Selecting a suitable HF reject on the trigger input can minimise this, but don't try and obtain total perfection, as the unit isn't that good.

So there it is, a project with a difference and one that should prove very useful in any electronic workshop or laboratory. ■

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30 SOLDERLESS BREADBOARD PROJECTS - BOOK 2
BP113 **$6.50**
This book describes a variety of projects that can be built on plug -in breadboards using CMOS logic IC's. Each project contains a schematic, part list and operantional notes.

POPULAR ELECTRONIC PROJECTS
BP49 **$9.50**
Provides a collection of the most popular types of circuits and projects covering a very wide range of interests, including Radio, Audio, Household and Test Equipment projects.

HOW TO USE OP-AMPS
BP88 **$11.00**
This book has been written as a designer's guide covering many operational amplifiers, serving both as a source book of circuits and a reference book for design calculations. The approach has been made as non-mathematical as possible and it is hoped, easily understandable by most readers, be they engineers or hobbyists.

IC 555 PROJECTS
BP44 **$9.50**
Every so often a device appears that is so useful that one wonders how life went on without it. The 555 timer is such a device. Included in this book are basic and general circuits, motorcar and model railway circuits, alarms and noise-makers as well as a section on the 556, 558 and 559 timers.

SIMPLE LED CIRCUITS
BP42 **$6.00**
Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components - the light-emitting diode (LED). Also includes circuits for the 707 common anode display.

50 SIMPLE LED CIRCUITS - BOOK 2
BP87 **$6.00**
A further range of uses for the simple LED which complements those shown in book number BP42.

50 PROJECTS USING RELAYS, SCRs AND TRIACs
BP37 **$8.50**
Relays, silicon controlled rectifiers (SCR's) and bi-directional triodes (TRIAC's) have a wide range of applications in electronics. This book gives tried and practical working circuits which should present the minimum of difficulty for the enthusiast to construct.

MINI-MATRIX BOARD PROJECTS
BP99 **$6.50**
This book provides a selection of 20 useful and interesting circuits, all of which can be built on a mini-matrix board just 24 holes by 10 copper strips in size.

REMOTE CONTROL HANDBOOK
BP240 **$13.00**
Replaces our original book DP73 and is aimed at the electronics enthusiast who wishes to experiment with remote control in its many aspects and forms.

MODEL RAILWAY PROJECTS
BP95 **$8.50**
Provides a number of useful but reasonably simple projects for the model railway enthusiast to build. The projects covered include such things as controllers, signal and sound effects units, and to help simplify construction, stripboard layouts are provided for each project.

ELECTRONIC PROJECTS FOR CARS AND BOATS
BP94 **$9.50**
Describes fifteen fairly simple projects for use with a car and/or boat. Each project has an explanation of how the circuit works as well as constructional details including a stripboard layout.

POWER SUPPLY PROJECTS
BP92 **$6.00**
Mains power supplies are an essential part of many electronic projects. This book gives a number of power supply designs, including simple unstabilised types, fixed voltage regulated types, and variable-voltage stabilised designs, the latter being primarily intended for use as bench supplies for the electronics workshop. The designs provided are all low-voltage types for semiconductor circuits.

ELECTRONIC SECURITY DEVICES
BP56 **$9.50**
This book, besides including both simple and more sophisticated burglar alarm circuits using light, infra-red and ultra-sonics, also includes many other types of circuit as well, such as gas and smoke detectors, flood alarms, doorphone and baby alarms, etc.

PRACTICAL ELECTRONIC BUILDING BLOCKS-Book 1
BP117 **$8.50**

PRACTICAL ELECTRONIC BUILDING BLOCKS-Book 2
BP118 **$8.50**
These books are designed to aid electronic enthusiasts who like to experiment with circuits and produce their own projects. The circuits for a number of building blocks are included in each book, and component values and type numbers are provided in each case. Where relevant, details of how to change the parameters of each circuit (voltage gain of amplifiers, cut-off frequencies of filters, etc.) are given so that they can be easily modified to suit individual requirements. No difficult mathematics is involved.

HOW TO DESIGN ELECTRONIC PROJECTS
BP127 **$9.00**
The aim of this book is to help the reader to put together projects from standard building blocks with a minimum of trial and error, but without resorting to any advanced mathematics. Hints on designing circuit blocks to meet your special requirements where no "stock" design is available are also provided.

HOW TO DESIGN AND MAKE YOUR OWN PCBs
BP121 **$6.50**
Chapter 1 deals with the simple methods of copying printed circuit board designs from magazines and books and covers all aspects of simple PCB construction as comprehensively as possible.
Chapter 2 covers photographic methods of producing PCB's and Chapter 3 deals with most aspects of designing your own printed circuit board layouts.

S.W., AMATEUR RADIO & COMMUNICATIONS

COMMUNICATION (Elements of Electronics-Book 5)
BP89 **$11.00**
A look at the electronic fundamentals over the whole of the communication scene. This book aims to teach the important elements of each branch of the subject in a style as interesting and practical as possible.

INTERNATIONAL RADIO STATIONS GUIDE
BP255 **$16.00**
Totally revised and rewritten to replace the previous edition (BP155), this book contains considerably more information which is now divided into thirteen sections including: Listening to SW Radio, ITU Country Codes, Worldwide SW Stations, European, Middle East & N. African LW Stations, European, Near East & N. African MW Stations, Canadian MW Stations, USA MW Stations, Broadcasts in English, Programmes for DXer's & SW Listener, UK FM Station, Time Differences from GMT, Abbreviations, Wavelength/Frequency Conversion

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Mini Construction Project:

POWER SUPPLY TO REPLACE PLUG PACKS

Many small electronic and electrical appliances are powered from 'plug-pack' supplies. This certainly makes them safe, by keeping 240V out of the appliance itself — but plug-pack supplies also have their disadvantages (like the space they need on power outlets, and the strain of supporting their weight). Here's a flexible, easy to build supply module that can be used to replace a plug pack, and is small enough to fit inside the case of many appliances.

by JIM LAWLER

I think there's a conspiracy going on in the appliance market!

Have you noticed that more and more small appliances are powered by plug-pack supplies? Not even this magazine is uncorrupted — many small projects run off the ubiquitous plug-pack.

Another thing, too! Have you noticed that most plug-packs are just wide enough to prevent two of them being plugged into a standard twin outlet? And they're also just so wide that with one in a twin socket, the other outlet is unavailable to even the smallest appliance plug!

They also have an irritating tendency to slowly unplug themselves from a wall-mounted power outlet, because of their weight.

Well, recently I rebelled. Many of my plug-pack powered units had room inside their cases for a small DC power supply, so I decided to design a universal supply module PCB that could replace all those *!@#% plug-packs. The little supply described here is the result.

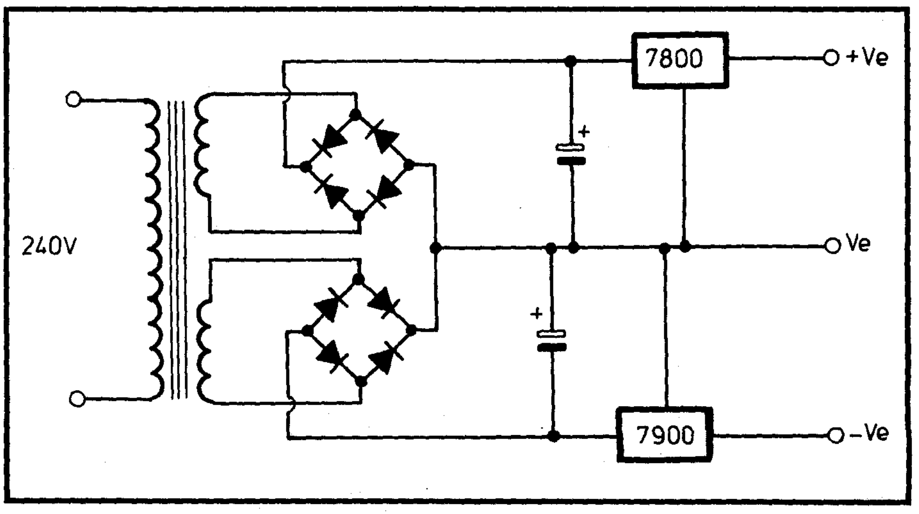
To begin with, I looked around for a suitable power transformer. I chose the Arlec 7VA range because it's designed for PCB mounting, it's available in a wide range of voltages, and its split secondary allows for variations in output and current rating.

I ordered one of these to use as a template for the PCB, and when it arrived I found it was not the one I expected. In fact, Arlec markets *two* kinds of 7VA transformer.

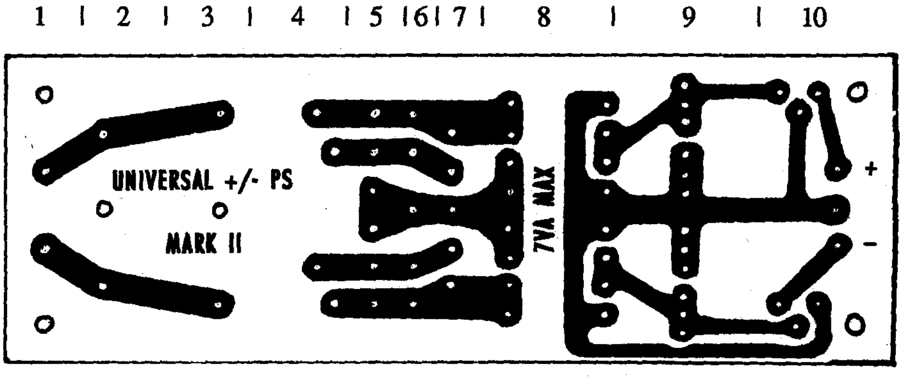
The 75000 series measures 35 x 35 x 40mm overall, while the AL7VA series measures 35 x 35 x 50mm. The smaller unit is labelled 'PCB Transformer' while the latter, also a PCB mounting type, is called the 'Low Profile' series. There is nothing to pick between them, so my small power supply is designed to take either.

The transformer voltage ratings are taken with the split secondaries con — nected in series. Thus, a 24V transformer actually has two independent 12V windings.

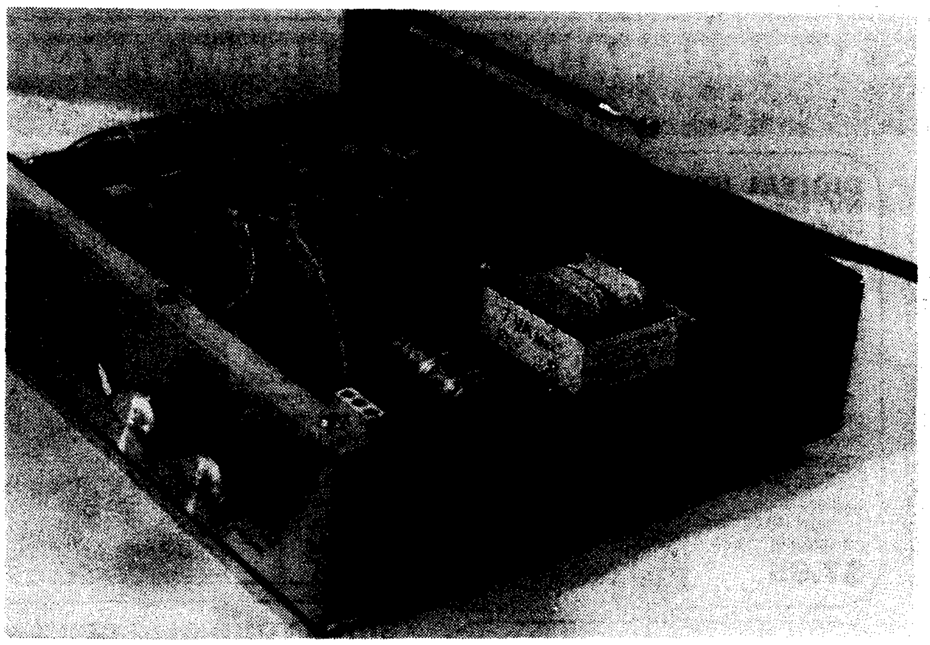
This allows the windings to be connected either in series for the full volt-



The basic circuit configuration assumed by the author for the power supply. However, his PCB pattern also allows for other configurations if desired.



The author's PCB etching pattern, reproduced here actual size. The zones identified by numbers along the top are referred to in the text; the pattern is designed to allow considerable flexibility in terms of components.



This photo shows a MkI version of the universal power supply board fitted into the case of a wireless microphone receiver.

age, or in parallel for half the voltage but twice the current.

My PCB allows for these alternative connections, as well as for a centre-tapped full voltage output — or a commoned plus and minus supply.

The transformer output is led to a series of pads, which provide for two full-wave bridge rectifiers. These are intended for plus and minus supplies, but could provide two positive rails if the second regulator has its legs bent to fit the 'negative' regulator's spot on the board.

Provision is made on the board to fit filter capacitors up to about 1500uF. I chose to use 1000uF caps, but still found half a dozen different sizes of package. Hence the range of holes at this spot on the board.

Finally, I used 7800 (+) and 7900 (-) three-terminal regulators to control the output. Unfortunately, pinouts for these two types are different, which accounts for the note above about bending the legs of the regulator for a twin positive output.

Access to and from the board is via PCB mounting screwdown connectors. Both are three-section connectors, but the one at the 240V end has its centre contact missing.

The overall size of the power supply is just 40 x 40 x 115mm and is very little bigger than a 300mA plugpack. It's a whole lot smaller than TWO 300mA plugpacks, where plus and minus or two positive supplies are needed!

To use this universal board for, say, a +/- 5V supply, you will need either an AL7VA/10 or 75010 transformer, eight small power diodes, two 1000uF/10VW electros and one each 7805 and 7905 three-terminal regulators. The two secondaries should be joined at the centre, and both connected to the centre rail. Take care with the diodes. The positive rail should have two *cathodes* together on the output side. The negative rail will have two *anodes* together at the equivalent point.

The regulators are installed with the metal tab facing outward. This is to allow the fitting of small heatsinks, should this become necessary for a particular application. Note that the centre legs have to be bent in opposite directions to fit the board with the tabs outward.

Space is provided on the board for PCB mounting pillars. I used plastic type pillars salvaged from an old TV set. Under no circumstances should metal standoffs be used — particularly at the 240 volt input end of the board.

After assembly and before installing the supply in your equipment, cover the 240V tracks with several layers of good quality electrical tape. Alternatively, large diameter heat- shrink tubing could be used to cover the entire supply. Also, make sure that the power lead is securely anchored inside the case. A knot is knot sufficiently secure!

I have built up four of these supplies, in various configurations, and all are working perfectly. With half a dozen spare boards on hand, I'll never be stuck for a suitable power supply again.

Construction notes

No wiring overlay is provided for this project, simply because there are so many permutations of the various connections. Instead, a diagram shows the purpose for each group of holes on the PCB. The various groups are as follows:

(1) AC connection and PCB standoffs.
(2) Hot end of AL7VA transformer.
(3) Hot end of 75000 transformer.
(4) Links to connect secondaries in parallel.
(5) Links to connect secondaries in series.
(6) LT end of 75000 transformer.
(7) LT end of AL7VA transformer.
(8) Diodes; provision for two four diode bridges.
(9) Filter capacitors; Up to 1500uF each side.
(10) Three terminal regulators, output connections and PCB standoffs.

There are also four holes along the centre line of the transformer. These are for anti-vibration screws, if necessary.

Unwilling plug-pack captives of the world unite — here is the means for your freedom! ■

This photo shows the universal power supply board fitted out as a +/- 12V supply for a small computer project.

BOOKS BOOKS BOOKS BOOKS BOOKS BOOKS BOOKS BOOKS BOOKS

ENHANCED MS/DOS BATCH FILE PROGRAMMING

By Dan Gookin

Best selling book - supplied with software disk.

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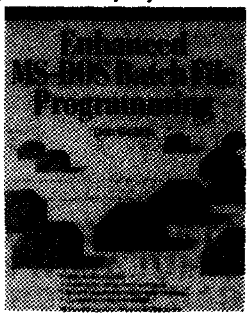

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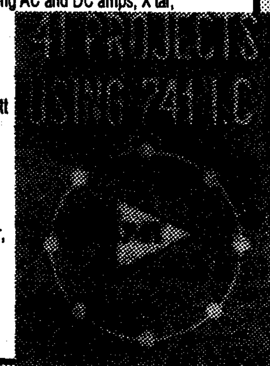
41 PROJECTS USING 741 IC

By M C Sharma

The 741 OP amp IC is very inexpensive yet its comparable to the best in respect of versatility and superb performance. We can't list every one of the 41 kits but here is a few examples: Inverting and non-inverting AC and DC amps, X'tal, magnetic, guitar, telephone and mic preamps, 3W and 12W amps, intercom, AC and DC motor control, schmitt trigger, square wave generator, flasher, timer, light op relay, DC voltmeter, AC millivoltmeter, RPM counter, A to D converter, etc., etc.



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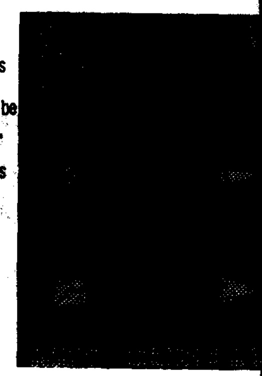
51 PROJECTS USING CD4011

By M C Sharma

The CD4011 CMOS IC consists of 4 NAND gates and can be put to many applications. The IC can be used as linear amplifiers, multivibrators, schmitt triggers, pulse generators and crystal oscillators. Some of the projects include light flashers, blinkers, metronomes, burglar alarms, voltage indicators, timers and games.



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DESIGNING, BUILDING & TESTING YOUR OWN SPEAKER SYSTEM WITH PROJECTS

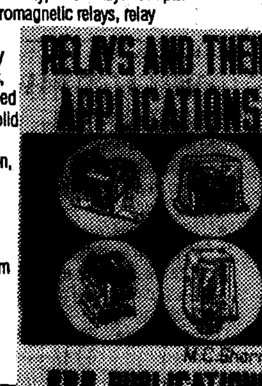
Build your own low-cost speaker system that's as good, or better than the most expensive on the market? You can with this 3rd edition book. Updated to reflect the latest trends in audio technology, this edition features coverage of:- • basic speaker theory • types and functions of speaker enclosures • closed box and ported box speaker construction • crossover networks and filters • PA systems and musical instrument spkrs • speaker equipment selection • speaker placement and acoustics • speaker testing and troubleshooting

214 pages 187 x 233mm Cat. BT-1322 **$34.95**

RELAYS AND THEIR APPLICATIONS

By M C Sharma

The aim of this book is to explain in a simple language, the variety, complexity, proper application, care and maintenance of relays. This knowledge is also useful for selecting the right relay for a specific job and to get a long trouble-free service from all types of relays. Chapter headings include: electromagnetic relays, relay construction, relay contacts, common relay types, time delay relays, reed relays, resonant reed relays, relay circuits, solid state relays, relay applications, installation, adjustment and testing. This is the first book we've seen soley on relays.



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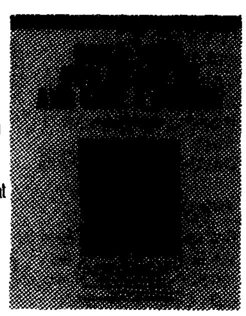
BUILD YOUR OWN 80486 PC AND SAVE A BUNDLE

By Aubrey Pilgrim

This new book shows you how to build your very own DOS and OS/2 compatible 486 computer out of inexpensive third-party components and equipment . . . no experience necessary! Find out which software packages will best suit your needs, and what business and personal tasks you can perform with your new home-built 486. You'll even find out how easy and inexpensive it can be to upgrade an older PC by installing new boards, displays, drives, and more. Not only will you learn all you need to know to build an 80486 machine, you'll get a complete course in microcomputer operation that in itself is worth the price of the book.



220 pages 185 x 233mm

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SIMPLIFIED PRACTICAL FILTER DESIGN

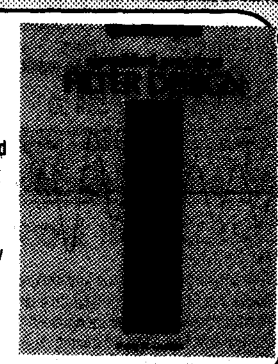
By Irving M Gottlieb

A "back-to-basics" guide to designing and building practical electronic filters - for engineers, technicians and hobbyists.

Using simple mathematics and straightforward procedures, Irving M Gottlieb promotes a thorough understanding of filter components, including how to determine their exact values and connect them properly. You'll learn common techniques for laying out and assembling

• low pass filters • bandpass filters • M-derived filters • crystal filters • high-pass filters • band-rejection filters • composite filters • crossover networks • and more!

Most importantly, you'll learn the differences between real-world and 'textbook' filters - discovering why filter designers are so often led astray by heavily mathematical texts - and how to avoid falling into the same trap with your own filter designs.



185 pages 185 x 235mm

Cat. BT-1326

$34.95

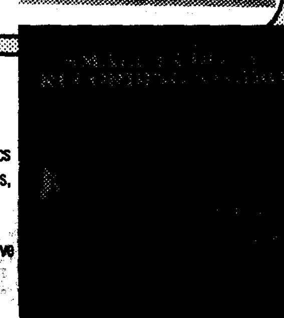
New and Bargain Books advertised last month - full specs in those ads

MS DOS/PC DOS Quick Reference	Cat. BM-2110	$16.95
Illustrated Lotus 1-2-3 Release 2.2	Cat. BM-2112	$24.50
Practical Transformer Design Book	Cat. BM2414	$17.95
The Encyclopedia of Electronic Circuits	Cat. BM-2310	$29.95
Teach Yourself DOS	Cat. BM-2114	$19.95
386 Computer Handbook	Cat. BM-2116	$24.50
Understanding Digital Troubleshooting	Cat. BM-2416	$12.95
Towers Digital IC Selector	Cat. BM-4558	$14.95
Towers Int'l Microprocessor Selector	Cat. BM-4564	$19.95
Towers OPamp and Linear IC Selector	Cat. BM-4557	$9.95
Semicon's Int'l Trans Index Data and Equi	Cat. BM-2342	$19.95
Microprocessor Data Handbook	Cat. BM-2340	$19.95

HOW TO BUILD A SMALL BUDGET RECORDING STUDIO

By F Alton Everest and Mike Shea

Practical guidance in the design, construction and operation of your own affordable acoustics studio. Every aspect of designing and building an audio studio is fully discussed: floor plans, control rooms, wall and ceiling treatments, reverberation time, air conditioning, observation windows, room proportions, acoustical tyreatment, noise considerations and more. It also shows you how to:- • set up a listening room, a recording studio, a control room and achieve good sound • control background noise • make acoustical measurements



295 pages 184 x 233mm

Cat. BT-1324 **$29.95**

SPEAKER BOO BOO!

We recently received a delivery of speakers from our overseas suppliers. They were supposed to be Cat. CE-2320 6" round twincone widerange. We received 6" single cone 10 watt widerange in the pin cushion frame style, as our AS-3012 is.
These speakers are worth $13.95 less $1 for no twin cone - so let's say $12.95.
You can purchase these for the crazy price of only $8.95 each. Saving you $4 off the usual price.
Cat. AS-3012

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At last a low cost quality, portable butane powered flame torch. Ideal for the hobbyist and professional. Adjustable flame, completely portable, up to 90 minutes use per fill, adjustable temperature control, mini size, uses standard butane gas lighter fuel. Ideal for shrinking heatshrink tubing.
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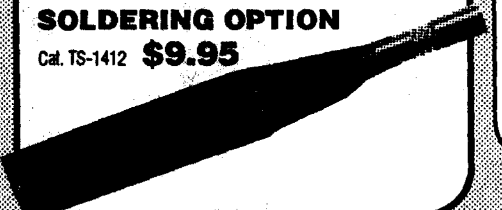
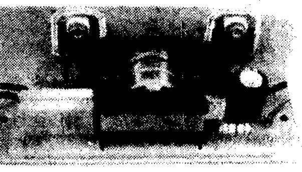


Fluoro Inverter Kit

Ref: Silicon Chip Feb 1991

This kit enables you to build a high power DC inverter suitable for driving a 20 watt fluorescent light from a 12V car battery. Short form kit. See catalogue for full details.



Cat. KC-5091 **$32.95**

INTELLIGENT GEL BATTERY CHARGER BARGAIN

We have a limited quantity of these quality chargers available. They are 240V operated with an output of 14.2V at 1.6A max. It is an intelligent charger, which means that when the battery is charged the unit will automatically switch itself to trickle charge saving damage to the battery and charger. Most Gel chargers don't have this feature.
It will charge our 6.5Ah batteries in about 10 hours and our 15Ah cells in about 20 hours. Output lead to battery is a 3 pin Cannon type which in most cases will need to be removed. Mains lead length 2 metres, output lead length 1.8 metres. Size 175(L) x 115(W) x 60(H)mm.
Cat. MB-3507 SAA APPROVED

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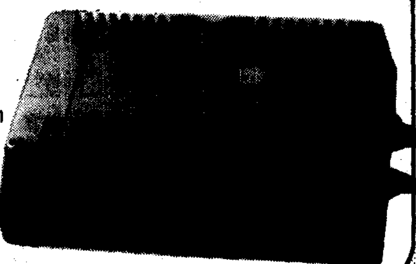

STEAM SOUND SIMULATOR KIT FOR RAILMASTER TRAIN CONTROLLER

Ref: Silicon Chip April 1991

Had enough of that silly whine coming out of your HO-scale "38" loco? This steam sound simulator makes a realistic "chuffing" sound that keeps pace with the loco speed.
Kit includes PC board all specified components and the expensive 82mm loudspeaker.
Cat. KC-5093

$24.95

Railmaster Train Controller kit Cat. KC-5028 $89. See catalogue for full details.

PHILIPS MICROPHONE BARGAIN

Don't miss this one!
It's a high quality stereo condenser electret microphone. Philips came to Jaycar to clear their excess stock. Their list price for this unit is $59.95!!!
Features include:-
- Uni-directional polar pattern
- Designed in windshield for distortion free sound
- For studio and home recording
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Specifications

Frequency Range	50-18,000Hz
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Sensitivity	—47dB ±3dB
Connector	6.5mm plug
Adaptor	6.5 to 3.5mm supplied
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Battery Supply	1.5V AA required

Cat. AM4085
Philips list price $59.95

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SMALL SPEAKERS

We had a quantity of these some time ago, and we still get asked if we have any more available. They are used in televisions. They have roll surrounds and are QUALITY small speakers.

TYPE 1

Oval speaker, rubber roll surround. Size: length 68mm, width 34mm, height 33mm. Impedance 7Ω. Power handling 1 watt.
Cat. AS-3020 **$3.95**

TYPE 2

Oval speaker, but with 4 holes for standard type mounting. Roll surround. Size: length 70mm, width 40mm, height 29mm. Impedance 12Ω. Power handling 3 watts.
Cat. AS-3021 **$3.95**

TYPE 3

Oval speaker with 4 holes for mounting. Same dimensions as type 2. Impedance 8Ω. Power handling 5 watts.
Cat. AS-3022 **$5.95**

TYPE 4

Small round speaker with an impedance of 500Ω. Could possibly be used as a small add-on tweeter for radio or TV etc. 40mm diameter. Mounting holes are 47mm apart. Depth 13mm.
Cat. AS-3024 **$1.95**

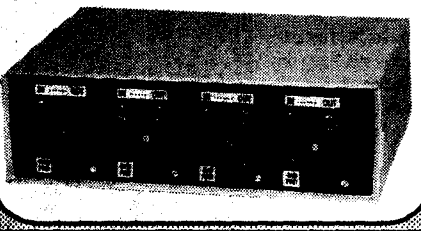
NEW KITS FOR JUNE

QUAD 'DI' BOX KIT

Ref: EA June 1991

This simple kit will replace four separate direct injection (DI) boxes, but at a fraction of their total cost. It offers excellent performance and is ideal for connecting a bank of musical instruments to a standard mixing desk.
The Jaycar kit includes PCB, instrument case, cannon type connectors, phono skts and all specified components to complete the project.
Cat. KA-1734

$79.95

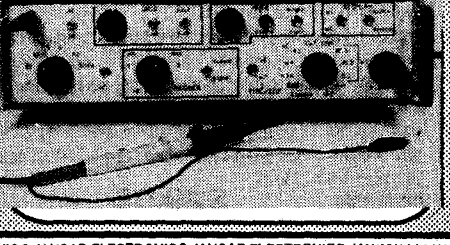


CRO ADAPTOR KIT

Ref: EA March/June 1991

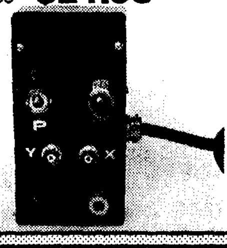
This project is a fully featured oscilloscope that uses a low-cost conventional computer monitor as the display. It's not your average CRO adaptor either! It can display waveforms of over 1MHz, can measure DC volts, (not display, actually measure), measure frequency and peak to peak voltage and it's a storage CRO!
The Jaycar kit includes 3 PC boards, mains transformer, IC sockets, switches, sockets, knobs and all specified components. No box supplied.
Cat. KA-1735

$179.50



CRO ADAPTOR/ COMPONENT TESTER KIT

Ref: EA May 1991
Using your CRO this kit and the Lissajous reference chart provided you can identify unknown devices, check whether they are defective and even identify their pin connections.
Kit includes box, transformer, switches, hardware and all components.
Cat. KA-1733 **$24.95**



STEREO AUDIO EXPANDER KIT

Ref: Silicon Chip May 1991
This project will add sparkle to your music cassettes, video or FM receiver by increasing the dynamic range of the signal. The kit includes PCB, box, panel labels, in/out sockets and all specified components. Option 12V AC plugpack
Cat. MP-3020 $16.95
Cat. KC-5094
$39.95

BARGAIN HOBBYIST BOX

Another surplus stock buy. This time a high quality steel box, which would make a good power supply box or for general kit work. It's painted white, has ventilation slots on the top and two sides. There is a hole on one end for a mains cable and cord grip grommet and on the other end two holes for banana terminals or switches, etc. Size 165(L) x 115(W) x 125(H)mm. You would expect to pay about $25 for this box, but you can purchase these now from Jaycar for only $12.95 or about 1/2 normal price.
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DTMF DECODER KIT

Control home appliacnes via your telephone

Ref: Silicon Chip May 1991
This kit will allow you to control equipment via the telephone line. It can control up to nine separate appliances and can be connected either directly to the telephone line or acoustically coupled via your answering machine. You can use it to turn on and off all manner of electrical items - e.g. house alarms, lights, water sprinkler systems, radios, Hi-Fi, heaters, air conditioners, etc., etc. The kit includes PCB, 600Ω transformer, switches, mic insert, telephone plug and cable and all specified components. No case supplied.
Cat. KC-5095 **$79.95**

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This unit is a self contained detector and operates from a 9V battery. Simply install the battery - attach it to the ceiling and forget about it. It will start beeping when the battery requires replacing (battery life approx 1 year with alkaline battery)
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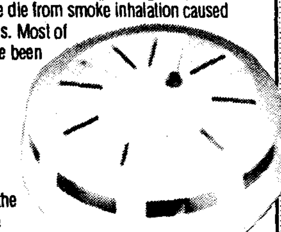
- Audible beep to indicate low battery

Size 125mm diameter x 45mm deep
Cat. LA-5090
$19.95



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Ref: EA August 1985
This kit has been replaced now by the Silicon Chip model. The new model sells for $109. This kit used to sell for $85 but you can purchase one of the last few remaining for only $54.75 - exactly half of the price of the new replacement kit.
Cat. KA-1595
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Ref: ETI Feb/March
We have made one last run of this popular kit. So, if you want one - don't wait any longer - you won't get another chance. Get maximum performance from todays engines with this transistor assisted ignition kit. Complete with die-cast box.
Cat. KE-4890
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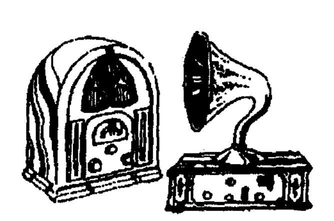
Vintage Radio

by PETER LANKSHEAR



A decade of radio development — 2

As we saw in the previous article, the primitive receivers of 1925, typified by the American made Stewart Warner 300, provided plenty of scope for development. This time we look at its lineal descendant, the 1935 model R-136 'Ferrodyne' chassis.

By the way, these American receivers have been selected because they were typical of their period, and Stewart Warner was one of the comparatively few manufacturers in business in 1925 who were able to survive the depression and thereby provide a continuity of models. I must emphasise that by 1935, locally made receivers compared very favourably with their US counterparts.

Continuous development

Each season there were such significant developments that often design details and cabinet fashion are sufficient to date receivers to the exact year of manufacture. Inevitably some ideas were abandoned after a brief trial, but by the mid 1930's, design had stabilised with features still to be found in receivers today.

Many historians regard 1930 as the transition year between the pioneering efforts and the 'modern' radio. By then, chassis construction, mains operation, and ganged tuning were standard, with increasing use of screen grid tetrodes and audio pentodes. Cabinets had become pieces of furniture, with integral moving coil speakers driven with adequate audio power.

Late in 1930, RCA relinquished its monopoly of the superheterodyne and within a year, other types were obsolete. Then followed variable-mu RF valves, RF pentodes, shortwave band switching, multi-function valves and much greater use of automatic gain control.

The golden years

There was a wide range of models available during the 1930's, ranging from elaborate 'top end of the market' receivers right through to budget priced rather 'low tech' models at the bottom end. Better grade broadcast receivers from this period can still hold their own alongside today's domestic radios.

By 1935, what may be called the standard superheterodyne had evolved. Thereafter, right to the end of the valve era, there were few major advances in domestic receiver technology. Of course there were still regular changes, but these were mostly in detail or cosmetic to meet the requirements of the marketing departments and simplification for economy. Design remained static during World War II and despite expectations to the contrary, few of the wartime developments in electronic technology had any significant influence on post war domestic AM receivers.

Later, smaller valves, which were not always as reliable as the older types, and better components became available, and in general receivers became simpler and cheaper, but not necessarily better. An example of a development that did nothing to improve valve receivers was the printed circuit. It is difficult to imagine solid state and integrated circuit technology without printed circuits, but boards in valve receivers were often carbonised from overheating by output valves and rectifiers, and cracks in the copper tracks were a problem.

But I digress. Let's compare Stewart Warner's R-136 receiver of 1935 with its predecessor of 1925.

First impressions

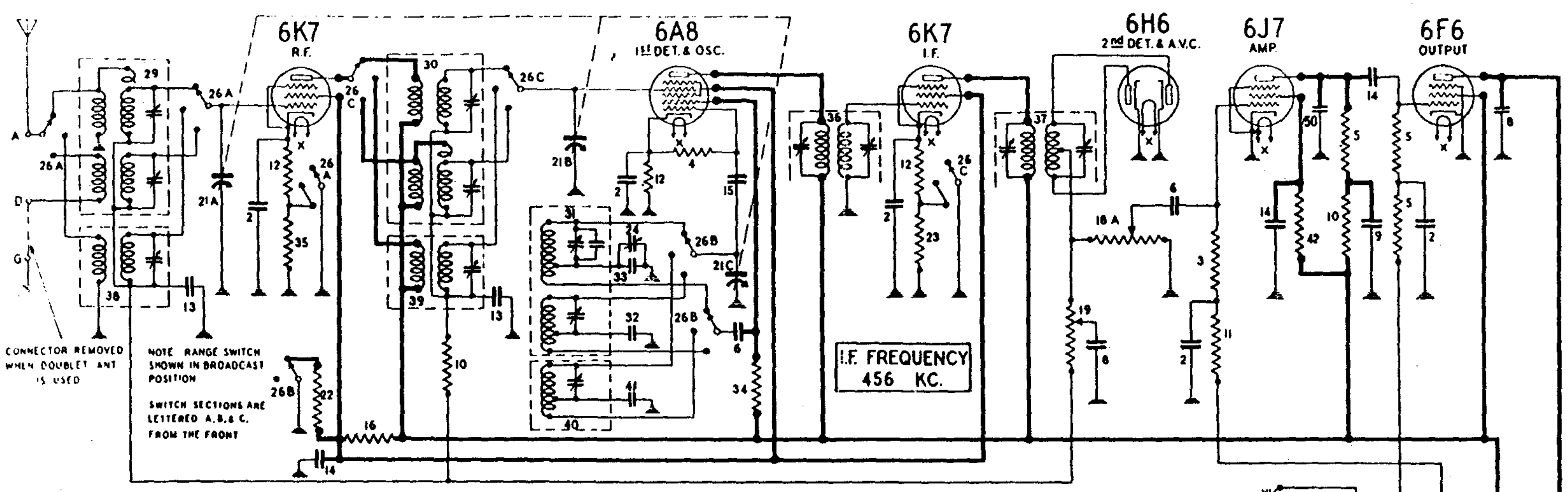
Seen side by side, it is difficult to believe that only 10 years separate the two receivers. The 300 is just a functional box with three large direct drive knobs, and covers only the medium wave broadcast band; but the cabinet of the R-136 has become a piece of furniture, featuring an elaborate 'Magic Dial' about 100mm in diameter. Frequency coverage is continuous in three bands, from 540kHz to 18.0MHz.

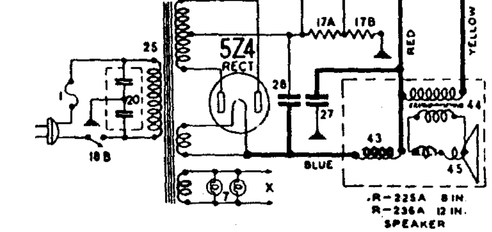
At this time, the term 'Magic' was in vogue, with receivers having 'magic eye' tuning indicators, 'magic brains' and in this case a magic dial. Stewart Warner had in fact used the description a couple of years earlier, to describe a dial in which the scales changed with band switching. In this case 'magic' refers to the scales being practically invisible unless the dial is lit!

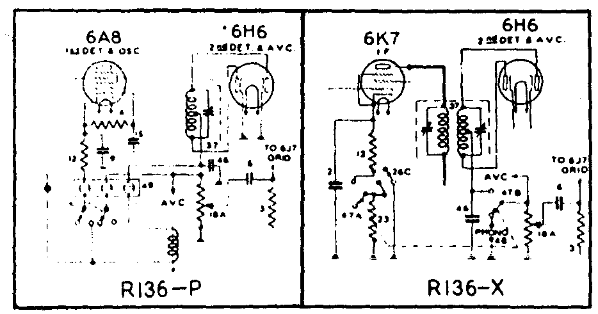
The dial calibrations are accurate and colour coded for each band. Mechanically, the dial is an elaborate combination of gears and a planetary drive, with two concentric tuning knobs. In high ratio, 4.25 turns of the outer knob are required to rotate the tuning capacitor through 180°, whilst at the same time, a small single ended pointer rotates four times around a 360° logging scale. For fine tuning the planetary drive multiplies the gearing by a ratio of 5:1. Matching the bronze escutcheon, the main pointer

Fig.1: This mantel set was one of a number of Stewart Warner models using the R-136 chassis. Typical of 1935 fashion, its walnut veneered cabinet is finished in highly polished nitrocellulose lacquer with turned wooden knobs.

STEWART-WARNER MODEL R-136 CHASSIS (RECEIVER MODELS 1361 to 1369)







PHONOGRAPH MODEL CIRCUITS

R-136 PARTS LIST

Diagram No.	Part No.	DESCRIPTION	List Price
1	38841	Fuse, 1 amp.	$0.10
2	81630	.1 mfd. 175 volt paper condenser	.30
3	83072	510,000 ohm ¼ watt carbon resistor	.20
4	83080	51,000 ohm ¼ watt carbon resistor	.20
5	83082	260,000 ohm ¼ watt carbon resistor	.20
6	83219	.01 mfd. 600 volt paper condenser	.30
7	83278	Dial lamp 6.3 volt	.15
8	83706	.006 mfd. 600 volt paper condenser	.35
9	83974	.1 mfd. 200 vdlt paper condenser	.25
10	84198	110,000 ohm ¼ watt carbon resistor	.30
11	84235	1.1 megohm ¼ watt carbon resistor	.20
	84312	Output transformer (R-225-A 8" spkr.)	2.50
	84504	Diaphragm and shell assembly (R-225-A 8 inch speaker)	2.50
	84505	Field coil assembly (R-225-A 8" spkr.)	3.75
12	84888	300 ohm ½ watt wire wound resistor	.15
13	85053	.05 mfd. 100 volt paper condenser	.35
14	85059	.05 mfd. 300 volt paper condenser	.35
15	85061	.000051 mfd. mica condenser	.15
16	85063	15,000 ohm 2 watt carbon resistor	,25
17-A / 17-B	85067	275 ohm wire wound bias resistor / 25 ohm wire wound bias resistor — one unit	.50

R-136 PARTS LIST — CONT'D.

Diagram No.	Part No.	DESCRIPTION	List Price
18-A / 18-B	85073	250,000 ohm volume control / Line switch — one unit	$1.25
19	85074	500,000 ohm tone control	.85
20	85075	Dual .01 mfd. 750 volt A.C. paper cond.	1.00
21A to C	85084	3 Gang variable condenser	4.50
22	85116	25,000 ohm ½ watt carbon resistor	.15
23	85117	1,000 ohm ½ watt carbon resistor	.20
24	85285	Padding trimmer	.40
25	85428	Power trans. 115 V 60 cycle (136-A only) (See 85760 for other voltages and frequencies)	5.50
26A to C	85429	Three deck range switch	3.00
27	85430	16 mfd. 300 volt electrolytic condenser	1.25
28	85431	16 mfd. 400 volt electrolytic condenser	1.25
29	85432	Antenna coil and shield assembly (B & No. 3 S.W.)	2.75
30	85433	R. F. coil and shield assembly (B & No. 3 S.W.)	3.00
31	85434	Oscillator coil and shield assembly (B & No. 3 S.W.)	3.00
32	85440	.00351 mfd. mica condenser	.40
33	85441	.00042 mfd. mica condenser	.25
34	85442	21,000 ohm ½ watt carbon resistor	.20
35	85443	2,000 ohm ½ watt carbon resistor	.20
36	85452	1st I.F. transformer	2.50
37	85453	2nd I.F. transformer	2.50
38	85455	Antenna coil assembly (No. 2 S.W.)	1.50
39	85456	R.F. coil assembly (No. 2 S.W.)	1.50
40	85457	Oscillator coil assembly (No. 2, S.W.)	1.25
41	85467	.00137 mfd. mica condenser	.30
42	85472	1.6 megohm ¼ watt carbon resistor	.15
43	85478	Field coil assembly (R-236-A spkr.) (See 84505 for R-225-A 8" spkr.)	5.00
44	85482	Output transformer (R-236-A 12" spkr.) (See 84312 on R-225-A 8" spkr.)	2.50
45	85592	Diaphragm and shell assembly (R-236-A 12" spkr.) (See 84504 for R-225-A 8 inch speaker)	3.50
50	81370	.00011 mfd. mica condenser	.15

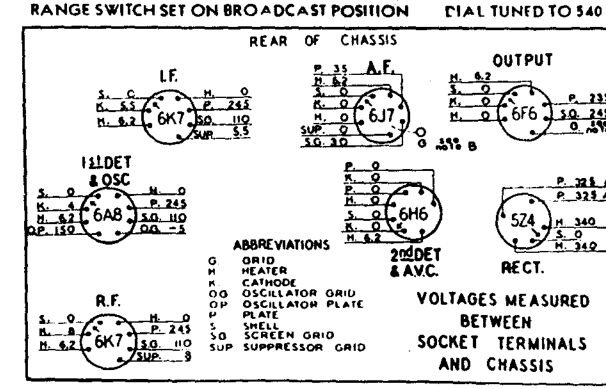
R-136P AND R-136X PARTS

Diagram No.	Part No.	DESCRIPTION	List Price
46	83539	.00026 mfd. mica cond. (136P & 136X)	$0.25
47A & B	84404	Phono toggle switch D.P.D.T. (136X)	1.10
48	84407	Phono terminal strip (136X)	.12
49	84112	3 lug terminal strip (136P)	.03
	85760	Power transformer 136X & 136-P only. (100 to 240 volts) (25 to 133 cycles)	8.50

Prices subject to change without notice

SOCKET VOLTAGES

LINE VOLTAGE 115 VOLTS Volume Control on Full ANTENNA GROUNDED
RANGE SWITCH SET ON BROADCAST POSITION DIAL TUNED TO 540 KC.



IMPORTANT: Use a high resistance meter of 1000 ohms per volt.
NOTE A: The grid bias on the 6F6 output tube is —16.5 volts, measured across the resistors 17A and 17B.
NOTE B: The grid bias on the 6J7 amplifier tube is —1.7 volts measured across resistor 17B.
Speaker field resistance is 1300 ohms with coil warm.

Compare the R-136 circuit schematic shown here with that for the 1925 set given in the previous article, to see the tremendous progress made in receiver design during that 10 year period. Locally produced sets of 1935 were very similar.

is of the double ended or 'airplane' type, the centre being reminiscent of a Roman shield. There is no tuning backlash and settings are repeatable, even at the highest frequencies.

Tidy interior

On looking inside the cabinet, the first things to catch the eye are the full set of metal valves. These, together with square coil and IF transformer cans, give the general impression of a tidy and uncluttered chassis. The eight-inch electromagnetic field speaker was almost a *de facto* standard in medium sized receivers, with consoles using twelve-inch speakers.

Two features were behind the term 'Ferrodyne' (techno-Latin-Greek for 'iron power'). One was the use of iron dust cores in the IF transformers — today used universally to improve efficiency in high frequency coils and inductors of all types. Stewart Warner has been credited with pioneering the use of iron cores, and these were first used in the R-136 chassis.

The other ferrous application was the use of the octal based metal series of valves. In May 1935, General Electric had marked their return to radio manufacturing by announcing their intention to equip their receivers with a full range of specially developed metal valves. In September, the first of these GE receivers appeared, and the circuit of the Stewart Warner R-136 chassis was published. It should be noted that despite the advertising fanfare and publicity surrounding the first series of metal valves, most were in fact existing types in new packaging.

Circuit details

Even a casual comparison of the circuit with that of the model 300 is sufficient to show that design had come a long way in 10 years, and readers may be interested in a detailed description of the R-136. Note that components are identified on the circuit by part numbers.

The aerial is switched between the primaries of the three aerial transformers. The broadcast and 6-17MHz coils are in shield can number 29, with the 1.5-6MHz coils in 38. A good feature is the provision for a balanced doublet aerial for the top band. The aerial transformer secondaries are connected at their lower ends to the AGC line and are switched to the tuning capacitor and the grid of the 6K7 RF amplifier valve by the band switch.

An interesting feature is the operating

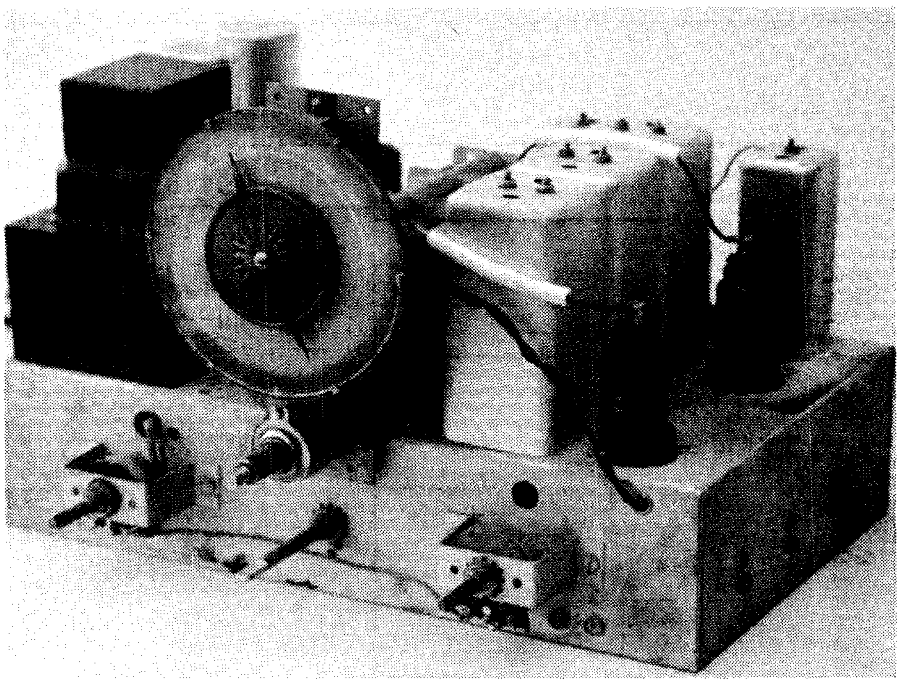


Fig.2: The uncluttered chassis of the Stewart Warner R-136. Below the dial is the planetary reduction drive and one of the brass gear wheels, a more sophisticated system than the string-driven pointer that later was to become fashionable.

conditions for this and the IF amplifier valve. For broadcast band operation, additional cathode bias resistors 23 and 35 are switched in to reduce gain overall by something like 15dB. This helps match performance between the broadcast and shortwave bands, and makes handling on the broadcast band more tractable. A compensating resistor, component 22, is switched in to keep the screen grid voltages correct with the higher broadcast band bias.

No local/distance switch

Automatic gain (or volume) control had come into common use during the early 1930's, but it had its critics. One problem with high gain receivers was the rise in noise level as the gain increased during tuning between transmissions. Another was that by flattening out the tuning peak, AGC made accurate tuning of strong signals difficult.

A common method of minimising these problems was to provide the option of reducing receiver gain with a local/distance switch. Rather than provide a separate switch, Stewart Warner compromised with a permanent modest gain reduction for broadcast band reception. Overall gain is still more than can be fully used.

The RF amplifier feeds the pentagrid 6A8 mixer by means of the RF coupling coils. AGC is applied to this stage via resistor 10. By using a form of Hartley oscillator with the padder in the feedback path, oscillator performance is more consistent than with the conventional arrangement, but does not eliminate one problem common to pentagrid mixers. Above 15MHz, strong signals can 'pull' the oscillator frequency, making tuning a bit critical.

IF, AGC and detection

Apart from the bias switching, the IF amplifier is quite conventional, and with the double-tuned iron cored transformers it has plenty of gain. Designers seem to have been divided in their opinions as to whether or not automatic gain control should be applied to IF amplifiers. Each method has its merits, but in the case of the R-136 chassis, the amplifier is left uncontrolled.

The detector uses one of the few new valves developed for the 1935 metal octal series, the 6H6 double diode with separate cathodes. Instead of the familiar single diode detector, there is a fullwave biphase detector fed from a centre-tapped transformer winding. This system was used for a few years, but was going out of fashion in 1935. It has the advantage of requiring minimal RF filtering, but develops only half the output of a half wave detector, requires a centre-tapped IF transformer winding, and there is no delay in the AGC voltage.

Potentiometer 18A is a standard volume control, while potentiometer 19 is used as a combination AGC filter resistor and tone control.

High gain audio

The audio output of the R-136 is rated at 3 watts — 200 times the power capability of the 01A valve of the model 300. The resistance-coupled 6J7 and 6F6 valves used in the audio amplifier were the same internally as the existing 6C6/77 and 42 pentodes.

A minor criticism is that with only about 0.15 volts needed on the grid of the 6J7 to drive the 6F6 to full output, there is an embarrassment of gain which is quite unnecessary even with weak shortwave signals. This results in the use of no more than the first 30° of the volume control's range. A smaller value of load resistor for the 6J7 would make the receiver more docile.

By 1935, power supply design had become standardised. Filtering is provided by two 16uF capacitors (27 and 28) and the field winding of the electromagnetic speaker. The diagram shows a smaller field winding in series with the voice coil and output transformer. This is the 'hum bucking' coil, a few turns of heavy wire producing an out of phase voltage to cancel hum generated by the ripple in the HT current flowing in the main field winding.

Grid bias for the audio stages is provided by the voltage drop across resistors 17A and 17B in the negative return of the power supply. Cathode bias for audio amplifiers, although preferable technically, was not very popular during the 1930's, probably because low voltage electrolytic bypass capacitors were then rather unreliable.

The 5Z4 rectifier used here was the one unsuccessful member of the introductory range of metal valves. It proved to be unreliable and pending its redesign, the old faithful 80 was recalled as a stop gap. Given an octal base, and renamed the 5Y3G, it continued to be used for many more years.

In the 10 years following 1925, radio technology made tremendous advances. Whereas the Stewart Warner model 300 is just an interesting museum piece, receivers like the R-136 are still capable of providing good service, with a performance that compares very favourably with their modern counterparts. ■

Still Available:
The Best of Australia's 'Wireless Weekly' in 1927

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READER INFO NO. 14

Information centre

Conducted by Peter Phillips

Getting technical

Amongst other things, a very popular misconception is put to rest (according to the correspondent) in this month's offerings. I also have some ideas on how to make Information Centre even more informative, and ask for readers to contribute on an even wider range of topics.

Regular readers may recall the day my face first appeared as the 'conductor' of this column. My brief was simple — make it interesting and informative. I then introduced the What?? question and promoted discussion around technical topics. But perhaps we've bogged down a little lately; perhaps it's time to be a bit more innovative. There are several suggestions floating around the office on how to expand the content without losing the original intent.

The prime aim of Information Centre is to discuss project difficulties, and to also present snippets of technical trivia that don't fall neatly into one of the various sections within the magazine. Although this month follows our usual pattern, I would like to invite readers to also contribute items on the following topics: unusual applications for commonly used devices, circuit designs with interesting twists to them, unusual faults, design ideas or technical items you think generally interesting to other readers.

We won't be able to use large items, as space is limited and I would like to keep the content reasonably relevant to electronics. For example, I'd prefer letters and circuits on electronic applications rather than say, a particle disintegrator. I usually write to contributors if their letter is being used, so you'll always know before it reaches the streets. I also try and acknowledge all letters, although some of the more irrelevant letters may not always get an answer. So how about it, folks? Oh, and don't forget to keep those What?? questions coming in.

Power supplies

I've received a number of letters that follow on from the discussion in March on the VA rating of transformers. I'm not presenting these letters at this stage, as there is so much material that I may be able to draw it all together for a feature article. The material supplied by the various contributors includes information on the size of the filter capacitor, diode ratings and so on. If any other readers have material they think useful, I'd be glad to receive it for possible inclusion in the proposed article. Naturally you'll be acknowledged in the article.

Phone Dialler

The next letter was sent some time ago, but due to various reasons, it has taken me a while to research the answer. First the letter...

The Telephone Dialler described in the November 1990 edition of EA fails to point out that it will not work on all types of lines.

In the 2000 and SE50 type exchanges, commonly known as step-by-step exchanges, the calling, or 'A' party has a line reversal after the 'B' party answers. This feature was used to control items such as public telephones.

If the Dialler is constructed and connected as described in the article, the line reversal from this type of exchange will result in the zener diodes shunting the line circuit and locking up the line until the unit is unplugged.

As there are still a large number of services connected to these exchanges, I can only assume that your design staff are not really familiar with telephone switching systems, proving the old saying 'a little knowledge is dangerous'. (J.F., Brookvale NSW).

After receiving this letter I contacted the original designer of the project who immediately recognised the problem. You are quite correct J.F., and the designer (CTOAN Electronics) has promised purchasers who experience these problems with either assistance in a modification or refund of the kit price for return of the kit.

However, this kit has been very popular and so far no one seems to have struck one of these exchanges. The modification would include a bridge rectifier, which was actually tried in the prototype but abandoned due to the voltage drops across the bridge affecting operation of the unit under some circumstances. There are other techniques, including use of a relay, but so far it has not proven necessary to design a suitable modification.

My research has led to some interesting facts, which I'm presenting in a very general fashion due to the variations that still exist within the Telecom network.

As a very rough guide, if you have a phone number with six or less digits, it is likely the exchange is a step-by-step (SXS) type. Some exchanges incorporate SXS technology along with the more advanced systems, although the phone numbers will have a different prefix depending on the technology they are connected to. To confirm whether your exchange is SXS, the easiest way is to contact Telecom.

The supply reversal referred to by J.F. is probably well known by regular users of public telephones, in which a one way conversation could be conducted (?) without inserting any money. Once a coin is received by the 'phone, the reverse bias on the speech circuit switches to forward bias allowing the caller to communicate with the other party. In a private phone, the line reversal triggers the phone meter.

It's difficult to even quote a percentage of phones still connected to an SXS exchange, and suggestions vary from

20% to 40% depending on the area. Telecom is continually updating exchanges and I'm told that the latest technology comes from STC-Alcatel. This system will allow private users to have several phones and a fax machine, it will incorporate remote access by authorities to items like the power meter, and will include the facility for video phones.

These days, fibre-optic cables are now commonplace and the days of 300 channels per co-axial cable have now been replaced by a capacity of 8000 per fibre-optic cable. Not bad when you realise the optical cable is no thicker than a hair. Incidentally, I'm also told that dialling numbers like 000 or 018 may well result in the call being trunked to anywhere in Australia. This avoids congestion and ensures a speedy response.

So as I write, it is likely another SXS exchange has bitten the dust, giving subscribers an extra digit or two to their phone number and eliminating the problems referred to by J.F.

Tuneable hum

A number of readers have responded to a letter published in March describing the problem of 'tuneable hum' being experienced by J.M., from Adinga Beach in SA.

All the letters identify the power mains as a cause, but for different reasons. The first letter suggests street lights may be to blame:

This problem has been experienced in Melbourne, and was apparently due to one or more street lights, of the mercury vapour or sodium vapour types. The RF from a broadcast station can be of such a level that cross modulation can occur when applied to a lamp with a non-linear function, such as those mentioned.

Because the power lines form very long and hence effective antennas, it is likely that an RF peak can occur at a particular lamp. The cure is to fit a suppression capacitor across the lamp terminals. It may be worthwhile contacting the ETSA or DoTac in Adelaide. (R.C., Benalla Vic).

The next letter offers another reason, and the writer seems to have experienced the problem several times. I've condensed the letter as space is limited.

This problem is not new, and the reason is obvious once you've dealt with it a few times. Technically, the phenomena is called Modulation Hum, in which the incoming radio signal is modulated with the power mains then radiated as a composite signal. The frequency is 50Hz, plus all the nasties of rectification buzz.

It shows up in areas where the direct radio transmission is weak because of multipath reflections, or the receiver is in a shadow reception area. In effect, the power lines carry the radio signal and radiate it near your receiver. As well, long runs of old galvanised fencing wire can add to the problem.

To reduce the problem, connect a 10nF, 240V AC rated capacitor between the active and earth pins of the power plug for the receiver, or to be more correct, at the GPO supplying the radio. Nowadays, you are not allowed to connect a capacitor greater than 5nF in any appliance from the active to earth, so placing the capacitor behind the GPO gets around this problem. This will also help reduce the effect in a portable radio as the RF will be attenuated.

If the problem is caused by corroded fencing wire, the PN junctions so formed will cause re-radiation, giving hum plus a crackling noise. The suppression capacitor will not fix this problem.

In another case, a customer experienced this problem whenever his neighbour turned on her CB set. This occurred whether the CB was transmitting or not, and the solution was to connect 10nF capacitors across the rectifier diodes in the CB power supply. So, if the problem is not in your own home, see the gal next door! (L.W., Dunedin NZ).

The last letter offers yet another reason, again with a simple cure:

Tuneable hum is quite a problem, and I have solved a few cases that all had the same origin. The ingredients for this annoyance are: (a) a resonant distance from the power substation, usually a quarter of a wavelength and (b) a power supply in which there is no electrostatic shield, and also in which one side of the secondary is earthed — quite a common occurrence in many devices. The higher the load current the better.

The result is 100Hz hum that appears on the semiconductor power supply diodes, plus the hot end of the resonant transmission line. Thus the diodes modulate the 'power line', and this reradiates the AM station carrier, plus the 100Hz modulation. The effect reduces for carriers over 1MHz, as the diodes are poor modulators for frequencies greater than 1MHz. As a result, the ABC suffers most. Oh well!

The cure is to detune the power line. This may not be possible if the source modulator is next door or some distance away, but if it is in your own home, connecting a 47nF capacitor (240V AC rated of course) between the active and neutral at the affected appliance will usually fix the problem. (B.B., Indooroopilly Qld).

So there's a variety of possibilities for you J.M. I hope one of these 'fixes' solves the problem, and my thanks to the correspondents for their suggestions.

The letter from B.B. included another topic, concerning the direction of an electric current. Actually, it has little to do with the direction of current flow, but asserts something I'm sure readers will find interesting. I'll let B.B. do the talking...

Ions don't flow

Some of the most erudite electrochemists suffer from the misconception of 'ions flowing from positive to negative'. Electrons DO NOT mount a radical and ride it, like Paul Revere charging off into the horizon.

Having been bugged many times in arguments on this topic, I decided to lay this furphy to rest at the August Conference of the Australasian Corrosion Association at Broadbeach in 1989, and presented the P.F. Thomson Memorial Lecture largely on this topic.

The rationale runs thus: It is relatively easy to measure the speed of electric current in an electrolyte. This involves an avalanche pulse generator, assorted power supplies, a fairly sophisticated double beam storage CRO and 20 metres of beverage tube filled with 3% sodium chloride. The measured speed is around half the speed of light, (or C/2).

If ions battled along at this speed — remembering that ions have significant weight, the electrolyte would be in earthquake mode. Somewhat like the path behind General Schwarzkopf!

To prove the point beyond doubt, we

conducted another experiment. A 20m length of beverage tube (6.5mm diameter) was filled at one end with 3% copper sulphate solution and the other end with 3% sodium chloride (that is, half of the tube with each solution). The copper sulphate is transparent blue/green, the sodium chloride colourless.

A current was passed through the tube for several days, sufficient in amount to account for a significant amount of copper ions (around 1g). If positive charges indeed grabbed the copper and 'rode' through the tube, they would contaminate the sodium chloride and be very visible. This did not happen. Likewise electrons astride chloride radicals would really clutter up the copper sulphate. This also did not happen.

By sampling the sodium chloride end of the tube and testing the solution with an atomic absorption spectrophotometer, which can detect metals or metal ions down around 1 part in 10^7*, we confirmed that there was no copper at the sodium chloride end of the tube. Naturally, diffusion at the junction of the solutions occurred, but no more than one would expect.*

I can swallow charge transfer from ion to ion, oddly akin to the process of electron movement through a semiconductor, but no ion speedsters please. By the way, consider electrolyte resistance. The more solute dissolved, the closer the ions, and the linear relationship of solution concentration to electrical resistance sits nicely with charge transfer. But it doesn't even begin to align with the Paul Revere mode of electrons astride an ion proceeding through the solution. Were this the case, more ions would mean more obstruction. Remember, ions are heavy things.

Oh well, enough for now. Back in my bottle! (B.B.)

I had to read this letter several times to understand its implications. If I've got it right, B.B. is saying that ion flow is *not* current flow. Rather it can be a transfer system for electron flow, by way of charge carriers. The ions move at one speed and the current flow (or electron flow) moves at C/2. From this, I assume that ions can therefore travel in one direction and electrons another.

I have to bow to the obvious authority with which B.B. writes, and I therefore need to change my views on current direction in an electrolyte. It all seems perfectly reasonable when you think about it, as an object with reasonable mass travelling at half the speed of light brings in Einstein's theory and all that it entails.

I wonder what readers think, as I'm sure most people have been brought up to believe that ion flow is also current flow. Interesting! Thanks B.B., I'm sure we haven't heard the last of this one.

Universal LED

On a less esoteric topic, the next letter confirms that the universal LED asked for by a correspondent in February actually exists.

I was interested to read the letter from K.W. concerning the universal LED. Such a device was described in ETI, March 1978 and had the following features: Supply voltage of 2V to 18V, reverse polarity protection, constant light output over 3V, same size as a conventional LED, 12mA to 14mA current, 300mW dissipation, low cost per unit.

This device was made by National with the type number NSL4944. I don't know if it is still available. (R.G., Rochester Vic).

While I haven't confirmed if this device is still available, it is certainly described in great detail in the 1980 National Linear Applications Handbook. The device incorporates an IC integral with the LED package and has many applications including the ability to operate with an AC voltage. It can also serve as a constant current source, with applications in timing circuits, protection circuits and so on. Thanks R.G., your information should certainly please K.W., who asked for such a device in February.

Cascading 4017's

I'm always pleased to receive letters from younger readers, and I'm presenting part of such a letter. The correspondent asks quite a few questions, and I may be able to include other parts of the letter next month, with my answers. Here's the first question our 16 year old reader wants answered:

I am struggling to understand as much about electronics as possible, although I've recently been blasted with a whole lot of Year 10 school work. To save me time and to give you something to do(!), could you possibly help me with a few questions.

How can I bridge several 4017 decade counters so the last output of the first chip initiates the first output of the second chip without the first chip starting its outputs until the second chip has finished. (A.P., Werribee Vic).

As I've mentioned, A.P. has other questions as well, so here's the answer to this one. The circuit shown in Fig.1 will do want you want, although the 4017 has the difficulty that the Q0 output starts in the high state. As I understand the question, you are after a circuit that effectively gives a moving '1', similar to a 20 stage, serial-in, parallel-out shift register.

The 4017 counter is different to most decade counters in that it produces a decimal output: that is, only one output at a time is high. The technical name for this type of counter is the Johnson counter.

In the circuit (which I've built and tested by the way), a D-type flipflop, connected as a toggle flipflop is used to gate each counter. At reset, the Q0 outputs of both counters are set to a high and all other outputs are low. The Q output of the flipflop is reset to a low, and the Q bar output is high.

Under these conditions, the first counter can respond to the clock as the enable input (pin 13) is low. The second counter cannot respond as its enable input is high.

When the Q9 output of the first

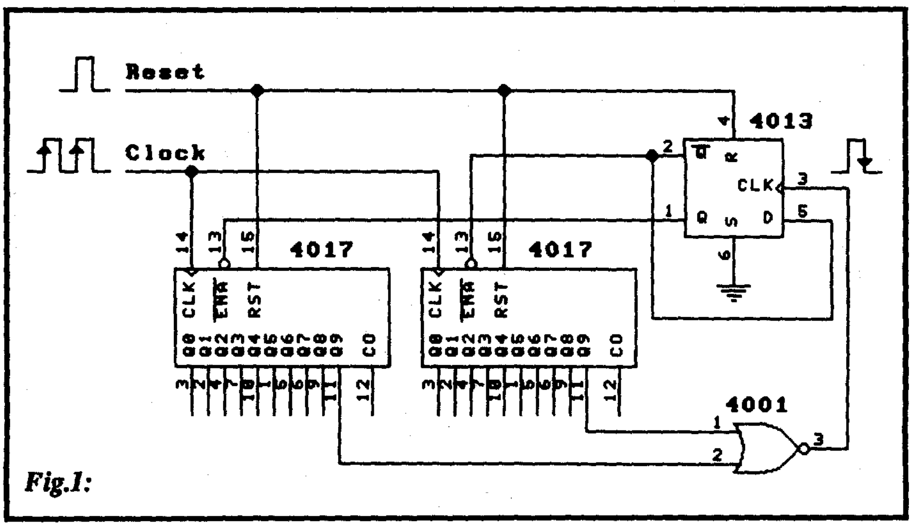


Fig.1:

counter goes high, then low, a trigger signal will be fed to the clock input of the flipflop via the NOR gate. This toggles the flipflop, enabling the second counter and disabling the first. When the Q9 output of the second counter has cycled, the flipflop is returned to its original condition and the sequence can continue.

Although not included in the circuit, it may be possible to use gating to produce an output for Q0 of the second counter that is initially off. However, time(!) has prevented me resolving that one. However, I cannot help thinking that two shift registers may be an easier way to achieve the required sequence.

What??

This month's question comes from England, courtesy of Mr Wen Liang Soong. I'm re-phrasing the question slightly, but otherwise it's original. Here's the question...

Show how a digital ammeter can be connected so that it reads 19mA on its 2A range when the current is actually 1.9A. The arrangement should therefore produce a reading of 1.9mA on the 200mA range and 0.19mA on the 20mA range of the ammeter. Assume the digital voltmeter part of the ammeter has a full scale deflection voltage of 200mV.

Answer to May's What??

The answer is 6F. Assume the capacitance of Cx is C farads, which as the question states is also the total capacitance of the circuit. The series combination of C2 (3 farads) and Cx can be determined with the equation $3C/(3 + C)$. The total capacitance (C) of the circuit is the sum of the series capacitance and that of C1 (4F). The equation is therefore $C = 4 + 3C/(3 + C)$.

Rearranging and cross-multiplying gives $C^2 - 4C - 12 = 0$, giving a quadratic with the solutions of $(C - 6)(C + 2) = 0$. Thus C = 6F or -2F. As you can't have a negative capacitance, the value of Cx is 6F. ■

NOTES AND ERRATA

MAINS FREQUENCY INDICATOR: (Circuit & Design Ideas, February 1991): The circuit published on page 81 will not work as shown. A link should be added between pin 3 and pin 4 of the LM2917 to correct the problem — the components remain as shown. Many thanks to reader Alan Grimes for drawing this to our attention. ■

Amateur Radio News

South East Radio Convention

This year's South East Radio Group annual convention is to be held over the weekend of June 8-9. As with previous SERG conventions, a balanced programme of trade displays and competitions is planned, to ensure that there will be 'something for everyone'.

Included in this year's events are the Australian Fox Hunting Championships and the Home Brew Competition, which is now split into a number of sections to encourage everyone from novices to experts. It is hoped that the competition, which involves prizes, will contribute to a greater involvement among amateurs in the tradition of building their own equipment.

Further details are available from the SERG Convention Co-ordinator David Edwards VK5FF, PO Box 1103, Mount Gambier 5290.

New bands for NZ amateurs

According to a report broadcast over VK2WI, two new bands have become available to Kiwi amateurs as a result of submissions made by the NZART. The new bands comprise 165-190kHz in the 1700m band, with a maximum EIRP of 5W, and 922-927MHz in the 32cm band, with a maximum EIRP of 25W.

Both bands are apparently available on application, to holders of the ZL General Licence.

No more kits from Heath...

The latest issue of *Amateur Radio* to come our way reports that the American Heath Company has now left the kit business, and is to concentrate on home study courses, home automation equipment and fully assembled products. So after many decades, there's to be no more Heathkits.

Silent key

It is with great regret and sadness that we report the sudden and untimely passing of one of Australia's best known and respected amateurs working on the VHF, UHF and microwave bands. Dick Norman, VK2BDN suffered a massive heart attack on March 21, 1991 and could not be revived.

Dick became interested in amateur radio in the late 1940's, after serving in the AIF during World War II. He first held a limited 'Z' call (VK2ZCF), but gained the full call and callsign VK2BDN in the early 1970's. On the way he had played, and continued to play an important role in pioneering operation on many of the then-uncharted VHF, UHF and microwave bands — working with other pioneers and creating quite a few long-standing records. One of which he was particularly proud was the first contact between Australia and New Zealand on 1296MHz.

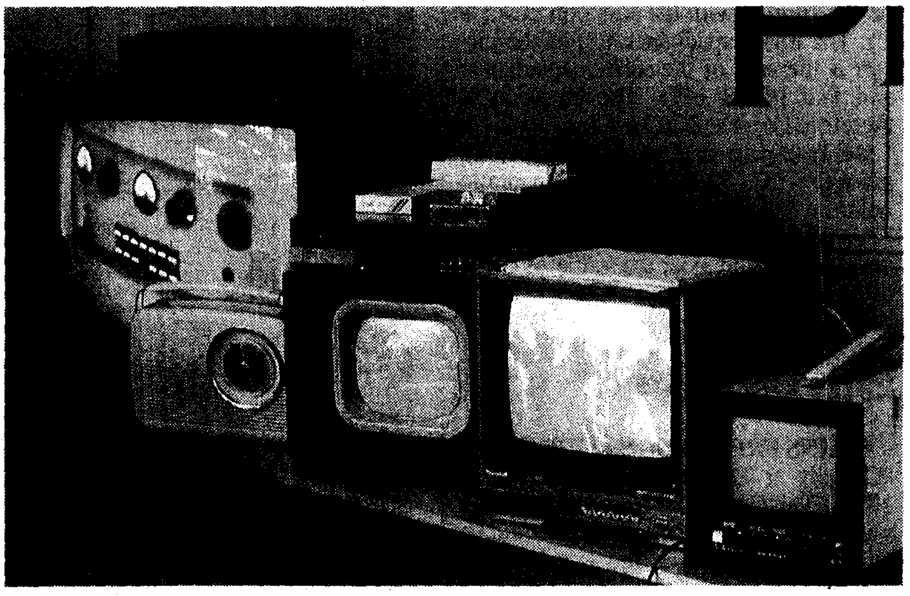
A man of many interests, Dick Norman built up his own sound recording system, hifi system and various TV receivers. Like his home-brew amateur gear, it was all meticulously constructed and professionally finished. And if it didn't work properly, Dick would want to know *why* — never relaxing until all the bugs were solved to his satisfaction.

In recent years Dick spent a lot of his time as a volunteer with his local community FM station 2RDJ, looking after its transmitter and other equipment and even producing a few programmes. He was also happy to help *EA's* editor test many of our recent amateur radio projects — valuable help which was greatly appreciated.

In an interview for an article we published in the September 1989 issue describing his achievements, Dick made the following comment:

"Of course what you need is a good mate at the other end — someone who will listen for your signal, and help you achieve the best results. I've been lucky to have good mates like this, and no doubt that's why I've been able to set a few records."

Those of his many friends who were able to attend his funeral were agreed that Dick Norman himself was indeed a 'good mate', and his passing marked a sad day for amateur radio. ■



Another picture taken by our editor at this year's Gosford Field Day. Shown here is part of the display of vintage television equipment presented by Vic Barker VK2BTV. In the centre is an original British 405-line receiver.

EA with ETI marketplace

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Icom 'Runner up' entries

Continued from page 16

Poltergeist?

I was living in a tiny village outside Cessnock (NSW). Against a disused fireplace was my shortwave listening post.

Atop the receiver was a homebrew antenna tuning unit, from which a wire ran up the chimney to a gum tree on the vacant land beside the house.

One night, as a fierce storm raged outside, I sat enthralled by a BBC program about poltergeists. Just as an actual recording of ghostly knocks was being played, it happened.

Before my very eyes, the ATU vacated at speed its position atop the receiver and rushed up the chimney — just as something struck, with an enormous bang, the roof above my head. All of this being accompanied by a blood-curdling scream!

The explanation, found when I'd stopped shaking, was a simple one.

I'd built the antenna to be rugged, and so it was. Unfortunately, the old chimney was less so. In a violent burst of wind, the tree had pulled the antenna, which in turn had pulled on the chimney.

The top of this had crashed to the ground, taking with it the lead-in wire and the ATU.

The scream? I'll admit that was mine. But to this day, I swear that the smell was ozone...

(Barry McDoanld, Dee Why NSW). ■

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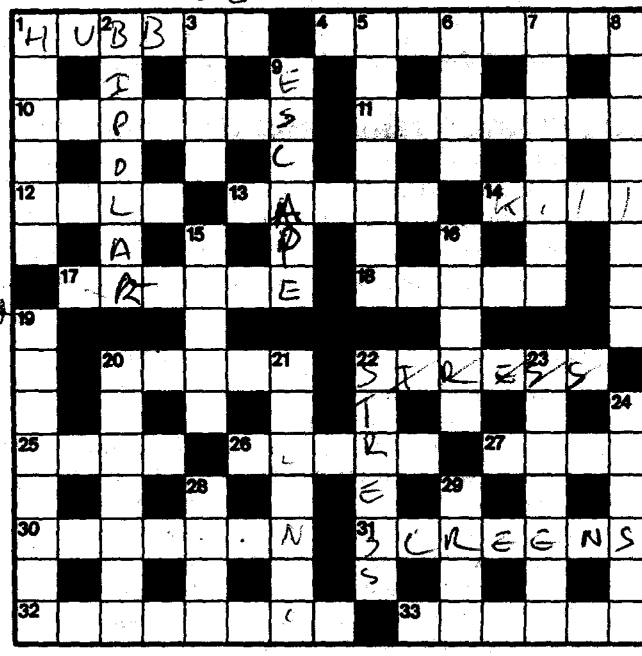


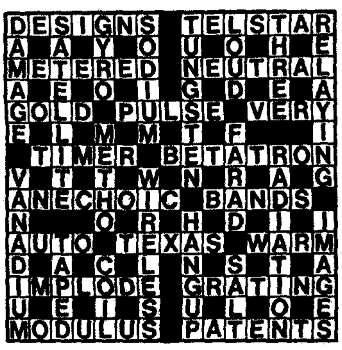
ACROSS

1. NASA's space telescope. (6)
4. This imitates. (8)
10. Portable devices. (7)
11. Signification. (7)
12. Blunt. (4)
13. Conduct.. (5)
14. Electrocute. (4)
17. Coulomb's origin. (6)
18. Strange monatomic gas. (5)
20. Consumer current. (5)
22. Traverses a screen. (6)
25. These transmit motion. (4)
26. Indication of impending alarm. (5)
27. New stellar body. (4)
30. Term for voltage. (7)
31. Put in parallel. (7)
32. Displays. (8)
33. Fused together. (6)

DOWN

1. Compound with group 7 element.. (6)
2. Said of certain transistors. (7)
3. Aerial with high directivity. (4)
5. Brand of floppy disks. (7)
6. Part of an electroscope. (4)
7. Training program. (7)
8. Limit voltage, etc. (8)
9. Critical speed of spacecraft, the —— velocity. (6)
15. Without illumination. (5)
16. List of words. (5
19. Likely place for bar code. (5,3)
20. Red-purple colour. (7)
21. Concerned with element having symbol Se. (7)
22. Generator of strain. (6)
23. Marked a position. (7
24. Returned to earth. (6)
28. Shape of certain antenna. (4)
29. Free from foreign elements. (4)

SOLUTION TO MAY



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.

June 1941

Frequency modulation: This new method of transmission has started a radio revolution in the USA as being the only country which so far has had time to think about it.

The results of experiments and practical work indicate that it is destined to have a big effect in the future on radio all over the world. Although it may be years before Australians have to worry about the system, one is behind the times without some knowledge of it.

Wireless cold cure: How his cold was stopped in ten minutes by the new short-wave radio treatment was related by Harold Pendlebury in the London 'Daily Mail'.

The Minister of Labour is enthusiastic about the treatment, which has cured 70% of 1000 head cold cases treated with the short-wave apparatus at a North West of England factory.

June 1966

Miniaturisation 'ad infinitum': The public is scarcely used, as yet, to the idea of 'micro-electronics' where entire electronic circuits containing perhaps dozens of components are packed into a container no bigger than a transistor. Packing densities in equipment have now reached 1000-10,000 components per square inch.

But one investigation, being carried out by Manchester University, is using an electron beam machine tool.

Its ultimate objective is the fabrication of a hundred passive elements (resistors, interconnections, etc.), in an area of one millimetre square inch.

Plainly, there is still a long way to go before we approach the packing density of the human brain (1000 million), but new technology may eventually open the way to even these fantastic densities.

Recharged batteries: Torch batteries with their own recharging apparatus built into them are now available in the USA. They are no larger than the corresponding ordinary primary cell for torch use, but have a resistance unit and rectifier encapsulated at one end. Thus, when exhausted they can be plugged into a power point, with the aid of a suitable adaptor, and recharged, without the use of a separate charger.

Pirate broadcast station: An Auckland company has announced plans to operate a 'pirate' commercial radio station, to be located outside territorial water off the coast of Auckland City in an attempt to break the broadcasting monopol of the New Zealand Broadcasting Corporation.

A spokesman for the Post Office said it could do little about a pirate radio station working outside the three-mile limit and this would be a matter for the government. Even so, it was pointed out that such a station would have difficulty in finding a frequency free of interference, as most frequencies were already in use.

Electronics Australia with **eti**

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TEST & MEASURING INSTRUMENTS FEATURE

NEW HANDHELD 50MHZ SCOPE/DMM FROM PHILIPS-FLUKE

COLOUR BAR/PATTERN GENERATOR FROM UK

PC-BASED CIRCUIT SIMULATORS: PSPICE

NEWS HIGHLIGHTS

PHILIPS/FLUKE RELEASE NEW 'SCOPEMETERS'

A new range of rugged, lightweight (1.7kg) hand-held field servicing instruments which combine a 50MHz bandwidth (25MS/s) dual channel digital storage oscilloscope with a full-featured 3000-count digital multimeter is being released by Philips/Fluke — the first jointly developed product range to emerge from their 'global alliance' announced some three and a half years ago. The new '90 Series ScopeMeters' are said to be the fastest handheld instruments currently available.

Advanced scope functions include a 40ns glitch capture time for intermittent faults, and a storage capacity of up to eight waveforms and 10 control setups. An 'autoset' function also sets up all major parameters automatically, to produce a stable display for any new input. Extensive multimeter functions are enhanced by additional features such as diode test; simultaneous display of maximum, minimum, average and current readings; a proprietary 'Touch Hold' facility; relative and percent-relative modes; dBm, dBv and dBw readings; and auto ranging. The probes supplied also allow floating high voltage measurements up to 600V RMS, and are used for both DSO and DMM measurements. Operation of the instruments is made easy by a set of five software-defined keys, guided by pop-up menues on the 240x240 pixel LCD display. Power comes from internal batteries, which can be either rechargeable Ni-Cads (supplied) or alkaline C cells. An optical data interface is fitted to all models as standard, for calibration.

There are three instruments in the Series 90 range. Model PM93 is the base model, while the Model PM95 adds measuring cursor and data recording facilities. The Model PM97 adds further waveform and setup memories; back lighting for the LCD display; an RS-232C serial interface, for remote control and transfer of waveform and set up data; component and data comms test ranges; and a generator which produces various test signals. All models come complete with test probes, an AC line adaptor and built-in battery charger, a protective holster and tilt stand.

Approximate prices are expected to be around $1750 for the PM93, $2200 for the PM95 and $2700 for the PM97.

Further information is available from Philips Test and Measurement offices in each state.

SENSITIVE MAGNETIC DETECTOR DEVELOPED

An instrument that detects extremely weak magnetic fields — the most complicated device yet to be made out of the new high-temperature superconducting compounds — has been developed by scientists at the Lawrence Bereley Laboratory and the University of California, Berkeley, in collaboration with a California start-up company, Conductus, Inc. of Sunnyvale.

According to physicist John Clarke, leader of the LBL/UC part of the collaboration, the sensitivity of the device, which is called a magnetometer, is so great that certain practical applications are now within reach. Such applications include laboratory instruments, geophysical surveying, and nondestructive testing. A major potential application is the noninvasive detection of magnetic signals from the human heart and brain. The device, the first to use high-temperature superconductors in multilayer devices, demonstrates that the technology to make electronic circuits out of high-temperature superconductors can indeed be developed. Such circuits would have broad applications in science and industry, not only in detecting magnetic fields but eventually in any electronic circuit involving high-temperature superconductors.

The newly developed magnetometer actually involves two components, each fabricated on its own chip. One is a superconducting quantum interference device (SQUID); the other is a superconducting flux transformer chip — a sort of 'hearing aid' that picks up magnetic signals over a comparatively large area and concentrates them in a much smaller, multiturn coil that is pressed tightly to the SQUID.

The SQUID used in the magnetometer is a thin-film loop of the high-temperature superconductor YBCO (yttrium barium copper oxide) interrupted by two 'weak links' or Josephson junctions (named after the British Nobel prize winner Brian Josephson).

In the presence of a current, the SQUID produces a voltage signal in response to a tiny magnetic field. The SQUID was developed and fabricated at Conductus, using a novel technique that produces grain-boundary Josephson junctions in YBCO films deposited on precisely controlled underlying layers. This process is not only suitable for SQUIDs but can be extended to more complex superconducing integrated circuits.

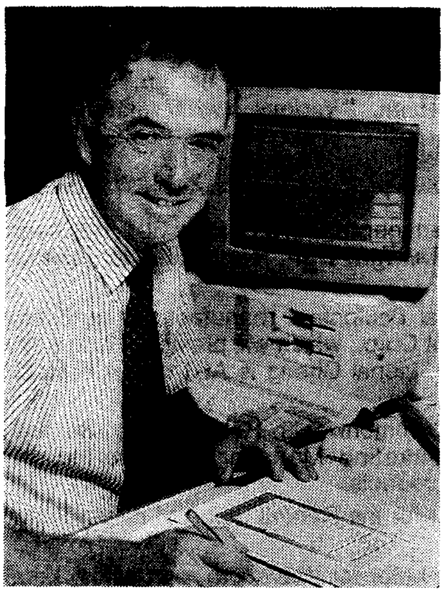
The flux transformers, fabricated at LBL/UCB, involve an insulating layer of strontium titanate sandwiched between two layers of YBCO. All three layers are laser-deposited on a heated chip so that they grow epitaxially — that is, with aligned crystal structures.

SRA, ERICSSON DEVELOP RAIL COMMS NETWORK

The NSW State Rail Authority and Ericsson Australia have successfully completed initial tests on a world-first touch-screen telecommunications control system for rail networks.

The system has attracted international interest from a number of overseas rail authorities regarding the possibility of its incorporation into their operations.

The system was planned for commissioning in May, bringing the whole SRA rail system in strategic metropolitan centres in and around Sydney under one



central control. It is part of State Rail's five year communications strategy of upgrading the rail network to a fully integrated voice and data system.

Ericsson's advanced digital PABX — the Ericsson MD110 voice and data transmission system — forms the backbone of the State Rail's communications network. The network will initially cover 12 locations in the Sydney metropolitan area, and State Rail is currently investigating expansion to the country area.

Ericsson and Brisbane-based telecommunications equipment manufacturing and design company Ansa developed the special Advanced Voice Operating System (AVOS) to complement the MD110 facilities.

UNI OF NSW BREAKTHROUGH IN 4.8KBPS SPEECH CODING

Researchers Dip Sen and Noel Gordon, under the supervision of Associate Professor Harvey Holmes, at the University of NSW, have recently demonstrated a stand alone fully duplex speech codec for providing good communication quality speech at 4.8kbps.

The codec has been fitted on a half Eurocard board measuring 100mm x 160mm and contains a single DSP32c for all its processing requirements.

It is believed this is the world's first single DSP fully duplex codec to be developed at 4.8kpbs.

Application areas for the technology include encryption telephony, voice mail, multiplexing voice and data on digital networks in satellite and HF radio communications.

Although available at present with a proprietary CELP (Code Excited Linear Prediction) speech compression algorithm, the codec can also operate with the recently defined US Department of Defence Standard CELP.

An algorithm for MBE (Multiband Excitation) code recently adapted by INMARSAT and AUSSAT is presently under development.

The codec is the first commercially oriented research goal achieved by the University of NSW under a recently awarded GIRD (Generic Industrial Research and Development) grant which it shares with the University of Wollongong.

The $960,000 grant was awarded in June 1990 with Binary Engineering being the commercial collaborator.

AUSTEL FLEXES ITS MUSCLES

The Australian Telecommunications Authority has signaled a tough stance on unapproved telecommunications equipment.

"Safety and network integrity are at risk. Unscrupulous suppliers are failing to warn buyers of the dangers of using unapproved equipment", said Norm O'Doherty, AUSTEL's Manager of its Compliance Branch.

He said: "AUSTEL's recently appointed Investigation Officer, Jim Helm, is targeting these suppliers in a crack down on the sale of unapproved equipment".

He has been doing the rounds of distributors and retail outlets, including Sydney's Flemington market.

Selling unapproved equipment without a warning that it cannot be connected to Telecom's network puts the seller at risk of a $12,000 fine. Purchasers who connect such equipment are also at risk of a $12,000 fine. AUSTEL's crack down is being supported by an advertising campaign in specialised computer and communications magazines and newspaper supplements.

The targets there are modems, fax machines and answering machines.

The advertisements warn of the dangers of connecting unapproved equipment and suggest that before they purchase buyers should check whether the equipment has an AUSTEL permit number.

Purchasers should look for an AUSTEL approval number (for example A90/00A/0000) or a Telecom Australia authorisation number (for example C86/00A/0000). Unapproved equipment should be disconnected.

NEWS HIGHLIGHTS

AUSTRALIAN CELLULAR INTERFACE SELLING IN US

Intercel, the recently developed Australian cellular radio interface which allows the hook up of mobile office technology like facsimiles, lap-top computers and answering machines has begun exporting to North America.

Developed by mobile office specialists Austmode, the interface attracted attention when it was launched at the recent CES in Las Vegas. Austmode has signed the $150,000 contract with Command Communications and expects further orders in the immediate future.

hIGHEST OUTPUT RED SEMICONDUCTOR LASER

Researchers at Toshiba R&D Centre in Tokyo have succeeded in developing a prototype red-light semiconductor laser diode with a maximum optical output power of over 100 milliwatts — the highest output power of any continuous-wave visible laser diode yet announced. The new device is expected to find use as a new light source for optical information storage products, replacing conventional semiconductor lasers.

Current optical information storage products, including electronic document filing systems and CD-ROMs, use semiconductor lasers as light source to write and read data. The present devices emit an invisible laser beam with 30mW of output power and a 830nm wavelength. Demand is increasingly growing, however, for devices with higher output power and a shorter wavelength in order to store data at a higher density and read them more accurately.

The new prototype device emits a maximum of 106mW at a wavelength of 690nm and is thus able to write data more minutely and read it more accurately than conventional semiconductor lasers.

TELECOM WINS JINDALEE CONTRACT

The Minister for Defence, Senator Robert Ray, has announced that Telecom Australia is the preferred tenderer for the $970 million contract for the Jindalee 'over the horizon' radar network.

Cabinet approval for the construction of Jindalee is a milestone for the Defence Science and Technology Organisation, whose scientists have established Australia as a world leader in OTHR technology. DSTO's Surveillance Research Laboratory is the R&D authority for the project and this role will continue throughout the life of the project.

AWAM ACHIEVES CHEAPER CHIPS

AWA Microelectronics has introduced a new service which means that the design and production of custom chips will now be within the price range of even the smallest business.

This cost saving is achieved through the innovative Multi-Project Reticle (MPR), which basically allows a number of different chips to be tested and produced on the same silicon wafer.

This provides a significant cost saving on the manufacturing of the mask set used for the chip production (which alone retails for approximately $16,000), the silicon wafer manufacturing and on the later commercialisation of the design.

The MPR offers advantages in particular to smaller companies which might not want a large number of the final chips, and who therefore want to keep the production and prototyping costs down.

Mr John Hann, Business Development Engineer for AWA MicroElectronics, says that the MPR takes advantage of standard design tools but produces a final Application Specific Integrated Circuit (ASIC) which is cost effective for use in products for the open market.

"The MPR has very little effect on the flexibility of chip design," says Mr. Hann. "Various size formats for the

NEWS BRIEFS

- David Hudson, formerly Engineering Manager of EMI's Studios 301, has been appointed Joint Managing Director of ***Fairlight ESP***, responsible for international sales and marketing.
- ***AST Research*** has signed an original equipment manufacturer purchase agreement with California-based FileNet Corp., which will provide it with entry into the new area of image processing. Lional Cheng is AST's new Director and Acting General Manager.
- Formerly Regional Manager with the Commonwealth Rehabilitation Service, Kathy Doric has been appointed Marketing Manager of ***Hypertec***, an Australian builder of PC enhancement products.
- ***Anitech*** is now the exclusive distributor for the Pantos range of instrumentation from ***Nippon Denshi Kagaku***.
- ***RF Devices*** is the new Australian distributor for Wavecom, part of the Loral group of companies, and also for the Schlumberger range of RF design, test and repair equipment.
- Mike Clarke is the new Regional Manager for ***Kingfisher's*** new Sydney office. The company supplies an extended range of fibre optic test and measurement equipment manufactured in Australia.
- The entire staff at ***Novatech Controls*** in Melbourne have become shareholders in a deal with Novatech's US partner, Driver Harris, which was a 75% owner for the last six years.
- ***Obiat*** has been appointed as Australian distributor for the Gould Test and Measurement Group of Ohio, USA.
- Andrew Tweddle has been appointed to head up the networking business unit of ***Webster Computing Corporation***. Mr Tweddle was previously networking engineer at Melbourne University, where he created what was claimed to be the world's largest campus fibre-optic network.
- The Australian ***Terran Computers*** has acquired the name and assets of Adelaide-based Microbyte. Microbyte's low-end educational computers will complement Terran's more powerful commercial and government systems.
- ***AWA Defence Industries*** has relocated its NATA Registered Instrument Calibration and Repair Facility from Leichhardt to Wyndham Street, Alexandria as a result of recent storm damage to its old building.
- Datel USA has appointed ***Quiptek Australia*** as local distributor for its range of component products.
- ***Soanar*** is now the Australian agent for the range of instrument cases made by Hammond Manufacturing of Ontario, Canada.
- ***Adilam*** is moving on June 10 its Melbourne head office to 5 Nicole Close, North Bayswater 3153 (PO Box 664). The new telephone number is (03) 761 4466.

MPR are available so that design complexities of up to 6000 gates and 100 I/O pads can be accommodated and the only restriction is that the die size for each format is the same size, to allow cutting of the wafer."

"We expect that the reduction in costs — to only approximately $4000 for a completed, packaged chip — means that many small businesses who have previously perceived custom chips as being too expensive, will now take a second look at the advantages of ASICs in improving reliability and reducing size in products."

INMARSAT-C LAUNCHED IN AUSTRALIA BY OTC

Inmarsat-C, claimed to be the world's most compact low cost mobile satellite communications system designed for ships and land mobiles such as long-distance transport vehicles and 4WD's, is now available in Australia following completion of OTC's two new satellite earth stations in Perth. These are linked to Inmarsat's Pacific and Indian Ocean satellites.

Known in Australia as OTC Satcom-C, the new service provides for suitably equipped mobiles, two-way 600bps data and telex communications with virtually any location in the world, for 24 hours a day and with what is described as 'complete reliability'.

One of the outstanding features of the system is the compact size of end-user equipment. The Satcom-C antenna is an omni-directional unit no larger than a small flower pot, while the terminal unit is about the size of a car radio and weighs only two kilograms. The terminal unit connects to a personal computer, message processor or data interface via an RS-232C line.

Current cost of a basic system without peripherals is around $10,000, but this is expected to fall as the number of manufacturers and production volumes increase.

COMMS TRUNKING 'SECURITY RISK'

A proposal to replace existing multiple simplex and duplex radiocommunications systems at airports with a common shared 'trunking' system has generated fears that this would result in a significant reduction in airport security.

An industry spokesperson said that a serious risk with such a shared trunking system is that a fault in the common base station would render all channels useless, making it more vulnerable to attack by terrorists.

The reduction in channel redundancy would also increase the risk of channel inaccessibility and subsequent delays in emergency situations, it was suggested.

The spokesperson, who wished to remain anonymous, suggested that those concerned about the increased security risks with trunking should make suitable representations to the Federal Airports Commission and/or the Civil Aviation Authority.

TRAINING CENTRE FOR MOORABBIN TAFE

Federal Minister for Employment, Education and Training John Dawkins has launched a new industry training centre for Melbourne's southern business region.

The Industry Training Centre is a joint venture between Moorabin TAFE, local industry and both the State and Federal governments.

At a projected cost of $35 million, the Centre will provide training in metals manufacturing, food processing, computing, management and quality control.

In launching the project, Mr Dawkins said that it is just the kind of development which is likely to be the leading edge of new developments between TAFE and industry, and may well become a role model for the rest of the country.

Located in the grounds of Moorabbin TAFE, the Centre is planned to be completed by December 1992.

PUBLIC BROADCASTING GETS OWN MAGAZINE

The Public Broadcasting Association of Australia has launched *Technical Notes*, a bi-monthly magazine designed to provide a forum for technical discussion and analysis of developments in this rapidly growing sphere of broadcasting.

The new publication will draw on contributions from the sector's engineers, which now number several hundreds. A stated goal is to prepare the public stations for a range of major new developments such as DAB (digital audio broadcasting). Senior contributing editor for *Technical Notes* will be Chris Burnatt, who currently oversees the operations of three public broadcasters in Sydney.

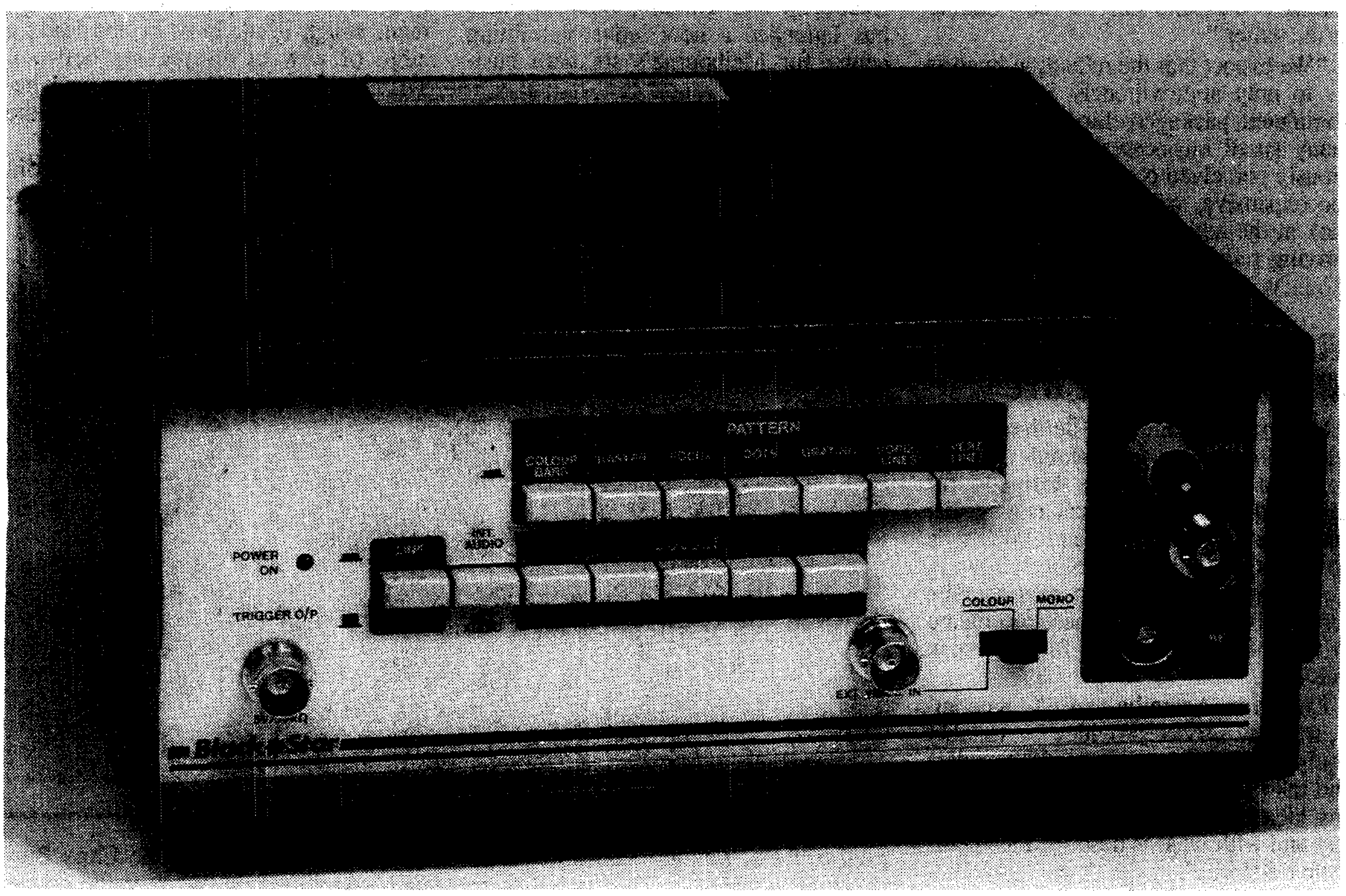
CD RENTAL 'THREAT TO INDUSTRY'

The rental of compact discs constitutes the greatest threat that the Australian music industry has ever seen, according to Denis Handlin, MD and CEO of Sony Music Australia.

Mr Handlin made this claim in a recent letter to everyone in the industry, urging them to take action to lobby for changing the laws concerning CD rental.

Claiming that the effect of CD rental on retail sales of records is 'devastating', Mr Handlin's letter quoted figures from Japan, suggesting that between 1980 and 1990 record sales in that country fell by up to 40% while record rental shops grew from virtually nil to over 6000.

Mr Handlin suggests that record rental shops are now 'starting to explode' in Australia, and that as a result there is an urgent need for action by the Federal Attorney-General's Department to change the Copyright Act. ■



TV/VIDEO PATTERN GEN, PROBES FROM BLACK STAR

Remember Black Star, the innovative British test equipment maker which set out to compete with Asian manufacturers? Well, it's still going strongly, as witnessed by two of its recent releases: a flexible pattern and colour bar generator for PAL TV and video testing, and a new range of passive test probes.

by JIM ROWE

As I noted back in the March 1990 issue shortly after the Black Star range of test instruments had been released in Australia, it's something of a surprise to discover that they're designed and manufactured in Britain. But that is indeed where they originate — from St. Ives, deep in the wilds of Huntingdon in Cambridgeshire. Black Star seems to have set out to take on the well-established Asian test gear makers at their own game — producing a range of well made, down to earth, low-end test instruments which provide cost-effective solutions for the service workshop, small development lab and serious hobbyist. And so far they look to be doing quite nicely, judging from the fact that their range continues to expand. It now includes a 15MHz battery oscilloscope, a 4.5 digit intelligent DMM, two 3.5 digit DMMs, about 12 different frequency counters and timers, two function generators, an I/O interface for PCs, and

PC software for testing a wide range of video monitors.

A few weeks ago, the firm's Australian distributor Obiat sent us for review samples of two of their newer products: the 'Orion' PAL TV and Video Colour Pattern Generator, and a range of passive measuring probes. Like the other products in the Black Star range these carry quite competitive price tags: the Orion sells for $725 (plus tax if applicable), while the probes sell for between $48 and $75 plus tax depending upon the model.

Pattern generator

The Orion Colour Pattern Generator is particularly interesting, because it provides rather more than the traditional TV test pattern and colour bar functions. For example it provides not only direct composite PAL video in addition to the usual modulated RF, but also a full set of separate 'component video' outputs: I, R, G and B, plus line and frame sync. And these are available in a choice of either 1V peak to peak or 'TTL' signal form, with the sync signals also available in either normal or 'inverted' polarity. Not only that, but the component signals are available either at individual BNC connectors, or together on a DB9 connector as used by many computer video graphics adaptors.

Additional features include a choice of 5.5MHz, 6.00MHz or 6.5MHz for the colour subcarrier, to make the generator suitable for just about any of the PAL system variations used in various countries; a direct audio output, providing a 1kHz sinewave (800mV RMS), plus the ability to accept an external audio input; a tuneable 'dual' RF output covering *both* high-band VHF and UHF channels, and which is also adjustable in output level; and external video input; and a scope trigger output, which provides a choice of either 'line' or 'frame' triggering pulses.

The unit also provides a notably wide range of test pattern signals. As well as the usual vertical and horizontal lines, dots and cross-hatch, plus a colour-bar signal, there's a 'raster' signal which can be used to generate screens of each of the primary and complementary-primary colours for purity testing, by using the I, R, G and B enable/disable buttons. There's also a 'focus' signal, which generates a closely-spaced set of vertical lines at 1MHz, for adjusting beam focus. And finally there's a colour killer button, to convert any of the other patterns to monochrome — converting the colour-bar signal into a grey scale, for example.

In short, it's a particularly flexible unit. Not just in terms of the signals it can produce, but also in its ability to provide signals for testing a wide variety of equipment.

We tried out the sample unit with a couple of standard TV sets, with a composite video monitor and with a multi-scan computer monitor. In each case it turned out to be very easy to produce stable patterns on the screen, and also to obtain stable waveforms on the scope — thanks to the Orion's external trigger output.

We did notice that the colour-bar patterns in particular were significantly crisper when displayed on an RGB monitor, compared with a PAL composite monitor or — worse — a TV set via the RF output. That's to be expected, of course; PAL encoding and RF modulation/demodulation must inevitably introduce some signal degradation. I'm not suggesting that the Orion's composite video or RF output signals were noticeably worse that those of similar instruments, by the way; just that the RGB signals gave a particularly crisp image.

Basically our tests suggested that the Orion should be very useful indeed in servicing and maintenance situations. With its facility to accept external video and audio, it should also be handy as a local signal source for manufacturing organisations.

Incidentally although the outputs from the Orion are compatible with at least some computer monitors (like the 'multi-scan' variety), Black Star is also coming out with a separate instrument dedicated specifically to these. To be called the 'Mon-T Monitor Tester', it will provide for some 12 different kinds of monitor from MDA/Hercules right up to to Super VGA/XGA, in addition to a couple of TV modes.

It will also provide both TTL and 'analog' outputs, and a choice of 9 pin, 15 pin and BNC output connectors. In addition to the range of test signals provided by the Orion, it will also provide a 'testcard' pattern.

At the time of writing the Mon-T was expected 'shortly', so it may well be available by the time you read this.

But returning to the Orion, we also looked briefly inside the case to inspect the construction.

It's based on the same modular case system used in the other Black Star instruments we've seen, with top and bottom half-cases and separate front and rear panels. In this case as the instrument uses 'tall' panels to fit in the required number of controls and connectors, there are also side 'spacer' panels to match.

As before, the construction is neat and tidy, and gives evidence of careful design. With the Orion there are actually three internal PCB modules: one mounted vertically immediately behind the front panel, another similarly mounted just 'behind' (i.e., inside) the rear panel, and a small power supply module which sits horizontally and centrally in the bottom of the case.

From our quick inspection it looked as if the 'front' PCB module provides the pattern generation circuitry, while the 'rear' module provides the video output

Rear view of the colour bar/pattern generator, showing the six component video BNC connectors with their level selection switches at bottom right. Also visible is the DB9 output connector and the sound carrier frequency switch.

drivers, sound signal processing and RF modulator.

Summarising then, the Orion seems to be well made as well as providing more than the usual range of functions and facilities. It therefore seems to represent good value for money at the quoted price.

Passive probes

The other new products that Black Star has released is a range of passive test probes, for use with oscilloscopes and similar instruments. There are five probes in all — three with fixed division ratios of x1, x10 and x100, one a higher performance x10, one with a switch providing either x1 and x10, and an RF detector probe.

The 'standard' unswitched divider probes are designated BS-001, BS-010 and BS-100 respectively. The bandwidth of the first is rated at 35MHz and both the second and third at over 250MHz, with risetimes of 10ns and less than 1.4ns respectively.

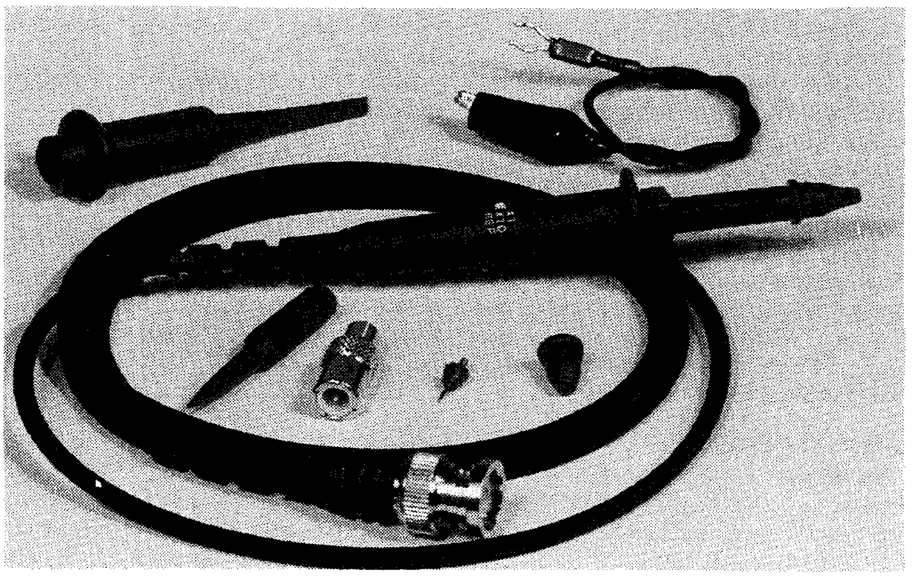
The corresponding input inpedances are the scope input plus 40pF, 10M in parallel with 16pF, and 100M//7.5pF respectively (assuming a scope input impedance of 1M//15pF).

As an alternative to the BS-010, the BS-300 offers a 300MHz bandwidth and 1.2ns risetime, for improved pulse response. It offers the same 10M//16pF input impedance.

For those who like the convenience of a probe with switchable division ratio, the BS-110 offers both x1 and x10 ratios with only a slight degradation in performance compared with the separate probes. Its bandwidth in the x1 position is 25MHz, with 14ns risetime and an additional input capacitance of 90pF (compared with 40pF), while in the x10 position the corresponding figures are 250MHz, less than 1.4ns and 10M//16pF.

A further feature of the BS-110 probe is that its switch has a third position, marked 'Ref'. This effectively grounds the probe tip via the 9M multiplier resistor, giving a convenient way to determine the ground reference level.

All of the divider probes have a response extending down to DC. The BS-001 and -010 units have a rated maximum input working voltage of 500V peak (DC plus AC), with derating for higher frequencies, while the BS-300 offers 600V peak and the BS-110 is derated to 200V peak for the x1 switch position. The BS-100 has a higher rating of 1200V peak, as you might expect.



The BS-110 divider probe comes with a selection of accessories, which also accompany the other probes. A three position slider switch allows selection of x1 or x10 division ratios, or reference ground level.

Incidentally, the compensating trimmer for the x10 and x100 divider probes is in the probe itself, which is somewhat more convenient than the alternative arrangement of having it in the BNC plug at the far end of the cable.

I suspect this arrangement is also more cost effective, as the BNC plug is quite standard and could even be replaced easily if this is ever needed. In any case, this scheme allows the minimum input capacitance to be set slightly lower than with the other configuration, which is preferable.

The BS-750 RF detector probe has an input capacitance of 7pF, and a bandwidth of 100kHz-500MHz +/-1dB (750MHz for +/-3dB).

It has an input isolation rating of 200V peak, but the maximum AC input voltage is 50V RMS — presumably limited by the detector diode's ratings. The quoted turn-on voltage is 250mV, suggesting that a Schottky diode may be used.

All five probes come with 1.2m of cable, ending in a standard BNC connector to suit the majority of scopes. They also come with a very nice kit of accessories: a push-on spring loaded test hook, a 20cm long ground lead with clip, an IC pin test tip, an insulating shroud and a BNC adaptor. In addition the x10 and x100 divider probes come with a compensation adjustment tool.

I should add that all five probes also have a 'swivel head' construction, making it easier to ensure that the spring-loaded clip remains clipped to an IC pin or component lead, despite any forces which might otherwise be exerted by the probe lead. This is a nice feature, as is the fact that the probe end of the detachable ground lead fits into a shrouded slot in the swivelling section.

The sample probe supplied to us for review was the switched BS- 110 divider probe, and judging from this the probes appear to be very nicely made indeed.

All parts are well finished, and both the probe and BNC output connector are provided with articulated plastic 'tails' to reduce strain on the cable due to flexing.

Tried out with a number of instruments, including a 100MHz analog scope and a late-model DSO of the same nominal performance, the probe gave a good account of itself.

The compensation adjustment was smooth, the risetime seemed to be somewhat better than the rated 1.4ns in the x10 position, and the input capacitance was nearer 14pF than 16pF. In short, it did everything one could ask of this kind of probe.

On the whole, Black Star seems to have done an excellent job with both the Colour Bar/Pattern Generator and the probes. They both give every impression of being carefully designed, well made and hence good value for money.

In short, if Black Star keep going like this, they seem bound to give the Asian makers a good run for their money!

For further information on either these or the other instruments in the Black Star range, contact Len Altman at Obiat, 129 Queen Street, Beaconsfield 2014 or phone (02) 698 4776. ■

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Three new multimeters - Top-of-the-line Fluke 79 and 29 offer capacitance, frequency, fast 63-segment bar graph and other features plus entry level Model 70 delivers unparalleled Fluke quality and safety.

Models 73, 75, 77, 21 and 23 are all upgraded - all for example now have Touch-Hold™

Accuracy Comparison

Range	70	73	75(21)	77(23)	79(29)
Vdc	0.5%+1	0.4%+1	0.4%+1	0.3%+1	0.3%+1
Vac	2.0%+2	2.0%+2	2.0%+2	2.0%+2	1.0%+2
Ohms	0.5%+1	0.5%+1	0.5%+1	0.5%+1	0.4%+1
Adc	NA	1.5%+2	1.5%+2	1.5%+2	0.5%+2
Aac	NA	2.5%+2	2.5%+2	2.5%+2	1.5%+2
Frequency	NA	NA	NA	NA	0.01%+1

Fluke 70

Lowest cost Fluke DMM ever!

- Now has automatic Touch Hold® (retains reading when probe is removed)
- New TL75 test leads with HardPoints™
- Range hold and manual ranging
- Continuity beeper
- 0.5% basic accuracy
- Vdc from 100μV to 1000V
- Vac from 1mV to 750V
- 300mV range
- Ohms from 0.1 to 32MΩ
- All inputs protected
- Battery saving "Sleep Mode"

$125.00 (ex tax)
$146.00 (inc tax)

Fluke 73-II

All Fluke 70 features plus

- Improved accuracy
- Now has 10A range (20A for 30seconds)
- Withstands 4800VA

$175.00 (ex tax)
$203.00 (inc tax)

Fluke 75-II

All Fluke 73 features plus

- Improved accuracy
- 32 and 320mA ranges
- 10μA to 10A

$260.00 (ex tax)
$302.00 (inc tax)

Fluke 21-II

Similar specifications to Model 75

- Now has 10A range
- Yellow model for high energy applications

$260.00 (ex tax)
$302.00 (inc tax)

Model 70

Fluke 77-II

All Fluke 75 features plus

- 0.3% basic accuracy
- Protective holster and Flex-Stand™
- Lower Price

$295.00 (ex tax)
$343.00 (inc tax)

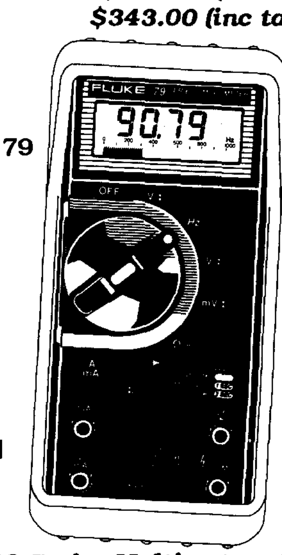
Fluke 23-II

Similar specifications to Model 77

- Yellow model for high energy applications

$295.00 (ex tax)
$343.00 (inc tax)

Model 79



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FLUKE

Fluke 79

All Fluke 77 features plus

- Improved accuracy
- Capacitance 10pF to 9999μF
- Frequency 1Hz to >20kHz
- Displays ac voltage in frequency mode
- High resolution (0.01Ω) Low-Ohms range
- High resolution 63 segment analog bar graph updated 40 times/ second
- Smoothing™ provides stable average of 8 readings for variable signals
- 4000 count display with 15 annunciators
- 10000 count mode on selected ranges

$350.00 (ex tax)
$406.00 (inc tax)

Fluke 29

Similar specifications to Model 79

- Yellow model for high energy applications

$350.00 (ex tax)
$406.00 (inc tax)

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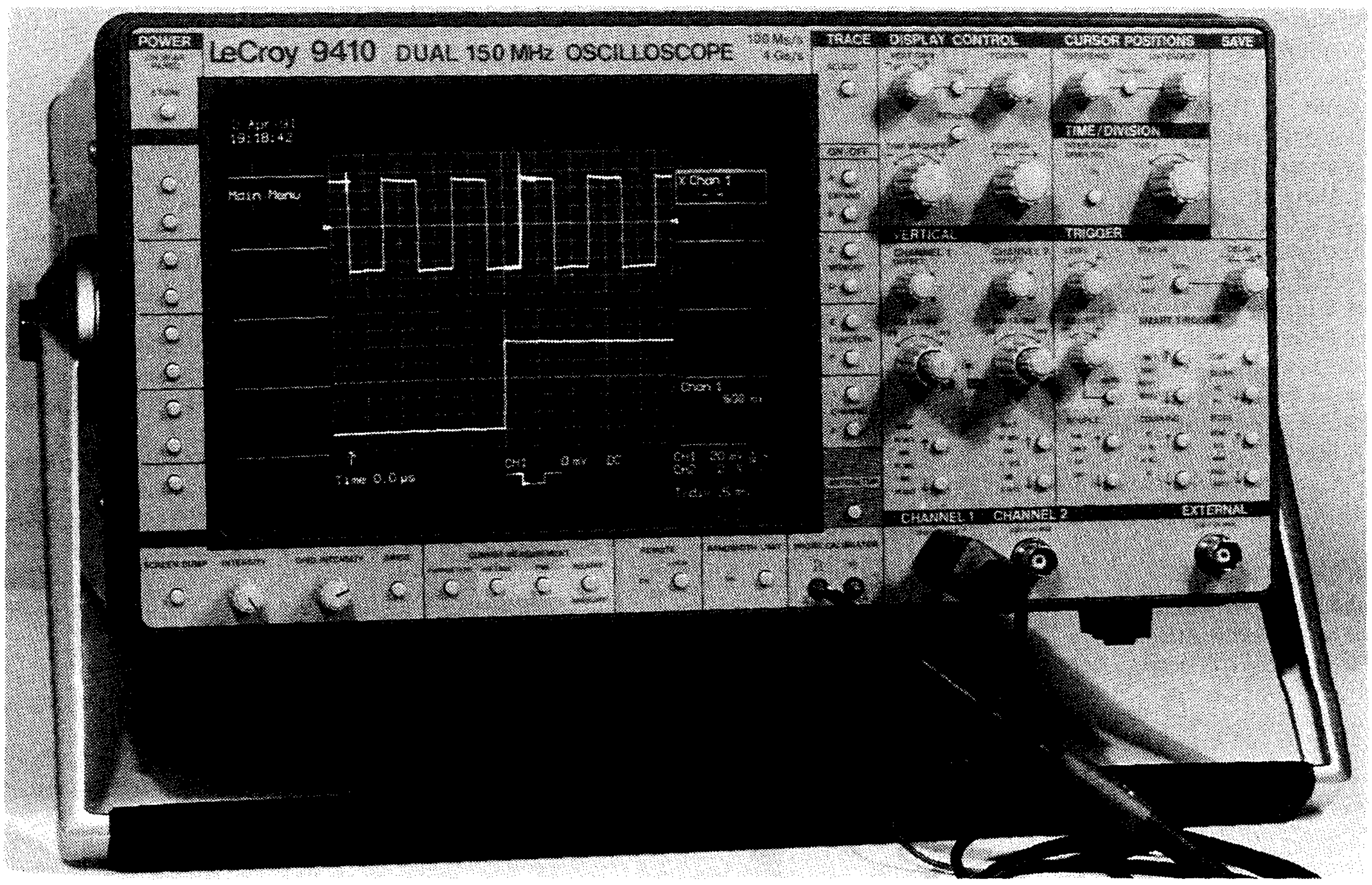
READER INFO NO. 19

LECROY'S NEW 9410 150MHZ DIGITAL SCOPE

Back in the April 1990 issue, we reviewed the very impressive LeCroy 9450 dual channel 350MHz digital scope. The firm has now produced the 9410, which is essentially a 'scaled down' version with many of the same features but a bandwidth of 150MHz. With this model some of the signal processing features are now also optional, rather than standard.

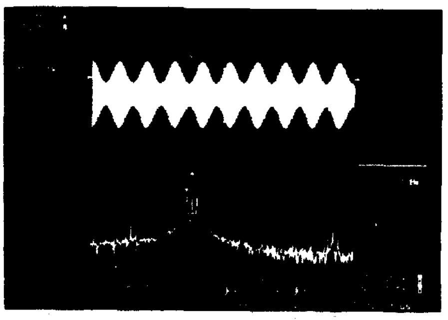
by JIM ROWE



Externally, the new LeCroy 9410 DSO looks almost identical to its larger brother. In fact you have to look very closely to detect any differences, as far as the front panel is concerned — which shows how many functional features it shares with the earlier model. The main difference is that the two uppermost rows of controls have been nudged a short distance towards the screen, to leave space for one of the options; more about this soon.

The similarities aren't merely confined to exterior appearance, either. Comparing the internal block diagrams shows that the two models have virtually the same architecture, as you might perhaps expect: after the input sample/hold and dual 8-bit analog to digital 'flash' converters, they're both essentially 68020-based microcomputer systems.

Where, then, do the differences lie? Well, the new 9410 has an input or 'analog' bandwidth of 150MHz, compared with the 350MHz bandwidth of the 9450. Maximum sampling rate is in this case 100 megasamples per second,



With the optional WPO2 spectrum analysis firmware, the 9410 can compute a 1000 point FFT in less than a second.

compared with 400MS/s, with an effective 'equivalent time' sampling rate of 4GS/s in random interleaved mode for repetitive signals, compared with 10GS/s. The effective bandwidth for single shot transients, where real-time sampling must be used, is about 10MHz compared with 40MHz.

Also the sample memories for each channel are only 10K words deep or 'long', compared with the 9450's 50K — although this is still quite long compared with many other instruments, it should be noted. This allows the 9410 to sample at its maximum rate for a larger range of timebase speeds, preserving bandwidth and time resolution.

These seem to be the main performance differences, although a closer look at the internal block diagrams shows that in its basic form, the 9410 also lacks some of the fancy digital signal processing facilities which are built into the 9450. These include facilities to perform averaging and arithmetic calculations; functions such as integration, differentiation, log, exponent, absolute value and square root; storage of extreme positive and negative waveform values; enhanced resolution processing to give effective 11-bit resolution; and spectrum analysis using the Fast Fourier Transform (FFT).

With the 9410 these additional facilities are actually still available, but in the form of two optional enhancement firmware packages: WP01, covering all of the basic DSP functions and resolution enhancement, and WP02 which covers the FFT spectrum analysis. Both fit inside the instrument, and can be purchased either with it or retrofitted at a later stage.

In addition to the two main firmware options, there's also a new 'memory card' option using credit-card sized battery backed SRAM memory cards. of either 128K or 512K capacity, conforming to the PCMIA/JEIDA format. The cards mate with a socket which is fitted into the top right-hand corner of the scope's front panel — hence the small blank area on the basic model.

The advantage of SRAM memory cards is that they provide a fast, rugged and reliable medium for either archiving or transferring waveform and setup data between the scope and other equipment (such as a personal computer — they're DOS compatible). There are no moving heads or other mechanical parts, transfer rates are around 100 times those of floppy disks (20 times that of hard disks), and the cards are also extremely light and compact.

LeCroy claims to be the first instrument maker to use the cards, in its latest portable DSOs like the 9410.

Of course the 9410 still provides both RS-232C and GPIB/IEEE-488 ports for data communications with a PC, plotter or other equipment. The RS-232C port operates up to 19,200 baud, while the GPIB port is configured as a talker/listener for data transfer at up to 380K bytes per second. The instrument's address is set via switches on the rear panel, and command syntax and data formats follow IEEE-488.2 standards.

Here's a recap of the other main functional features which the 9410 shares with its larger brother:

- A large 125 x 175mm screen display with bright, crisp vector plotting rather than raster scan. The screen resolution is 4096 x 4096 pixels.
- An automatic calibration facility, which ensures overall vertical accuracy of +/-2% of full scale and a timebase interpolation accuracy of +/-20ps RMS. Both vertical and timebase systems are re-calibrated each time settings are altered.
- A very wide range of trigger facilities, with selection from many different triggering sources, modes and conditions. In addition to all of the normal functions, a 'Smart Trigger' facility provides single-source triggering with holdoff by time or number of events, or qualification by pulse width or interval width; state qualified triggering, again with time or events delaying; and TV triggering on a chosen line within a chosen field.
- The ability to perform high speed automated measurements on up to 10 signal characteristics including RMS voltage, risetime, falltime, mean, standard deviation and pulse width — not only for input signals but also for stored, expanded and processed waveforms.
- An auto-setup facility, which selects the appropriate control setting for a stable signal display in under a second.
- The ability to expand waveforms by up to 200 times, as a result of the storage resolution provided by its 10K memories.
- Vertical sensitivity down to 1mV/division, which can be extended down to 50uV/division via vertical expansion and signal processing.
- Offset compensation ranging between +/-12 times to +/-120 times the sensitivity setting, up to +/-12V.
- Selectable scaling to compensate for probe division factors, up to x10000.
- Full programmability of all front-panel control settings (including cursor position), via the RS-232C or HPIB interfaces.
- Support for a wide range of printers and plotters for hard-copy output. Printers supported include IBM, Epson, and HP Quietjet, Thinkjet and Laserjet. Screen dumps are made in parallel with normal operation, and are initiated by either a front-panel button or remote command.

In short, it's a very powerful measurement system indeed.

We were able to borrow a sample 9410 for a couple of days, to try it out. It was fitted with both the WP01 and WP02 options, bringing its capabilities very close to those of the larger 9450 — apart from bandwidth, of course. We tried it out with a variety of different kinds of signal, including pulses, off-air TV signals, signals from various signal generators and so on.

As with our previous experience with the 9450, we found it a very impressive instrument. As well as being powerful, flexible and capable of making a wide range of precision measurements, it was also commendably easy to drive. The 'look and feel' is quite like a conventional analog scope, so that intuition generally leads you to finding the right way to make your desired measurements — without a need for frequent reference to the manual. And the nice thing about the 9410 is that in its basic form, it costs only around *half* that of its larger brother: around $12,000.

For more information about the 9410 or any of the other LeCroy models, contact distributor Scientific Devices Australia, of 2 Jacks Road, South Oakleigh, 3167. Or phone them on (03) 579 3622. ■

New Test and Measuring Instruments

Hand-held LAN fault finders

Hewlett-Packard has introduced its first family of handheld, local-area-network (LAN), media-test products. The three handheld time-domain reflectometers (TDRs) are scanners, designed for network-service organisations and private-network managers who install and/or maintain LANs.

The new HP family of media-test scanners include the HP J2181A cable scanner, the HP J2177A pair scanner and the HP J2187A quick scanner. The HP cable scanner locates faults in twisted pair or coaxial LAN cabling systems. It can monitor LAN traffic and graphically display or print out a 24-hour daily activity log.

The HP pair scanner is designed to solve problems found in more complicated twisted-pair networks. It includes all the features of the HP cable scanner, plus network-testing and monitoring functions. The menu-driven HP quick scanner troubleshoots networks and performs standard LAN diagnostic tests. HP believes that more than 50% of network problems are related to the physical transmission media. Designed specifically to address these problems, the HP scanners are inexpensive, easy-to-use and rugged.

All three scanners quickly isolate faults in the physical LAN media of most LAN cabling systems, including IEEE 802.5 token-ring, IEEE 802.3 Ethernet and Arcnet networks.

For more information, ring Hewlett-Packard on (008) 033 821.

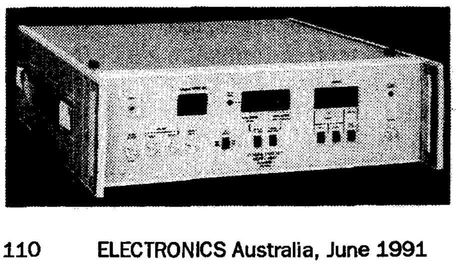
IF noise tester

One of the digital telecommunications test instruments manufactured by Scientific Atlanta is the model 4647 IF (intermediate frequency) noise test set.

The product has many applications for both digital and FM Radio measurements, including satellite modems.

It simplifies bit-error-rate threshold tests, enables clock phase adjustments and simplifies pseudo-error alarm adjustments, AGC curve measurements and FM threshold measurements.

By using the noise tester at the 70MHz equipment IF to simulate path fade, it requires less time than current methods, such as adding RF attenuators to the waveguide.



By allowing the accurate simulation of fade conditions, it also highlights problems such as path misalignment, low S/N ratio, and bad equalization, which may not be perceptible under normal conditions.

For more information circle 245 on the reader services coupon or contact Scientific Atlanta, 2/2 Aquatic Drive, Frenchs Forest 2086; phone (02) 452-3388.

Radio and TV measurement receivers

The Grundig ME series of radio/TV level measurement receivers, handled by Rohde & Schwarz (Australia), provide convenient and simple solutions to servicing, antenna installation, CATV systems and off-air field strength monitoring and measurement.

All the ME series are programmed for pushbutton access to all Australian TV channels from VHF through UHF, from channel 0 through to channel 69. Cable TV and hyper band TV are also included, as is the VHF FM band 87.5 — 108Mhz.

The basic, general purpose ME400 offers both mains and battery operation with a discharge warning device.

Features include automatic measuring range selection with digital display of the level values for both vision and sound carrier.

Correction values specific to the unit are calculated in the display.

The ME500 model includes a small, inbuilt printer for automatic logging, while the larger ME600 incorporates a picture tube for simultaneous evaluation of picture quality.

The ME800 includes measurement of both first and second sound carriers plus a spectrum monitor mode on the picture tube, allowing rapid and effective identification of both signals and interference.

For further information circle 241 on the reader service coupon or contact Rohde & Schwarz (Australia), 63 Parramatta Road, Silverwater 2141; phone (02) 748-0155.

Programmable pressure controller

The Druck DPI 510 digital pressure instrument measures, indicates and controls pressure values in any scale units and has an accuracy of better than 0.04% of reading on a +/- 99999 display. It supersedes the DPI 500 pressure controller and provides many extra features not available on the earlier instrument.

Continued use is made of the Druck range of pressure transducers as the sensing elements, but with improvements in stability, temperature performance and construction techniques.

The programmable, versatile and stable controller enables a total calibration facility to be provided in one unit.

Design highlights are: microprocessor techniques which significantly enhance the reliabiity and serviceability aspects of the design, and software generated routines to provide a multitude of extra features which were impossible in earlier analog based instruments.

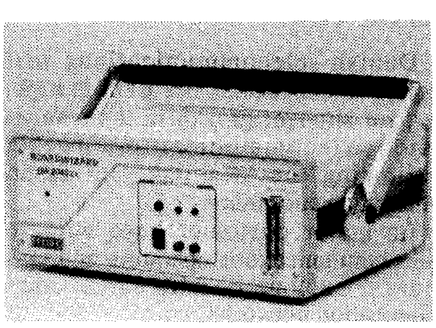
For further information circle 242 on the reader service coupon or contact M.B. and K.J. Davidson, 17 Roberna Street, Moorabbin 3189; phone (03) 555-7277.

PCB tester

Various methods have been used to locate failed components on printed circuit boards. The 'Boardwizard' by Proteq Technologies combines two of the most effective of these in one unit: signature analysis and in-circuit function testing.

The 'Wizard' consists of the main unit, software, IC leads with clips and a dedicated card that fits inside the user's IBM compatible PC.

Signature analysis is carried out on PCBs in a power off situation, with a sine wave signal being injected between earth and the test points. Traces obtained are compared to those previously learnt from a good board, allowing faulty components or track faults to be revealed.



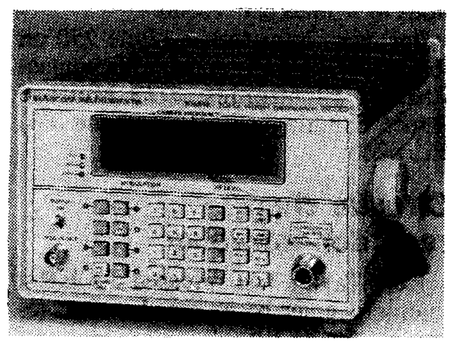
For in-circuit testing, the internal power supply of the Wizard provides 5 volts at up to 5 amps to power the board under test. Library information on the disk is used to test each gate or function to reveal faulty TTL or CMOS devices.

The unit can even identify many unknown devices and can learn from good components, allowing it to write its own test routine for PALs, static or dynamic RAMs and ROMs.

For further information circle 243 on the reader service coupon or contact Nilsen Instruments, 200 Berkeley Street, Carlton 3053; phone (03) 347-9166.

Low cost RF signal generator

Marconi Instruments has released the new model 2022D synthesised RF signal generator, covering 10kHz to 1GHz.



The 2022D is an extremely small and lightweight unit (7.5kg), making it ideal for field applications, for use where space is at a premium — like most work benches, and for areas where size and weight are critical factors.

An extremely easy to use generator with a host of user facilities, it permits quick and accurate testing on a wide range of receivers. The new 2022D has +13dBm output with a very accurate attenuator, reverse power protection to 50 watts, 100 non-volatile memories for commonly used settings, comprehensive modulation capabilities and option GPIB interface.

Amongst the new features appearing for the first time in the 2022 is a new higher speed GPIB capability, and increased FM deviation capability to 999kHz at 1GHz. Also available is a new internal modulation source with selectable audio frequencies allowing comprehensive testing of in-band receiver performance.

For further information circle 247 on the reader services coupon or contact Marconi Instruments, Level 4, 15 Orion Road, Lane Cove 2066; phone (02) 418 6044.

Handheld 2.4GHz universal counter

Optoelectronics Inc (OEI) has released a handheld universal counter that measures up to 2.4GHz.

The UTC-3000 features a direct count frequency capability (1Hz resolution in one second) to over 150MHz, and switched prescalers to maximise resolution for frequencies to over 2.4GHz. It has multiple preamplifiers, for maximum usable sensitivity to permit efficient antenna pick-up measurements. A 16-segment bargraph displays input signal level to ensure reliable counting and to aid in RF sweeps.

The universal counter features on the UTC-3000 include period, period average, time interval, time interval average (0.1ns resolution) and ratio. Both 50 ohm and 1 Mohm input amplifiers are provided.

For more information, circle 248 on the reader services coupon, or conatct Emona Instruments, 86 Parramatta Road, Camperdown 2050; phone (02) 519-3933.

Programmable curve tracer

Tektronix has announced the 371A high-power, programmable curve tracer, a new version of its most powerful curve tracer. Fully programmable, the 371A stores up to 80 front-panel setups and displays on a combination of internal memory and built-in 3.5" MS-DOS compatible diskette drive.

The new systems tests high power semiconductor devices up to 400 amps, 3000 volts and 3000 watts. It also provides remote setup, computerized

control and comprehensive software analysis with external programming over the IEEE-488 GPIB.

Three cursor modes deliver automated cursor measurements. The Dot Cursor gives a direct on-screen readout of voltage, current, gm or beta at any selected point on the displayed curve. The Window Cursor, positioned between two curves, measures small signal beta or gm with on-screen readouts of the value. The same cursor can be used to establish visual go/no-go test limits. Finally, the Function Line Cursor provides on-screen readout of a slope or intercept value for instant viewing of resistance or early voltage measurements.

For more information circle 246 on the reader services coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888-7066.

Micro ohmmeter

Atmo Instruments has introduced a micro-ohmmeter, type AT405, capable of measuring from 1 micro-ohm to 200 ohms. The instrument is made in the UK, and is one of the lowest cost

precision micro-ohmmeters on the market.

The AT405 uses the four-terminal method of low resistance measurement, and has a basic accuracy of +/-0.25%. The LCD display reads directly in micro-ohms, milli-ohms or ohms. Maximum test current is only 300 mA. Kelvin clips are supplied to enable four-terminal measurements to be made in a wide variety of applications from busbars, joins and pcb tracks to contact resistance in switches and relays, as well as tests on motors, generators and transformers.

An Australian distributor is required by Atmo Instruments, of 42-44 Shortmead Street, Biggleswade, Bedforshire SG18 OAP, UK.

IEEE bus analyzer

Priority Electronics has released the PCLA-488 bus analyzer, as a low cost alternative for monitoring and analyzing the IEEE-488 bus activities. The PCLA-488 is a stand alone benchtop analyzer weighing only 4.6kg and its compact rugged construction is designed for portability and field use.

The analyzer is claimed to simplify the diagnosis of IEEE-488 software and hardware problems, by allowing the user to view and control the actual characters and control lines on the IEEE bus. This is achieved by the use of LED monitors for all signal lines on the bus and switches for the data, management and handshaking lines.

When used in system-debugging, the analyzer can step through bus transactions one at a time, allowing observations of device addressing, data and control lines. It can also be set in continue mode to slow down bus transactions to 2 times per second.

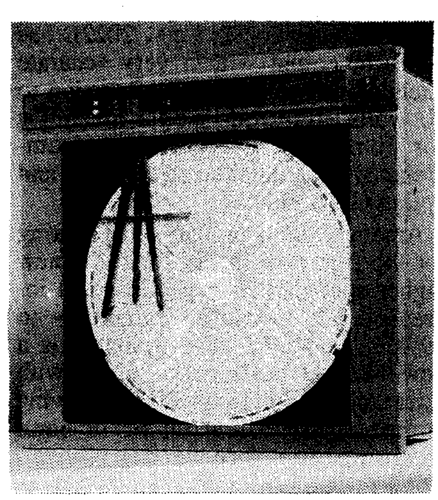
For more information, circle 250 on the reader services coupon, or contact Priority Electronics, 7/23 Melrose Street, Sandringham 3191; phone (03) 512 0266.

Circular chart recorder/controller

Kent-Taylor has released its latest microprocessor-based circular chart recorder, the PX105.

This replacement for the P105M offers both recording and control is a self-contained unit, which is equally competent in stand-alone roles or when networked into a supervisory computer system.

The PX105 accepts signals from a wide range of transducers including most types of thermocouples, RTD, current loop, frequency and pulse, on

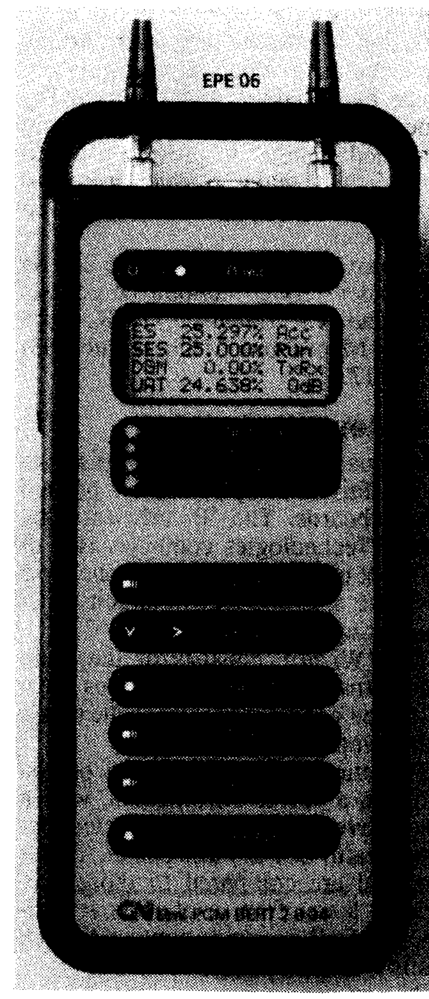


up to three measurement channels with up to three output/control channels.

Operated and programmed via front panel, sealed, tactile membrane switches, it has a high visibility flourescent display. Its simple menu driven instructions allow the user to programme the instrument for a specific task. Alternatively the PX105 can be supplied factory programmed at no extra cost.

For more information, circle 251 on the reader services coupon, or contact ABB Kent-Taylor, 70 Box Road, Caringbah 2229; phone (02) 525-2811.

Danish instruments for telecomms



Danish telecommunications test equipment specialist GN Elmi is looking for stronger growth in the deregulated telecommunications market following the establishment of an Australian subsidiary.

Its major customer base will be telecommunications operators and corporate customers with large communication networks.

The GN Elmi product range includes bit error rate testers (BERTS), PCM meters, PCM signal generators, signal monitors and protocol analysers. During the last few years, this product range has been expanded to include portable instruments and equipment for testing ISDN communication systems.

For more information circle 244 on the reader service coupon or contact GN Elmi Australia, 37 Prospect Street, Box Hill 3128; phone (03) 890-6677.

Nanovolt digital meter

Keithley Instruments has introduced a sensitive digital voltmeter with 1nV sensitivity.

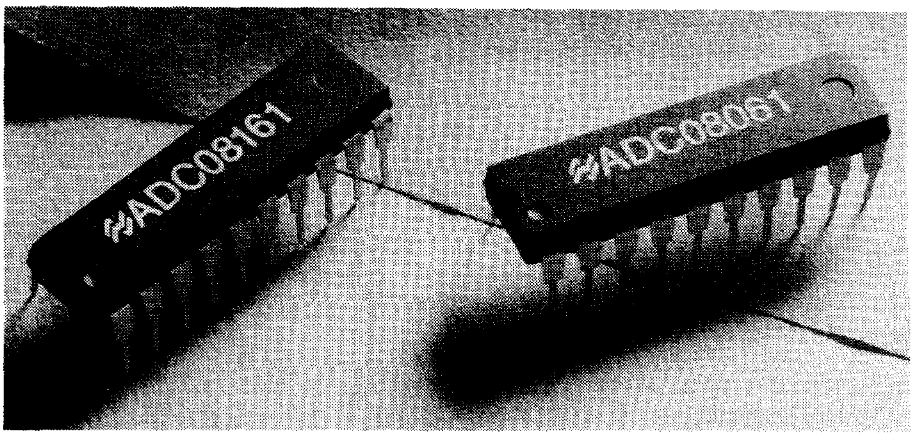
With 6-1/2 digit resolution, the Model 182 Sensitive Digital Voltmeter offers users a combination of sensitivity and accuracy superior to many high-resolution digital multimeters. This high level of accuracy is possible because the Model 182 is an instrument engineered exclusively for measuring voltages, unlike multi-function DMMs, where the additional circuitry required to perform more than one kind of measurement may compromise the accuracy of any single measuring function.

The instrument's special low thermal input connector and cable reduce a major source of low voltage measurement error. Unlike competitive instruments equipped with 'banana' inputs, the Model 182's low thermal input connector substantially minimises thermal electromotive forces to ensure the integrity of the reading. The Model 182 also offers high input resistance — greater than 10GΩ on all voltage ranges — which also helps ensure accuracy by preventing the instrument from affecting the voltage measurement. The noise level is held to just 15nV peak-to-peak even on its lowest range, providing highly stable readings for low voltage applications. ■

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

High speed parallel converters



With the introduction of the ADC08061/ADC08161 family of high speed parallel converters, designers no longer need to use power-hungry flash converters to achieve fast conversion times. Using National's patented Multistep architecture, these eight bit 500 nanosecond converters dissipate only 100mW of power on a +5V supply.

Unlike flash or half-flash architectures, Multistep allows for better speed-to-power performance by limiting the total number of comparators needed.

In addition to an onboard multiplexer and sample and hold, ADC08161 family members offer an onboard 2.5V reference. These features are important in the space saving designs of disk drives, mobile telecommunication equipment, high speed data acquisition, and portable test equipment.

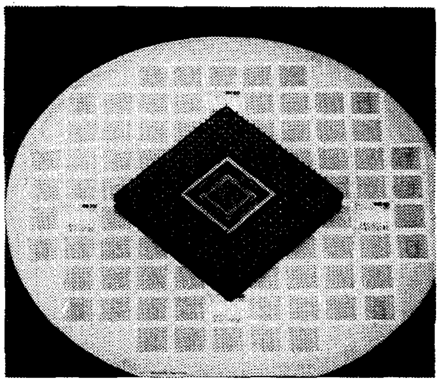
For more information, circle 271 on the reader services coupon or contact National Semiconductor Australia, Building 16, Monash Business Park, Nottinghill 3168; phone (03) 558-999.

Submicron gate array

A family of submicron BiCMOS gate array products, which includes a 150,000 gate device, has been announced by Texas Instruments. The gate array family, which includes seven devices, meets the demands of system designers for ASIC designs incorporating high performance, high levels of integration and low power consumption on a single chip.

These new designs typically consume only 10% more power than equivalent CMOS designs. This allows designers to create a cost effective solution for high performance systems, especially in the telecom and electronic data processing industries.

Designated the TGB1000 gate array family, TI's BiCMOS devices are fabricated in 0.8 micron EPIC triple-level metal, sea-of-gates BiCMOS process.



The basic TGB1000 provides the ability to integrate dual-port and single-port random access memory blocks by means of net customisation.

A memory compiler makes it possible for such memory to be configured to exact clients specifications, within few limits and with little or no design time penalty.

For more information, circle 274 on the reader services coupon or contact Texas Instruments Australia, 6-10 Talavera Road, North Ryde 2113: phone (03) 887-1122.

Programmable timer chip

Philips Components has introduced a new CMOS delay timer and oscillator that provides stable, programmable delay periods from 100ns to several days.

The 74HC/HCT5555 is designed for applications where low cost, low power consumption and high timing precision are required. It's capable of maintaining accurate timing despite wide temperature swings and power supply fluctuations. Typical applications include domestic appliances, automotive and industrial applications. The 5555 contains a 24 stage binary counter, an oscillator, a retriggerable or non-retriggerable monostable, a power-on reset and a master reset circuit. It accepts either an external or crystal oscillator or RC network to operate the on-chip oscillator. The device provides accuracy of better than 1% for delays exceeding 400ns, when an RC network or crystal oscillator is applied.

For more information, circle 273 on the reader services coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 805-4455.

Erasable flash memory

Veltek has introduced a 5V CMOS 512K bit (64K x 8) flash erasable and electrically reprogrammable memory, ideally suited for systems requiring onboard code updates. The Catalyst 512K bit memory is divided into sectors of 2K bytes each. The CAT27F512V5 features 'sector erase', by which the user can selectively erase any one or all of the 2K byte sectors. This enhances system performance, as the need for erasing the entire memory content is eliminated. Product highlights include a 200ns access time, high speed programming (100us/byte typical) and 10 year data retention.

For more information circle 275 on the reader service coupon or contact Veltek,22 Harker Street, Burwood 3125: phone (03) 808-7511.

Colouring portable PCs

UK Company INMOS has released the IMS G177 Power Down Colour Look Up Table (CLUT), a very small low powered VGA graphics CLUT designed especially for lap-top notebook, handheld and other portable PCs.

This small footprint device has an onchip power management system to guarantee minimal power consumption at all times — up to a thousand times less than a standard device. This gives portable PC manufacturers greatly reduced power consumption, and therefore heat dissipation, enabling the production of even smaller machines with further increased battery life.

In standby mode, the device consumes as little as 200uA. In review mode, the data in the CLUT remains valid and can be accessed through the microport while the rest of the device is powered down. This results in a power consumption of only 500uA and is used for CRT (flat panel) operation.

In normal mode, the CLUT (or colour palette) interfaces the computer to the monitor. It is capable of displaying 256 different colours on screen at one, from a total choice of more than 256,000 colours. The G177 enables the portable PC to be connected to a full colour monitor, giving the same resolution, number of colours and picture quality as high-end desk-top machines.

For more information circle 279 on the reader services coupon or contact Promark Electronics, PO Box 381, Crows Nest 2065; phone (02) 906-1300.

Modem kit

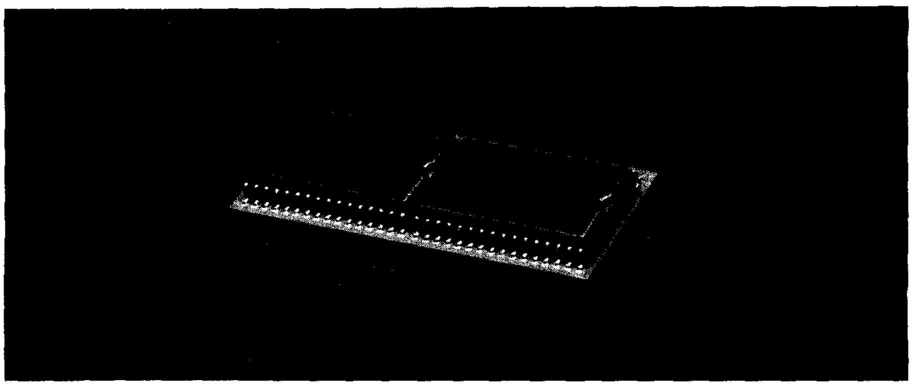
Rockwell has released a new modem development kit, the RC9696AC, that meets the growing PC-retail OEM need to make V.32/V.42bis available to the high volume personal computer marketplace.

The RC9696AC is a fully integrated modem solution for personal computer and peripheral manufacturers.

The advantages of the RC9696AC modem development kit are a reduction in time-to-market and development costs for a fully featured, high-end V.32 modem.

To make a complete 9600bps modem, all an OEM needs to do is add memory, supporting components, line interface circuitry and power supply.

For more information, circle 272 on the reader services coupon or contact Hardie Technologies, 205 Middleborough Road, Box Hill 3128; phone (03) 899-1179.



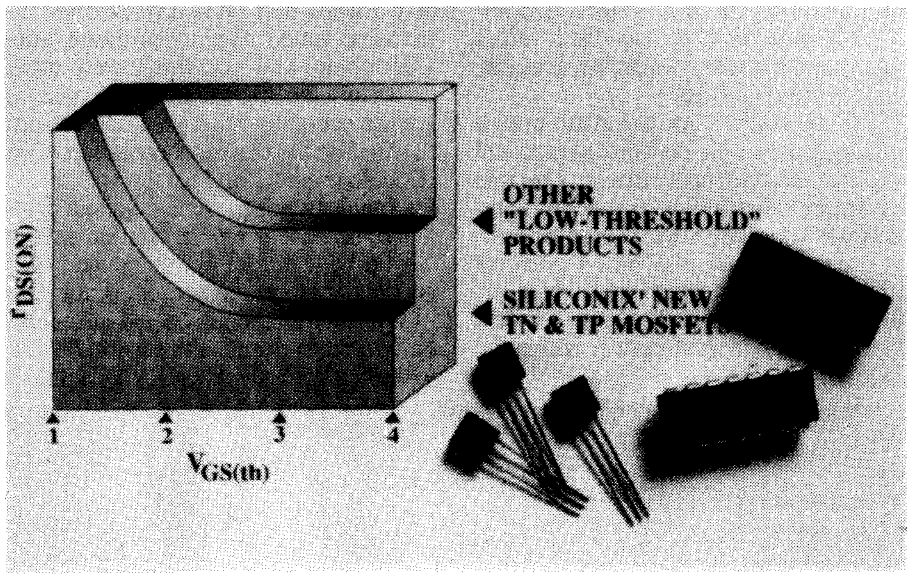
High speed 4Mb SRAM

The New 8M8512C/P/LP from EDI is a fast four megabit Jedec compatible SRAM static RAM module organised as 512K x 8. Based on four high speed 128K x 8 devices in plastic SOJ packages mounted onto a 32-pin ceramic multi-layer substrate, the module is available in fast access times from 35 to 70ns and is pin-to-pin compatible with the forthcoming 512K x 8 monolithic devices, allowing for future replacement.

All versions are fully TTL compatible and operate from a single +5V supply. Current consumption is typically 140mA, dropping to 5mA in standby and less than 1mA for the LP version in data retention mode.

Being fully asynchronous, the device requires no refresh or clock circuitry.

For more information, circle 278 on the reader services coupon or contact KC Electronics, PO Box 307, Greensborough 3088; phone (03) 467-4666.



Low power MOSFET

Siliconix has released 15 new MOSFETs that feature low threshold voltages and low on-resistance. The TN, TP and TQ series are general-purpose, low power MOSFETs for use in a wide range of applications — from level translation to motor control and power regulation. The low VGS(th) of these parts makes the TTL and 5V CMOS compatible. At TTL levels, they feature lower rDS(on) than any competitive product Siliconix has also specified a guaranteed maximum rDS(on) at 3.5V for the TN series (n-channel) and 4.5V for the TP series (p-channel).

The chips are well suited for low current, cost sensitive applications. Their low gate capacitance means that they can be driven directly from the low-current output of logic without greatly sacrificing switching speed. It also makes them excellent drives for larger MOSFETs and small motors.For more information, circle 280 on the reader services coupon or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 748 4066. ■

PC-based Circuit Simulators - 1:

PSPICE VERSION 4.03

Here's the first of three articles looking at circuit simulator packages designed to run on personal computers such as the IBM and Apple Macintosh. MicroSim's PSPICE was the first version of the mainframe simulation package SPICE to appear for PCs, and is perhaps the best known. Peter Phillips reviewed a special low-cost introductory 'PSPICE Student Kit' (Version 3.06) back in the February 1989 issue, but in this article we review an evaluation copy of the enhanced and more recent Version 4.03, released last year.

by JIM ROWE

Back in the dim dark days before integrated circuits, the traditional way for a engineer to confirm that his or her circuit design would work correctly was to wire up the components on a 'breadboard', and test the physical circuit thoroughly with an array of measuring instruments — generators, oscilloscopes, meters and so on. To check the effect of parameter spreads in critical components, selected components with 'high' or 'low' limit values for these parameters would be wired in, and the tests repeated.

Unfortunately this physical breadboarding approach became impractical with ICs, for two main reasons. One was that the circuitry in ICs became too complex to wire up with discrete components; the other was that a practical array of discrete components couldn't realistically simulate all of the electrical interactions that would occur within the final IC.

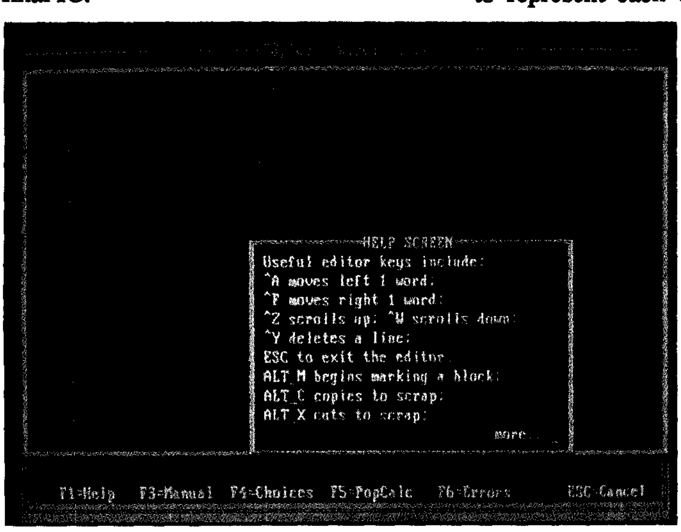
At first, the only way to confirm circuit operation was to have a small number of sample ICs made 'on spec', and then test them. The design would then be modified if necessary, and further samples made until correct operation was confirmed. Needless to say this process became ever more costly and time consuming, as ICs grew more complex.

By the late 1960's, it became apparent that a faster and more cost-efficient alternative would have to be found. And with computers becoming ever more powerful, the logical approach was to see if a computer program could be used to *simulate* the electrical operation of an IC, before it was fabricated.

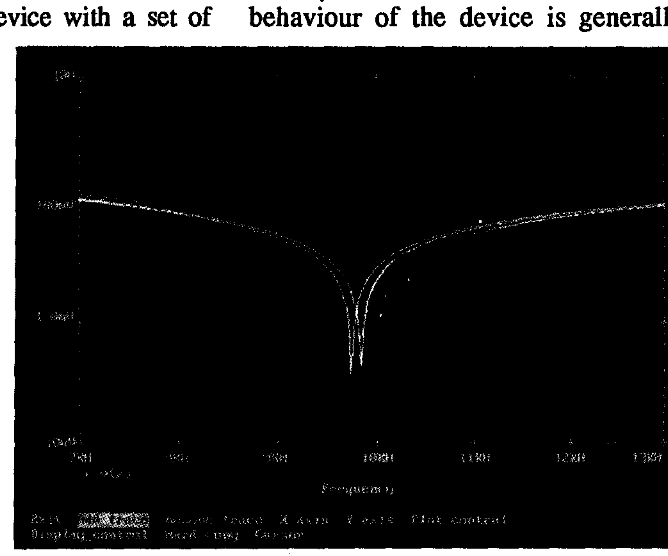
Obviously this presented quite a challenge, because if a computer simulation was to be useful, it had to contain very accurate mathematical 'models' for each of the electronic components in the circuit. In other words, it needed to be able to represent each device with a set of expressions and equations, which would describe the relationships between the various voltages and currents so well, that the circuit behaviour predicted by the simulator would be very close to that of the real components in a real circuit.

This is by no means a simple task, because in practice even simple passive components are not 'pure', but exhibit second-order characteristics which complicate their operation. A resistor generally has self-inductance and capacitance; an inductor has resistance and self capacitance; a capacitor has series resistance and possibly loss resistance; and so on. Most of these parts also vary their primary behaviour with voltage, temperature or current, and often they have other kinds of nonlinearity as well...

Things are even more complex when it comes to 'active' components like diodes, transistors and FETs. Here the behaviour of the device is generally



A shot of the screen when PSPICE's control shell text file editor is running. A help function window has also been opened at lower right, to provide a list of available functions.



The kind of graphical screen display produced by PSPICE's Probe facility. In this case it's a display of the response curves of a notch filter circuit after Monte Carlo analysis...

described by kinds of *characteristic curve*, relating its various input and output voltages and currents. Representing these curves accurately by mathematical equations is often not easy. And even more so than with passive devices, active devices tend to exhibit all kinds of secondary behaviour, 'parasitic' reactances, temperature coefficients and non-linearities.

Of course quite apart from modelling the individual components themselves, a simulator program also has to be able to model what happens when a set of components is connected together in any desired way to form a circuit. So it must also contain mathematical models for the various basic 'laws' which determine circuit operation: Ohms law, Kirchoff's laws, Thevenin's and Norton's theorems, the interactions of resistances and reactances as a function of frequency, and so on.

Needless to say it took quite a while to develop simulator programs which were sufficiently good at all of this to make them really useful. But by the early 1970's it was achieved, notably with the development of a program called *SPICE* at the Berkeley campus of the University of California. The name 'SPICE' is an acronym, standing for *Simulation Program with Integrated Circuit Emphasis*.

Soon after it first appeared *SPICE* was enhanced and became *SPICE2*. Like its predecessor, this was written in FORTRAN and designed to run on a large mainframe computer. However as both programs had been developed using public funding, U.C. Berkeley placed them in the 'public domain' and made them available to anyone wishing to use them. This plus *SPICE2*'s powerful and accurate circuit modelling capability soon made it the accepted simulation tool throughout the US electronics industry, and beyond.

PC versions

When 16-bit personal computers like the IBM-PC appeared in the early 1980's, it was inevitable that sooner or later someone would produce a version of *SPICE2* to run on them. The first to appear was *PSPICE*, which was released by Californian firm MicroSim Corporation in January 1984.

In the seven years plus since *PSPICE* was first released, it has reputedly become the best-selling and most widely used of all PC-based circuit simulators. In fact it is said to have sold more copies than all other *SPICE* derivative programs combined. It has also been revised and enhanced quite a few times.

With Version 3.0, released in 1987, MicroSim completely rewrote it in 'C' instead of the original FORTRAN, to speed up its operation and allow for more efficient further development. Also added were features like *PROBE*, a post-processor package to provide improved graphical output of simulation results on both the screen and hard copy device.

PSPICE Version 4.00 followed in late 1988, adding additional features including an interactive control shell, analog component and subsystem behavioural modelling and digital simulation. Since then the program has been upgraded and enhanced a number of further times; in fact the very latest version is Version 4.05, which MicroSim released in the USA early this year.

There are now versions of *PSPICE* to run not only on IBM-compatible PCs (DOS, DOS/16M and OS/2), but on the Macintosh; the NEC personal computer; Sun-3, Sun 4 workstations and SPARCstation; DECstations 2100, 3100 and 5000; and on the VAX/VMS system machines. The library of device models now contains over 3500 different analog devices, plus over 1500 digital devices.

```
Q1 4 2 6 QNL 1.5
Q2 5 3 6 QNL 1.5
RS1 100 2 1K
RS2 3 0 1K
RC1 4 101 CRES 10K
RC2 5 101 CRES 10K
Q3 6 7 102 QNL
Q4 7 7 102 QNL
RBIAS 7 101 20K
CLOAD 4 5 5PF
```

Fig.1: The net list description of a simple circuit which is supplied with PSPICE as an example.

The current range of simulation features and facilities is very broad, including:

- Fully integrated statistical analysis allowing for component value and parameter spreads (*Monte Carlo* option)
- A stimulus editor (STMED) for creating, deleting and editing V and I sources
- The ability to provide cycle by cycle simulation of switch-mode power supplies, via pulse width modulator (PWM) models
- Support for all standard colour graphics adaptors, and a very wide range of printers including HP Laserjet, Deskjet and Quietjet, and both high and lower resolution Epson LQ
- Bessel function approximation
- A Step/Impulse response option, which performs an FFT on the frequency domain transfer function to show the time domain characteristics
- A .WATCH statement has been added to allow monitoring of up to three voltages or currents during a simulation, and pausing if a specified value is reached. Also .SAVEBIAS and .LOADBIAS statements, to shorten simulation time for large circuits and aid in convergence problems
- Choice of Akerberg-Mossberg, Tow-Thomas or KHN (Kerwin- Huelsman-Newcomb) models for 3-amp RC Biquad circuits
- Support for three commercial switched-capacitor filter ICs: Linear Technology's LTC 1060, 1064 and 1164 (The National Semi and Maxim MF10 are pin-compatible with the 1060)

In short, it's a very powerful package indeed, offering personal computer users just about all features of the mainframe version of *SPICE2*, plus quite a few more.

Features of *SPICE2* which *PSPICE* doesn't provide are the .DISTO (small signal distortion) statement, which has errors in the Berkeley original; the 'IN=' option on the .WIDTH statement; and various minor options for the .OPTIONS statement. On the other hand additional features provided by *PSPICE* include Monte Carlo analysis; logarithmic and extended DC sweep; extra statements, such as .LIB and .INCLUDE; extended syntax for output variables in .PRINT and .PLOT; optional models for resistors, capacitors and inductors, including temperature coefficients; and additional device models such as gallium arsenide transistors, non-linear magnetics and voltage-and current-controlled switches.

PSPICE evaluation

MicroSim's local distributor is Technical Imports Australia, which sent us an evaluation copy of *PSPICE Version 4.03* in the latter part of last year. We've been trying it out since then, to get a reasonable 'feel' for both its capabilities and ease of use.

The evaluation copy is not the standard version of *PSPICE*, by the way, but a 'hobbled' version modified to limit its simulation and analysis capabilities to relatively small circuits — while still allowing it to be used for evaluation of all *PSPICE* functions and facilities. The largest circuit which can be simulated is one with 10 transistors, 25 nodes or 10 logic gates. It also comes with a stripped-down library of device models, containing a sampling of some 23 representative devices from the 5000-odd provided by the full package. The sample library provides four bipolar transistors, four diodes, two FETs, two op-amps, a comparator, two power MOSFETs, four TTL logic elements, three ferroxcube pot cores and an optocoupler.

Another difference between the evaluation version and the full version is that whereas the full version requires the computer to be fitted with a floating point co-processor, with the evaluation version this is optional.

Although the full version will only run with a hardware 'security plug' device or 'dongle' fitted to the PC, this is not required for the evaluation version. Nor is it copy protected; in fact MicroSim invites users to copy it, so that others can try the program out for themselves.

Apart from these differences, the evaluation version is like the full version in just about every respect. It will run on any PC, XT, AT or PS/2, or close compatible, with 640K of RAM plus a fixed disk, colour graphics adaptor and MSDOS 3.0 or later.

This is probably a good point to mention that the evaluation version is actually available in two forms — either as a bare set of three 1.2MB diskettes containing the software itself and a README.DOC file, or in an 'evaluation kit' comprising the disks, a 334-page *PSPICE* user manual and a copy of the paperback book *SPICE: A Guide to Circuit Simulation and Analysis Using PSPICE*, written by Paul W. Tuinenga of MicroSim and published by Prentice-Hall. The bare disk set is basically intended for people who are already reasonably familiar with *SPICE*, perhaps from a university or college course, and therefore need only the disks to evaluate *PSPICE*. The complete kit is more for people who do not have this background, and need more support.

In effect, we were able to try out the complete evaluation kit, because TIA was good enough to send us a copy of the *PSPICE User Manual* with the disks, and we already had a copy of the Tuinenga book. Incidentally this is also available separately in its own right, from many bookstores.

In operation

The complete evaluation version consists of a number of different software items: the basic *PSPICE1.EXE* analog simulator itself; the graphics post-processor *PROBE.EXE*, which is an interactive 'software oscilloscope', to allow viewing and/or printing out the *PSPICE* data output file in high resolution graphical form; *STMED.EXE*, an interactive stimulus waveform editing program; and *PARTS.EXE*, an interactive program which allows you to create model libraries for new devices using manufacturer's data.

As with the original *SPICE2*, *PSPICE* itself is essentially a noninteractive file-to-file processor. It takes for its input a text-format 'circuit file', describing the circuit to be simulated in 'netlist' form together with various definition and simulator control statements, and processes it to produce an output file. While the processing takes place, a status/progress screen is displayed.

The input circuit file must be created separately. The netlist portion can be produced using either a schematic entry package capable of generating a file in the right format (such as OrCAD or P-CAD), or worked out by the user themselves and simply keyed into a word processor/text editor. Even if a schematic capture package is used to produce the basic netlist file, a word processor or editor must then be used to add the control statements.

An example of the netlist portion of an input circuit file is shown in Fig.1, with the corresponding circuit schematic shown in Fig.2. Note that the circuit is described in terms of the components connected between its various junction *nodes*, which are numbered beginning with ground as node 0. The circuit models for components such as transistors are defined in terms of their names in *PSPICE*'s library, such as 'QNL'.

The full circuit file required for simulation of the example circuit shown in Fig.2 tends to be somewhat larger than shown in Fig.1, by the time simulator control statements are added. It can also have comments added, for documentation purposes. This circuit example is in fact supplied with the *PSPICE* evaluation version, and when printed out the EXAMPLE1.CIR file runs to nearly four pages (10,237 bytes). But this includes a lot of explanatory comments.

The interactive programs *STMED* and *PARTS* are also used separately in advance of the actual simulation, to produce any desired/appropriate custom circuit stimulus waveforms and produce any non-standard circuit models needed for specific devices, respectively.

After *PSPICE* has processed the input circuit file, its output simulation data file can then be examined/printed out in graphical form using *PROBE*.

With early versions of *PSPICE*, the only way to make this piecemeal approach a little more friendly was to call the program via a small batch file, which allowed specification of the circuit and output filenames, and also automatically fired up *PROBE* after simulation, if it found that a PROBE.DAT file had been generated (in response to a .PROBE statement in the input file). If changes needed to be made to the circuit, as is often the case, the circuit file would have to be modified by going back to the word processor, and then the cycle repeated — rather tedious and time consuming.

This way of using *PSPICE* is still available, but all PC-environment versions since 4.00 have also been provided

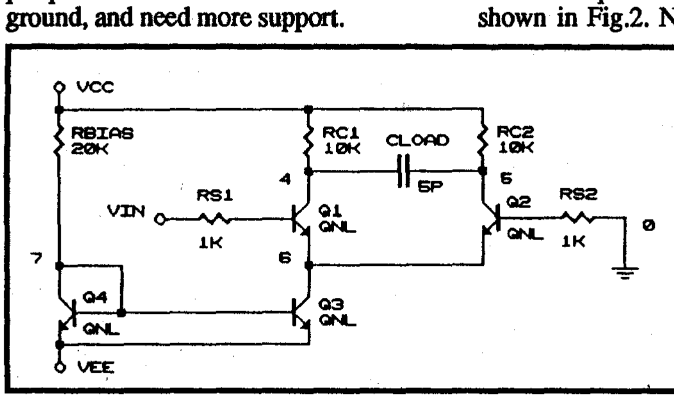


Fig.2: This is the actual schematic for the sample circuit described in the net list of Fig.1.

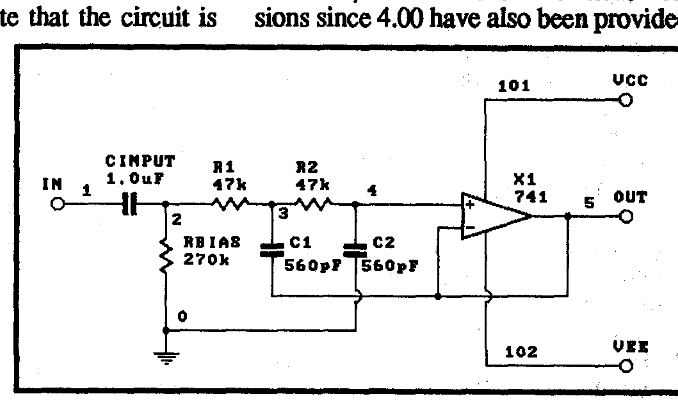


Fig.3: The schematic of a simple low pass active filter circuit, used by the author in reviewing PSPICE.

with an interactive 'control shell' program called *PS.EXE*, which effectively allows *PSPICE1*, *PROBE* and *STMED* to be run as a single integrated and interactive package. In addition *PS.EXE* also provides a full page-orientated text editing facility, allowing editing and even creation of circuit files without having to leave and call a separate word processor. This makes the basic simulation process rather faster and more convenient, although you still have to deal with *PSPICE*'s text-format circuit files.

A further handy feature of *PS.EXE* is an on-line context sensitive help facility, which can be called up at any time by pressing the F1 key.

```
LPFILTER.CIR - Low Pass Filter circuit example
.TEMP 25
.DC VCC 7.5 9.0 0.1
.OP
.AC DEC 10 1HZ 10KHZ
.NOISE V(5) VIN 10
.MC 10 AC V(5) YMAX OUTPUT ALL
.LIB NOM.LIB
VIN 1 0 AC 1
VCC 101 0 DC 9
VEE 102 0 DC -9
CINPUT 1 2 1.0UF
C1 3 5 CFIL 560PF
C2 4 0 CFIL 560PF
RBIAS 2 0 270K
R1 2 3 RFIL 47K
R2 3 4 RFIL 47K
X1 4 5 101 102 5 UA741
.MODEL RFIL RES (R=1 DEV=5%)
.MODEL CFIL CAP (C=1 DEV=5%)
.PROBE
.END
```

Fig.4: The complete circuit input file written by the author for PSPICE, for the schematic shown in Fig.3. It includes a number of control statements for PSPICE itself, in addition to the circuit net list.

Our reactions

It took me a while to get the hang of driving *PSPICE*, because it was really the first opportunity I've had to try out *SPICE* in any form (it wasn't around, when I went through uni in the early 1960's). But after studying the User Manual, reading Paul Tuinenga's book and also running through the EXAMPLE1.CIR file supplied on the evaluation disks, it gradually began to fall into place.

One thing I did find confusing was that neither the User Manual nor the README.DOC file on the evaluation disks make more than a brief passing mention of running *PSPICE* via PS.EXE, the interactive shell. In both cases they describe using the software in the 'old' way, preparing your circuit file on a separate schematic capture package and/or word processor, and then calling *PSPICE* via the batch file. I had to find out for myself the much more convenient method of using PS.EXE and its inbuilt text editor.

Why MicroSim seems to be almost 'hiding' this much more friendly and convenient way of driving *PSPICE* escapes me. Unless you take advantage of PS.EXE and its editor, the package really seems quite archaic — even disjointed — in comparison with most modern PC-based software; but using them, it's much more integrated and acceptable.

Of course even with this significant enhancement, you still have to prepare your circuit in the form of a text-format *SPICE* input file, before *PSPICE* can run any simulation or analysis. This is one fairly major way in which it's still much the same as the original *SPICE*.

In effect, you have to learn a whole new language: the vocabulary, grammar and syntax that *PSPICE* uses to describe each kind of electronic component and device, and the way it describes their interconnections in a circuit. In addition, there are the control statements for *PSPICE* itself, to ensure that it performs the simulation analysis you want and produces the results you want.

As with any new language this inevitably takes some time — perhaps slightly more than you'd expect, in this case, because the language is only moderately intuitive. And as *PSPICE* is a very powerful package, with the ability to perform a lot of different kinds of analysis on circuits with many different kinds of component (some of which are themselves quite complex to model), there's a lot to learn. Of course if you have a schematic capture package which produces netlist files in *PSPICE*-compatible format (such as *OrCAD*), this would certainly help. But even then, you'd still have to learn the *PSPICE* control statements. For those like myself who have had no previous direct experience with *SPICE*, it takes a while to get used to translating your circuit into this new text-format language, before you can carry out any analysis.

After a reasonable amount of experimenting I'm by no means an expert, of course, but I've now been able to perform most of the various kinds of analysis that *PSPICE* can perform, on a variety of simple circuits. I must say, though, that it seems much harder to visualise a circuit from a *SPICE* text file, than from a schematic. And even harder to spot when you've made an error! Nonetheless, once you're familiar with the way *PSPICE* works, it can take a surprisingly short time to analyse a typical not-too-complex circuit — from preparing the initial circuit file to viewing the results

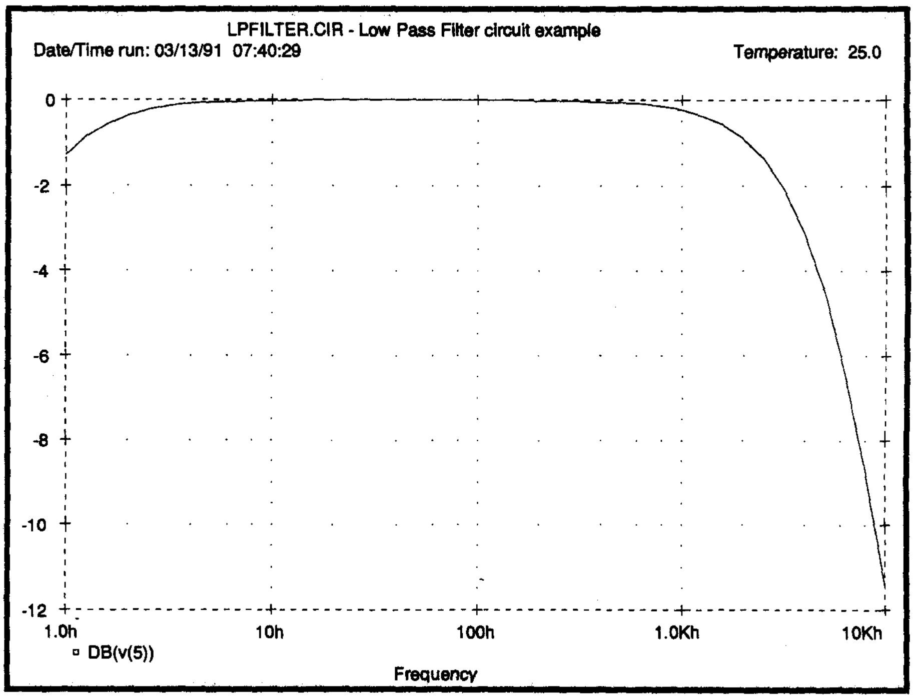


Fig.5: This is a reduced version of the laser printout from PSPICE's Probe utility, showing the frequency response of the low pass filter circuit of Fig.3.

PSPICE 4.03

and printing them out. Of course you often then have to go back and modify some of the component values, to 'zero in' on the result you want; so that there can be a number of iterations of the cycle.

Still, even with a number of iterations this can still be rather faster than finding all of the components, wiring them up on a 'breadboard' and measuring the circuit's performance. For example I tried simulating a simple low-pass active filter circuit, using a 741 op-amp (it's one of the few devices in *PSPICE*'s evaluation library). The schematic is shown in Fig.3, while the corresponding LPFILTER.CIR input file that I wrote for *PSPICE* is shown in Fig.4.

The initial version of this file took only a few minutes to write and key in, and as it only called for a 'nominal component value' run, the basic DC and AC analysis took only about 2.5 minutes to run on a 286 machine running at 12MHz (but without a floating point co-processor). After a couple of iterations to adjust the values for C1 and C2 to get the turnover frequency I wanted, this allowed me to view and print out the frequency response shown in Fig.5.

I suppose this took about 30 minutes in all, which compares quite well with physical breadboarding. By the way I could also view and print out a plot of the output DC level against varying VCC (to look at input bias drift), and noise output voltage versus frequency — all from the same run. Then I decided to try running a Monte Carlo statistical analysis, to see the likely effect of tolerance variations in the value of R1, R2, C1 and C2 on the filter's turnover frequency. This involved expanding the input file as shown, with the RFILT and CFILT parameters added to the lines for each of the four components, and adding the .MC and .MODEL statement lines. Then I could run it again — only this time it took about 10 times as long, because of the multiple runs. Even on a 20MHz 386SX machine (no co-processor), the run now took about 13 minutes.

The result was as printed out in Fig.6. As you can see, it gives the kind of information that would have taken quite a while to obtain in any other way. Still without firing up even a soldering iron, let alone the instruments...

Summary

Judged from the evaluation version, *PSPICE Version 4.03* is certainly a very powerful and valuable PC-based tool for circuit simulation and analysis. It also seems a lot more 'integrated' and convenient to use than either earlier versions, or the original mainframe *SPICE*.

Compared with a good deal of other modern PC-based software it's still not particularly 'user friendly', though. This is mainly because of its continuing reliance on *SPICE*'s text-format input, although both software and the User Manual often also seem to be rather unhelpful.

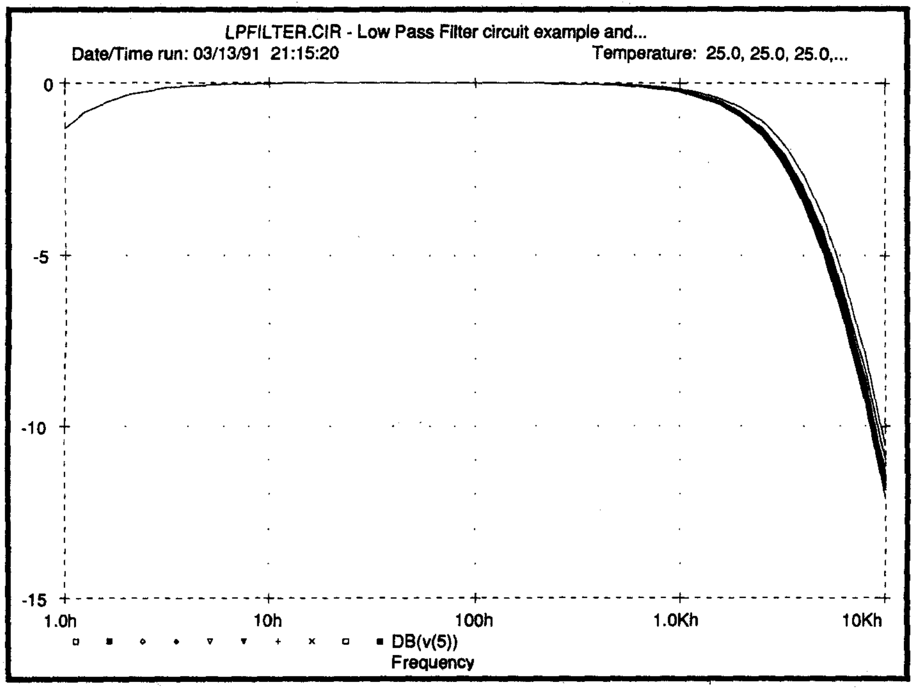


Fig.6: The results of a Monte Carlo run on the low pass filter circuit, as displayed on the frequency response, note the multiple plots at the upper end.

It took me a surprising amount of time and hassle to find out initially how to get *PROBE.EXE* to display and print out the results of a Monte Carlo run, for example. Similarly it was only by accident that I discovered how to get a plot of noise voltage. And I still haven't worked out how to plot phase responses, or how to manipulate both cursors on *PROBE*'s display, to make relative measurements!

So both the software and the manual still seem to have a way to go, before they're really friendly. There are also a few other little things about *PSPICE* that I didn't like, such as its insistence on using a capital 'K' for the decimal kilo multiplier, and conversely its use of a small 'h' as the abbreviation for hertz. These are both nonstandard and hard to adjust to, although I gather they're inherited from mainframe *SPICE*.

There's an irritating omission from the text editor in *PS.EXE*, too: despite having almost every other facility to load, save, create and edit your circuit files without having to return to DOS or a word processor, it has no facility to print them out! It would be nice if this were remedied, especially if you could print out to the same printer used by *PROBE.EXE* circuit file.

For most of my testing of *PSPICE*, I was printing out my plots to a Postscript laser printer (one of the many kinds of printer that *PROBE* and *STMED* can use). It was very irritating that in order to print out a current version of my circuit file, I had to go out of *PSPICE* altogether and fire up either *Wordstar* or DOS's *PRINT* utility — after changing the laser printer back into H-P Laserjet II emulation mode (and then back again, to return to *PSPICE*).

Of course these criticisms aside, *PSPICE* is still a very powerful package for circuit simulation and analysis, and can obviously be a valuable tool for the circuit designer. It isn't exactly cheap, though. The full basic analog simulation package for DOS machines is priced at $1200. This doesn't include the *PROBE*, *PARTS* or behavioural modelling options, but for $3000 you can get the 'deluxe' version which includes virtually all the main options except digital simulation.

Luckily you can 'try before you buy' with the evaluation versions. The set of three software evaluation disks alone is actually free, while the Evaluation Kit with the User Manual and Tuinenga book as well is a very reasonable $200.

For further information, contact Technical Imports Australia, PO Box 927, Crows Nest 2065 or phone (02) 954 0248. ■

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Zoom Mode[1]		●	●	●	●	●
Zero Mode[2]		●	●	●	●	●
Live Trend Memory[3]		●	●	●	●	●
Logic Function		●	●	●	●	●
Min/Max Recording			●	●	●	●
Store 5 readings			●	●	●	●
Relative Mode			●	●	●	●
RMS Conversion					●	●
Frequency					●	●
dB level					●	●
High Accuracy(0.1%) 4-20mA				●		●
Intrinsic Safety EEx ib IIC T6				●		
HBC fuse protection	●	●	●	●	●	●

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PROCESS CONTROL IN HAND SOLDERING

The potentially increased reliability offered by modern miniaturised components and surface-mount technology can only be realised when adequate process control is exercised during the crucial soldering process. This is done as a matter of course in machine soldering, but it's just as important for hand soldering as well.

by ALAN ROYSTON
Managing Director, Royel International

Since the advent of the transistor in 1948, the integrity of the soldered connection between increasingly miniaturised and sophisticated electronic components has become the most critical factor affecting circuit reliability.

Clinical levels of process control have been normal practice for many years in semiconductor fabrication and packaging. These standards have now reached the printed circuit assembly line in the vital areas of control of solderability and machine soldering operations. The increasing complexity of printed circuitry has led to a corresponding increase in problems associated with even the slightest electrical resistance in interconnections.

Process control in soldering (and desoldering) is crucial to circuit reliability.

Soldering is essentially a metallurgical process. It involves the inter-alloying of carefully selected materials, within an empirically determined narrow temperature range, to achieve maximum strength and durability while restricting the formation of brittle intermetallic compounds.

Temperature control during hand soldering must be just as important to circuit reliability as it is in machine soldering.

In addition, important new families of electronic devices are subject to degradation or catastrophic damage by low level extraneous magnetic or electrostatic potentials during the soldering or desoldering process. Protection should be part of equipment design.

This article reviews the technical factors involved and the development of modern hand soldering and desoldering tools and equipment, to provide the means of effective process control.

The soldering process

Let us look more closely at the actual task of soldering, which is fundamental to all electronic manufacturing processes.

Solder is basically an alloy of tin/lead with minor additives. The electronic grades are liquidus around 180-200°C (360-390°F). However, the ideal temperature to give good wetting and hence high reliability joints is in the range of 240-270°C (470-520°F). In other words, the solder has to be at a temperature above the liquidus temperature, but not substantially so. The task can be reduced to supplying sufficient heat to raise the joint to this ideal wetting temperature and do that without damaging the workpiece.

The best technique, as everyone involved in manufacturing will know, is wave soldering. These machines have the advantage of a large thermal mass at the optimum temperature, 250-260°C (470-500°F). The heat transfer from the solder wave to the board is carefully controlled and repeatable. Heat stability of the solder wave is known to be critical to success.

Prior to entering the solder wave the circuit board is 'heat conditioned' by passing over a preheater. Preheaters have been incorporated in wave soldering systems since the early days and this is a very important part of the wave soldering process to boil off the volatiles in the flux; to allow the tarnish reducing action of the flux to commence; and to elevate the temperature of the circuit board and components to avoid thermal shock.

Ideal preheat temperature is 190-200°F (90°C), measured on the top side of the circuit board just prior to entering the soldering wave. Excess preheating temperature causes resin flux to break down and lose its effectiveness.

A hand soldering tool cannot have infinite thermal mass. The tool has to be portable, light and easily manipulated and with a fine tip profile to address modern miniaturised terminations. Therefore, the hand-held tool can only have a small thermal mass — a few grams. Consequently, to transfer the required amount of heat, the tip has to be at a temperature higher than the ideal. How *much* higher depends on the thermal efficiency of the hand soldering tool. The target then, is to supply the required quantity of heat to the joint with the minimum of thermal shock.

Why the emphasis on minimum excess temperature?

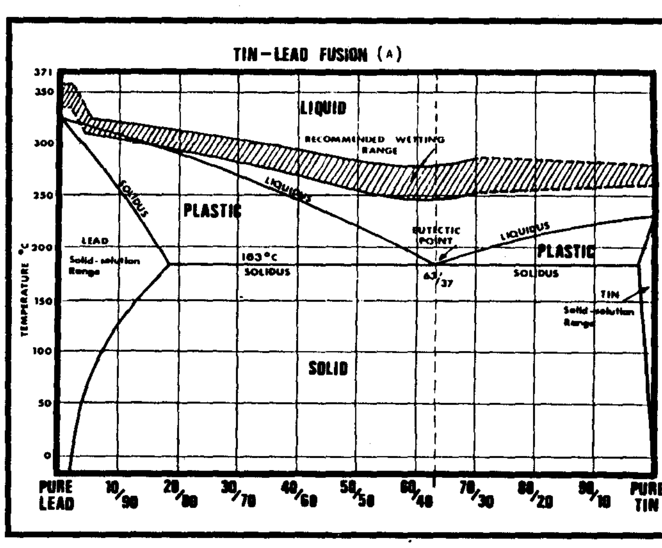
Delaminated solder pads caused by the use of excessive temperature are well known.

On a double-sided, plated through board, the damage may be within the hole of the plated through board and not visible on the surface. Measling ('frog's eyes') is evidence of overheating the fibreglass epoxy substrate and, in military work, could be the cause for rejection of the board assembly.

The flux extruded in the 'cored' solder degrades if overheated. The flux comprises a solvent vehicle, usually alcohol, with the resin active agent further enhanced by activators to a greater or lesser extent. Excess temperature boils off the vehicle before wetting can take place, leaving the resin with activators impotent.

Copper is soluble in the tin content of the solder. This gives us the 'magic' of the solder bond, providing permanent attachment with zero resistance to the flow of electricity. The ideal is a thin intermetallic bond for greatest durability and joint strength.

As the dwell time and temperatures are elevated the intermetal-



A temperature-phase diagram for tin-lead solder of various ratios between lead and tin. The cross hatched zone shows recommended temperatures for correct wetting.

lic layer increases and joint strength and durability of the interconnection diminishes.

Finally, at too high a temperature, a fine copper track could disappear entirely into the solder — but considerable damage to the function of the circuit would occur before this.

Perhaps less well known is the fact that ceramic capacitors by their very method of manufacture have a silver electrode layer. With excessive temperature, the assembly solder reflows, becomes liquid and can absorb this silver electrode layer, thereby changing the capacitance of the capacitor.

This effect is time temperature dependent. With other types of capacitor, damage generally results in an increase in leakage current or noise levels, thus degrading the ultimate circuit.

In many IC's the silicon chip is eutectically bonded to the substrate. Excess temperature can reflow and weaken the bond.

Ceramic surface mount resistors, capacitors and so on, are particularly susceptible to thermal shock, and having a coefficient of thermal expansion (CTE) substantially different from the fibreglass epoxy PCB are particularly susceptible to thermal stress during hand soldering, in the absence of stress relieving connecting wires or leads.

Choice of equipment

With a non controlled soldering iron, the energy input is balanced by heat dissipated to maintain an equilibrium. Thermal mass is small due to the need to restrict the size of the soldering tip. Nevertheless, heatup to saturation or equilibrium temperature could take up as much as seven or eight minutes.

The equilibrium temperature is selected by the manufacturer as that temperature just below the level at which tip tinning would be lost by oxidation.

At these temperatures solubility of copper in tin is high and flux is easily degraded during the first joints. Remember, too, that a change in voltage means a larger proportionate change in tip temperature. When the tip is applied to a termination, the temperature drops and while it is replenished at a slightly faster rate than the original (slow) heat-up, the operator has no way of knowing the tip temperature.

It starts too high and finishes — where? — depending on the size and number of terminations made. 'Standard' tools should not be used on modern circuitry. The potential for inadvertent damage is too high.

On the other hand with temperature controlled tools, we have a big improvement. Because the idling temperature is restricted, a more powerful element can be used. Operating temperatures can be reduced — how low depends on the speed of heat recovery — due to the thermal efficiency of the heating element/tip mechanism.

The most common method of limiting the temperature has been to use an electro-mechanical switch. Such a switch can energise the circuit at any point in the AC mains cycle, activated by a nickel rod expanding under the influence of heat, a 'Curie Point' magnetic mechanism, producing potentially large voltage transients which can be coupled into the workpiece. Others use thermistors, which can be non-linear and therefore, do not lead to a close temperature control.

Australian manufacturer Royel has incorporated cold junction compensation in its Thermatic T300 and T500 soldering irons, together with an Australian developed 'N' type thermal couple to control idling temperature within 3°C of set point. Thermatic tip temperature recovery is virtually instantaneous, allowing soldering within the recommended wetting range.

The Thermatic irons have 24 volt DC elements to eliminate switching transients, and incorporate a patented tip-to-ground connecting device to eliminate tip to ground leakage damage to micro electronic components.

Conclusion

Electronic components, and particularly surface mount components, are increasingly susceptible to thermal and electrical damage and therefore a modern soldering station with inbuilt control and protection is the most important investment a technician concerned with high reliability can make.

For further information on the Thermatic range of soldering irons, contact Royel International, 27 Normanby Road, Notting Hill 3168; phone (03) 543 5122. ■

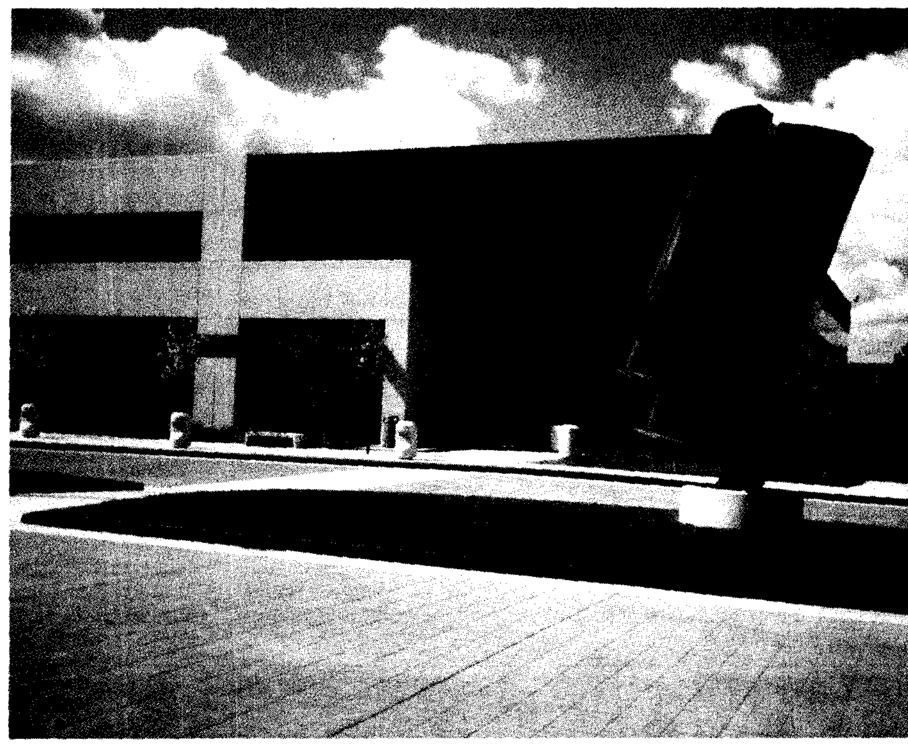
Silicon Valley NEWSLETTER

DEC lays off 3450 workers

In a desperate move to significantly cut operating expenses, Digital Equipment has abandoned a life-long no lay-off policy and given some 3450 workers notice of their dismissal by June 30.

The lay-off total is higher than had been expected and will add to the 2600 DEC workers severance payment programme. In all, DEC had planned to reduce its workforce by some 6000 people. A DEC spokesman said that the company has yet to select the workers that will be let go and the decision of where the lay-offs will hit hardest will be made on a business-by-business basis. "We expect most of the reductions to be completed by the end of our third quarter (June 30)," said spokeswoman Nikki Richardson.

Last Year, Digital took a one-time charge of $550 million against earnings to cover the cost of its cost-reduction programme. The latest lay-offs will be financed out of that fund.



MIPS Computer Systems is moving into this new three-building complex in Sunnyvale. The structure is highlighted by a work of art whose colours — mostly red and a little bit of black — ironically reflect MIPS financial performance of the past six months...

AT&T moves closer to NCR acquisition

AT&T has moved in a position to complete its hostile takeover of NCR, following the acquisition of 70% of NCR's publicity-held stock. AT&T has been offering to pay US$90 for each share of NCR stock.

According to AT&T, it has secured the approval of 50% of NCR's shareholders for a special shareholders meeting, at which AT&T will ask for a vote to support an AT&T controlled slate of new directors. If successful, as expected, the new board will cancel NCR's poison pill anti-take-over programme, clearing the way for AT&T to take complete control of the company.

According to most industry analysts, the latest developments will leave NCR's management little choice but to negotiate for a friendly take-over, if they are at all interested in remaining in control of their company.

But at their regular monthly meeting in New York, NCR directors showed continued defiance at the AT&T threat, reaffirming their intent to keep NCR independent. NCR directors also said they don't want to be part of AT&T's desperate effort to rescue its ailing computer strategy.

Nintendo faces second suit

Leading videogame maker Nintendo will have to fend against a second anti-trust lawsuit, the latest being filed by a small US competitor, San Jose based American Video Entertainment.

In the suit, AVE claims Nintendo made it possible for companies like AVE to sell Nintendo game cartridges without specific authorisation from Nintendo. The suit claims Nintendo quietly adopted minor technical changes in its game console, making it impossible for the machines to play unauthorised games.

That action, AVE claims was designed to allow Nintendo to monopolise the market for game software, and violates anti-trust laws. AVE is seeking US$106 million in damages. If the company wins, any amount of damages would automatically be tripled under US anti-trust law.

Not entirely by chance, AVE filed its lawsuit at the outset of the annual Consumer Electronics Show in Las Vegas, where Nintendo disclosed plans for a new game machine wth twice the power of its current model.

Currently, Nintendo requires game developers to submit their games for approval to Nintendo and forces them to pay a hefty licence fee. Special circuitry in the game console prevents unauthorised games from being played on its machines.

Besides AVE, Atari Games of Milpitas also has an on-going anti-trust suit against Nintendo, filed in 1988 after the company developed a clone of Nintendo's patented chip circuit designs.

The suit challenges the legitimacy of the Nintendo chip patents. If Atari Games wins, it could legally produce a clone of the Nintendo game console.

Zilog goes public

After more than 17 mostly troublesome years, a revitalised Zilog has announced plans to offer its stock to the public for the first time. Zilog said it hopes to raise US$22-24 million through the sales of 1.2 million shares of stock, about 2% of the total available shares. The deal would give the company a book value of US$106 million.

For most of its existence, Zilog was owned by Exxon which bought the company in 1976. Despite pumping hundreds of millions of dollars into the firm, Zilog lost money for much of the 1970's and 80's. Then in June 1989, Exxon accepted a US$40 million management buy-out proposal that gave the company back its independence.

Zilog had already adopted a new product strategy at the time Exxon decided to sell out and had also begun to turn a decent profit.

During fiscal 1991, Zilog earned US$7.2 million on US$100 million in sales. Two years earlier, it lost US$14.5 million on US$82 million in revenues.

Zilog's struggle was due in large part to the insignificant role its Z-80 microprocessor family has played in the personal computer market since the launch of the Intel-based IBM PC. Prior to that, the Z80 was the main building block for many PCs, and reportedly, Zilog was close to a deal with IBM when the giant decided to chose the Intel chip for its PC despite the superior performance of the Z80.

Intel loses 386 trademark to AMD

Advanced Micro Devices scored another major victory in its on-going legal battle with arch rival Intel as Federal District Court Judge William Ingram blew away Intel's trademark rights to the popular 80386 microprocessor.

The decision is a stunning blow to Intel, which had hoped to keep AMD and other 386 clone makers at bay by preventing them from using the '386' number in the designation of their products.

If Intel had won, it would have posed a major problem for AMD and others to market 386 compatible chips. Most notably, it would have prevented system houses from using the 386 number in the name of their computers if the systems were not using actual Intel-made 386 chips.

"Justice has once again been served. Competition will benefit the entire electronics industry," said AMD's Jerry Sanders, whose company is now expected to launch its Am386 chip. The chip has been available in sampling quantities to system houses and so far, has reportedly been well received.

Ingram handed down his decision in a 17 page document. He added that he will soon rule on whether computer makers will be able to use the 386 designation without infringing on Intel's trademark if they used non-Intel processors. He added that he expects that ruling to be similar, as in the AMD case. Also significant, the Ingram ruling may well imply Intel has lost trademark rights to subsequent product generations, such as the 486, 586, etc.

Am386 hot item on grey market

AMD's Am386 processor hadn't even been formally announced when the chip became the hottest item on the grey chip market, after a thief took off with $170,000 worth of the chips.

The heist occurred in Penang, Malaysia, where an AMD truck driver was held up at gun point. The robber knew exactly what he was after, as he took only boxes containing the fastest version of the Am386 chip.

"Whoever did it, knew what he wanted. There was plenty of other stuff on the truck," said AMD spokesman John Greenagel. He added that 864 chips were taken altogether. If nothing else, the theft shows AMD plans to sell the chip at just over $200 per chip, given the company's estimated loss and the number of chips taken.

Greenagel couldn't resist the opportunity to give the theft a humorous twist in light of the rivalry with Intel.

"Intel said nobody would want our chip. And here we haven't even launched the part and we already have a grey market demand." He added that Intel is not suspected to have played any role in the incident.

Linear pioneer dies in Mexico

Robert Widlar, one of Silicon Valley's chip pioneers, who almost single-handedly established National Semiconductor as the world's premier supplier of linear circuits, died recently at the age of 53 from a heart attack. He died in Mexico, where he has resided for more than a decade.

Among many other inventions. Widlar was credited with the development of the first chip-based voltage regulators and comparators in the early 1970's. The inventions were so basic that companies like National are still selling millions of dollars worth of these chips.

"Bob Widlar was a Silicon Valley original and a true genius of IC design. He was the world's first, and by any margin, the greatest linear designer," commented National president Charles Sporck, Widlar's boss until 1974.

Widlar first entered the industry in 1963 at Fairchild, the breeding ground for a vast majority of today's leaders in the semiconductor industry of the valley. He left Fairchild in 1966 to join National, and set up that company's linear product group. After he left National, Widlar worked mostly as an independent consultant. In that role, he went on to design numerous key linear chips for National, for many years.

Philips to resell Sun workstations

Sun Microsystems has signed an agreement that will allow electronics giant Philips NV of the Netherlands to sell Sun's entire line of Sparc-based workstations.

Philips Information Systems will use the Sun workstations as the main building block for a new integrated document management system for commercial users. Such a system would be marketed towards paper-intensive application markets, such as tax form and insurance claims forms processing. The first of the new Philips systems may reach the market by the end of this year.

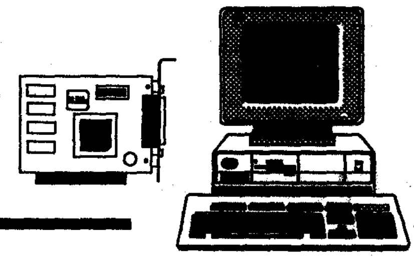
"As an open systems suppliers, we are committed to industry standards, and leading edge technology, as is Sun," said Jay Stevens, a manager at the Philips Information Systems group.

Fujitsu launches smallest cellular phone

The race for miniaturisation of portable communications has intensified, as Fujitsu America launched what it claims to be the smallest cellular phone on the market. The Pocket Commander, at 5.3" in length and 10.2 ounces in weight, is even smaller and lighter than similar pocket size cellular phones from Motorola and Mitsubishi.

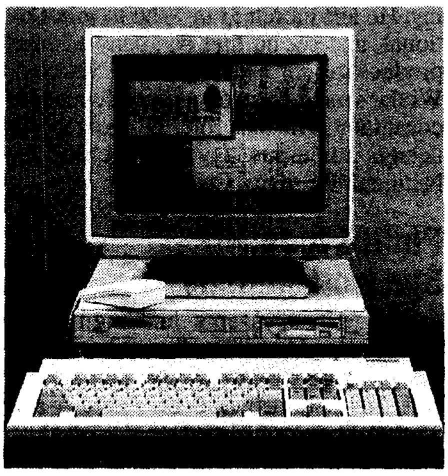
The Fujitsu phone will be sold in the US at the suggested retail price of US$1195. ■

Computer News and New Products



Powerful RISC system

Acorn Computers Australia has introduced the Archimedes 540, the latest and most powerful addition to its range of Reduced Instruction Set Computers (RISC). The 26MHz system operates more than three times faster than other models in the Archimedes family, exceeding the speed and performance of



25MHz Intel 486 processors.

The Archimedes 540 has been designed to deliver high performance at an affordable price to users in the education market. It combines fast, fully addressable and expandable RAM with configurable high resolution onboard video display capabilities. This is claimed to make it an ideal system for desktop publishing, complex mathematical applications, CAD/CAM, image analysis and multi-media training.

The system, which costs $7995 (excluding tax), comes standard with application software, 100MB hard disk, 4MB of RAM (upgradable to 16MB), three expansion slots, ports for up to six external peripherals and video support for high resolution VGA and super VGA monitors.

For more information, circle 161 on the reader services coupon, or contact Acorn Computers, 12 Gipps Street, Collingwood 3066; phone (03) 419 3033.

Protel for the Mac

Protel's first products for Apple Macintosh personal computers have arrived. They combine the professional capabilities of a dedicated PCB CAD system with distinctive Macintosh user environment.

The Mac version of Easytrax was designed 'from the ground-up' to conform to Macintosh human interface guidelines. It includes metric/imperial grids, pad-to-pad autorouter, pen plotter support, Gerber and N/C drill files. PCB files and user libraries are fully portable across the two systems.

The version of Autotrax, like Easytrax, combines all the outstanding features of the DOS version with the 'point and click' simplicity of the Mac.

It includes an enhanced autorouter, auto component placement, design verification features, metric/imperial grid system and comprehensive output options.

Again, user files and libraries are completely portable between DOS and Mac versions of the software.

Autotrax for the Mac will support netlist input from popular DOS schematic capture packages as well as Macintosh schematic packages such as DesignWorks, Mac SE30, LC or Mac II with min.2MB RMA is required.

For more information, circle 162 on the reader services coupon, or contact Protel Technology, GPO Box 204, Hobart 7001; phone (002) 73 0100.

Portable 'word publishing'

Canon has taken 'word publishing' in a new direction with the launch of the Starwriter 80, a combination word processor/bubble jet printer that is portable, inexpensive and easy to use.

Priced at $1695 recommended retail (inc tax), the Starwriter 80 offers an advanced solution for managers and professionals whose sole requirement is the creation, manipulation and printing of text on plain paper.

The Starwriter 80 has 60KB tex memory and five inbuilt fonts: Courier, Script, Swiss, Dutch and Humanist. Type size varies from 9 - 36 point, in bold italic and outline.

There are 325 characters plus 206 scientific and graphic symbols (giving a

20-language capability).

Other features include a built-in spellchecker/corrector and thesaurus; a backlit screen; and, through the Bubble Jet process, silent, high-resolution, high-speed printing. A 3.5" 720KB floppy disk drive provides removable storage.

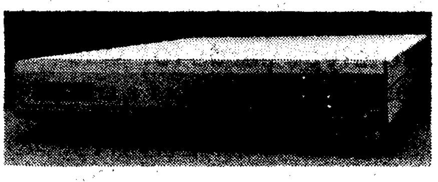
Word processing features include full cursor and correction function, block editing, mail list/merge, automatic page numbering and label print, along with other familiar WP functions.

For more information, circle 163 on the reader services coupon, or contact Canon Australia, 1 Thomas Holt Drive, North Ryde 2113; phone (02) 805 2000.

Tape drive for PCs

A new 9-track tape drive designed for the data interchange and backup needs of today's PC-based office has been released by the Overland Data company of California.

At a height of only 90mm and with a weight of 13.5kg, Model OD3210 is a



small and light autoloading 9-track tape drive, which consumes a low 45 watts of power. It supports 1600 and 3200bpi tape densities, and also features 1MB of cache memory to enhance its tape speed of up to 60ips and 550KB data transfer rate. With far fewer moving parts and electrical component count to generate less heat, the drive has an extremely high mean time between failure of 25,000 hours.

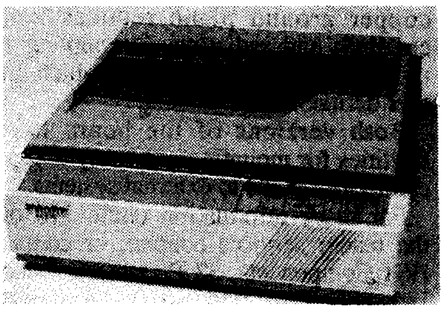
For more information, circle 164 on the reader services coupon, or contact Elmeasco Instruments, 18 Hilly Street, Mortlake 2137; phone (02) 736 2888.

A3 flatbed colour scanner

Sharp has announced the Australian launch of the JX-600, the recent winner of the Eddy Award from *MacUser* for 'Scanner of the Year'.

The JX-600 is a one pass, flatbed colour scanner capable of scanning flat images at a maximum resolution of 600dpi. It can scan up to A3 transparencies with true 600dpi resolution using the lamp unit supplied, so it is a fully commercial image digitising system.

Sharp's Charged Couped Device (CCD) technology allows a greater range of colours to be recognised and distinguished - identifying 1024 gradations each of red, green and blue. To ensure true accuracy the JX-600 scans in 10-bit-per-colour digital data. After the image is processed it saves a guaranteed 8-bit-per-colour data.

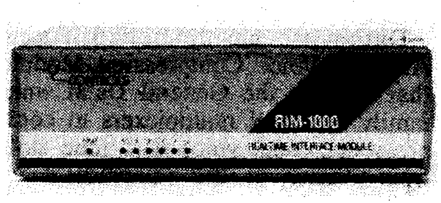


The JX-600 is very flexible because it can be used in various modes including black and white, grey scale and colour at resolutions ranging from 75-600dpi. Available as a colour scanner on its own, or as part of a system for the Macintosh, IBM or PS/2 personal computer, RRP is $19,950.

For more information, circle 165 on the reader services coupon, or contact Sharp Corporation Australia, 1 Huntingwood Drive, Huntingwood 2148; phone (02) 831 9111.

RS-232C interface module

Novatech has released the latest version of its Australian-designed Realtime Interface Module, the RIM-1000. The RIM-1000 connects any computer with an RS 232-C serial port to the 'real world' at a low cost. The new version



has modem control facilities which allows 'dial-up' monitoring and control at remote sites.

The RIM-1000 module, in a surface mount instrument case, can be connected together in a network to provide hundreds of inputs and outputs. Each box has 17 analog inputs, two analog outputs and 14 digital inputs or outputs. Eight of the digital inputs can be used as counters or accumulators.

Inputs can be from temperature sensors, load cells, pH meters, poer meters, position transducers, shaft encoders, proximity detectors, limit switches, relays and many others.

For more information, circle 166 on the reader services coupon or contact Novatech Controls, PO Box 240, Port Melbourne 3207; phone (03) 645 2377.

Switched PC bus extender

The PCL-756 bus switch extension card is designed to extend the PC-bus signals and allow them to be switched on/off without disturbing the system. With a PCL-756 in your PC, you can plug-in and unplug any add-on card from the slot connector at the top of the PCL-756 while the PC is still running.

The PCL-756 can be used on any PC/XT/AT, 386 or compatible to extend and switch XT bus signals for any XT type add-on cards. No software is required. The complete card interface is priced at $220.00 (ex tax).

For more information, circle 167 on the reader services coupon, or contact Priority Electronics, 7/23 Melrose Street, Sandringham 3191; phone (03) 521 0266.

More small HDDs

Toshiba Corporation is expanding its production capacity for small-size (2.5" and 3.5") hard disk drives suitable for small-size personal computers.

The company's Ome plant near Tokyo, which currently produces 50,000 units of 2.5" and 3.5" HDDs monthly, will also expand its production lines in the second half of fiscal 1991 to raise capacity to 70,000 units a month.

Voice compression module

Datamatic has launched a new ADPCM Voice Compression Module that enables the General DataComm family of ISDN multiplexers to compress individual voice 64K time slots from a variety of PBX equipment down to 32K or 24K or 16K, whilst ensuring that channel 16 and/or channel zero can be left uncompressed so that signalling information can be used. The card also supports bulk voice compression and is compatible with a wide range of PBX equipment.

In conjunction with multiplexers, the module can take the output from the PBX at 2.048Mbps, individually compress each of the 32 time slots and then distribute time slots to different locations domestically or internationally over ISDN or standard carrier services. The ADPCM also permits inter-connection of digital and analogue PBXs for more flexible voice networking.

For more information, circle 168 on the reader services coupon, or contact Datamatic, 16 Suakin Street, Pymble 2073; phone (02) 449 8133.

Terminal emulator for Windows

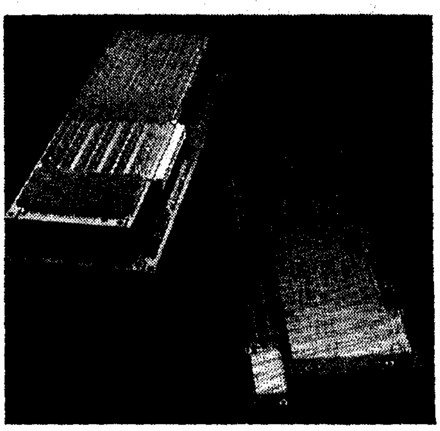
'Access for Windows' is a sophisticated IBM 3270 terminal and printer emulator that runs under Microsoft Windows 3.0. Developed by Elcon Technology of Canada, the program is designed to provide total integration of multiple office automation applications with multi-host access over wide area networks.

Access provides existing IBM and Windows users, and potential OS/2 and LAN users, with the ability to view all concurrent sessions on one screen; switch between a Windows host session and a typical office application such as Excel; maintain each Window in the PC's memory when entering the full-screen environment; transfer files from one window to another window or a corporate host, or out to a server-based printer.

For more information circle 169 on the reader services coupon or contact J.N. Almgren, 16 Smith Street, Chatswood 2067; phone (02) 417 6177.

Prototype cards for Mac

Bicc-Vero has launched a new range of prototyping boards specifically designed for microcomputers operating in the Nu bus environment, particularly the Apple Macintosh II. In its Speedwire version, the board has four layers, providing a high density pin pattern and areas for fitting pin grid array devices. The power plans are divided and facilities are included for the addition of decoupling-inductors and/or capacitors. Wiring time is reduced as no wire stripping is required. The reduced pin profile allows adjacent slot positions in a system to be used, improving packaging density.



The Microboard version is double-sided and features Bicc-Vero high density PTH pattern for maximum reliability. Two adaptive square pad areas provided for pin arrays and the copper ground plane reduces both crosstalk and radiation. Decoupling is provided for the supply rails, which are user definable.

Both versions of the board have facilities for mounting a 37 way D-type connector for I/O to external systems.

For more information circle 170 on the reader services coupon, or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 748 4066.■

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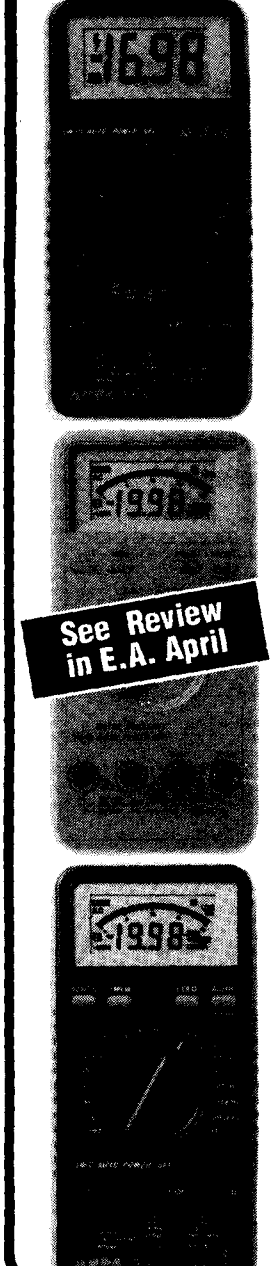

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- Data hold
- Memory offset

Ranges
Vdc 200mV, 2V, 20V, 200V, 1000V
Vac 200mV, 2V, 20V, 200V, 750V
Adc 200μA, 2mA, 20mA, 200mA, 2A, 20A
Aac 200μA, 2mA, 20mA, 200mA, 2A, 20A
Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ

$166.80

Model 98
- 3 1/2 digit plus 41 segment analog bar graph
- Autoranging or manual selection
- 8 Functions - Vdc, Vac, Adc, Aac, Ohms, Diode, Frequency, Capacitance
- Data hold
- Memory offset

Ranges
Vdc 200mV, 2V, 20V, 200V, 1000V
Vac 200mV, 2V, 20V, 200V, 750V
Adc 200μA, 2mA, 20mA, 200mA, 2A, 20A
Aac 200μA, 2mA, 20mA, 200mA, 2A, 20A
Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
Frequency 2kHz, 20kHz, 200kHz
Capacitance 2nF, 20nF, 200nF, 2μF, 20μF

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Model 76 Component Tester
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- Capacitance 200pF to 20μF
- Resistance 200Ω to 20MΩ
- Transistor hfe and Iceo
- Diode displays Vf at 1mA
- LED displays Vf at 2Ma and 10mA
- Battery tests 9V and 1.5V cells
- SCR Pass/Fail test

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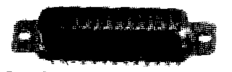
LOOK!



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04	1Hz Timebase	22.40
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07	10MHz Timebase	45.60
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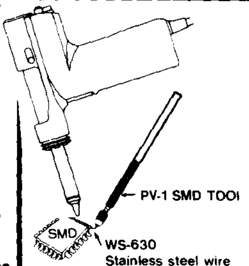

The NEW SC5000A DIC Desoldering Tool.

Now fitted with 80W heater, NEW Hot air nozzle makes it easier to remove surface mount devices. Price is unchanged at **$399** ex tax ($478 inc tax)

If you're working on surface mount devices you'll need the

SMD Removal Kit.

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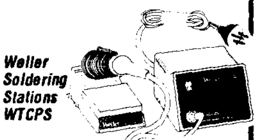

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- Non-burning silicon rubber cord
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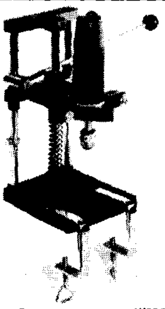

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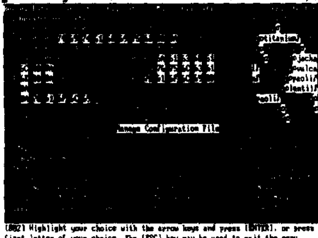
- Handles baud rates up to 115.2kbaud.
- View each byte in ASCII or EBCDIC, decoded to hex, decimal, binary or octal



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- Split line DTE over DCE display **$395** plus sales tax

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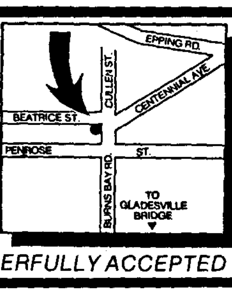

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C. PC boards and supplies
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